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Human Kinetics Historical Foundations Lectures

Presider/Moderator: Penny McCullagh, California State University – East Bay

The Historical Foundations Lecture for the 50th anniversary of NASPSPA will include lectures from three eminent and longstanding NASPSPA members who will represent the three areas of Motor Learning and Control, Sport and Exercise Psychology and Motor Development. Each lecturer will present their “take” on the fascinating highlights of their area during the four decades from 1967 to 2006. Speakers will focus on paradigms, theories, methods, and trends and will highlight contributions from NASPSPA members within the overall context of scientific developments in their respective fields.

Speakers

Motor Learning and Control

Motor Control and Learning Research in NASPSPA: The First 40 Years

Speaker: Bob Christina, Professor Emeritus, University of North Carolina at Greensboro

Before the late 1960s, motor control and learning (MCL) research used an S-R or product-oriented approach in which response outcomes of complex real-world and laboratory motor tasks were studied as a function of the manipulation of stimulus variables (e.g., practice, KR). By the late 1960s, NASPSPA MCL researchers shifted toward an information processing (IP) or process-oriented approach using simple movements to study the cognitive processes acting on the stimulus information that elicited the response. Much of the focus from the late 1960s into the 1980s was on understanding how movement information was processed and coded, stored, represented in memory. It also was on understanding MCL in terms of topics such as attentional processes, speed-accuracy, open- and closed-loop systems, time required to process feedback and amend movements, motor programs, response programming, Adams' Closed-Loop Theory (1971), and Schmidt's Schema Theory (1975). And from the 1980s into the 2000s we revisited how practice scheduling and augmented feedback could be organized to optimize ML. The early and mid-1970s also saw a growing interest in MC research that sought to understand what was being controlled, how the process was organized, and what purpose it served. A new constraints-based perspective emerged with a strong connection to physical biology and ethology that combined Bernstein's (1967) ideas on degrees of freedom, context-conditioned sensitivity, and functional synergy (i.e., coordinative structure) with Gibson's (1966, 1977, 1979) ecological view. MCL research from the 1980s into the 2000s searched for principles and laws of “self-organization” of movement control, and answers to the degrees of freedom problem, that is, how a human motor system with so many independent parts could be controlled without the

need for an executive decision-maker and brain mechanisms such as memory, motor programs, and schemas as proposed by the IP approach. The mid-2000s found us thinking about the extent to which the IP and constraints-based views of MCL were divergent or complimentary.

Sport and Exercise Psychology

NASPSPA Sport and Exercise Psychology Research Across Four Decades: A Sketch

Speaker: Lawrence R. Brawley, University of Saskatchewan

The trouble with history is that we often recollect what we “think” happened. The perspective I offer is just that – my recollection of trends characterizing research presented and discussed at NASPSPA over 40 years. Briefly, what do I remember?

1967 -77 A beginning to “systematic” research and an era of drives, motives and testing “first principles”. A time of pioneering efforts to make the science more empirical and based upon social psychological theory.

1978-87 An era of social-cognitive and social psychological research trends. The graduates of well known pioneers explored theories and processes describing phenomena in many levels of sport.. The names of psychologists Bandura, Weiner, Harter and others appeared in multiple presentations. A proliferation of texts influenced what graduate students likely presented at conferences. A new society arose – AAASP – partly as a consequence of NASPSPA’s decision to focus on research versus application. Psychophysiological research gained attention and continued into the decade that followed. Meta-analyses were offered.

1988-97 An era of “expansion” in the amount of sport psychology research and an influx of exercise and physical activity research focused on links between exercise and health. The graduates of pioneers and their trainees became more prolific in examining use of theory. Conceptual frameworks more specific to sport were offered and related measures developed. Examples were sport -related confidence, motivation and its orientations, leadership and cohesion.

1998-2006. An era of “diversification” and growth in a wide range of sport and exercise psychology topics. New models and lifespan views were introduced, feminist perspectives offered, differing research models proposed and qualitative methods championed and utilized.

In reflection, I offer thoughts about the way we have used some theories, methods we champion, and measures we create. Is this last decade one that reflects systematically developed knowledge? Does it reflect an eccentric and/or refreshing picture of the exercise and sport psychology to come?

Motor Development

Pentimento: A 21st Century Look at the Canvas of Motor Development

Speaker: Jane E. Clark, University of Maryland, College Park

How we understand the emergence and development of motor behavior and skillfulness has itself developed over the last 50 years. In reflecting on the history of motor development, it is important to recognize that these ‘reflections’ are much like the painter’s “pentimento.” That is, the ‘canvas’ we paint today of what our science was decades ago is actually a painting with

many layers – each representing where our views have changed along the journey. I do not “repent” with these reflections, as suggested by the term, *pentimento*, but rather I seek to bring a developmental perspective to our scientific inquiries into motor development with an element of a revisionist’s approach. What were the key discoveries and the seminal papers that influenced our canvas of motor development that we view today? Almost three decades ago, we (Clark & Whittall, 1989) outlined an historical framework for the field of motor development. Today, we can look back at that framework and the ensuing science and consider where we have been and what we have learned and, ask: What does the *pentimento* of our motor development canvas reveal?

Janus Symposia

In ancient Roman mythology, Janus is the god of beginnings and endings, gates and doorways, transitions and time. He is often depicted as a head with two faces – one looking backwards into the past and one looking forward into the future. In recognition of the 50th Anniversary of NASPSPA, the Janus Symposia provide an opportunity for scholars in Motor Learning and Control, Sport and Exercise Psychology, and Motor Development to reflect on the most recent decade (2007-2016) and to offer their insights as to what we might expect in the future. Each of the symposia has been organized independently and so a variety of formats will be implemented as we consider the recent evolution of NASPSPA’s sub-disciplines.

Motor Learning and Control

President: Howard N. Zelaznik, Purdue University, USA

Moderator: Timothy D. Lee, McMaster University, Canada

Looking through the rear view mirror while driving forward at speed: Some key recent developments and likely future directions in motor control and learning research

Presenters: A. Mark Williams and Bradley J. Fawver, University of Utah

In this presentation, we review some of the most innovative and impactful developments in the field of motor control and learning over the past decade. We utilize citation reports from some of the most prominent journals in the field, as well as relying on subjective opinion from leading academic experts to identify notable contributions to knowledge generation and applied practice in this broad and dynamic field. We delimit the scope of this task by focusing our efforts on three specific areas of study, notably, visual control of action, perceptual-cognitive expertise, and skill learning. In looking back over the last decade through a rear view mirror, we attempt to provide some direction to help drive the field forward by highlighting potential areas for important theoretically driven work and applied research in the future. Our hope is that over the next few decades these fields of study will have even greater influence and translational impact on society across multiple domains of human activity.

Catching the integration train: A look into the next ten years

Presenter: Cheryl M. Glazebrook, University of Manitoba

The next decade will be a time for testing new theories, striving for integration and fostering communication. As we build on our strong theoretical roots, as well as the developments of today, we will continue to refine our understanding of human motor behaviour using novel technologies and analysis techniques that enable new insights into the underlying processes for motor control and learning. Advances in brain imaging, behavioural and statistical techniques will facilitate novel perspectives through an integrated understanding of the contributions of sensory, cognitive and emotional processing with motor performance. The application of an integrated approach will be far reaching, including education, healthcare, and human-machine interfaces. In keeping current with technology we must be engaged with developers so that new techniques, laws, and plans are logically constructed, in other words with a solid theoretical framework. Similarly, as the healthcare and education sectors are pushed to do more with less, our fundamental understanding of human motor control and learning will provide crucial insights into how to work together and stay on track. With rapid change will come a need for rapid output, creating a need to shift our patterns of behaviour with respect to how to share our theoretical findings to the broadest audience both efficiently and ethically. As experts in motor control and learning it is our responsibility to forge new connections across our respective subdisciplines and the various sectors of our society.

Motor Development

Presider: Jill Whittall, University of Maryland, Baltimore, USA

Moderator: Michael G. Wade, University of Minnesota, USA

Motor Development is Fundamental to Human Development

Presenter: David I. Anderson, San Francisco State University

We are born to move but learn to move skillfully. The fascinating process by which the poorly coordinated newborn transforms into a willful child, a clumsy adolescent, a competent mover, potentially an elite performer, and an older adult capable of compensating for declines in multiple biological systems, continues to evoke interest in laypeople, researchers, and clinicians alike. The last 10 years of research in motor development have reaffirmed the centrality of movement in all human endeavors. Learning to act and move skillfully has consequences that extend well beyond the motor domain, though the motor domain continues to be undervalued in its own right. The last 10 years have also reminded us how much we still have to learn about development. Despite uncovering remarkable capacities in the newborn, discovering that early capacities predict later developing capacities in the same and different domains, revealing new linkages among motor activity, perceptions of competence, fitness, health, and psychological functioning, expanding descriptions of how skills develop, highlighting the multimodal nature of perception and action, validating assessments, intervening to promote motor development in children with disease or disability, and translating research into practice, many aspects of motor development remain a mystery. Moreover, despite forging collaborations with researchers and clinicians in neuroscience, cognitive science, embryology, pediatrics, robotics, the learning sciences, and public health, motor development researchers are only beginning to understand the complex web of processes that underlie developmental change. Nevertheless, progress has been made! This section of the Janus talk will overview the themes and topics that have dominated research in motor development over the last 10 years and highlight some of the most

important discoveries that have been made. These discoveries reaffirm that human beings are self-organizing, self-stimulating, complex systems that play a central role in their own development by virtue of being inherently active.

Motor Development is a Discipline with a Bright Future

Presenter: Leah E. Robinson, University of Michigan, Ann Arbor

Movement is how we explore our environment. The discipline of motor development has made valuable contributions to science as it relates to the study of human movement and human development. This section of the Janus Symposium will highlight future directions for motor development research. It is imperative that researchers strive to make a conscience effort and continue to conduct translational research - the process of transforming scientific discoveries arising from laboratory or population studies into clinical or real-world applications to address issues that are plaguing our society. Researchers must remain committed to conduct interdisciplinary research and integrate motor development with various disciplines within and outside our field. This will allow for the development of new techniques, tools, perspectives, concepts, and theories that will advance our fundamental understanding or solve problems beyond the scope of our discipline. Based on the current state of the literature and science there are four areas of interest for future research considerations. a) Advances in medicines have contributed to individuals living longer which results in a need to focus more research on special populations that include the elderly and diseased. b) New non-invasive neuroimaging tools can answer critical questions related to the brain-behavior interaction. Neuroimaging can now enable researchers to understand “what the brain is doing while moving and the effect of a motor skill intervention on the brain”. c) Discoveries in the biomedical sciences can contribute knowledge to the gene-environment interaction through epigenetics and answer questions like “why motor delays or disease may occur?” d) There is a need to explore the relationship and effect of motor development on developmental and health outcomes on the population. Understanding these outcomes will support the public health and educational relevance of motor development as a discipline. As you can see, motor development research has a bright future -- bountiful with many questions that await to be answered.

Sport and Exercise Psychology

Back to the Future: Sport and Exercise Psychology in the Past and Future Decades

Presider: Maureen R. Weiss, University of Minnesota, USA

Moderator: Glyn C. Roberts, Norwegian School of Sport Science, Norway

Panel Participants:

Mark Eys, Wilfrid Laurier University

Diane L. Gill, University of North Carolina at Greensboro

Kathleen Martin Ginis, The University of British Columbia

Alan L. Smith, Michigan State University

In the Janus Symposium for Sport and Exercise Psychology (SEP), a panel format will be used to obtain multiple and diverse perspectives from one senior and three mid-career scholars. Panel members Diane Gill, Mark Eys, Kathleen Martin Ginis, and Alan Smith will offer their

insights about the most recent decade of research in the field (2007-2017) and then generate a vision for SEP research in the decades to come. A set of questions will be posed to the panel for their response, and audience members will be encouraged to follow up on ideas following each question. Some questions include: (1) In the last 10 years, what research has had an impact on your work and has it changed how you think about or conduct your research? (2) In today's contemporary research and funding environment of "translatable research," is the use of theory a realistic mandate for the future? Why or why not? (3) For decades, the "parent" discipline of psychology has provided direction to the research pursuits and practices of SEP. What will be the future of this influence on SEP and are there other disciplines that are of equal influence? (4) Is SEP taken seriously in the broader disciplines (e.g., psychology, medicine)? If not, what can we do about that? This question is based on the idea that researchers in other fields often do not cite SEP research in their articles or recommend physical activity as part of a broad-based mental health or clinical treatment program. (5) Given the current, and probably future, emphasis on securing funding for research, should beginning scholars be advised to focus their research efforts on topics that are most fundable rather than on topics they find most interesting or are most passionate about? (6) What research areas will wane in interest/import over the coming decades, which ones will take off, and what areas will exist that do not exist presently? Several other questions of a similar nature will be posed to panelists for their perspectives, and we envision the audience having ample opportunities to interact with panel members on these questions.

Early Career Distinguished Scholar Lectures

How we use startle and brain stimulation to understand fast movements

Anthony N. Carlsen, University of Ottawa, Canada

It is clear that people are able to “get ready” for an upcoming action (think of an Olympic sprinter), yet it is not clear exactly what brain areas are involved and when they are active. My research program explores these neural processes using brain stimulation techniques such as TMS as well as the common startle reflex, allowing us to understand the processes underlying motor preparation from multiple viewpoints. With a better understanding of how the brain prepares to act (or react), we can set to work developing ways of optimizing these processes in athletes and in persons with motor disorders such as Parkinson’s disease. Here I will highlight some of the key moments in my career that have led me to my current research focus, as well as colleagues and mentors that have helped guide my research. The studies discussed will provide data that begin to address how the human central nervous system prepares to react to upcoming stimuli, including recent data from our lab that suggests that multiple distributed sources of activation from both cortical and subcortical brain areas contribute to both the preparation and initiation of actions. Furthermore, we show that these brain activation levels can be modulated using non-invasive direct current brain stimulation. This knowledge has application to motor learning and rehabilitation, as well as other advanced technologies.

To autonomy and beyond! Understanding and promoting physical activity motivation

Ben Jackson, The University of Western Australia

Researchers interested in physical activity (e.g., sport, exercise) participation have, for some time, focused their attention on studying issues associated with motivation – what are the factors, for example, that encourage (or discourage) goal pursuit, that make us persist (or not) when faced with obstacles, and that stimulate feelings of enjoyment and agency (versus apathy and ineffectiveness)? As a result, much is now known about the development, measurement, and outcomes of physical activity motivation, and well-established theories – such as self-determination theory – provide valuable frameworks for the study and promotion of motivation in sport and exercise. Described in this presentation are experiments and intervention studies in which we have focused on identifying novel ways through which we might better understand and/or enhance motivational processes. We have recently explored, for instance, how our knowledge of interpersonal relationships, nonconscious stimuli, and messaging and persuasion principles might all be used to help us find new ways to promote or protect important motivation concepts within physical activity settings. Aside from studying the causes of motivation, we have also begun to examine if, and how, physical activity motivation might influence health outcomes outside of the physical activity domain. To illustrate, recent experimental work in our lab has shown that individuals’ exercise motivation – and exercise environments that are designed to manipulate motivation – may be responsible for shaping post-exercise (i.e., dietary) outcomes. Our research program is driven by the goal of supporting physical activity and health within the community, and so, in closing, I will present examples of how we translate our research findings by integrating them into our work with community partners and organizations.

The NASPSPA Outstanding Student Paper Award Recipients

Motor Control and Learning

Expecting to teach enhances motor learning and information processing

Marcos Daou, Julia Montagner Sassi, Keith R. Lohse, Matthew W. Miller; Auburn University

There is some evidence that people learn academic (declarative) information better when studying with the expectation of having to teach, but this has not been demonstrated for perceptual-motor skills, which also rely on declarative information but more heavily on procedural knowledge. To address this possibility, we conducted a series of three experiments wherein participants studied golf instructions and practiced putting with the expectation of having to teach another participant how to putt or the expectation of being tested on their putting. Learning was assessed with delayed posttests (1-day and/or 7-days later), wherein all participants were tested on their putting. The first experiment ($N = 56$) revealed expecting to teach enhanced motor learning, but did not elucidate the mechanisms underlying the effect. The second experiment ($N = 56$) replicated the first experiment's results and revealed expecting to teach increased information processing, as reflected by lengthened motor preparation time preceding practice putts. However, it was still unknown whether this increased motor preparation time *explained* the effect of expecting to teach on motor learning. In the third experiment ($N = 80$) we attempted to answer this question. Specifically, we limited motor preparation time preceding practice putts for half of the participants who were expecting to teach and half of the participants who were expecting to test, in order to see if the expecting to teach advantage for motor learning disappeared for participants whose motor preparation time was limited. Results revealed the effect of expecting to teach on motor learning was eliminated for both participants whose motor preparation time was limited *and* those participants whose motor preparation time was not. However, expecting to teach still yielded a motor learning benefit that was directionally consistent with the first two experiments. Taken together, the three experiments indicate expecting to teach enhances motor learning, and suggest the underlying mechanism may be related to motor preparation during practice.

Motor Development

Two worlds colliding: a motivational and motor development perspective on youngsters' engagement in physical activity and sport

An De Meester, Johan Pion, Mireille Mostaert, Farid Bardid, Greet Cardon, Gert-Jan Demuyneck, Matthieu Lenoir, Leen Haerens; Ghent University

Objectives: Physical activity (PA) is associated with many health benefits but low PA levels have been reported across the globe, even among young children. Despite evidence in support of the Self-Determination Theory (SDT, Deci & Ryan, 2000)-proposed relationships between competence satisfaction, autonomous motivation, and PA in adults and adolescents, there is only limited proof that these relationships also apply to children. Likewise, there is no conclusive evidence for the mediating effect of perceived motor competence (PMC) in the relationship

between actual motor competence (AMC) and PA in children, as suggested by the conceptual model (Stodden et al., 2008). Therefore, the aim of the current study was to examine whether the PA-pathways as suggested by the conceptual model and SDT apply to children. Methods: 627 children (51.67% boys, age=10.40±1.15y) completed validated questionnaires to assess weekly sports participation (FPAQ), PMC (SPPC), competence satisfaction (PNSE), and motivation for sports (BREQ). Children's AMC was assessed with the KTK. Structural Equation Modeling was conducted to examine the theory-based pathways from AMC via PMC, competence satisfaction, and autonomous motivation to organized sports participation. Results: We found a significant, direct effect from AMC to sports participation ($\tau'=.142$, $p=.001$) with PMC, but not competence satisfaction or autonomous motivation, partially mediating this relationship ($\alpha\beta=.119$, $p<.001$). Conclusion: The results suggest that, among children in middle and late childhood, AMC relates to sports participation and this relationship is, as proposed in the conceptual model, mediated by PMC. PMC also significantly relates to competence satisfaction and autonomous sports- motivation but the last two SDT-related constructs do not add to the prediction of organized sports participation when being integrated in the conceptual model. Based on the evidence that both AMC and PMC are crucial with respect to children's sports participation, it is recommended that physical education teachers and coaches foster both.

Capturing Infant Naturalistic Use of Postures Using Network Analysis: A Longitudinal Study

Sabrina L. Thurman, Daniela Corbetta; University of Tennessee Knoxville

Locomotor development provides infants with new means to explore and also extends the range of behaviors infants previously had available. Here, we investigated how infants position themselves and transition through various postures during free play sessions and across locomotor development in the first two years. Thirteen infants were observed biweekly in 10-min free play sessions held in a laboratory, from 6 to about 17 months. The room contained toys, a couch, and a small set of stairs. Changes in locomotor skills were captured with Touwen's Group III Neurological Assessment Scale. Infant postures (laying down, sitting, on all fours, squatting/kneeling, creeping, standing/bending over, cruising, and stepping) were video-coded continuously using The Observer XT. We grouped data into 4 time blocks centered around creeping and walking onsets, each containing 3 sessions: pre-creeping, novice creeping, experienced creeping/pre-walking, and walking. We determined for each time block how often each infant switched from one posture to another during play and mapped those data using Social Network Analysis and Visualization software. We assessed changes in posture network densities and centrality with ANOVA and Friedman tests. Over time, the network density between postures increased significantly ($p<.000$). Therefore, infants showed more variability in the range of postures displayed within sessions and as a function of locomotor development. Despite this variability, one posture was most centrally utilized depending on the infants' locomotor level. This posture was 'sitting' for pre-creeping sessions ($p<.000$), was 'on all fours' for creeping sessions ($p<.000$), and was 'squatting/kneeling' for both pre-walking and walking sessions ($ps<.000$). These data are the first to show that as infants acquire new locomotor milestones, their repertoire of postural skills expands, meaning that infants are able to exploit whatever full range of postures they have available at any developmental time. Infants continue to rely on prior skills during play, despite acquiring new ones.

Sport and Exercise Psychology

Exergaming intervention to foster executive functions in children with attention deficit hyperactivity disorder: preliminary results from a clinical trial

Valentin Benzing, Mirko Schmidt; University of Bern, Switzerland

In childhood and adolescence Attention Deficit Hyperactivity Disorder (ADHD) is one of the most frequent mental disorders. Reduced attention, poor control of impulses, as well as increased motor activity are its key symptoms, which seem to be associated with decreased performance in Executive Functions (EF), finally affecting academic achievement. Although medication usually has some effect on symptoms, concerns about regular drug intake and possible side effects result in a need for alternative treatments. For this purpose, sedentary cognitive trainings are frequently used, although transfer effects seem to be limited. To increase potential effects, interventions combining physical and cognitive demands targeting a broader range of cognitive processes are called for. Therefore, the aim of the current study was to examine the effects of cognitively and physically demanding exergaming on EF of children with ADHD. In total, 36 children between 8-12 years ($M = 10.63$; $SD = 1.32$) diagnosed with ADHD were assigned either to an 8-week exergame intervention group (three training sessions per week à 30 min) or to a waiting-list control group. The EF performance in updating (color span backwards), inhibition and shifting (Simon task; Flanker task) was assessed before and after the interventional period using computer-based tests. On average children trained 2-3 times a week; manipulation checks indicate that exergaming was physically and cognitively challenging to the participants. With regard to interventional effects, ANCOVAs (one-tailed; pre-test values as covariates) revealed that children in the exergame group improved their inhibition and shifting performance significantly ($ps < .05$). In summary, positive effects of a combination of cognitive and physical training in children with ADHD on EF could be revealed. Results indicate that, in future, exergaming might serve as promising tool to improve the EF in children with ADHD. However, further improvements with regard to child appropriateness, cognitive as well as physical challenge are warranted.

Monday, June 5

Symposium

Motor Learning and Control

The contextual interference effect after 35 years: History, current research, future directions

Organizer: Nancy Getchell, University of Delaware, United States

Discussant: Shailesh S. Kantak, Moss Rehabilitation Research Institute

Contextual Interference: A Historical Perspective

Shea, John B., Indiana University

In the spirit of the 50th Anniversary of NASPSPA I would like to use the Shea and Morgan (1979) publication which first documented contextual interference in the motor learning domain to provide a historical context for this symposium. This experiment showed that a group which practiced three tasks in a blocked order (in which all trials on one task were completed before the next task was introduced for practice) performed better during practice than a group which practiced these tasks in a random order (in which all tasks were practiced in an unsystematic order). However, the group which practiced in a random order performed better than the group which practiced in a blocked order during retention and transfer tests. This finding was considered counterintuitive at the time of its publication. One persistent question for me has been why this experiment opened such a floodgate of interest which has continued over the ensuing 38 years? There are a number of reasons for the contextual interference experiment gaining attention. Among these which I will mention are a) the emergence of cognitive psychology in place of behaviorism in the motor domain, b) the multifactor characteristic of contextual interference which emphasizes ecological validity, c) the emphasis of contextual interference on inquiry as opposed to disproof, d) the development of new technologies, and c) the interest in training/retraining for the aged and chronic disease populations. Finally, I believe that more than any particular theoretical perspective the greatest contribution of contextual interference has been the introduction of a research paradigm. The use of 'blocked versus random' practice schedules has been adopted across disciplines and this has ensured its continuance. The paradigm has successfully made the leap from an earlier research approach aligned with information processing to the current paradigm emphasizing neuroimaging (fNIRs, fMRI). The papers presented in this symposium will be aligned with this neuroimaging approach.

Pay now or pay later - assessments of cognitive load in virtual environments using optical imaging within contextual interference paradigms

Shewokis, Patricia A., Drexel University; Shariff, Faiz U, Lehigh Valley Health Network; Ayaz, Hasan, Drexel University; Getchell, Nancy, University of Delaware; Izzetoglu, Meltem, Drexel University; Lind, D. Scott, University of Florida-Jacksonville

Functional near infrared spectroscopy (fNIR) is a noninvasive, portable optical imaging tool to monitor changes in hemodynamic responses within the prefrontal cortex (PFC) in response to sensory, motor or cognitive activation. We used fNIR for monitoring PFC activation during learning with three different virtual environment investigations (two used simulated three-dimensional spatial navigation tasks; one used simulated laparoscopic surgical tasks). Each study was at least four days with each study having one day for delayed retention and transfer tests. Various objective assessments of cognitive load were compared across the studies for acquisition and transfer phases.

When considering cognitive load (effort) and the role of the PFC during performance and learning, the dorsolateral PFC is associated with performance of the essential aspects of a task. The anterior medial PFC is associated with the deliberate use of cognitive strategies to facilitate learning and with the maintenance of multiple items in working memory.

Our focus is on cognitive effort and we expect that during acquisition, random practice (RA) will exert higher cognitive effort (i.e., pay now) with lower cognitive effort during transfer in contrast to blocked practice (BL) who will exert less effort during acquisition and more effort (i.e., pay later) during transfer. Our results for the studies show consistent increased effort for RA in the PFC during acquisition when compared to BL while during transfer there is decreased effort for RA relative to BL.

We place the combined findings within Shea and Zimny's (1983) Elaboration/Distinctiveness in Processing explanation for RA advantages. They suggest that RA invests more cognitive effort during task acquisition while during transfer RA uses less effort and performs the task more effectively and efficiently than BL. Our results provide evidence for extending understanding of contextual interference to include explanations on differential activation of the PFC during acquisition and transfer for RA and BL schedules.

Challenge to promote change: The neural correlates of the contextual interference effect in young and older adults

Pauwels, Lisa; Chalavi, Sima; Sunaert, Stefan; Maes, Celine; Swinnen, Stephan P., KU Leuven

Since motor performance generally deteriorates at older age, studying the effects of different types of training on motor improvement is particularly important. Optimizing learning can be facilitated by presenting an optimal level of desirable difficulty during practice by manipulating practice structure, an effect called contextual interference (CI). The aim of this study was to investigate the neural correlates of the CI effect when learning a complex bimanual task over three days of practice. A total of 32 young and 28 older adults were randomly assigned to either a blocked or random practice group. Using functional magnetic resonance imaging (fMRI), brain activations were acquired during the first and last day of training as well as during retention. Whereas behavioral results were explored for all participants, preliminary neuroimaging data were analysed for a subsample of 10 young (5 blocked, 5 random) and 10 older (5 blocked, 5 random) participants. Behavioral results showed that older adults had more difficulty performing the task compared to younger adults. However, typical CI effects were observed in both age groups, i.e. superior performance during acquisition but inferior performance during retention for the blocked compared with the random groups. With respect to the neural correlates, blocked practice induced more activation in the sensorimotor areas (primary motor, primary sensory and supplementary motor area) whereas random practice activated higher level (pre)frontal cortices, suggesting a more profound dependence on cognitive resources in random practice. This was

true for both age groups. During retention, random compared with blocked practice groups showed more activation of the precuneus, which is a key region in visual imagery memory recall. When comparing the age groups, older adults recruited a more widespread neural network as compared with younger adults. Our findings may have major implications in the optimization of practice schedules and rehabilitation settings.

What's under the hood? Examining prefrontal cortex activity using fNIRs within a contextual interference paradigm

Getchell, Nancy, University of Delaware; Shewokis, Patricia A., Drexel University; Wunsch, Emily, University of Delaware; Schilder, Alex B., Emory University

Since Shea and Morgan's 1979 publication, many studies have investigated the contextual interference (CI) effect in different tasks, settings and populations, but only recently have researchers had the ability to examine associated brain activity. Functional near-infrared spectroscopy (fNIRs), a brain imaging technology that measures hemodynamic responses associated with neural activation, offers an innovative way to examine changes in brain activity within this paradigm. Our research aim was to examine the neural activation differences in the prefrontal cortex (PFC) associated with blocked and random practice schedules when learning and performing 3 different computer mazes using fNIRs in a sample of adults. Participants completed either a blocked (BLK) or random (RND) protocol over 3 acquisition sessions and in a forth session, performed retention and transfer (2 novel mazes) blocks. Using fNIRS, relative changes in concentration of oxygenation and deoxygenation were measured. During the acquisition trials, both groups improved on all three mazes with no performance differences by the final block. On the retention trials, BLK showed significant performance decrements; these were associated with high, widely dispersed PFC oxygenation suggesting increased cognitive effort. By contrast, RND showed significantly lower oxygenation with focal activation points. On the two transfer mazes, RND performed better than BLK and also had significantly lower oxygenation. Our preliminary results suggest that a random practice schedule provides a more efficient and effective learning environment than blocked practice. The comparatively lower activation levels seen in the RND group during retention and transfer suggest that these participants could traverse the mazes with a greater amount of automaticity, using fewer cognitive resources. These results show the importance of practice structure and environment when learning a computer task.

Sport and Exercise Psychology

The imperative of bringing implicit processes to the spotlight: Exercise psychology in the postcognitivist era

Organizer: Zachary Zenko, Duke University, United States

Discussant: Panteleimon Ekkekakis, Iowa State University, United States

The imperative of bringing implicit processes to the spotlight: Exercise psychology in the postcognitivist era

Zenko, Zachary, Duke University

Like other domains of the behavioral sciences, exercise psychology will inevitably make the transition to the postcognitivist era, expanding its theoretical perspective to include dual-process models to understand exercise behavior. According to dual-process theories, behavior is influenced by both 'Type 1' and 'Type 2' processes. Type 1 processes are automatic and implicit; Type 2 processes are controlled and reflective. Type 1 'implicit attitudes', 'implicit associations', or 'automatic evaluations' are increasingly attracting the interest of researchers in exercise psychology. However, there is a lack of consensus about terminology, methodology, and relevant theoretical postulates. This symposium will prepare attendees to apply dual-process perspectives to explain and promote exercise behavior. The first presentation will discuss the theoretical implications of dual-process models for exercise psychology, underscoring the need to acknowledge the role of automatic, implicit processes in exercise behavior. The second presentation will introduce empirical evidence of the causal relation between implicit processes and exercise behavior. Specifically, implicit processes were found to predict exercise choices when controlled, Type 2 processes were inhibited. The third presentation will review the literature on the role of implicit processes in exercise behavior, emphasizing the lack of agreement between measurement techniques and the heterogeneity in exercise parameters in studies of implicit associations. The final presentation will highlight the necessity of choosing valid and reliable measurement techniques, and will introduce data from the first systematic, comparative validation of implicit measures in the context of exercise. In sum, this symposium will offer attendees a cutting-edge overview of implicit influences on exercise behavior, covering both the relevant theoretical background and the latest methodological advances.

Exercise psychology at 50: From wide-eyed radical cognitivist to nuanced dual-process theorist

Ekkekakis, Panteleimon, Iowa State University

The advent of research on the psychological processes underlying physical activity and exercise behavior coincided with the height of the cognitivist revolution. Thus, it is unsurprising that researchers adopted existing theories that reflected the zeitgeist of the time, such as the theories of reasoned action and planned behavior, social cognitive theory, and self-determination theory. Decades later, these theories, none of which was developed with physical activity and exercise in mind, remain the main prisms through which exercise-psychology researchers study their phenomena of interest. In the process, researchers seem to have either overlooked or tacitly endorsed the assumptions underpinning these cognitivist theories. For example, investigating physical activity from the perspective of the theory of planned behavior

entails adopting the "reasoned action" framework upon which it was built. Likewise, grounding research on social-cognitive theory presumably means accepting Bandura's portrayal of human beings as constant information gatherers and analyzers and of behavior as the result of calculations about the likelihood of future outcomes. As an outgrowth of these assumptions, current intervention approaches attempt to change behavior solely by providing information (e.g., about capabilities, benefits versus barriers, social support). Exercise-psychology researchers must now confront the fact that the cognitivist theories that propelled the field for the early years of its history have accounted for limited portions of behavioral variance and the few theory-based interventions have demonstrated limited efficacy in changing behavior. The postcognitivist era will be characterized by two inevitable trends, namely (a) a turn to broader, dual-process conceptual models that incorporate nonrational, nondeliberative paths to behavior, assigning an important role to past affective experiences, and (b) the contemplation of the features that make exercise and physical activity distinct from other health behaviors, including their physiology and energetic demands.

The role of automatic evaluations in exercise choices under ego-depletion. An experimental approach from a dual-process perspective on affective evaluation of exercise

Brand, Ralf, University of Potsdam; Utesch, Till, University of Muenster

Dual-process theories suggest that people can use evaluative judgment (e.g., reflection on the potential health benefits of exercising) to reach a decision to ignore automatic evaluations based on prior exercise experience (e.g., of temporal contiguity between exercising and feeling achy). We studied whether ego-depletion, a state in which mental resources for self-control are minimal and the influence of reflective evaluative judgment is thus marginalized, will lead exercisers to behave according to their automatic affective evaluations of exercising. First, the automatic and reflective evaluations of exercise were measured. Participants were randomized to either a depletion or a nondepletion control group and then asked to spontaneously choose a weight from a dumbbell rack for use in a light resistance-training exercise. Polynomial regression with surface analysis was used to test the interrelated effects of automatic (as measured with an ST-IAT) and reflective evaluations (self-report) on the chosen dumbbell weight in the two experimental conditions. As expected, dumbbell weight could be predicted from automatic evaluations in the depletion group (participants with more positive automatic evaluations chose higher weights). Interestingly, in the nondepletion control group, higher weights could be predicted from larger discrepancy between automatic and reflective evaluations. These findings highlight the influence of automatic affective evaluations on exercise choices, especially in situations in which motivation and opportunity to deliberate are low. Further analysis is needed regarding the role of evaluative automatic-reflective discrepancy. The state of consciously experiencing a large evaluative discrepancy could present a situation similar to that of cognitive dissonance, with the individual striving for a subjectively rational behavioral solution; participants could have chosen their (higher) weight (in the nondepletion group) according to their impression of what could be the socially desired behavior in this situation.

Automatic evaluations and exercising: A qualitative literature review

Antoniewicz, Franziska; Schinkoeth, Michaela, University of Potsdam

Dual-process theories of social cognition, distinguishing between automatic and controlled information processing, provide a theoretical framework for understanding automatic evaluations and their relationship to (exercise) behavior. Automatic evaluations of exercising (AEE) are characterized as immediate affective (i.e., pleasant-unpleasant) responses a person has toward exercising or exercise-related stimuli. A growing body of literature underscores the importance of AEE for different aspects of exercise behavior, like exercise maintenance, exercise-setting choice, and exercise dose. However, the existing studies are very heterogeneous in a) the measurement of AEE, b) the exercise parameters associated with AEE, and c) the magnitude of the relation between AEE and these exercise parameters. The aim of the present literature review was to summarize and evaluate the existing findings. A search in the following databases: PsycINFO, PSYINDEX, PsycARTICLES, SPORTDiscus and PubMed, delivered 1129 records. After removal of duplicates, 484 records remained and 14 studies were included in the qualitative synthesis after checking for eligibility (e.g. only peer-reviewed articles). Grade of evidence of each study was evaluated. Studies allowing causal inference (i.e. experimental data) were considered high quality, prospective or longitudinal studies were considered moderate quality, and cross-sectional studies were considered low quality of evidence. The qualitative rating was lowered when, for example, a risk of bias was present. One study (7.14%) provided high-quality evidence, six studies (42.86%) provided moderate-quality evidence, and seven studies (50%) provided low-quality evidence. In sum, the literature review collected evidence for the influential relation between AEE and exercising for different age groups (e.g. children, adults) and target groups (e.g. people with normal weight and obesity) and highlights the necessity of further experimental research for a better understanding of the causal connections between AEE and exercise behavior.

Measuring implicit exercise associations: Comparative validation

Zenko, Zachary, Duke University; Ekkekakis, Panteleimon, Iowa State University

Implicit exercise associations (IEA) will play a crucial role as exercise psychology makes the transition to dual-process models. Having measures of IEA with demonstrated psychometric properties will be critical for the success of this endeavor. Thus far, measures of IEA have yet to be systematically validated against exercise-related criteria, precluding researchers from providing empirical justifications for their measurement choices. The purpose of the present study was to compare the validity coefficients of nine measures of IEA against affective responses to moderate-intensity exercise, recalled affect, self-reported exercise behavior, and explicit exercise attitudes. Ninety-five participants first underwent maximal exercise testing to identify their ventilatory threshold (VT). One week later, the participants returned to the laboratory for a session that included 10 min of exercise on a recumbent cycle ergometer at the intensity corresponding to their VT. This intensity was chosen to maximize interindividual variability in affective responses in accordance with the dual-mode theory. Ratings of pleasure-displeasure during exercise were obtained with the Feeling Scale (Hardy & Rejeski, 1989). Recalled affect of the exercise session was measured 5 min postexercise using the Empirical Valence Scale (Lishner, Cooter, & Zald, 2008). One week later, participants completed nine measures of IEA in random order. Participants also responded to questions about their explicit affective attitudes and exercise behavior using the International Physical Activity Questionnaire (Craig et al., 2003). Eight tasks had acceptable-to-high internal consistency. Only the Approach-Avoidance Task was significantly related to any of the validity criteria (i.e., self-reported exercise behavior) after adjustment for multiple comparisons ($r = -.332$, $p = .001$). These data suggest

the Approach-Avoidance Task may be the most valid measure of IEA and, pending confirmation by independent laboratories, this task should be preferred in future research.

Motor Learning and Control

Noninvasive brain stimulation to improve motor performance and learning: Help or hype?

Organizer: Bradley R. King, KU Leuven, Belgium

Discussant: Genevieve Albouy, KU Leuven, Belgium

Introduction

King, Bradley R., KU Leuven

A promising avenue to enhance motor functioning that has received considerable attention over the last decade is non-invasive brain stimulation (NIBS), an umbrella term that covers various stimulation approaches such as transcranial magnetic stimulation (TMS), transcranial direct current stimulation (tDCS) and transcranial alternating current stimulation (tACS). Collectively, NIBS is considered both safe and well tolerated and has been shown to modulate corticospinal excitability and motor behavior in healthy young and older adults, as well as in pathological populations such as stroke patients. However, there has been increased criticism of NIBS techniques over the last several years, including questioning whether the electrical current in standard protocols even reaches brain tissue. The purpose of this symposium is to address the following overarching question: 'Help or Hype: What are the effects of NIBS on motor performance and learning?' We will present data from experiments employing various stimulation protocols (e.g., tACS, tDCS and rTMS) and motor tasks (e.g., motor adaptation, motor sequence learning and bimanual coordination) that aim to not only investigate the influence of NIBS on motor behavior, but also elucidate potential mechanisms of these effects at the brain level. Collectively, our presentations will suggest that NIBS can indeed modulate behavior. However, stimulation-induced performance changes are highly sensitive to stimulation parameters (e.g., electrode montage, targeted cortical site, polarity and timing of stimulation, etc.) and tasks, factors that have undoubtedly contributed to the heterogeneity of results in the available literature.

Minimizing deficits in motor memory consolidation in older adults via transcranial direct current stimulation: Behavioral and neuroimaging investigations

King, Bradley R., KU Leuven

A substantial impediment to healthy living in older adults is the compromised functioning of the motor system, and the neuroplastic processes underlying the learning and consolidation of motor skills in particular. A promising tool to boost motor-related neuroplasticity in older adults is non-invasive brain stimulation (NIBS), and transcranial direct current stimulation (tDCS) in particular. However, systematic investigations of this intervention at both the behavioral and neural levels are currently lacking. This presentation will highlight results from a series of recent experiments demonstrating that tDCS can be used to enhance offline motor memory consolidation in healthy older adults. However, the effects critically depend on the parameters of the stimulation, including the targeted area of the cortex (i.e., primary motor vs. premotor), polarity (i.e., anodal vs. cathodal stimulation), and the timing of the stimulation relative to completion of the motor task (i.e., immediate vs. delayed). These stimulation-induced changes in behavioral performance are paralleled by systematic changes at the neural level; specifically:

1) a relative decrease in concentration of gamma-aminobutyric acid (GABA), the primary inhibitory neurotransmitter in the CNS, in the stimulated motor cortex; and, 2) alterations in the activity of task-relevant networks during motor performance as well as in the connectivity patterns of resting state networks assessed before and after the stimulation intervention. Results will be discussed in the context of the growing debate of whether non-invasive brain stimulation is a viable and effective avenue to enhance motor functioning in both healthy and pathological populations.

Cerebellar tDCS enhances motor adaptation in healthy older adults

Hardwick, Robert, Johns Hopkins University

Non-invasive brain stimulation is highlighted as a tool that can improve behavioral performance, while simultaneously allowing researchers to gain a better understanding of the neural mechanisms underlying the task. The beneficial effects of brain stimulation have great potential in groups with minor behavioral deficits, such as healthy older adults; as the aging population presents an unprecedented challenge for society, developing novel approaches to combat age related declines is key to maintaining their health and independence. Here we examined the effects of non-invasive brain stimulation on motor adaptation, a form of motor learning that involves reducing errors related to changes in the environment. Motor adaptation depends critically on the cerebellum, and been shown to be impaired in healthy older subjects compared with their younger counterparts. We applied sham or anodal transcranial direct current stimulation over the cerebellum as participants performed a 'center-out' reaching task, adapting to the sudden introduction of a visual cursor rotation. Older participants receiving sham stimulation were slower to adapt than younger participants. However, older participants who received anodal stimulation adapted faster, with a rate similar to younger participants. We found no confounding differences in movement speed or perceived sensations associated with stimulation that could explain this result, indicating that the stimulation itself was responsible for the enhanced rate of adaptation. These results indicate that non-invasive brain stimulation provides a feasible approach to enhancing learning in healthy older adults. However, we argue that a major proposed benefit of brain stimulation - enhancing our understanding of the mechanisms underlying performance - is frequently overstated. This is highlighted by our recent work suggesting that 'motor' effects of cerebellar stimulation could equally be attributed to enhancement of cerebellar-prefrontal loop activity, suggesting these results could instead be explained by enhancement of cognitive activity.

The cerebellum: an elusive gatekeeper for cortical plasticity and motor learning

Popa, Traian, National Institute of Neurological Disorders and Stroke

Plasticity of the human primary motor cortex (M1) has a critical role in motor control and learning. Recent studies have shown that artificial stimulation of the cerebellum in healthy humans can reversibly influence the cortical responses to specific plasticity-inducing protocols: excitation of the cerebellar cortex can attenuate the heterosynaptic M1 plasticity, whereas inhibition of the same can enhance and prolong it. Here we discuss the functional relevance of cerebellar modulation onto M1 plasticity. We argue that increase in cerebellar cortex output prevents the selection of unsuited or new motor programs from sources external to M1 and provides stability to already selected motor maps. In contrast, inhibition of cerebellar cortex output facilitates afferent inputs to M1 and thereby providing a 'controlled instability' of motor maps, which might enable updating the currently selected motor programs by facilitating the insertion of elements of a new motor program. Strong topography-specific connections among

the basal ganglia, cerebellum, and their projections to overlapping areas in the motor cortices suggest that these networks could influence each other's functions and plastic responses, including the interaction supporting motor learning. New evidence emerged supporting a bidirectional effect of cerebellar stimulation on explicit motor learning. We will present the example of an explicit motor sequence that can be acquired either faster or slower than in a large control group, after right cerebellar continuous or intermittent theta-burst stimulation, respectively.

Motor Development

Exploring Seefeldt's Proficiency Barrier

Organizer: Danielle Nesbitt, University of South Carolina, United States

Discussant: Matthieu Lenoir, University of Ghent, Belgium

Exploring Seefeldt's Proficiency Barrier

Nesbitt, Danielle, University of South Carolina

Recent research emphasizes that the acquisition and maintenance of motor competence from early childhood into adulthood is a key component to living a healthy and active lifestyle (Robinson et al., 2015), specifically related to health-related fitness (Cattuzzo, 2014) and physical activity (Lubans, Morgan, Cliff, Barnett, & Okley, 2010; Logan, Barnett, Goodway, & Stodden, 2016; Holfelder & Schott, 2014). With this emergence of research illustrating the dynamic relationship between these variables (Stodden, et al. 2008), very little research answers the question of what level of motor competence (proficiency barrier) is necessary for promoting healthy and physically active lifestyles. This symposium will explore the relationships of Seefeldt's hypothesized proficiency barrier on MC, perceived MC and PA in children. The first presentation is a revisiting of Seefeldt's (1980) concept of a motor competence 'proficiency barrier' as it relates to both developmental trajectories and health-related outcomes. The 2nd presentation examines the association between physical activity and weight status in children. This study demonstrated the hypothesized proficiency barrier effectively predicted significant different classifications on weight status. The 3rd presentation examines children's actual and/or perceived motor competence to determine if there is a proficiency barrier which effects if a child is likely to attain 60 min of moderate-to-vigorous physical activity. The final presentation asks the question, what is the effect of motor skill competence (e.g., stability/mobility) on FITNESSGRAM scores (e.g., Healthy Fitness Zone, Needs Improvement, Health Risk)? This symposium will conclude with a reaction to these papers while highlighting challenges and areas for future research.

Revisiting Seefeldt's Proficiency Barrier concept in the 21st century: Implications for locomotion

Getchell, Nancy, University of Delaware; Brian, Ali; Stodden, David, University of South Carolina

In the late 1970's through the 1980's, the field of motor development saw a surge in theoretically-based research examining the stage-like developmental progression of motor skill acquisition. We would like to revisit an under-developed concept introduced by Vern Seefeldt in 1980, that of motor competence 'proficiency barriers'. In his words, 'The proficiency barrier is placed between the 'fundamental' and 'transitional' skills because our work has shown that children who are deprived of learning the fundamental skills have difficulty when they attempt to learn the transitional motor skills'. While Seefeldt did not gain traction at the time, researchers have recently resurrected the proficiency barrier concept when looking at both developmental trajectories and health-related outcomes. We will review Seefeldt's proficiency barrier concept, hypothesize on developmental timing and potential mechanisms based on both theoretical and empirical evidence in locomotion. We suggest that young children move from movement profiles that provide maximum stability to ones that allow for increased mobility (stability/mobility trade-off) as the most likely point at which proficiency barriers in locomotion skills begin. In terms of mechanisms, lack of skills specific practice during periods of heightened neural plasticity during early childhood may inhibit change towards greater proficiency. Motor competence (MC) is associated with physical activity (PA) and a healthy weight in childhood years. The purpose was to test a MC proficiency barrier (PB), below which children would not achieve enough PA levels to be healthy. Cut-off values in KTK test results were determined with ROC analysis using a cross-sectional sample of 734 (353 girls) 10 year-old children. These cut-off values were subsequently used to define two different groups (high and low MC) in a short term longitudinal sample of 217 (118 girls). MC, PA, and BMI were assessed at baseline (12.1±0.4 years-old) and after two years (14.6±0.3 years-old). RM ANOVA (2x2) were performed to analyze the difference in BMI, sedentary time (ST) and moderate-to-vigorous PA (MVPA) changes between low and high MC at baseline. 2 X 2 Chi-square tests were conducted to test the independence of low and high MC on weight status, PA, and ST. Logistic regressions were conducted to find if the odds of being obese, sedentary, or active were different according PB status at baseline. The MC cut-off of 79 and 75 for girls and boys respectively, were used as PB. In both boys and girls there were no significant changes in BMI, ST, and MVPA, according to MC level. PB effectively predicted significant different classifications on weight status, and combined weight status and MVPA, at both baseline and follow-up. The probability of being overweight two years in the future, when below the hypothesized PB at baseline was 2.78 higher than when above the PB.

Testing the motor proficiency barrier hypothesis for physical activity and weight status

Lopes, Vitor P., School of Education of Polytechnic Institute of Braganca; Lopes, Luis, University of Porto; Santos, Rute, University of Wollongong; Stodden, David F., University of South Carolina; Rodrigues, Luis P., Instituto Politecnico de Viana do Castelo

Motor competence (MC) is associated with physical activity (PA) and a healthy weight in childhood years. The purpose was to test a MC proficiency barrier (PB), below which children would not achieve enough PA levels to be healthy. Cut-off values in KTK test results were determined with ROC analysis using a cross-sectional sample of 734 (353 girls) 10 year-old children. These cut-off values were subsequently used to define two different groups (high and low MC) in a short term longitudinal sample of 217 (118 girls). MC, PA, and BMI were assessed at baseline (12.1±0.4 years-old) and after two years (14.6±0.3 years-old). RM ANOVA (2x2) were performed to analyze the difference in BMI, sedentary time (ST) and moderate-to-vigorous

PA (MVPA) changes between low and high MC at baseline. 2 X 2 Chi-square tests were conducted to test the independence of low and high MC on weight status, PA, and ST. Logistic regressions were conducted to find if the odds of being obese, sedentary, or active were different according PB status at baseline. The MC cut-off of 79 and 75 for girls and boys respectively, were used as PB. In both boys and girls there were no significant changes in BMI, ST, and MVPA, according to MC level. PB effectively predicted significant different classifications on weight status, and combined weight status and MVPA, at both baseline and follow-up. The probability of being overweight two years in the future, when below the hypothesized PB at baseline was 2.78 higher than when above the PB.

Identification of a motor competence proficiency barrier among children for meeting physical activity guidelines

De Meester, An, Ghent University, Belgium; Stodden, David F., University of South Carolina; Goodway, Jacqueline, The Ohio State University; True, Larissa, State University of New York at Cortland; Brian, Ali, University of South Carolina; Ferkel, Rick, Central Michigan University; Haerens, Leen, Ghent University, Belgium

Objectives: This study examined whether there is evidence for a threshold level (proficiency barrier) of actual and/or perceived motor competence below which a child is not likely to attain 60 min of moderate-to-vigorous physical activity (MVPA) per day. **Methods:** The Self-Perception Profile for Children was used to assess perceived motor competence on 326 children (48.5% boys; age = 9.50 ± 1.24 yrs) while their actual motor competence was assessed using the Test of Gross Motor Development-2. MVPA was measured with accelerometers. We used a multiple regression analysis to test whether actual motor competence, perceived motor competence and the interaction between both significantly predicted the percentage of children meeting the guideline of 60 min of MVPA per day. A chi-squared test was then performed to further examine the relationship between the levels of actual motor competence (low, average, high) and the percentage of children meeting the guideline. **Results:** Only actual motor competence significantly predicted the percentage of children meeting the MVPA guideline ($\beta = .10$, $p < .001$) and the chi-squared test showed that more children with high actual motor competence (65-100 percentile; 40.74%) met the guideline than children with average (28-64 percentile; 25.49%) or low actual motor competence (0-27 percentile; 11.69%) respectively ($X^2(2) = 18.65$, $p < .001$). **Conclusions:** The present study provides evidence for the existence of a proficiency barrier in terms of actual motor competence. Almost 90% of the children whose actual motor competence is below the 'average' threshold do not meet the MVPA guideline. As more children with higher levels of actual motor competence meet the guideline than their peers with average or lower levels of actual motor competence, it is crucial to sufficiently develop children's actual motor competence.

The effect of motor competence "proficiency barriers" on health-related fitness

Nesbitt, Danielle, University of South Carolina; True, Larissa, State University of New York at Cortland; Stodden, David F., University of South Carolina

Objectives: The purpose of the current study was to examine the effect of motor skill competence (MC) (e.g., stability/mobility) on FITNESSGRAM scores (e.g., Healthy Fitness Zone, Needs Improvement, Health Risk) in children. **Methods:** Three samples of young children, ages 7-13 years (225 boys, 236 girls; M age = 8.85 years, SD = 1.2), were included in the final dataset. Body composition measurements included height and weight. Health-related fitness was measured using the FITNESSGRAM (PACER, curl-ups, and pushups). Each participant's

hopping performance was coded for modal component developmental sequences, which were then classified as stability or mobility. A cumulative odds ordinal logistic regression was run to determine the effect of MC, age, sex, and BMI on PACER scores. Two binomial logistic regressions were run to predict the effects of MC, age, sex, and BMI on the likelihood participants fell in the Healthy Fitness Zone or Needs Improvement category for pushup score and curl-up score. Results: The odds of children in the stability category of MC being in the Needs Improvement or Health Risk category of PACER scores was 8.353 times that of children in the mobility category of MC, $\chi^2(1) = 11.216$, $p = .001$. The odds of being in the Healthy Fitness Zone for pushups were 4.881 times higher for those individuals in the mobility category compared to individuals in the stability category of MC ($p < .0005$). For curl-ups, only BMI added statistical significance to the model. The odds of being in the Healthy Fitness Zone group for curl-ups were .284 times greater for individuals' classified as under- or normal weight compared to individuals classified as overweight/obese ($p < .05$). Conclusions: Children with better MC (e.g., more mobility) exhibited greater cardiovascular fitness (as measured by the PACER) and upper-body strength (as measured by push-ups). Although MC did not predict placement in curl-up category, children of normal weight and underweight children tended to fall in the Healthy Fitness Zone for curl-ups more than overweight/obese children.

Sport and Exercise Psychology

Psychophysiological insights into the association between health behaviors and cognition

Organizer: Matthew Pontifex, Michigan State University, United States

Discussant: Jennifer L. Etnier, University of North Carolina Greensboro, United States

Symposium description

Pontifex, Matthew B., Michigan State University

In an era where sedentary behaviors continue to increase, it is important to understand the implications of those lifestyle choices for cognitive health and effective function. For well over three decades, research in this area has continued to advance drawing heavily from the domains of kinesiology, cognitive psychology, and neuroscience to gain insights into the relationship between health behaviors and cognition. Utilizing non-invasive electrophysiological and hemodynamic measures, a greater understanding of how these health behaviors relate to aspects of attention, the detection of conflict, and strategic adjustments in behavior can be provided. This symposium will examine how these psychophysiological approaches have been utilized across the diverse area of research broadly clustered within Health Neuroscience. First, Eric Drollette will focus on the chronic effects of physical activity for brain function and cognition in children. Feng-Tzu Chen will follow this up to present recent findings regarding the association between exercise modalities and neural activation in the prefrontal cortex in an aging population. Brandon Alderman will then examine the benefits of chronic physical activity for cognitive control in individuals with depression both as a stand-alone intervention as well as in combination with meditation. Finally, Matthew Pontifex will highlight evidence demonstrating the beneficial effects of just a single bout of physical activity for neural processes indexing attention and action-monitoring in both in typical and atypical populations. Collectively, these findings demonstrate an important role for health behaviors in ensuring optimal cognitive health and effective functioning.

Chronic physical activity for the developing brain

Drollette, Eric S., University of Illinois at Urbana-Champaign

A major threat to global public health is the pandemic of physical inactivity. Arguably, the most devastating health consequence of current trends will be on younger generations with increasing rates of school age children diagnosed with type-II diabetes, obesity, and other metabolic disorders. Surprisingly, given that such health consequences are at the forefront of concern for our youth, schools continue to obviate physical activity during school hours to facilitate core academic learning. Such trends may represent a maladaptive adjustment in school curriculum given recent evidence identifying physical activity as a marker for enhanced brain health, cognition, and academic achievement. Accordingly, this talk will focus on chronic effects of physical activity and the benefits to brain function and cognition in developing children. This ongoing work has utilized various neuroimaging techniques to better understand functional brain mechanisms underlying physical activity induced changes in cognition and brain function. Such findings have considerable momentum for altering educational practice and may further provide school administrators and teachers critical information for tailoring physical activity interventions to afford the best opportunity for benefits to body and mind of young children.

Exercise mode and working memory in late middle-aged adults: A functional MRI study

Chang, Yu-Kai; Chen, Feng-Tzu, National Taiwan Sport University

Several recent studies have highlighted the importance of regular exercise in aging populations, in which the aerobic exercise related benefits impacting executive function have been paid more attention. However, the relationship factors regarding exercise mode, and both behavioral modification and neural activation, remain unknown. The present study was implemented in order to examine the association between exercise mode and executive function, especially regarding the working memory aspect, as well as its task-evoked brain activation. Forty-five late middle-aged adults were classified into open-skill, closed-skill, and control groups regarding their regular exercise participation. All participants completed a working memory task, measured via a spatial working memory task. Additionally, participants also simultaneously were scanned by functional magnetic resonance imaging during their performing of the task. The results revealed that exercise groups, regardless of their exercise modes, increased their spatial working memory accuracy with consistently unchanged reaction times. In addition, participants in the open-skill group exhibited decreasing activation in the region of the left ventrolateral prefrontal cortex, which involves re-orienting attention and executive function processes, indicating less effort required in engaging visual perception and activating working memory in late middle-aged adults. These findings replicated previous studies associated with closed skill exercise and further extended the existing knowledge by revealing that participating in an open-skill exercise could facilitate spatial working memory and reduce the risk of brain neural decline.

Exercise as a stand-alone or combination treatment for cognitive control deficits in major depression

Alderman, Brandon L., Rutgers, The State University of New Jersey

Lifestyle physical activity and exercise interventions have been extensively studied as alternative approaches to conventional treatments for major depressive disorder (MDD). Motivated by Beck's (1967) cognitive model of depression and the National Institute of Mental Health's (NIMH) Research Domain Criteria (RDoC) initiative for developing new ways of

classifying mental health disorders based on behavioral and neurobiological dimensions, there has been recent interest in identifying treatments that specifically target neurocognitive impairments in MDD and other biobehavioral disorders. Aerobic exercise may be particularly effective for ameliorating cognitive deficits in MDD, considering that a large body of empirical evidence supports the influence of exercise on neurocognitive function. Despite the parallel lines of inquiry of exercise benefits for depression and cognitive function, insufficient research attention has been devoted to the effects of exercise training interventions on neurocognitive function in MDD. Findings from several clinical trials using exercise as a stand-alone treatment or in combination with focused-attention meditation to target neurocognitive deficits in individuals with MDD will be outlined. We have indexed these adaptations using several event-related potential (ERP) components, including the N2, P3, and error-related negativity (ERN). Collectively, findings from these trials suggest significant improvements in depressive symptomatology and cognitive function from pre-to-post intervention, although improvements in cognitive control were not found to mediate reductions in depressive symptoms. Similar effects of exercise were found regardless of whether exercise was performed alone or in combination with meditation. However, the dose of exercise was lower in the combined treatment intervention. Implications from these trials including the use of ERPs to assess modifiable neural targets within a clinical trial will be discussed.

What if I don't want to exercise today?: The association between bouts of physical activity and cognition

Pontifex, Matthew B., Michigan State University

The benefits of chronic physical activity engagement and increased aerobic fitness for both physical and mental health have been demonstrated through converging evidence across both human and animal models. Despite this relationship however, attempts to enhance physical activity engagement on the population level have had limited success with epidemiological investigations indicating an increasing prevalence of sedentary behaviors. Refocusing physical health interventions on the potential short term benefits of physical activity may have greater utility as similar to the way in which a dose of medication is administered, physical activity is engaged in through single acute bouts of exercise. Leveraging insights provided through psychophysiological recordings, we have examined the association and effects of these single doses of physical activity as they relate to neural processes indexing the allocation of attentional resources and action-monitoring. In ongoing research, we have specifically focused on 1) the effect of a single dose of physical activity on these processes in both in typical and atypical populations, and 2) the neurobiological mechanisms that regulate the relationship between physical activity and these neural processes. Our results highlight the importance of physical activity for sustaining or evening enhancing aspects of high-level cognitive functions, particularly for those children with poorer cognitive abilities and attention-related impairments, such as ADHD. Although the mechanisms underlying such findings are still unknown, early evidence suggests that the beneficial effects of these single doses of physical activity may be multi-faceted.

Tuesday, June 6

Symposium

Sport and Exercise Psychology

Mo and Thelma, have we been listening? The application and utility of viewing youth sport through a developmental lens

Organizer: Travis Dorsch, Utah State University, United States

Discussant: Maureen Weiss, University of Minnesota, United States; Thelma Horn, Miami University, United States

Mo and Thelma, have we been listening? The application and utility of viewing youth sport through a developmental lens

Dorsch, Travis E., Utah State University

Organized youth sport is a salient developmental context for children (Côté & Fraser-Thomas, 2007). As early as the 1980s, kinesiology researchers (e.g., Weiss & Bredemeier, 1983) called for scholars to adopt a developmental lens in youth sport research. Despite this call, there remains an underrepresentation of research in sport and exercise psychology that truly addresses research questions through a lens of human development. While no theory is singularly fit to frame developmental research in sport and exercise psychology, we will use Bronfenbrenner's Process-Person-Context-Time (PPCT) model as an organizing fixture for the symposium. The symposium will begin with a historical overview of developmentally based youth sport literature, while offering insights into the 'intersection' of youth sport and human development. Four individual studies will then be presented, highlighting the intersection of process, person, context, and time factors in organized youth sport. The first study details the impact of the goal profiles parents have for their children in sport on the paralinguistic qualities (e.g., frequency and amplitude) of parents' verbal sideline behavior across a range of organized youth sport contexts. The second study was designed to assess differences in sport perceptions (i.e., perceived competence, comparison tendency, and modeling) across sibling relationship profiles in youth sport. The third study highlights the impact of young athletes' competence, confidence, connection, and character on their interactions with teammates, opponents, and coaches in a recreational community basketball league. The final study explicates the design and content of an innovative coach development program and introduces a novel tool that allows researchers to capture a contextualized picture of coaches' leadership behaviors over time. Two discussants will address the current state of developmental research in sport and exercise psychology, the studies presented, and considerations for how future generations of researchers might best hone their developmental lenses.

It's not what you say, but how you say it: The impact of parents' goal profiles on vocal emotional arousal during organized youth sport competitions

Grimm, Marshall X.; Dorsch, Travis E., Utah State University

Within the PPCT model (Bronfenbrenner, 1999, 2005), proximal processes, or the interactions individuals have with the people and objects in their environment, are described as the primary catalyst for development. One developmental context that affords parents and children a forum for regular interaction is organized youth sport, and perhaps the most common form of interaction in this context is parent-to-child communication. Although descriptive literature in the sport and family sciences describes what parents say on the sidelines, little is known about how they say it. The present interdisciplinary study was designed to address this gap by examining the paralinguistic characteristics (i.e., vocal emotional arousal) of parents' in-competition communication in light of the goal profiles they held for their children in sport. Ninety-five parents (Mage = 40.57 years; SD = 8.34) with children (Mage = 11.02 years; SD = 2.40) participating in a range of organized youth sports were recorded during a competition (range 58-124 minutes). Subsequent to the competition, parents completed a brief demographic questionnaire as well as a 48-item survey assessing the instrumental, identity, and relational goals they held for their children's sport participation. A hierarchical cluster analysis was used to classify parents based on their respective goal profiles, and three distinct profiles emerged. Goal profiles reflect disparities in the importance of instrumental, identity, and relational goals among parents. An ANCOVA was conducted to determine whether parent goal profiles predicted statistically significant differences in their vocal emotional arousal during competition after controlling for child sex and sport type. These findings extend present understanding of parent goals and verbal sideline behavior (Dorsch et al., 2015; Holt et al., 2008) and inform youth sport administrators and coaches who wish to develop contexts that foster positive outcomes for youth participants.

Sibling relationship profiles and sport perceptions in young athletes

Blazo, Jordan A., Louisiana Tech University; Smith, Alan L., Michigan State University; Whiteman, Shawn D., Utah State University

Sibling relationships are common and enduring, yet little is known about their role in youth sport. These relationships are characterized by expressions of warmth and conflict that tie to social and personal perceptions (Blazo et al., 2016; Whiteman et al., 2009). Recognizing that relationship qualities do not exist on a continuum, an ideographic approach allows for examination of relationship profiles and their salience to sport perceptions. Accordingly, and in line with Bronfenbrenner's conception of human development (Bronfenbrenner & Morris, 2006), our purpose was to (a) describe sibling relationship profiles in youth sport and (b) assess profile differences in sport perceptions (i.e., perceived competence, comparison tendency, and modeling). Informed by past work (e.g., McGuire et al., 1996), profiles of higher warmth were expected to exhibit higher sport perceptions. The opposite was expected for profiles of higher conflict. Profiles simultaneously expressing higher warmth and conflict were expected to show the highest perceived competence and comparison tendencies, and lower modeling. Sport-involved younger siblings (N = 207; Mage = 10.5 +/- 1.6 years) completed established measures of study variables. Cluster analysis of sibling warmth and conflict perceptions yielded a 5-cluster solution. Analysis of profile differences on sport perceptions partially supported the hypotheses. Those with sibling profiles expressing relatively high warmth reported higher perceived competence, comparison tendency, and modeling. Those with profiles expressing relatively higher conflict reported lower perceived competence, comparison tendency, and

modeling. Profiles exhibiting relatively high warmth and conflict did not emerge. Profile differences were significant and exhibited medium and large effects for comparison tendency ($p = .09$) and modeling ($p = .15$), but only yielded a trend for perceived competence ($p = .04$). Collectively, these findings show that proximal processes tied to sibling relationships and youth sport perceptions warrant continued examination.

Positive youth development and observed interpersonal interactions in recreational sport
Vierimaa, Matthew, Utah State University; Bruner, Mark, Nipissing University; Cote, Jean, Queens University

Competence, confidence, connection, and character are regarded as outcomes of positive youth development (PYD) in sport. While researchers have begun to examine the relevance of these outcomes in sport, the specific athlete behaviors associated with different PYD profiles are not well understood. Thus, the purpose of this study was to investigate the relationship between athletes' observed interpersonal interactions during sport competitions and their perceptions of PYD outcomes. Sixty-seven youth athletes (Mage = 12.42 years; SD = 1.29) from a recreational community basketball league were observed during competition near the end of their season. Competitions were videotaped and athletes' interactions with teammates, opponents, and coaches were assessed using the Athlete Behavior Coding System (Vierimaa & Côté, 2016). Athletes also completed measures of the 4 Cs (i.e., competence, confidence, connection, and character). A person-centered analysis approach was used to examine the relationship between PYD profiles and observed interpersonal interactions. A cluster analysis identified two homogenous groups of athletes characterized by relatively high and low perceptions of confidence, connection, and character, respectively. A MANCOVA revealed that after controlling for gender and years of playing experience, the group that scored higher on the 4 Cs engaged in more frequent sport-related coach-athlete interactions. These results highlight the critical role of coaches' interactions during games as an important variable that affects the developmental experiences of young athletes in sport.

Coaching for Youth Development

Cote, Jean; Turnnidge, Jennifer, Queens University; Vierimaa, Matthew, Utah State University

There is growing recognition that effective youth sport coaching is not only about developing better athletes, but also about developing better people (Vella et al., 2010). To achieve this important goal, coach research and education are needed to develop evidence-based programs that focus on high-quality interpersonal relationships. This presentation will describe the design and content of an innovative coach development program and introduce a novel tool that allows researchers to capture a contextualized picture of coaches' real-time leadership behaviors. The Transformational Coaching workshop is an evidence-informed workshop designed to enhance coaches' leadership skills, and ultimately improve the quality of their interpersonal relationships. A series of interactive and reflective activities help increase coaches' understanding of the principles of transformational coaching and their ability to develop strategies for implementing transformational coaching behaviors in their own coaching practice. To assess the effectiveness of this workshop, measurement tools are needed to explore the dynamics of the interpersonal relationships that occur between coaches and athletes in sport. Accordingly, the Coach Leadership Assessment System (Turnnidge & Côté, 2016) was designed to provide an objective assessment of coaches' interpersonal behavior over time, while analyzing coach behaviors in relation to the content (instruction/feedback, organization, and general communication), recipient, and context. Drawing from an integration of the dimensions emphasized within the full-

range leadership model, and particularly, transformational leadership (TFL) theory (Bass & Riggio, 2006), this presentation will emphasize the need for more coaching research and educational programs that focuses on the interpersonal aspects of coaching while considering the short and long-term effects on athletes' development. By becoming more effective leaders in different contexts, coaches can positively contribute to their athletes' performance, long-term participation, and personal development.

Motor Development

Motor Skills and Physical Activity in Young Children: Potential Factors that Influence Self-Regulation

Organizer: Leah E. Robinson, University of Michigan, United States

Discussant: Sam Logan, Oregon State University, United States

Motor Skills and Physical Activity in Young Children: Potential Factors that Influence Self-Regulation

Robinson, Leah E., University of Michigan

Symposium Overview: Engaging in motor skills is critical to the growth and development of children while physical activity aids in wellness. During the early childhood years, there are dramatic changes in self-regulation (SR), the ability to control behavioral impulses, manage emotions, and maintain focus and attention. Early SR capacities set the stage for children to control their thoughts, emotions, and actions to achieve desired goals. The body and brain work harmoniously together to understand and interpret the world around us. But there is a need to further understand how movement experiences contribute to self-regulation in young children. This symposium will include five empirical studies to gain a better understanding of this question. Study 1: Examined young children with developmental disorders and the relationships between: 1) SR and motor development; 2) developmental challenges and parents' perceptions of barriers to PA; and 3) parents' qualitative descriptions of children's early PA experiences. Study 2: Determined the relationship between motor skills and SR in four and five-year-old children from both low and higher SES families. Study 3: Examined the differences in executive functions between young children who were developmentally delayed and who were not delayed in gross and fine motor skills. Study 4: An interventional study that examined whether (a) enriching physical education with designed physical activity games may positively impact not only children's game skills in the gym, but also SR skills in the classroom, and (b) these expected outcomes are linked by a mediation path leading from the gym to the classroom. Study 5: An interventional study that evaluate the 'Move for Thought preK-K' physical activity program, designed to target whole-child development within and outside of the preschool classroom.

Educating the 'Whole' Child with Physical Activity Games: Self-regulation outcomes in the Classroom and Mediating Skills

Pesce, Caterina; Marchetti, Rosalba, Italian University Sport and Movement; Schmidt, Mirko, University of Bern

Introduction. The assumption that physical activity (PA) is critical to holistic development underlies the call for 'whole child' initiatives of PA promotion particularly in schools. A key PA

outcome for the school context at the intersection of cognitive function and life skill domains is the improvement of self-regulation (SR). This interventional study examined whether (a) enriching physical education (PE) with designed PA games may positively impact not only children's game skills in the gym, but also SR skills in the classroom, and (b) these expected outcomes are linked by a mediation path leading from the gym to the classroom. Methods. Ninety-six, 3rd and 4th graders were class-randomized to either generalist-led PE, or a designed, specialist-led PE intervention lasting 2 school years enriched with playful coordinative and cognitive demands, goal setting and reflection on action tasks. At three time points (pre, post, follow-up), they were assessed for decision making and support skills in team sport situations (Game Performance Assessment Instrument for Invasion Games). Self and peer ratings of children's impulsivity and disruptiveness were obtained (Multisource Assessment of Social Competence Scale). Results. Children assigned to the 'enriched' intervention showed more improvements in sport-related decision making and support skills in the second intervention year and a reduction of irascibility (as rated by both the child and his/her peers) and of disruptive behaviors (as rated by peers). Mediation analysis performed on pre-follow-up delta scores revealed that the extent to which peer-rated disruptive behavior diminished from the beginning to the end of the intervention was partially mediated by the improvement in making effective decisions in sport game. Discussion. Results suggest that: (a) designed PA games have the potential to positively impact emotional and behavioral SR; (b) this may be at least partially a far transferable effect of the training and improvement of decision making skills in PA game situations.

Relationship between Motor Skills and Self-Regulation in Preschoolers from Diverse Backgrounds.

Palmer, Kara; Chinn, Katherine; Conroy, Colleen; Persad, Catherine C.; Bala, Cecilia; Brown, Matthew; Miller, Alison; Robinson, Leah E., University of Michigan

Introduction: Recent work has demonstrated that motor skill interventions are effective for maintaining self-regulation (SR) in preschoolers from families with low socioeconomic status (SES). However, scant work exists that examines this relationship across children from a diverse set of backgrounds. The purpose of this study was to determine the relationship between motor skills and SR in four and five year old children from both low and not low SES families. Methods: A total of 113 children (53% boys, Mage= 4.7 yrs) from both low SES (n=48, 56% boys, Mage = 4.6 yrs) and not-low SES (n=65, 50% boys, Mage = 4.8 yrs) served as participants in this study. SR was assessed using the Raver's Preschool Self-Regulation Assessment (PSRA). The PSRA measures a wide array of SR behaviors including inhibitory control, impulsivity, emotion regulation, delay of gratification, and attentional focus. Motor skills were assessed using the Test of Gross Motor Development-2nd Edition. The relationships among SR, motor skills, and child characteristics (i.e., age and SES) were examined using simultaneous regression models. Results: After controlling for SES and age, locomotor skills were a significant, positive predictor of emotional regulation (beta = .25, p = .03) and toy wrap latency (beta = .28, p = .02); total motor skills were a significant, positive predictor of emotional regulation (beta = .24, p = .048) and toy wrap latency (beta = .28, p = .02). Discussion: This study found that locomotor and total motor skills scores were significant predictors of emotional regulation, whereas object control skills, age, and SES were not significant predictors of emotional regulation. Motor skills were not a significant predictor of inhibition nor delay of gratification. These findings support the relationship between SR and motor skills, but this relationship appears to vary depending on what aspect of SR is being assessed. SR is a complex phenomenon. More work is needed to examine the relationship between motor skills and multiple aspects of SR.

Relationships between motor skill delay and executive functions in vulnerable children aged 3-5 years

Okely, Anthony; Howard, Steven; de Rosnay, Marc; Mackie, Franca; C Veldman, Sanne L.; Melhuish, Ted, University of Wollongong

Introduction: Preschool children's motor skills and executive functioning have both been shown to enhance self-regulation outcomes. Yet to our knowledge, associations between motor skills and directly assessed executive functions among preschoolers have not been investigated. The purpose of this study was to examine the differences in executive functions between young children who were developmentally delayed and who were not delayed in gross and fine motor skills. **Methods:** Cross-sectional data from 571 children (298 boys, 273 girls; mean age 4.4y from 32 Early Childhood Education and Care (ECEC) centers in low-income communities in New South Wales, Australia) were used. Assessments were conducted in centers by trained researchers. Fine and gross motor skills were assessed using the Ages and Stage Questionnaire. Three executive functions (inhibitory control, working memory, and cognitive flexibility) were assessed using the Early Years Toolbox. Based on their motor skills scores, children were categorized as delayed/at risk of delay or not delayed. These categories were then compared across each of the executive function outcomes using independent samples t-tests, with all analyses adjusting for clustering within centers. **Results:** The proportion of children delayed or at-risk of delay for gross and fine motor skills was 11% and 22%, respectively. Compared with children who were developmentally on track in their motor skills, those who were delayed had significantly lower scores on all three measures of executive function for both gross and fine motor skills (all $P < .05$). These differences were marginally greater for fine compared with gross motor skills. **Discussion:** In young children, developmental delay in gross and fine motor skills appears to be strongly associated with lower scores on measures of executive functions. As executive function is an important predictor of school readiness, providing evidence-based programs to improve motor skills may be important for executive function and other aspects of school readiness.

Early Self-Regulation and Motor Challenges May Be Barriers to Participation in Physical Activity

Lakes, Kimberley, University of California Irvine; Abdullah, Maryam, University of California, Irvine; Aizik, Shlomit, University of California Irvine

Introduction: Physical activity (PA) is an important component of healthy growth and development and has the potential to enhance motor skills and SR. Developmental challenges and parent concerns about how a child might be perceived and treated may become barriers to PA. This study examined young children with developmental disorders, and the relationships between: 1) self-regulation (SR) and motor development; 2) developmental challenges and parents' perceptions of barriers to PA; and 3) parents' qualitative descriptions of children's early PA experiences. **Methods.** 146 participants (M=31.81 months; 75% male) were evaluated using the Parent Perceptions of Physical Activity Scale, Vineland Scales of Adaptive Behavior-Parent Form, the Autism Diagnostic Observation Schedule (ADOS), a physician diagnostic evaluation, and body mass index. 115 met Autism Spectrum Disorder (ASD) criteria on the ADOS and received an ASD physician diagnosis. Three years later, a subsample of parents attended focus groups to discuss their children's subsequent PA experiences. **Results.** 23% of children were overweight or obese at initial assessment. SR was significantly correlated with motor development. Ratings of children's daily living skills, socialization skills, and motor skills, but not communication skills, significantly predicted barriers to PA. Focus group discussions highlighted

barriers to PA, including the time demands of multiple therapies, parental fears about children's acceptance in PA programs, and concerns about how children's behavioral and physical challenges would be perceived by others. Parents described positive experiences and individual progress in supervised activities like swimming, horseback riding and karate. While acknowledging that individual sports often present fewer barriers, parents expressed a desire for increased access to team sports. Discussion. Developing PA interventions for children with developmental challenges should be an important priority given their concurrent challenges in developing motor and SR skills.

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Wednesday, June 7

Symposium

Sport and Exercise Psychology

Coach-Athlete Relationships: Global and Effective Coaching Practices

Organizer: Gordon Bloom, McGill University, Canada

Discussant: Wade Gilbert, California State University, Fresno, United States

Introduction

Bloom, Gordon A.; McGill University

Coach-athlete relationship quality as a gauge of coaching effectiveness

Jowett, Sophia, Loughborough University

Anecdotal evidence alludes to the importance of coaches and athletes working closely together where mutual trust, respect, commitment, and a sense of responsiveness and receptiveness underlines their actions. Correspondingly, empirical evidence has shown that a high quality coach-athlete relationship is negatively associated with conflict, depression, and negative affect (Felton & Jowett, 2013), and positively with motivation (e.g., Adie & Jowett, 2010), satisfaction, team cohesion, and collective efficacy (Hampson & Jowett, 2014; Jowett & Nezelek, 2012). The present study examined the assertion that effective coaching is dependent on high quality coach-athlete relationships. A total of 399 athletes completed the Coach-Athlete Relationship Questionnaire (Jowett, 2009) and the Coach Behavior Scale for Sport (Côté et al., 1999). Structural equation modelling with maximum likelihood analysis tested the hypothesis that the relationship would predict athletes' perceptions of coaching behaviors. Closeness and Commitment predicted most of the positive coaching behaviors. Complementarity (co-operation) predicted Positive Personal Rapport only, while Negative Personal Rapport was predicted by Closeness. The results suggest that athletes whose relationships with their coaches were characterized by trust, respect, and appreciation, as well as commitment to maintain a long-term working relationship, perceived their coach as effective (e.g., technical and physical information, goal setting, mental preparation, and competition strategies). Athletes' efforts to develop quality relationships with their coaches may compel coaches to treat these athletes with understanding, empathy and concern (positive rapport) as opposed to intimidation, favoritism, and control (negative rapport). Consequently, it is important to educate both coaches and athletes about the various factors that impact the coach-athlete relationship in order to optimize athlete performance and personal well-being.

High performance coaches' perspectives on managing difficult athletes

Bloom, Gordon A.; Heelis, Liam; Caron, Jeffrey G., McGill University

The role of a coach is to facilitate, moderate, and mold a group of diverse individuals into a cohesive unit that achieves success and personal satisfaction (Vallée & Bloom, 2005). Dealing with difficult athletes is a major factor impeding the job of the coach, so it is somewhat surprising to learn there is minimal research examining this topic (Cope, Eys, Beauchamp, Schinke, & Bosselut, 2010). A difficult team member withholds effort, expresses negative emotions, breaks team rules, and/or mistreats teammates (Cope et al., 2010). Although research on effective coaching strategies is well documented, information on how to effectively manage the difficult, dysfunctional, problematic, or cancerous athlete in sport is much less developed. The purpose of the present study was to investigate how high performance coaches managed difficult athletes. Coaches of teams in the Canadian Hockey League (CHL) were purposely sampled since this is the premiere development stream to the National Hockey League. Athletes in the CHL are between 15-20 years old, are typically living away from home for the first time, and have various levels of maturity. Semi-structured interviews were conducted with eight male coaches who had averaged 21 years of coaching experience. Results from our thematic analysis (cf. Braun & Clarke, 2013) revealed that coaches (a) encouraged problem athletes to reflect on how their behaviors were adversely affecting the team environment, (b) established a relationship with problem athletes that was built on trust and mutual respect, and (c) clearly communicated expected behaviors with the individual. Findings from the present study offer insights into the impact of difficult athlete behavior in high performance sport, how these behaviors can impact group functioning, as well as examples of leadership strategies that have been successfully implemented by these experienced coaches.

Emotional intelligence as a predictor of conflict responses and coach-athlete relationship quality

Wachsmuth, Svenja; Jowett, Sophia; Harwood, Chris, Loughborough University

Interpersonal conflict has been a recurring topic within recent sport psychology literature (e.g., Mellalieu et al., 2013). Conflict is often associated with negative consequences such as low mood or high stress, and thus, has been deemed detrimental for well-being and performance (e.g., Partridge & Knapp, 2016). Nevertheless, conflict may also promote positive outcomes, including opening paths of communication, enhancing problem-solving, or development of closer relationships (e.g., Holt et al., 2012). A recent study found that emotional regulation may play an important role in shaping conflict processes (Wachsmuth et al., 2016). This finding is supported by research focusing on romantic and work relationships which has highlighted a link between conflict experiences and emotional intelligence (EI), including the ability to manage one's own and other's emotions (Smith et al., 2008). Thus, the present study examines the hypothesis that conflict responses provide a mechanism through which EI and the quality of the coach-athlete relationship are associated. Coaches and athletes completed a survey containing the Schutte Self-Report Emotional Intelligence Test (Schutte et al., 1998), the Coach-Athlete Relationship Quality Questionnaire (Jowett, 2009), and the Interpersonal Conflict in Sports Questionnaire (ICSQ; Wachsmuth et al., 2017). The ICSQ assesses functional and less functional responses to conflict (e.g., problem-solving vs escalating behaviours). Initial results indicate that problem-solving conflict responses fully mediated the effect of EI on the coach-athlete relationship quality ($R^2 = .23$; $p < .001$; Indirect effect: $b = 0.54$, $SE = 0.19$; 95% CI [0.27; 1.01]; $N = 119$). Accordingly, the positive impact of EI on developing and maintaining high quality coach-athlete relationships may be explained by problem-solving responses to conflict. Thus, coaches and athletes are advised to stay calm, rational, and confident in the face of conflict, as well as to openly discuss the problem at hand rather than withdrawing from the situation, or reacting emotionally.

Coach support and the injured athlete: Are athletes' getting what they need?

Podlog, Leslie, University of Utah

The role of social support in mitigating the challenges of injury recovery is well documented (Wiese, Weiss, & Yukelson, 1991). Social support has been defined as “an exchange of resources between two individuals perceived by the provider or the recipient to be intended to enhance the well-being of the recipient” (Shumaker & Brownell, 1984, p. 73). Given the importance of coaches in the lives of athletes, researchers have sought to understand their role in facilitating injured athletes' well-being and recovery (Bianco, 2001; Clement & Shannon, 2011). This presentation examines the extent to which coach support effectively addresses the well-being and rehabilitation needs of injured athletes. In order to examine this issue, the optimal matching hypothesis will be drawn upon to interpret the extant research findings. According to this hypothesis, the effectiveness of social support is a reflection of the degree to which the support provided, matches the type, amount, and timing of that required by the recipient (Cutrona & Russell, 1990). This presentation will focus primarily on two studies examining coach perspectives of support provided to injured athletes (Podlog & Dionigi 2010; Podlog & Eklund, 2007). Recent work on athlete perspectives of coach support will also be examined to better understand athlete satisfaction with the type, amount, and timing of support received. Finally, the influence of the coach-athlete relationship on coach provision of, and athlete satisfaction with coach support will be discussed. As the final theme has yet to receive empirical testing, the presentation will highlight fruitful areas for further inquiry on the coach-athlete relationship and injured athlete support. The presentation will also provide practical information for coaches regarding the emotional, informational, and practical support needs of athletes. Finally, the presentation will help identify athlete perspectives regarding areas where coach support behaviors could be enhanced.

Motor Learning and Control

Sleeping on the Motor Engram: The Multifaceted Nature of Sleep-Related Motor Memory Consolidation

Organizer: Genevieve Albouy, KU Leuven, Belgium

Discussant: Bradley R. King, KU Leuven, Belgium

Enhancing performance across the healthy adult lifespan: Behavioral and neural correlates of sleep-facilitated motor sequence memory consolidation

Albouy, Genevieve; King, Brad, KU Leuven

Understanding the conditions under which optimal motor memory consolidation processes are triggered is one of the most exciting challenges in our field. In this presentation, I will review recent neuroimaging studies demonstrating that optimal motor memory consolidation in young healthy adults is conditional on the particular combination on specific patterns of activity and connectivity in the hippocampus and the striatum during memory encoding and the occurrence of a subsequent sleep episode. I will also present recent results showing how the recruitment of these cerebral structures is modulated by age, task requirements and behavioral interference, and how these factors, in turn, influence sleep-related consolidation processes. These results will be discussed in the context of determining boundary conditions for motor memory optimization. Overall, this presentation will emphasize that sleep is critical for motor memory consolidation processes and should be a focus of future research in the field of motor learning.

Sport and Exercise Psychology

Neuroplasticity and sleep-related consolidation: Insights from motor imagery practice

Debarnot, Ursula, University Claude Bernard Lyon; Schwartz, Sophie, University of Geneva; Guillot, Aymeric, University Claude Bernard Lyon

The most remarkable property of the human brain is its ability to reorganize across the entire lifespan. In the sensorimotor domain, such neuroplasticity has been investigated either by promoting the acquisition of new skills or by compensating for the loss of motor function. Due to its parallel characteristics with physical practice, motor imagery (MI) _mental representation of an action without engaging its covert execution_ is a relevant technique to enhance skill learning. The effect of the consolidation following MI, and in particular the impact of sleep, has however received little attention. In this presentation, we review data focusing on the sleep contribution to motor memory consolidation following MI practice. We first consider findings demonstrating that memory for imagined movements, as for physical practice, are consolidated either after a night of sleep or a nap, yielding subsequent motor performance gains. Further results showing that the most complex movements imagined are the most effective in promoting sleep-related performance gains, will also be discussed. When considering the robustness of the motor learning to retroactive interference, MI practice has been reported to elicit a more durable and flexible representation of the skill compared to physical practice. Although current data support both sleep-dependent and MI-dependent brain plasticity in the motor learning domain, we will discuss a recent study exploring the effect of maladaptive neuroplasticity on sleep consolidation, when sensory inputs and motor outputs are interrupted by short-term immobilization. Especially, we will consider how MI might compensate the adverse effects induced during 12 hours of arm-immobilization, hence possibly triggering subsequent sleep features. Overall, results provide evidence that MI prevents the slowdown of the sensorimotor processes as well as the maladaptive neuroplasticity induced by immobilization. These data shed light on how scheduling relevantly MI interventions and sleep periods for fruitful applications designed to enhance rehabilitation.

Specificity of sleep spindles in motor memory consolidation

Boutin, Arnaud, University of Montreal

Growing evidence supports the benefits of sleep on the consolidation of motor sequential skills. Previous studies have shown that NREM sleep and associated thalamo-cortical spindle activity play a critical role in this mnemonic process. Recent findings further show consolidation-related changes in striatal and hippocampal activity. However, direct experimental evidence supporting the contribution of sleep-dependent physiological mechanisms to motor memory consolidation is still lacking. Hence, in this study simultaneous EEG-fMRI sleep data were recorded following practice of a motor sequence learning task (MSL). A delayed retention test was performed the following day to assess the level of MSL consolidation. We sought to determine whether regionally- and feature-specific spindle oscillations support active reprocessing of the memory trace and favor MSL consolidation. To that end, we automatically detected sleep spindles and conducted EEG source reconstruction on spindle epochs in both cortical and subcortical regions using novel deep-source techniques. Coherence-based metrics were adopted to estimate functional connectivity between cortical and subcortical structures over specific frequency bands. Results revealed that participants showed post-MSL overnight performance improvements, with the magnitude of off-line gains positively correlating with spindle frequency, amplitude and duration at the parietal midline derivation (Pz). Moreover, regional spindle-amplitude asymmetries correlating with MSL consolidation were found over central (C4-C3) and parietal (P4-P3) sites, reflecting a genuine local homeostatic interhemispheric spindle regulation over the primary motor, sensorimotor and somatosensory cortex. Interestingly, our findings also point out the role of EEG alpha-/spindle-band coherence in the coalescence of post-MSL

cortical and subcortical brain activity during sleep spindles. These neural rhythms may be the basis for sleep-dependent MSL consolidation in sustaining the flow of information within a functional thalamo-striatal-hippocampal-cortical network.

The impact of sleep on gross motor learning / adaptation

Hoedlmoser, Kerstin, University of Salzburg

Two studies examining sleep effects on (i) gross motor learning: 3-ball cascade juggling and (ii) gross motor adaptation: riding an inversed steering bike will be presented. Study 1: 32 subjects (16 male; 19-29yrs) trained to juggle in the evening (sleep-group; N=16) or in the morning (wake-group; N=16). After an 8h retention interval performance (number of ball-catches) was tested. The sleep-group spent 3 nights in the lab: i) baseline-night (without prior learning) ii) control-night (after simple motor learning) and iii) experimental-night (after complex motor learning). Study 2: 12 male subjects (20-35yrs) trained to ride an inverse steering bike. 6 subjects (sleep-first) practiced in the evening and were tested immediately after training, after 8h of sleep and in the evening following wakefulness. The other 6 subjects (wake-first) trained and were tested in the morning, after 8h of wakefulness and after 8h of sleep. Performance was quantified by the steering angle and the riding time for 5x30m. Results: Study 1: Juggling performance remained stable after sleep but was reduced after wake. The sleep-group showed higher sleep spindle activity during the experimental-night and enhanced performance after sleep. A trend for a negative relationship between REM sleep duration during the experimental-night and overnight performance changes was found. Study 2: Riding performance after wake was decreased, while sleep substantially stabilized it. Higher spindle activity during the night after training and during the night after 8h wakefulness preserved performance. Discussion: For motor learning (study 1) we found that sleep in comparison to wake supports the stabilization of 3-ball cascade juggling, which is in line with earlier studies on fine motor skills reporting gains or at least stabilization. Sleep spindles and REM sleep are involved in the consolidation process, yet with opposing effects. For motor adaptation study 2 shows that a retention interval containing sleep with higher sleep spindle activity helps to stabilize the adaptation of a gross motor task.

Sport and Exercise Psychology

Nonverbal behavior and person perception in sports

Organizer: Philip Furley, German Sport University, Cologne & Mirko Wegner, University of Bern, Switzerland

Discussant: Philip Furley, German Sport University, Cologne

Symposium Overview

Furley, Philip A., German Sport University Cologne; Wegner, Mirko, University of Bern

We are constantly forming impressions of other people based on observable cues (e.g. body language) and information we receive and store in memory (e.g. reputations). This dynamic process of person perception influences social interactions within sporting contexts. Although the media frequently report on the body language of athletes and the role of reputations of sporting officials, research in this field is scarce and has only recently received increased attention. In this symposium we present contemporary research on nonverbal behavior and person perception in sports.

The introductory presentation gives an overview of research on nonverbal communication in sports from an evolutionary perspective. Research suggests that nonverbal behavior evolved to communicate internal states helping to organize group life. Studies show that although athletes and officials have the goal of presenting themselves favorably their nonverbal behavior changes depending on the situation (e.g. when athletes are losing or when referees communicate difficult decisions) and that perceivers recognize these systematic changes and are influenced by them. The 2nd presentation builds on these findings and shows that individual differences exist in interpreting nonverbal cues of athletes. He provides evidence that the implicit power motive of perceivers predicts the sensitivity of detecting nonverbal cues associated with dominance and submissiveness. Subsequently an experimental study highlights how dominant and submissive body language influence anticipation and behavior in soccer penalties. Finally, a study is presented showing that other informational cues beyond nonverbal behavior influence the person perception process by providing evidence that the experience and qualification pathways of football referees influences impressions of football players and coaches. The discussant completes the symposium by critically discussing the presented findings from a theoretical, methodological, and applied perspective.

Nonverbal behavior in sport: An evolutionary perspective

Furley, Philip A., German Sport University Cologne; Schweizer, Geoffrey, University of Heidelberg

Evolutionary accounts of nonverbal behavior suggest that humans have developed adaptive mechanisms of displaying and detecting relevant nonverbal signals that facilitate social behavior and group life. Dual-process theories suggest that humans can deliberately control their body language (nonverbal behavior), but also unintentionally leak information associated with certain internal states. Of relevance to the sports context, athletes and officials have been shown to be motivated to present themselves favorably, even if 'things are currently not going so well'. However, evolutionary accounts predict that both athletes and officials sometimes 'out themselves' by nonverbally leaking internal states. A series of studies (Furley & Schweizer, 2014a; 2016) with over 500 participants and large effect sizes provided evidence for this theorizing by showing that observers were well equipped for differentiating between leading and trailing athletes based on the body language of trailing athletes who displayed nonverbal cues associated with submissiveness, shame, and a lack of confidence. Further, athlete participants (N=40) were more confident when anticipating competing against an observed athlete who was currently trailing although participants were not aware of the current score (Furley & Schweizer, 2014a). Similarly, observers (N=158) rated referees' body language as less confident when they were communicating ambiguous decisions compared to unambiguous decisions in professional soccer matches and that players anticipated that they would be more likely to debate with the referee when referees nonverbally communicated less confidence (Furley & Schweizer, 2017). These findings show that although the nonverbal communication of internal states has probably been of high adaptive value for humans by helping to organize group life, they might have unwanted consequences during competitive sporting encounters. Athletes and officials have unintentional ways of 'outing themselves' to others which likely influences further interactions during competition.

The implicit power motive helps identifying nonverbal sport behavior

Wegner, Mirko, University of Bern; Furley, Philip, German Sport University Cologne; Schweizer, Geoffrey, University of Heidelberg

The implicit power motive is a recurrent non-conscious, non-verbal, and affect-based concern for dominating others mentally, emotionally, or physically. Its importance has previously been illustrated in sports like karate, table tennis, or basketball. Identifying cues that allow dominant behavior is an important precondition for successful dominant behavior. Thus, it should be easier for a power-motivated individual to identify submissive or dominant behavior displayed by athletes in a sport competition. It was previously documented that athletes and non-athletes alike are able to infer competition scores from athlete's nonverbal behavior. The hypothesis for the present study was that the implicit power motive predicts accuracy and speed in identifying scores in short basketball and table tennis videos.

German and Swiss sport students (N = 156) took part in the study. With a computer-based test we measured nonverbal dominance behavior in 72 short basketball (BB) and table tennis (TT) videos. Participants were asked to guess whether the athletes displayed in the video were (1) far behind, (2) close behind, (3) whether the score was tied, (4) they were in close lead, or (5) in high lead. Participants' accuracy and response time was measured. The Picture Story Exercise (PSE) was used to measure the implicit power motive. The implicit power motive was significantly associated with accurately and quickly identifying nonverbal behavior in both sports, basketball and table tennis. The results illustrate how an athlete's implicit power motive as an individual difference variable is involved in the identification of cues in the sport environment that might even be of nonverbal format. Future research may further look at the motive-dependent perception of non-conscious cues.

On top of the rock? Effects of penalty takers' body language on impression formation, gaze behavior and goalkeepers' anticipation performance in soccer

Bijlstra, Gijs, Radboud University; Smeekens, Marjam; Nieuwenhuys, Arne, Radboud University Nijmegen

Recent evidence suggests that, in soccer, dominant and submissive body language of penalty takers can influence impression formation in goalkeepers (Furley et al., 2012). Building on these findings, the current study investigated implications of penalty takers' body language (dominant vs. submissive) for goalkeepers' anticipation performance and tested whether a potential effect may be mediated by (a) impression formation or (b) changes in gaze behavior. 40 participants (27 female; Mage = 25.9 years) adopted the role of goalkeeper and performed anticipatory judgements (left or right) in relation to video clips of penalty takers taking penalties to either side of the goal. Penalty takers' body language (dominant vs. submissive) was manipulated within-subjects and randomly distributed over trials. Clips were occluded 240ms before football contact. After each clip, participants indicated their impression of the penalty taker (i.e. competitiveness, experience, confidence; 0-100 scales). During the clips, gaze behavior (i.e. % viewing time to the head/torso, legs/feet, ball) was registered continuously using a mobile eye tracker.

Reputation bias in football players' and coaches' judgments of refereeing competence

Oldfield, Luke; Manley, Andrew J., Leeds Beckett University; Thelwell, Richard, University of Portsmouth

Within sporting contexts, it is well documented that people use various source of information range to form expectancies of different personnel including coaches, athletes and opponents. However, little is known about how people form initial impressions and expectancies of sports officials. The current study aimed to investigate how two specific informational cues - experience and qualification pathway - may influence judgements made about the competence of football referees. Using a between-subjects experimental design, 112 football coaches and players were asked to read one of four refereeing vignettes, where the two independent variables of experience (extensive vs. limited) and qualification pathway (longitudinal vs. fast-track) had been manipulated. After familiarising themselves with the vignettes, participants completed the Referee Self-Efficacy Scale to rate their perceived competence of the referee who had been described in the vignette. Competence was categorised according to six characteristics; communication, confidence, fitness, impartiality, consistency and respectfulness. A factorial MANOVA revealed that extensively experienced referees were rated as significantly more competent for all six characteristics compared to the referees with limited experience. Furthermore, follow-up ANOVA showed that referees who had completed the longitudinal pathway (i.e., had progressed through every qualification level) were rated significantly more competent for the characteristic of communication than referees who had gone through the fast-track scheme. These findings have important implications for football referees and other sports officials. By harnessing available reputation information, referees can create more positive impressions prior to direct interaction with players and coaches, which may in turn help to reduce the likelihood of interpersonal conflict within competitive contexts.

Motor Development

Clinician perception of actual and recommended dosage of tummy time: a comparison to the literature

Adkins, Chelsea M.; Hauck, Janet L., Michigan State University; Wentz, Erin, Upstate Medical University

Prone positioning, or tummy time (TTIME), is the deliberate placement of an infant on his or her belly for tolerable amounts of time while awake. It is a highly relevant and important developmental practice implemented during early infancy to promote motor milestone achievement and prevent plagiocephaly (flat head). Prior to the back-to-sleep campaign (1994), TTIME was a frequently used position. Since 1994, use of this position has drastically decreased. The resultant delayed motor skills in a generation of infants spur the need for determining an evidence-based recommended prone dosage (RPD). However, RPD reported in the literature are highly variable. This study summarized both clinician perception of accumulated TTIME minutes and those reported in the literature, and made comparisons to the American Academy of Pediatrics (AAP) and clinician RPD. Methods: Pediatric clinicians including PTs and OTs (N = 7) were surveyed via email on TTIME practices in infants aged 0-6 months. Survey items consisted of questions related to perceived accumulation of TTIME, professional RPD, and common facilitators and barriers. Results: The AAP (2008) recommends 2-3 sessions of 3-5 minutes of TTIME per day starting immediately following birth, which can be increased once an infant shows interest in the position. Surveyed pediatric PT and OTs report a recommended dose of approximately 50.35 +/- 41.6 minutes per day for infants younger than 3 months and 81.53 +/- 57.48 minutes per day for infants 3 to 6 months of age. These clinicians believe that infants younger than 3 months currently accumulate 26.69 +/- 26.16 minutes per day and infants 3 to 6 months accumulate 49.36 +/- 42.82 minutes per day. Conclusions: There is considerable variability in current reported TTIME and RPD. A major concern is the vast difference in RPD between practicing pediatric clinicians and AAP guidelines. Many researchers report lower accumulated TTIME than the pediatric clinicians surveyed; only one study had quantities in line with AAP suggestions. Clinician reported strategies and common barriers will be discussed.

Movement Strategies used by Children and Adults to Retrieve an Object from the Ground

Anderson, David I.; Motiwala, Arwa; Hamel, Kate A., San Francisco State University

The ability to pick up an object on the ground from a standing position is central to functional independence and is widely used to diagnose problems associated with pathologies in the spine and lower extremities. Despite the importance of this action, little is known about the movement strategies used to accomplish it and how these strategies vary as a function of age, experience, morphology, disability, and social or cultural norms. The purpose of this exploratory study was to examine the strategies and variations from trial to trial used by children and adults to pick up a small object from the floor. Twenty adults (18-35 years) and 77 children (11 months to 5 years, organized into 4 age groupings) were videotaped performing 10 trials of a task that required insertion of

a racquetball into the opening of a tube located at eye level and retrieval of the ball from the other end of the tube on the floor. The most frequently used movement strategy to retrieve the ball was the full squat (64.9% of trials), followed by the semi-squat (14.9%), kneeling (10.2%), stooping (5.4%), sitting (2.2%), w-sitting (1.7%), resting on hands and knees (0.5%), and resting fully prone (0.2%). The proportion of trials on which each strategy was used varied across the five age groups, Chi-square (12, $N = 97$) = 87.8, $p < .05$. In addition, the number of strategies used by each participant varied significantly across the groups, $F(4, 92) = 2.86$, $p < .05$. Adults used the fewest strategies (1.3) and the 2 year-old children used the most strategies (2.3) on average during the 10 trials. These findings may provide clinicians with realistic expectations about the strategies that adults and children of different ages use to perform the task of picking up an object from the ground. They may also contribute to the development of age-appropriate teaching methods for children and adults who have difficulty in these movements and to the development of strategies to maintain healthy mobility throughout life.

Developmental changes in drop-land and drop-land-run decisions in typically developing children

Angulo-Barroso, Rosa M., California State University; Rosales, Marcelo, California State University Northridge; Busquets, Albert, INEFC, University of Barcelona; Romack, Jennifer, California State University Northridge

Research examining how children drop from a height and make subsequent decisions to either stay or run in different directions has not been previously reported. Little is known about the developmental changes of this important motor skill that is widely used in sports and recreational activities. Previous studies comparing adults with adolescent while landing suggest less hip and knee flexion in the younger population. The purpose of this study was to describe children's drop landing strategies while adjusting drop height based on the child's leg length and vertical jumping ability, and also comparing three landing conditions: drop and stay (S), drop and run to the right (R), and drop and run to the left (L).

Forty four children (mean 6.2 years, SD 1.8, range 3.1-8.9) divided into four evenly distributed age-groups (G1-G4) were asked to hang from a horizontal bar placed at an individually calculated height and then let go (drop) and land on two force plates. Five trials per conditions (S, R, L) were randomly collected (Qualisys 3D), including coding for taking or not a step and type of step. Data were analyzed using a 4 (Group) x 3 (Cond) ANOVAs with Cond as a within factor.

Results suggested that all groups made a similar percentage of stepping errors in the S condition, but the youngest group (G1) showed less effective stepping strategies than older groups when running was required after the drop ($F(3,40)=3.7$, $p<.02$, Eta Squared=.22). Results also showed that G1 produced about 30 deg less of maximal hip flexion during landing compared to older children ($F(3,40)=3.2$, $p<.04$, Eta Squared=.19). The knee angle demonstrated a similar trend. There were no differences in the timing of maximal knee or hip angles across the groups or conditions. However, timing of the Toe-off was faster in S when making errors than in R or L conditions, especially for G1 and G2. These results suggest that the timing of maximal hip and knee flexion is well established around 3-4 years of age, but more effective stepping strategies after a drop-land and larger leg joint flexion develop with age in children.

Sitting Postural Sway of 12-Month-Old Infants at Low and High Risk of Autism Spectrum Disorder

Arnold, Amanda J.; Harris, Rachel C.; Liddy, Joshua J.; Schwichtenberg, A.J.; Claxton, Laura J., Purdue University

Although typically not diagnosed until age 3 (CDC, 2016), identifying early risk-markers of Autism Spectrum Disorder (ASD) would allow for earlier diagnosis, resulting in more effective early intervention therapies. Since older children with ASD exhibit more postural sway under challenging postural conditions than typically developing children (Molloy et al., 2003), identifying sway differences in infancy could be a useful early risk-marker. Therefore, we investigated how postural sway in high (HR) and low risk (LR) infants may differ while sitting on solid (easy postural task) and foam (challenging postural task) surfaces. 12 12-month-olds (5 HR, Mean age=12 mos; 1 wk) participated as part of a larger longitudinal study investigating early risk-markers for ASD. HR infants have an older sibling with an ASD diagnosis and LR infants have a typically developing older sibling (Ozonoff, 2011). For up to 5 trials in each condition, infants sat on solid and foam surfaces placed on a Wii Balance Board to capture center of pressure data. At trial onset, the researcher shook a container of cheerios to maintain the infant's attention. Synchronized video was used to identify segments of at least 2 seconds within each trial when the infant sat independently looking forward without extraneous movements. Statistical analyses were performed using 2(Risk) X 2(Surface) mixed-model ANOVAs. Regardless of risk, infants had a larger sway area when on foam (603mm²) as compared to solid (270mm²); $p=0.03$. All infants also had a higher net sway velocity when on foam (77mm/s) as compared to solid (52mm/s); $p<0.01$. There was a moderate interaction effect for AP sway velocity; $p=0.06$. HR infants swayed marginally faster in the AP direction when on solid (HR: 49mm/s, LR: 36mm/s, $p=0.10$), with no difference on foam (HR: 56mm/s, LR: 62mm/s, $p=0.29$). This finding suggests that HR infants may have more difficulty controlling their forward-backward sitting sway even during easy postural tasks. Once ASD diagnoses are obtained, we hope to identify additional individual differences in postural sway.

Executive function and motor function in obese children

Augustijn, Mireille J.C.M., Ghent University, Belgium; D'Hondt, Eva, Vrije Universiteit Brussel; Lenoir, Matthieu, Ghent University, Belgium; Caeyenberghs, Karen, Australian Catholic University; Deconinck, Frederik J.A., Ghent University, Belgium

Childhood obesity (OB) has often been associated with lower levels of motor competence (MC). Based on previous research, Liang et al. (2013) suggested that executive functioning (EF) may be another important factor in understanding the behaviour of children with OB. Although several studies have found a negative association between childhood OB and different components of EF, a comprehensive picture is currently lacking. Therefore, the aim of the present study was to compare EF between children with OB and peers with a healthy weight (HW). Additionally, the potential link between EF, MC and OB was examined. Thirty-two children with OB (14 boys) and 32 HW peers (18 boys), aged 7-11 years old, participated in this study. All children were assessed with the Movement Assessment

Battery for Children Second Edition (8 motor tasks) to measure MC. EF was assessed using 4 tests of the Cambridge Neuropsychological Test Automated Battery, including measures of updating, inhibition, attentional shifting and reaction time. Group differences were analyzed using MAN(C)OVAs, controlling for age. Additionally, Pearson correlations were performed to assess the relationship between EF, MC and OB. Lower levels of general MC ($p \leq 0.001$) were observed in OB vs. HW children, with 19 OB and 3 HW children presenting with severe motor impairments (percentiles ≤ 5). Additionally, children with OB demonstrated reduced inhibition control ($p = 0.001$) and updating abilities ($p = 0.003$), while having a greater reaction time ($p = 0.001$) compared to HW controls. No difference was found in attentional shifting ($p = 0.790$). Finally, no significant associations ($p > 0.05$) were observed between EF, MC and OB.

The findings of the present study supported existing evidence that a considerable proportion of children with OB experience motor difficulties. These motor problems are accompanied with lower scores on EF, in particular for inhibition and updating. Future studies are needed to better understand the cognitive- and motor difficulties associated with childhood OB.

Are morphological brain differences associated with motor difficulties in obese children?

Augustijn, Mireille J.C.M., Ghent University, Belgium; Deconinck, Frederik J.A., Ghent University, Belgium; D'Hondt, Eva, Vrije Universiteit Brussel; Lenoir, Matthieu, Ghent University, Belgium; Caeyenberghs, Karen, Australian Catholic University

Motor difficulties in obese (OB) children have been well documented over the last years. Although motor impairments have been linked to grey matter (GM) alterations in other clinical populations, the potential role of morphological differences in motor problems of OB children remains unclear. In the present study, we compared GM volumes between 21 OB (11 boys) and 25 healthy weight (HW; 17 boys) children (7-11 years), and examined the association with motor impairments. Children's level of motor competence was assessed using the Movement Assessment Battery for Children Second Edition (MABC2). In addition, all children completed a T1- anatomical magnetic resonance imaging scan. FreeSurfer was used to extract 5 global, 14 cortical and 6 subcortical GM volumes. These outcome measures were compared between groups using one-way ANCOVAs, controlling for age and total intracranial volume (TIV). Partial correlations were used to compare motor performance and volumetric measures of motor-related subcortical GM regions (i.e., cerebellar cortex, thalamus- proper, caudate, pallidum and putamen), controlling for age, gender and TIV. Results showed that OB children performed worse on all MABC2 subtests ($p < 0.05$), except for ball skills. Lower GM volumes were found in OB vs. HW children for total GM ($p = 0.040$), cerebellar cortex ($p = 0.032$), rostral middle frontal ($p = 0.025$) and superior parietal volumes ($p = 0.047$), while higher GM volumes could be demonstrated in the thalamic-proper ($p = 0.005$). After correcting for multiple comparisons ($p < 0.0083$), only thalamic-proper volumetric differences remained significant. Partial correlations revealed that decreased motor competence was linked to cerebellar GM atrophy ($r = 0.579$; $p = 0.019$) in OB children, however this result did not remain significant after Bonferroni corrections. To our best knowledge, this is the first study showing motor-related volumetric (sub)cortical GM

differences between OB and HW children. Future research is needed to better understand the mechanisms underlying this association.

Infants at high-risk for ASD exhibit longer fixation durations than infants at low-

Averhoff, Alyssa; Motz, Zach; Wickstrom, Jordan; Kyvelidou, Anastasia, University of Nebraska at Omaha

We are lacking quantitative ways to assess and diagnose Autism Spectrum Disorder (ASD) in the first year of life. ASD is a neurodevelopmental syndrome that affects one in 68 children in the United States, a rate that has increased by 78% in the last decade. Currently, ASD is being diagnosed between two to four years of age, but the rapid increase in ASD has made it imperative for earlier diagnosis and earlier interventions to be administered. The purpose of this study was to examine differences in gaze preference and fixation patterns between infants at high-risk for ASD (with a diagnosed sibling) and infants at low-risk (no ASD in the family) for ASD. Twenty-two infants at low-risk and eight infants at high-risk were examined at three, six, nine, and 12 months of age. They were shown a preference paradigm displaying geometric and social images side-by-side while sitting on a parent's lap. Their gaze was measured by an eye tracker. This allowed us to determine 1) whether infants at high-risk spend less time fixating on social images and more time on shapes than infants at low-risk, and 2) whether infants at high-risk for ASD exhibit shorter fixation durations than children at low-risk regardless of stimulus type. Our results indicate that both groups of infants displayed a preference toward social images at six, nine, and 12 months, but not at three months. In addition, the overall fixation durations for the infants at high-risk were significantly greater than infants at low-risk. Based on our results, fixation duration may be a potential quantitative measure that we can use to assess ASD in the first year of life. More research on this topic is needed in this population before this conclusion can be affirmed.

Funding Source: NIH

Investigating the construct of motor competence in middle childhood

Bardid, Farid, University of Strathclyde; Utesch, Till, University of Muenster; Lenoir, Matthieu, Ghent University, Belgium

Literature has shown that motor competence plays a crucial role in children's physical activity engagement (Robinson et al., 2015). In light of this, different assessment tools have been developed to capture and monitor motor competence across childhood. Motor assessments generally produce a composite score-consisting of diverse motor skills-under the assumption that motor competence is a one-dimensional construct. Although a one-dimensional structure among a wide range of motor items has been shown in early childhood (for an overview Utesch et al., 2016), it is still unclear if this holds true in middle childhood which is marked by an increased participation in sports and other types of physical activities. The aim of the study is therefore to examine the dimensional structure of motor competence in children aged 6-11 years using a large item set. A total of 2538 children completed the Bruininks-Oseretsky Test of Motor Proficiency - 2nd Edition Short Form (BOT-2 SF). The BOT-2 SF consists of 14 skill items and covers different motor domains: fine motor precision, fine motor integration, manual dexterity,

bilateral coordination, balance, running speed and agility, upper-limb coordination and strength. In accordance with the BOT-2 SF manual, point scores were computed for each item. Early analyses using the polytomous IRT (item response theory) model showed that many items demonstrate unordered threshold parameters, possibly due to ceiling effects. However, after introducing empirical categories for each item, Rasch modeling revealed a one-dimensional structure with 12 items, as shown by the item fit statistics ($.09 < p < .79$). The study provides some proof of a one-dimensional construct underlying motor assessment in middle childhood when adopting a test-theoretically sound scoring system. Continued efforts should be made to ensure that valid composite scores are used in motor assessment in order to have better understanding of motor competence across childhood.

The role of cognitive change in the relationship between actual and perceived motor competence in young children

Bardid, Farid, University of Strathclyde; Goodway, Jacqueline D., The Ohio State University; Lenoir, Matthieu, Ghent University, Belgium

Literature suggests that the relationship between actual and perceived motor competence emerges over time as young children shift to a higher level of cognitive development (Harter, 1998; Stodden et al., 2008). From Piaget's theoretical perspective, this entails a transition from the intuitive, preoperational stage -when children rely heavily on visuospatial experience- to the concrete operational stage -when children start to develop logical thinking and mental representation. The purpose of the present study is to examine the effect of this cognitive change on the relationship between actual and perceived motor competence in the early years. Children ($N = 349$; 51.6% boys) aged 5-7 years took part in the study. Actual motor competence was measured using the *Körperkoordinationstest für Kinder* (Kiphard & Schilling, 1974, 2007), perceived motor competence was assessed with the Pictorial Scale of Perceived Competence and Social Acceptance for Young Children (Harter et al., 2012), and cognitive change was evaluated using three Piagetian conservation tasks (i.e., conservation of number, length and mass; Piaget, 1984). Three moderation analyses were conducted with each conservation task separately. Results showed that - after controlling for sex and age - cognitive change has a moderating effect on the relationship between actual and perceived motor competence (p values $< .05$). For children who cannot conserve, there is no significant association between actual and perceived motor competence (p values $> .05$). For children who can conserve, there is a positive relationship between actual and perceived motor competence (p values $< .001$). These findings provide some proof that cognitive processes play an important role in young children's emerging ability to accurately assess their actual motor competence.

What is the contribution of actual motor skill, fitness, and physical activity to children's self-perceptions of motor competence?

Barnett, Lisa, Deakin University; Lubans, David R., University of Newcastle; Timperio, Anna, Deakin University Institute for Physical Activity and Nutrition (IPAN), School of Exercise and Nutrition Sciences; Salmon, Jo; Ridgers, Nicola D., Deakin University

Background. A high perception of physical competence is important for physical activity engagement. If perceptions of motor competence are an important potential predictor of health outcomes such as physical activity, then it is important to understand what factors might influence perceptions of motor competence. This study aimed to examine the contribution of objective measures of physical fitness (musculoskeletal and cardiorespiratory), physical activity and motor skill to motor perceptions. A total of 122 children (63 boys) aged 9-11 years were assessed. **Methods.** Independent t-tests assessed sex differences in all variables. Two linear mixed models adjusted for sex and age were performed with perceived object control and locomotor skills (pictorial scale of Perceived Movement Skill Competence for young children) as outcomes. Aerobic (multi-stage fitness test) and muscular fitness (long jump, grip strength), moderate-to-vigorous physical activity (ActiGraph accelerometry), movement skill (Test of Gross Motor Development-2), age and sex were predictors. **Results.** Boys had higher object control skills (actual and perceived) and fitness. Age (decreasing) and long jump distance (positive) explained 16% of locomotor skill perception variance. Sex (boys) explained 13% of object control skill perception variance. **Conclusions.** Children's skill self-perceptions may be influenced by fitness attributes as these are more evident to them. This is important considering the theoretical notion that having a positive motor self-perception will predict, in a cyclical fashion, higher physical activity and fitness in subsequent years (Robinson, et al., 2015; Stodden, et al., 2008). The fact that girls have lower actual object control competence and fitness than boys suggest girls are an important intervention target.

Validity and Reliability of the Test of Gross Motor Development-3 for children with visual impairments

Brian, Ali; Taunton, Sally A., University of South Carolina; Haibach-Beach, Pamela; Lieberman, Lauren J., State University of New York's College at Brockport

FOCUS COPY - The Test of Gross Motor Development-2 (TGMD-2) is a valid and reliable assessment for children with and without visual impairments. The TGMD-3 is scheduled for release in 2017 but has not yet been validated for children with visual impairments. The purpose of this study is to determine the validity and reliability for the TGMD-3 for children with visual impairments. Participants included children (N = 66) ages 9-19 (Mage = 12.93, SD = 2.40) enrolled in a sports camp for children with visual impairments and are considered a convenience sample. The majority were boys (n = 41; 62.1%) while 25 were girls (37.9%). Children completed the TGMD-2 and TGMD-3 within three days at camp. All factors significantly ($p < .05$) loaded into either the locomotor or ball skills subscales. Factor loadings ranged from .57 - .92. The ball skill and locomotor subscales strongly correlated (.90). There was good model fit with chi square ($Df = 1$) = 1.12, $p = .069$, chi square/Df ratio = 1.12, RMSEA = .06, GFI = .86. Associations among both subscales (object control/ ball skills; locomotor) from the TGMD-2 and TGMD-3 were all significant ($p < .001$). Correlations ranged from $r = .98$ - .99 demonstrating strong agreement. Cronbach's alpha for the gross motor (.91), ball skills (.96), and locomotor skills (.93) subscales all demonstrate high internal consistency for the TGMD-3. ICC scores between raters indicated strong inter-rater reliability for gross motor (ICC = .91; CI = .85 - .94), ball skills (ICC = .92; CI = .87 - .95), and locomotor skills (ICC = .92; CI = .87 - .95). Associations among both subscales (object control/ ball skills; locomotor) from the TGMD-2 and TGMD-3 were all significant ($p < .001$). Correlations ranged from $r = .98$ - .99 demonstrating strong agreement. Our results indicate that the TGMD-3 is a valid and reliable assessment for motor skill performance for children with visual impairments.

Motivations for participation in physical activity and movement interventions for children and adolescents with cerebral palsy: A systematic review

Bridges, Claire E.; Pangelinan, Mary E.; Pangelinan, Melissa E., Auburn University

We conducted a systematic review of empirical studies to examine the motivations of children and adolescents with cerebral palsy and/or their parents with respect to participation in physical activity and exercise programs. The initial search resulted in a total of 66 articles; 33 articles met inclusion criteria based on title and abstract screening (33 were removed). A total of 17 studies met inclusion based on full-text review and were categorized into the following six topic areas: (a) types of participation in leisure activities and physical activity, (b) rehabilitation and physical therapy interventions, (c) at-home interactive gaming to increase physical activity, (d) exercise and physical activity interventions, (e) perceptions of parents and children participating in sports programs and physical education programs, and (f) physical activity and perceived competence. The 17 studies included participant samples that ranged from 8 to 95 participants with cerebral palsy (i.e., hemiplegia, diplegia, and quadriplegia) between the ages of 5 to 18 years. Taken together, these studies show that parents of and children with cerebral palsy want and need to be physically active, similar to their typically developing peers, despite the children's movement limitations. These results suggest there is a need for fun, enjoyable, and active programs and/or interventions that allow children with cerebral palsy to benefit from physical activity and exercise.

The influence of manual dexterity ability in visual motor integration and handwriting skills of 5-year-olds

Cacola, Priscila M.; Butler, Christi, University of Texas at Arlington

Manual dexterity is the ability to make coordinated hand and finger movements to grasp and manipulate objects and is an essential component of fine-motor skills. Difficulties with manual dexterity and fine-motor skills have been associated with Developmental Coordination Disorder (DCD), a condition linked to poor physical and mental health outcomes. Therefore, the purpose of this study is to evaluate the role of manual dexterity on visual motor integration and handwriting skills of 5-year-olds. 128 children starting kindergarten were evaluated with the manual dexterity category of the Movement Assessment Battery for Children, 2nd ed. (MABC-2), the Beery-Buktenica Developmental Test of Visual-Motor Integration, 2nd ed. (Beery-VMI), and the Evaluation Tool of Children's Handwriting (ETCH). Children scoring lower than the 15th percentile on Manual Dexterity (MD) were classified as low MD, while the ones scoring above were considered average MD. Results indicated that children with low manual dexterity scored significantly lower in all components of the Beery-VMI and ETCH assessments, $ps < .05$. These results indicate that manual dexterity is an essential component in visual motor integration and handwriting skills at this age. Obviously, this ability can still undergo

considerable improvement with practice, but it is important to note that the ability to perform simple tasks of manual dexterity, that can be easily stimulated before the age 5 with games and toys, can significantly help handwriting when starting school. Students with handwriting dysfunction are frequently referred to therapy, and are at risk for poor academic outcomes. This data reinforces the notion of early assessment and intervention of manual dexterity as well visual-motor integration and handwriting abilities, to prevent poor academic and other physical and mental health outcomes later in life.

The Influence of Teacher's Knowledge of Instructional Strategies on Throwing Performance of Elementary-aged Children

Chang, Seung Ho, San Jose State University; Goodway, Jacqueline; Ward, Phillip, The Ohio State University; Lee, Jihyun, San Francisco State University; Tsuda, Emi, The Ohio State University

This study examined the influence of the teacher's knowledge of instructional strategies on the performance of overarm throw in 1st and 2nd grade children. A total of 66 students who were 1st grade (n=38) and 2nd grade (n=28) and one physical education teacher participated in this study. Students were randomly assigned to one of the two conditions (n=33 comparison and 33=experimental). Each group received 140 min (35 min for 4 days) of throwing instruction delivered by the physical education teacher. A workshop was the independent variable in this study. After teaching the comparison group, the teacher received a 3-hour workshop focusing on knowledge of instructional strategies to teach throwing (e.g., demonstrating techniques, providing tasks, and identifying students' skill level of throwing). Then the teacher taught the experimental group. Mean body component levels for the step, trunk, humerus, and forearm were used to examine the influence of the teacher's knowledge of instructional strategies on student learning of overarm throw. A Mann-Whitney U test was used to determine if there were significant differences for the comparison and experimental classes for each component. In the pretest, the Mann-Whitney U test ($p < .05$) revealed that there was no statistically significant differences for each component; step ($U = 411, p = .074$); trunk ($U = 495, p = .442$); humerus ($U = 459, p = .134$); and forearm ($U = 445, p = .057$) between the comparison and experimental classes. However, The Mann-Whitney U test revealed that the gained score from pre-to post-test (posttest minus pretest) for step ($U = 285, p = .000$), trunk ($U = 348, p = .003$), humerus ($U = 231, p = .000$) and forearm ($U = 189, p = .000$) was statistically significant different. This study found that there were significant differences in gained scores for each body complement between the experimental and comparison conditions. Furthermore, findings of this study provide implications for training physical education teachers in order to effectively teach overhand throwing for elementary-aged children.

The Effect of Motor Interventions on Motor Competence: A Systematic Review with Meta-Analysis

Chaves, Karla; Jimenez, Judith; Salazar, Walter, University of Costa Rica

The purpose of this study was to use the aggregate data meta-analytic approach to assess the effectiveness of motor intervention programs on motor competence.

Research of motor program interventions published up to 2016 were included by searching fourteen databases, cross-referencing and expert review. Studies were selected and data was extracted by two authors independently. Risk of bias was assessed using 10 questions of the TESTEX scale (maximum points = 10). Random effects model using the standardized mean difference effect size (ES) were used to pooled results. Heterogeneity was examined using the Q statistic and inconsistency using Isquared. Of 160 studies screened, 29 studies meet the inclusion criteria: (1) experimental design, (2) motor program intervention, (3) assess one or more motor skills, (4) report statistical data. Included studies are representing 1842 participants, with ages between 4 and 13 years. 305 ES were calculated in three groups: (1) motor program intervention, (2) free play and physical education (PE) regular classes, and (3) control group. Risk of bias was $M = 6.19 \pm 1.2$. Intervention group significantly improved performance from pretest to posttest ($ES = 0.91$, $p < 0.001$, $CI = 0.79$ to 1.02 ; $n = 187$; $Q = 1713$). Free play and PE regular classes, also improved motor performance ($ES = 0.22$, $p < 0.001$, $CI = 0.14$ to 0.29 ; $n = 106$; $Q = 293$). While, control group did not improved motor performance ($ES = 0.09$, $p < 0.57$, $CI = -0.12$ to 0.31 ; $n = 12$; $Q = 24$). The overall ES suggest that motor interventions improved motor competence in children and adolescents (for overall motor development, locomotion, object control and others), free play or PE regular classes promotes less improvement on motor competence. Nonetheless, no intervention at all, produce no change in motor performance.

Parents and the Pygmalion Effect: Exploring relations between parent efficacy beliefs and children's fundamental movement skills

Clancy, Carolyn; Jackson, Ben; Dimmock, James A.; Thornton, Ashleigh L., The University of Western Australia

Children rely on parental assistance to engage in physical activity and develop proficient fundamental movement skills (FMS). As such, in order to understand the psychosocial predictors of child FMS proficiency, it is important to consider both parent as well as child factors. The purpose of this study was to examine the direct and indirect predictive relations between (selected) parent and child relational efficacy perceptions, child self-efficacy beliefs, and children's FMS proficiency. Ninety-four children aged 7-9 years and their parents were recruited. Children's FMS proficiency was assessed using the Test of Gross Motor Development-2; prior to FMS assessment, children reported their confidence in their FMS ability (i.e., self-efficacy). Following FMS assessment, children estimated their parents' confidence in their (i.e., children's) FMS ability (i.e., relation-inferred self-efficacy, RISE). Parents reported their other-efficacy beliefs (i.e., confidence in their children's FMS proficiency) and their support behavior. A bootstrapped serial mediation model was used to examine the direct and indirect relationships between parent other-efficacy and child FMS proficiency, with parent support, child RISE, and child self-efficacy entered as mediators. Significant direct relationships revealed that parents provided greater FMS support when they were highly confident in their child's ability, and that parent other-efficacy, parent FMS support, and child RISE perceptions all positively predicted children's confidence in their FMS proficiency. Child self-efficacy emerged as a significant, positive predictor of FMS proficiency, and accordingly, noteworthy indirect pathways revealed that parents' confidence in their child's FMS proficiency may support actual FMS proficiency through the provision of greater support

and encouragement of favorable confidence perceptions among children. These findings reveal novel insight into the ways through which parents' interpersonal perceptions and behaviors might shape children's perceived and actual FMS competence.

Association of Functional Movement with Perceived and Actual Motor Skill Competence in Young Adolescents

Coker, Cheryl A.; Collins, Sean M., Plymouth State University

The purpose of this study was to examine the relationship between functional movement and both perceived and actual motor skill competence in young adolescents. Participants were 117 7th and 8th grade physical education students ($M=12.60$ years of age; $SD= 0.66$). The Children and Youth Physical Self-Perception Profile (CY-PSPP) was used to assess perceived competence. The CY-PSPP includes subscales for perception of Sports Competence (Sport), Physical Condition (Cond), Body Attractiveness (Body), Strength (Strong) and overall physical self-worth. One week later, functional movement and motor skill competence were assessed. Functional movement proficiency was determined using the Functional Movement Screen (FMS) which rates 7 individual movements from 0-3 according to the quality of their performance resulting in three variables of interest (1) FMS composite score (2) number of asymmetries and (3) number of movement pattern dysfunctions. The Get Skilled: Get Active process-oriented motor skill assessment was used to determine kick, overhand throw (OT), run, and vertical jump (VJ) proficiency. Spearman correlation with pairwise deletion of missing values estimated Rho and P-values using R (3.3.2, Hmisc package). Ranks were computed using mid-ranks for ties and P-values were approximated using the F distribution. Results revealed a significant positive correlation between FMS composite score and the CY-PSPP constructs of Body and Condition as well as with VJ performance. A positive relationship was also found between the number of asymmetries and OT performance. Finally, a significant negative correlation was found between the number of movement pattern dysfunctions and the CY-PSPP subscales of Body, Condition, and Strength as well as with VJ and run performance. Given these findings, the assessment of functional movement and subsequent correction of identified dysfunctional movement patterns should be considered for inclusion in middle school physical education.

Funding Source: Plymouth State University Faculty Research & Scholarship Fund Grant

Relationship between Body Mass Index and Functional Movement, Perceived Physical Competence and Motor Skill Proficiency in Middle School Students

Coker, Cheryl A.; Collins, Sean M., Plymouth State University

The purpose of this study was to examine the association of body mass index (BMI) with functional movement, perceived physical competence and motor skill proficiency in middle school students. Participants were 117 7th and 8th grade physical education students ($M \text{ age}=12.60$ years, $SD= 0.66$; $M \text{ BMI} = 21.14$, $SD = 4.46$). All participants were measured for body weight and height and completed the Children and Youth Physical Self-Perception Profile (CY-PSPP). One week later, functional movement was

assessed using the Functional Movement Screen (FMS) which rates 7 individual movements from 0-3 according to the quality of their performance. In addition, four fundamental motor skills, kicking, throwing overhand, running, and jumping vertically, were performed in accordance to the procedures outlined by The Get Skilled: Get Active process-oriented motor skill assessment and digitally recorded for later analysis of technical execution. Spearman Rank Order correlation with pairwise deletion of missing values to estimate the Spearman Rho and P-values was performed using R version 3.3.2 with the package Hmisc. Ranks were computed using mid-ranks for ties and P-values were approximated using the F distribution. A significant negative correlation was revealed between BMI and the composite FMS score ($r = -0.38$). In addition, a significant negative correlation was identified between BMI and all of the subscales of the CY-PSPP with the exception of Strength. No relationship with BMI was revealed for any of the motor skills examined. Although overweight youth perceived themselves as less physically competent, their motor skill proficiency did not differ significantly from their peers. BMI was, however, a correlate of functional movement. This raises the question as to whether physical perception is tied to functional limitations or motor skill proficiency. Additional studies are needed to explore the operational definition of motor competence.

Funding Source: Plymouth State University Faculty Research Grant

Look and reach behaviors in 9-month-old infants: Comparing between eye-trackers

Connell, John P., University of Tennessee, Knoxville; DiMercurio, Abigail; Romano, Alexandra C., University of Tennessee Knoxville; Reynolds, Greg, University of Tennessee, Knoxville; Corbetta, Daniela, University of Tennessee Knoxville

Prior research on infant looking and reaching behavior using a Tobii X50 eye-tracker has found that infants directed their hand towards the most looked at area of the object, but only if the object had a visually salient area (Corbetta et al., 2014). The eye-tracker used in this research had a modest sampling rate of 50 Hz. The goal of the current study is to attempt to replicate previous findings with an EyeLink 1000 Plus, an eye-tracker that samples at a much higher rate of 500 Hz. The two studies samples included 44 infants aged 9-months-old. Fifteen infants were tested with a Tobii X50, and 29 with an EyeLink 1000 Plus. During testing, both groups were randomly presented a rod or drumstick shaped stimulus held out of reach for 5 seconds. After presentation, the stimulus was moved forward into the infants' mid-line reaching space to allow for reaching for and interacting with the object. Eye-tracking was recorded during the 5 second object presentation. Accumulated looking time at the object according to three distinct object areas (sphere, middle rod, end rods) and the area of the object that was first touched were analyzed.

Results on the looking behavior from both groups revealed similar trends. For the drumstick objects, infants directed their visual attention significantly more towards the sphere part of the object - the most visually salient part of the drumstick - while looking patterns on the plain rod object were more evenly distributed across object areas. These findings suggest that eye-trackers with different sampling rates do not significantly affect looking trend results. Future analysis on the reaching patterns will determine whether infants in both studies similarly directed their hand towards the most looked object area.

Pupil dilation, motor imagery and cognitive load

Cordova, Alberto; Camargo, Elena; Land, William; Yao, Wan Xiang, University of Texas - San Antonio

Empirical and analytical methods are used every day by researchers to study and understand how the human brain gathers and processes information that is presented to it (Paas, Tuovinen, Tabbers, & Van Gerven, 2003); some of the techniques that provide additional insight on cognitive load measurement are mental load, effort, and performance. (Paas et al., 2003). Besides the physiological response to light exposure and emotions, pupil dilation has shown to be a reliable indicator of mental effort and resource allocator (S. Moresi, Adam, Rijcken, & Van Gerven, 2008). To our knowledge, no studies have been done addressing a relationship between pupil dilation and motor imagery. Purpose: Therefore, the purpose of this study was to examine if pupillometry can be utilized to measure cognitive load across five different tasks (Baseline, Stroop Test, Two- and Three-Dimensional Mental Rotation, and Motor Imagery). Seventeen undergraduate students at the University of Texas – San Antonio participated in the study. All participants performed all five tasks which involved making immediate verbal responses to the stimulus being presented. A set of ASL Mobile Eye Tracking Device was used to record pupil dilation. A one-way repeated-measures ANOVA showed significant differences between the tasks ($F(4,56) = 13.45$, $p < .001$; eta partial squared = .49). Further analysis to determine where the differences lied (Bonferroni) showed that the Motor Imagery and Two-Dimensional Mental Rotation tasks were different from Baseline and the Three-Dimensional Mental Rotation Tasks. The Two-Dimensional Mental Rotation task showed no difference to the Motor Imagery task. Chi square results showed differences between accuracy for the Two- (88% accurate) and Three- (63% accurate) Dimensional Mental Rotation Tasks. Our findings indicate that pupillometry could be a window into assessing cognitive load. Further investigation will need to address the reliability and sensitivity of this measurement across different tasks and under different circumstances and perhaps across special populations.

Can children do what they think they can? The influence of performance level on the accuracy of perceived motor competence in childhood

Cordovil, Rita, Universidade de Lisboa; Almeida, Gabriela, Universidade de Evora; Luz, Carlos, Instituto Politécnico de Lisboa; Rodrigues, Luis Paolo, Instituto Politécnico de Viana do Castelo

Children generally overestimate their motor competence. This tendency has been more frequently reported in younger ages, and boys, but the influence of the child performance level on its perceptual judgment has not yet been thoroughly investigated. In this study, we analyzed the relationship between estimation and actual performance in children with different performance levels in fundamental movement skills. Both motor actual and perceived motor competence were evaluated using a test battery with stability, locomotor and manipulative skills. Children had to provide a quantitative estimation of what they think they could do in a specific task (e.g., I can jump that far). A total of 303 children (6-10 years) estimated their maximum performance in jumping, kicking, throwing, and walking backwards on a balance beam. After completion of the tasks, participants were divided in tertiles according to their performance in each task.

Absolute percent errors (APE; i.e., deviation percentage from accurate estimations), and error tendency (i.e., frequency of underestimations, right judgments, or overestimations) were calculated. All groups tended to overestimate their competence at all tasks, except for the 3rd tertile group at the walking backwards task. ANCOVA results indicated that children in the lower tertiles were consistently less accurate than children in the upper tertiles, exhibiting greater absolute percent errors (non-significant differences occurred between 2nd and 3rd tertiles for jumping and kicking tasks). No differences were found in error tendency according to gender (mostly overestimations), except for the jumping task, where girls underestimated more than boys. APE was similar for boys and girls, except for the kicking task where girls were more accurate. Age was negatively correlated with APE, except for the kicking task (no correlation). The overestimation tendency might positively influence children's engagement in physical activities, but unrealistic estimations might be a safety problem in physical education classes or at free play.

Two worlds colliding: A motivational and motor development perspective on youngsters' engagement in physical activity and sports

De Meester, An, Ghent University, Belgium; Pion, Johan, HAN University of Applied Sciences; Mostaert, Mireille, Ghent University, Belgium; Bardid, Farid, University of Strathclyde; Cardon, Greet; De Muynck, Gert-Jan; Lenoir, Matthieu; Haerens, Leen, Ghent University, Belgium

Objectives: Physical activity (PA) is associated with many health benefits but low PA levels have been reported across the globe, even among young children. Despite evidence in support of the Self-Determination Theory (SDT, Deci & Ryan, 2000)-proposed relationships between competence satisfaction, autonomous motivation, and PA in adults and adolescents, there is only limited proof that these relationships also apply to children. Likewise, there is no conclusive evidence for the mediating effect of perceived motor competence (PMC) in the relationship between actual motor competence (AMC) and PA in children, as suggested by the conceptual model (Stodden et al., 2008). Therefore, the aim of the current study was to examine whether the PA-pathways as suggested by the conceptual model and SDT apply to children. **Methods:** 627 children (51.67% boys, 8-13 yrs) completed validated questionnaires to assess weekly sports participation (FPAQ), PMC (SPPC), competence satisfaction (PNSE), and motivation for sports (BREQ). Children's AMC was assessed with the KTK. Structural Equation Modeling was conducted to examine the theory-based pathways from AMC via PMC, competence satisfaction, and autonomous motivation to organized sports participation. **Results:** We found a significant, direct effect from AMC to sports participation ($\beta = .142$, $p = .001$) with PMC, but not competence satisfaction or autonomous motivation, partially mediating this relationship ($\beta = .119$, $p < .001$). **Conclusion:** The results suggest that, among children in middle and late childhood, AMC relates to sports participation and this relationship is, as proposed in the conceptual model, mediated by PMC. PMC also significantly relates to competence satisfaction and autonomous sports- motivation but the last two SDT-related constructs do not add to the prediction of organized sports participation when being integrated in the conceptual model. Based on the evidence that both AMC and PMC are crucial with respect to children's sports participation, it is recommended that physical education teachers and coaches foster both.

Cross-cultural assessment and comparison of motor competence in 5- and 6-year-old children from Belgium and Greece using the BOT-2 SF: A critical look at potential country and gender differences.

D'Hondt, Eva, Vrije Universiteit Brussel; Venetsanou, Fotini, National and Kapodistrian University of Athens; Kambas, Antonis, Democritus University of Thrace; Lenoir, Matthieu, Ghent University, Belgium

BACKGROUND: Targeting motor competence (MC) in childhood may help to promote physical activity and fitness levels along with a healthy weight status. Yet, no single motor assessment tool is internationally recognized and used, limiting our understanding of MC profiles on a continental/global level. **METHOD** The purpose of this study was to assess and compare MC levels in children (70-83 months) from Belgium (BEL; N=325, 45.2% boys) and Greece (GRE; N=246, 45.9% boys) using the short form of the Bruininks-Oseretsky Test of Motor Proficiency, 2nd edition (14 items). **(M)ANCOVA** procedures were executed to examine the effect of country and/or gender on the BOT-2 SF scores, with BMI and/or age included as the covariate(s). Chi squared tests were used to compare the observed distributions across the BOT-2 SF descriptive performance categories between countries as well as against the expected distribution based on the U.S. reference sample.

MAIN FINDINGS: Raw score analysis revealed significant interaction effects (2 items) as well as several main effects for country and gender (8 items each). However, only 2 opposing country differences (copying a square: BEL<GRE; knee push-ups: BEL>GRE) could be considered sufficiently large ($\eta^2 \geq 0.14$) to be of any practical importance. No significant effects were found for the total point score. Nevertheless, children from GRE showed a higher standard score and percentile rank than in BEL. In both samples, fewer children scored (well-)below average than could be expected but a higher percentage of GRE children scored (well-)above average.

CONCLUSION: Besides statistical significance, effect sizes should be reported for comparative study results to be adequately interpreted. Furthermore, caution is warranted when using test batteries that are not norm-referenced specifically for the own country/region or perhaps on an international level. As such, the development and wide adoption of a single MC assessment tool would strongly contribute to more precise knowledge on children's motor development in different environmental/sociocultural contexts.

Funding Source: Flemish Government (for the Belgian data)

Postural Control Differs between Normal Weight and Overweight Infants

Dinkel, Danae; Snyder, Kailey, University of Nebraska at Omaha; Molfese, Victoria, University of Nebraska at Lincoln; Kyvelidou, Anastasia, University of Nebraska at Omaha

Evidence suggests obesity can have a negative influence on a child's motor development and postural control behavior. During infancy achieving motor milestones is key to an infant's development however infant obesity may alter natural movement patterns and hinder this development. Little research has examined the impact of infant weight on gross motor behavior, particularly postural control at the onset of sitting.

Therefore, the purpose of this study was to determine whether normal weight and overweight infants differed in their postural control strategies at the onset of sitting and one-month post onset of sitting. 29 infants (n=19 normal weight, n=10 overweight) were recruited to participate in this study. Infant's length and weight were measured to the nearest 10g and .1 cm at 3 months of age (visit 1). Visit 1 occurred at 3-months of age (mean age [SD], 3 months, 3 days [11.98] days), visit 2 occurred at the onset of sitting (5 months, 3 days (160 [27.15] days), and visit 3 occurred one-month post onset of sitting (6 months, 5 days (195 [26.24] days). Infant's center of pressure (COP) was measured on an AMTI force platform at the onset of sitting (visit 2) and one-month post onset (visit 3). Data were analyzed using linear measures (range and RMS for the anterior/posterior (AP) and medial/lateral (ML) directions, sway path) and nonlinear measures (Sample Entropy in AP and ML directions). Overweight infants had significantly greater RMS values in the ML direction at visit 2 and reduced Sway Path values in comparison to normal weight infants at visits 2 and 3. Further, there was a significant difference in Sample Entropy as overweight infants increased Sample Entropy from visit 2 to 3 while normal weight infants decreased Sample Entropy values during this time period. These findings suggest overweight infants adopt a different postural control strategy. This altered strategy may limit exploration early in development. More research is needed to determine if longitudinal differences continue to emerge.

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A comparative study of gross motor development of American and Chinese school preschoolers: A pilot study

Downing, Kaitlyn; Gregg, Daniel, University of Memphis; Wang, Kun, Shandong Sport University; Dowling, Collin; Taylor, Satomi; Li, Yuhua, University of Memphis

Gross motor development is important to young children. Although it is widely accepted that childhood motor development is greatly influenced by sociocultural circumstances, limited studies have been conducted in the literature. Therefore, expanded research efforts are initially needed to delineate the nature of any associations and subsequently to determine if causation can be demonstrated. The purpose of the present study was to examine if there would be any similarities and differences in the development of gross motor skills among four year old American and Chinese children. Fifty children at the age of four from Memphis, US and fifty from Rizhao, Shandong Province, China (Boys = 53 and girls = 47) participated in the study. Parental permission was obtained prior to testing. A modified standardized test, TGMD-2 was used in the study. Specifically, three skills in 'locomotor subtest' (i.e., run, hop and horizontal jump) and three from 'object control subtest' (i.e., stationary dribble, catch and kick) were selected. A 2 (groups) X 2 (gender) ANOVA was performed to access the significant differences between the two groups of children's skill performances, as well as the gender effects on the six test skills. The results showed that: 1) a significant group difference was found on run, kick and catch ($p < .05$) with American children obtaining higher scores on run and kick, and Chinese children having higher scores on catch; 2) a significant gender difference was revealed on hop and horizontal jump across both groups with girls had higher scores

than boys ($p < .05$). Further investigations are needed using children at multiple locations to confirm these findings.

Funding Source: University

The Perceived Motor Competence Questionnaire in Childhood (PMC-C)

Dreiskaemper, Dennis; Utesch, Till; Tietjens, Maike, University of Muenster

The self-perception of motor skills has been shown as an important correlate to the degree of participation in physical activity and the fitness level of children (Stodden et al., 2008). For early childhood valid instruments are available to measure the self-perception of children's locomotor and object-control skills via pictorial scales (Barnett et al., 2016). During childhood, self-perception develops and becomes more complex and differentiated (physical self-concept, Marsh et al., 2001). Therefore, the aim of this study was to develop a questionnaire (PMC-C) for this age group to comprise this differentiation. The PMC-C was adapted from the given pictorial scale and items of the Test of Gross Motor Development 3 (TGMD-3, Ulrich, 2000). In a pilot study the questionnaire was tested for different age groups (primary school classes 2-4). In the main study the (polychoric) reliability, scale usage validity (probabilistic threshold parameters), the assumed two-dimensional latent structure as well as concurrent validity to related constructs (PA and sport enjoyment) of the questionnaire were examined. The results indicate good construct validity ($\chi^2 / df = 1.76$, $N = 197$, $p < .001$, $TLI = .91$, $CFI = .90$, $RMSEA = .06$) and internal consistency (Cronbach's Alpha = .79-.91) for the 24-item questionnaire. Scale scores were ordered and showed substantial correlations to PA ($r = .56-.62$, $p < .001$) and sport enjoyment ($r = .36-.43$, $p < .001$). The PMC-C is an economic and suitable contribution for motor development research in middle and later childhood. Together with the PSC-C (Dreiskaemper et al., 2015) it allows to measure the physical self-perception of children based on skills and fitness perception. How these dimensions interact with each other and in which developmental periods the different parts are more or less influential on physical activity behavior and also relevant for global self-esteem will be discussed.

Age-related differences in generalizing motor sequence learning depend on the sequence structure

Du, Yue; Clark, Jane E., University of Maryland, College Park

Generalization of motor sequence learning allows the flexibility to extend what has been learned in one context to a novel context; for example, from one effector to another. Compared to the greater attention given to inter-manual transfer, two crucial aspects of sequence learning generalization, however, have been neglected. First, little is known whether learning a sequence is transferrable to another novel sequence that shares the same probabilistic structure with the original learned sequence. Second, few studies have investigated age-related differences in sequence learning generalization. Here, we asked children ($n = 30$; 4.8-12.95 yrs) and adults ($n = 10$; 18.35- 21.09 yrs) to perform a serial reaction time (SRT) task (Exp. 1). We examined whether the learning of a fixed sequence A could be generalized to a novel sequence A1 that shared the same probabilistic structure with sequence A. Interestingly, the generalization of sequence

learning was observed only in children. We found that the failure of generalization in adults was not due to chunk learning or over-fitting. Instead, given that fast learning, the initial learning stage that facilitates generalization, was reflected by different age-related processes (i.e., online process in adults and offline process in children), we proposed that the age-related generalization of sequence learning may be related to the online and offline processes. To test this hypothesis, in Exp. 2, we asked children ($n = 26$; 6.03-13 yrs) and adults ($n = 10$; 19.2-21.5 yrs) to learn a probabilistic sequence. Probabilistic sequence learning favored greater procedural memory where the online process in adults' learning was overtaken by an offline process (Du et al., 2016). After the probabilistic sequence was learned, we found comparable generalization between adults and children. These results suggest that the age-related differences in sequence learning generalization rely on the sequence structure and such differences may result from the involvement of online and offline processes during the initial acquisition of the sequences.

Age-related offline and online learning processes underlie age-independent fast motor sequence learning

Du, Yue; Clark, Jane E., University of Maryland, College Park

Children and adults both learn motor sequences, but they do so differently. In a previous study (Du et al., Manuscript submitted for publication), we found that adults employ an online process (i.e., continuous improvement in performance as the task is performed) while 6-year-old children use an offline process (i.e., performance improves following a short rest with no physical practice). However, our understanding of these two behavioral processes and their developmental profile is limited. Here, we asked young adults ($n = 12$; between 18.64 and 25.2 years) and children from 5 to 14 years of age ($n = 27$; between 5.39 and 14.37 years) to perform a self-paced serial reaction time (SRT) task. There were six learning blocks and a three-minute rest between blocks. The same learning sequence was presented in blocks 1 to 4 and 6, while a novel sequence was introduced in block 5. As revealed by the difference in mean RT between blocks 1 and 4 as well as between blocks 4 and 5, we found comparable sequence learning across age. When the online and offline processes were examined through the progressive RT changes within and between blocks (i.e., block 1 to 4), we found that the offline process attenuated while online process became stronger as age increased. These developmental changes were present in early childhood (i.e., prior to around 11 years of age). After 11 years of age, online and offline processes remained unchanged. Importantly, we demonstrated that the offline process was unlikely to be an artifact of fatigue, a common factor that is assumed in the literature to cause the offline improvement in performance. Rather, the online and offline processes could be active learning mechanisms that may result from competitive memory systems of procedural and declarative learning. Collectively, this study characterized the developmental landscape for sequence learning in children from 5 to 14 years and demonstrated the developmental profiles of online and offline learning that underlie the acquisition of motor sequences which itself is age-independent.

Auditory and visual cues in sequence learning: comparing typically developing children and adults

Duna, Kayla V.; Glazebrook, Cheryl M.; Passmore, Steven; Wittmeier, Kristy, University of Manitoba

Implicit learning has been explored in both children and adults using sequence tasks. Both age groups can successfully learn through practice and without explicit sequence awareness. Previous studies provide evidence that school-age children's auditory and visual-perceptual development nears adult levels, but it is unclear to what extent children are able to integrate audio-visual information for movement tasks. The current study explored the effect of vision and the combination of vision and audition when learning an implicit learning sequence task. Eighteen children (mean age = 7.7 years (SD = 0.9), 6 females) and 20 adults (mean age = 23.1 years (SD = 5.1), 13 females) completed a sequence task in either visual-only (V) or audio-visual (AV) conditions where they responded to images of four different animals on a screen using a serial response box (Psychology Software Tools, Inc). The protocol involved two consecutive days: Day 1: acquisition, and Day 2: retention, transfer, motor skill recall (MSR), and explicit awareness. A block of trials in an auditory-only condition defined MSR. Median reaction time (RT) reduction provided an index of implicit learning. Mixed ANOVA models with between group factors of condition (V,AV) and age (children, adult) were applied to RTs and accuracy in acquisition, retention, transfer, and MSR blocks. Main effects for age and condition were found in each analysis performed, demonstrating both age groups learned the sequence and adults responded faster than children. A significant main effect for condition during MSR demonstrated greater accuracy in the V condition. This result reflects AV condition may have hindered learning due to excess information. Explicit awareness test results were consistent with the literature in that despite awareness of the sequence participants had equivalent accuracy scores. Although, past literature reports school-age children's visual and auditory development is near that of adults, faster RT integration of auditory and visual cues using a sequence task is under developed in children versus adults.

Funding Source: MHRC

Can we build profiles to understand how ability (fitness, motor skill) and engagement in physical activity relate to children's motor perceptions?

Estevan, Isaac; Garcia-Masso, Xavier; Villarasa, Israel; Molina-Garcia, Javier, University of Valencia; Barnett, Lisa M., Deakin University

Background. Actual and perceived motor competence (MC), physical activity (PA), and physical fitness play an important role in children's health lifestyles. Based on a person-centered approach this study aimed to establish profiles according to the children's actual and perceived MC, PA participation and fitness. Methods. A sample of 179 children (52.5% boys) aged between 3-11 years was recruited from schools. The Test of Gross Motor Development third version, the pictorial Perceived Movement Skill Competence scale, the Physical Activity Questionnaire for Children and static long jump were used for assessments. A Self-Organizing Map was used to classify and visualize the values of children in the variables tested. A K-means cluster analysis was applied to establish the number of profiles. Results. Six profiles (quantification error = 0.76) according to the four variables were determined: 1) Low ability and low-mid engagement

matched with poor perception; 2) Low ability but high engagement = high perception; 3) Mid ability but low engagement = mid perception; 4) Mid ability, mid engagement matched with mid perception; 5) High ability, but low engagement = mid perception; and 6) High ability and engagement = mid-high perception. Conclusions. Some children (the poorest and those mid ranged) were matched in their ability (fitness and skill), level of PA engagement and their perception (Profiles 1, 4). Other profiles were mismatched; either they had ability but were not active (Profile 5), or they had less ability but were very engaged in PA (Profile 2). Interestingly, those with the highest ability did not have the highest perception (Profile 6); rather those with the least ability had highest perceptions (Profile 2). This implies that engagement in PA seems to be more important to positive motor perception than fitness or skill ability. The person-centered approach offers a new perspective for studying MC in children, and may allow researchers to guide interventions more accurately.

Who can best report on children's actual motor skill competence: children, parents or teachers?

Estevan, Isaac; Molina-García, Javier; Álvarez, Octavio, University of Valencia; Barnett, Lisa M., Deakin University

Background. Actual and perceived motor competence (MC) is relevant for young people to be physically active. Significant others (e.g., parents & teachers) play a relevant role in why individuals are active or not because the perception of others may drive children's behavioural and cognitive processes. The aim of this study was to analyze who can best report on children's actual MC (i.e., locomotion, object control), i.e. children, parents' or physical education (PE) teachers. Methods. A sample of 67 Spanish children aged between 6-9 years (48.2% girls) from two primary schools, their parents and 4 PE teachers participated. The Test of Gross Motor Development third version and the pictorial Perceived Movement Skill Competence scale (original and adapted to proxy reports) were used for assessment. Correlations were first performed. Independent linear regression analyses adjusted to age and sex (child) were conducted to analyse the predictive power of the self- and proxy-reports of the children's actual MC. Results. There was a positive correlation between children's perceived and actual MC in object control ($\rho=0.27$) but not locomotor. Parents and PE teachers' could report on children's locomotion ($\rho=0.28$ and $\rho=0.35$, respectively) and object control ($\rho=0.41$ and $\rho=0.59$) (all $p<0.05$). Once adjusted by age and sex, children were no longer able to report on their object control competence but could explain 15.1% of variance in their own locomotion. Parents explained 17.1% and 33.9% of the children's locomotion and object control; respectively. PE teachers' proxy report explained 19.6% and 43.5% of the children's locomotion and object control competence. Conclusions. Parents and PE teachers may be useful sources of information regarding children's MC to educators, researchers and/or therapists saving the resources involved in objective assessment, although it must be noted that parents and teachers could report on object control competence better than locomotor competence.

The role of motor competence and mediating role of perceived motor competence in preschooler's physical activity levels on the playground

Famelia, Ruri; Tsuda, Emi; Goodway, Jacqueline, The Ohio State University

Prior research has raised concerns about disadvantaged children's physical activity (PA) levels with a need to better understand underlying mechanisms influencing PA (Vander Ploeg et al., 2014). Self-Determination Theory (SDT) suggests that competence (part of needs satisfaction) is a critical variable influencing motivation and ultimately PA levels. In this study, we examine how actual motor competence (AMC) and perceived motor competence (PMC) influence PA levels of disadvantaged preschoolers on the playground. Specific Aim 1 investigated the extent to which AMC predicted playground PA levels and how playground PA predicted AMC. A secondary aim investigated the role PMC, BMI and gender played in mediating the relationship between AMC and playground PA. Participants were disadvantaged preschoolers (N=72) from two urban child cares. AMC was assessed using the Gross Motor Quotient (GMQ) from the TGMD-2, and PMC evaluated using Harter & Pike's physical competence subscale. PA was evaluated by 3-day accelerometry during playground time at school, and percent of playground time spent in MVPA was calculated (MVPA%). A linear regression revealed AMC explained 15.1% of MVPA% during playground time [$p < .01$]. Additionally, MVPA% on the playground explained 15.1% of AMC [as measured by the GMQ, $p < .01$]. A mediation analysis with SPSS using PROCESS demonstrated that PMC ($p < .001$) mediated the relationship between AMC and MVPA% on the playground in both directions. Additionally, logistic regression revealed Gender ($p < .001$) mediated the relationship between AMC and MVPA% on the playground in both directions. Boys (39%) spent more time in MVPA% than girls (33%) on the playground. BMI did not mediate the relationship between AMC and MVPA% on the playground. These findings suggest that the competence construct from SDT (both actual and perceived) is important in supporting the PA behaviors of young children. As we develop playground PA interventions we need to consider gender, and how to increase AMC and PMC of disadvantaged preschoolers.

Exploring the Physical Activity, Actual Motor Competence and Perceived Motor Competence of Urban and Rural Indonesian Preschoolers

Famelia, Ruri; Goodway, Jacqueline D., The Ohio State University; Bakhtiar, Syahrial, State University of Padang

This study explored: 1) gender and location (rural/urban) differences in physical activity (PA), perceived motor competence (PMC), and actual motor competence (AMC) of Indonesian Muslim preschoolers, and 2) predictors of school day and playground PA and predictors of PMC. Sixty-six preschoolers from Padang, West Sumatera, Indonesia (n=35 rural, n=31 urban, girls=36) aged 3-6 years were recruited to participate. Preschoolers PA was measured by 3-day accelerometry at school and percent of school day spent in MVPA (%SD-MVPA) and sedentary behaviors (%SD-SED), and percent of playground time spent in MVPA (%PG-MVPA) and sedentary behaviors (%PG-SED) was calculated. Actual motor competence (AMC) was evaluated with the Test of Gross Motor Development-3 raw score (balls skills and locomotor skill subscales) and PMC using the Pictorial Scale of Perceived Movement Skill Competence (PMSC) for young children and Perceived Physical Competence subscale (PPC). The only significant findings from the 2 Location X 2 Gender ANOVAs on AMC and PMC was that boys

(Mean=18.93) were significantly better than girls (Mean=16.39) in ball skills ($p=.01$). The only significant finding of the 2 X 2 MANOVA on PA measures revealed rural children (Mean %PG-SED =74.6) were more sedentary than urban children (Mean %PG-SED =67.8) on the playground ($p=.04$). To examine the predictors of MVPA and sedentary behavior (%SDMVPA; %SDSED; %PGMVPA; %PGSED) four stepwise multiple regressions analyses were conducted. It was found that 13.8% of %PG-SED was predicted by location and locomotor skills ($p=.01$), and 13.3% of %PG-MVPA was predicted by PPC and locomotor skills ($p=.01$). None of the other regression analyses were significant. A stepwise multiple regression also found that ball skills explained 7.7% of the variance of PPC ($p=.02$). This study concluded boys (regardless of location) were better than girls at ball skills. Also that locomotor skills significantly predicted %PG-SED and %PG-MVPA and ball skills predicted PPC. As such AMC is important and preschools should provide interventions to promote AMC.

Funding Source: State University of Padang

The influence of gender in motor skills of children aged 1 month to 3 years

Felzer-Kim, Isabella; Zott, Gabriella; Hauck, Janet L., Michigan State University

Introduction: Previous literature suggests a clear gender gap in object control fundamental motor skills, evidenced as early as age 4. Object control skills allow children to engage in developmentally appropriate, beneficial physical activity opportunities, thus this disparity warrants investigation. Still, little is known regarding the age when this gender gap emerges. The purpose of this study was to evaluate motor skill differences by gender in children at 1 month, 3 months, 6 months, 1 year, 2 years, and 3 years.

Methods: Motor skills were assessed using the Bayley Scales of Infant Development-3rd edition (BSID-3), fine and gross motor subsets. For each age group, mean raw scores for each subset were compared between genders through independent sample t-tests.

Results: At 1 month ($n=27$), fine [$t=0.667$; $p=0.516$] and gross [$t=1.615$; $p=0.130$] motor scores did not significantly differ by gender. At 3 months ($n=27$), fine [$t=-1.657$; $p=0.516$] and gross [$t=-0.731$; $p=0.472$] motor scores did not significantly differ by gender. At 6 months ($n=26$), fine [$t=0.281$; $p=0.783$] and gross [$t=0.076$; $p=0.940$] motor scores did not significantly differ by gender. At 1 year ($n=35$), fine [$t=-1.316$; $p=0.201$] and gross [$t=-1.791$; $p=0.088$] motor scores did not significantly differ by gender. At 2 years ($n=17$), fine [$t=0.954$; $p=0.355$] and gross [$t=-1.258$; $p=0.229$] motor scores did not significantly differ by gender. At 3 years ($n=14$), fine [$t=0.596$; $p=0.562$] and gross [$t=-0.376$; $p=0.715$] motor scores did not significantly differ by gender.

Conclusion: Fine and gross motor scores did not significantly differ by gender in children aged 3 and younger. The results provide insight that the motor skills gender gap may arise after the age of 3. Given the lack of object control assessments prior to age 3, exploration of this specific phenomenon is limited. Critical review of specific fine motor items tested will be discussed. The results of this study should generate research further exploring the origins of the object control gender gap.

Family Day Care Providers' Proxy Report of Pre-schoolers' Motor Skill Competence

Figueroa, Roger; Wiley, Angela, University of Illinois at Urbana-Champaign

Background: Assessing children's motor competence (MC) objectively is resource intensive. Family day care providers are with young children for much of the week and therefore may be utilized as a source of information on children's competence. The study aim was to examine how well family day care providers' can proxy-report on pre-schoolers' MC (i.e., locomotion, object control, overall motor skills). **Method:** A total of 78 preschoolers (3-5 years old; 53.1% girls) attending family day care homes and 26 family day care providers in a U.S. city participated. The Test of Gross Motor Development second version (TGMD-2) was used to assess MC and an adapted version of the pictorial scale of Perceived Movement Skill Competence (PMSC) was used to assess preschoolers' MC as reported by family day care providers. T-test assessed sex differences. Bivariate correlations examined the associations between actual and family day care providers' proxy-report of children's MC. Regression analyses assessed the predictive power of family day care providers' proxy-report of preschoolers' locomotor, object control, and overall MC; controlling for age and sex. **Results:** There were no sex differences in children's MC or providers' reports on children's MC. There were moderate significant correlations for locomotor ($r=0.30$), object control ($r=0.38$), and overall motor skill competence ($r=0.36$). Family day care providers' proxy-report of pre-schoolers MC explained 17.4%, 20.9% and 20.1% of preschoolers' variance in locomotion, object control, and overall MC, respectively after age adjustment (increasing). Sex was non-significant. **Conclusions:** Family day care providers appear to predict the object control domain better than the locomotor domain. That family day care providers perceived girls and boys no differently in terms of MC reflected actual MC data and thus supports them being used as a source of information. More research is warranted to better understand the role of providers in assessing preschoolers' MC and providing opportunities for MC development to children.

Motor, but not cognitive ability, is associated to movement imagery capacity in children

Fuchs, Chadwick; Hudson, Susan; Young, Jessica; Cacola, Priscila, University of Texas at Arlington

Motor imagery provides a unique window on the integrity of movement representation. While it is somewhat established that motor imagery abilities are formed by age seven, little is known about the contribution of motor and cognitive abilities in this capacity. When looking at kinesthetic and visual modalities, it is known that the kinesthetic modality is rated by children as the most difficult imagery task to perform, while the external visual imagery is the easiest. Therefore, the aim of the present study was to evaluate whether movement components of imagery capacity could be distinguished by differences in motor and cognitive ability. Using the Movement Imagery Questionnaire for Children (MIQ-c); a questionnaire developed for children, thirty-eight children with ages between 7 and 12 years were tested with the Movement Assessment Battery for Children, 2nd edition (MABC-2), Kaufmann Brief Intelligence Test, 2nd edition (KBIT-2), and the MIQ-C. A one-way ANOVA was conducted for each one of the capacities for three levels of motor and two levels of cognitive ability, determining that lower levels of motor capacity (< 5th percentile) were associated with lower scores on kinesthetic imagery ($p = .05$). Pearson correlation analysis revealed a moderate relationship between kinesthetic imagery and manual dexterity ($r = .45$) and with total motor ability ($r =$

.32). Results indicated that individuals with high motor ability are also high in their kinesthetic imagery ability, as compared to their internal and external visual imagery. However, this could be due to the fact that the children performed the simple movement tasks prior to being asked to image the movement. Further exploration of the involvement of cognitive and motor abilities and how they interact to promote movement imagery is warranted. Future studies will be directed towards using kinesthetic imagery as a therapeutic modality for children with developmental motor cognition disorder.

English to Portuguese reverse translation and initial evidence of rater-expert agreement for the FG-COMPASS

Furtado, Ovande, California State University Northridge; Mazzardo, Oldemar, Universidade Estadual do Oeste do Parana; Watanabe, Priscila I.; De Campos, Wagner, Universidade Federal do Parana; Gallagher, Jere D., University of Pittsburgh

The Furtado-Gallagher Computerized Observational Movement Pattern Assessment System (FG-COMPASS) is a process-oriented assessment tool designed to assess fundamental movement skill (FMS) competency in children ages 5-10 years. Validity and reliability evidence were collected for the FG-COMPASS (Furtado & Gallagher, 2012; Furtado, 2004; Furtado & Gallagher, 2017; Woolever, Furtado, et al., 2017). The aim of this study was to translate and assess expert-rater agreement for the Brazilian Portuguese version of the FG-COMPASS. Prior to data collection, the English version of the test's protocol was translated to Portuguese by two native Brazilian expert speakers in Motor Behavior who are proficient in English. Then, two different experts in Motor Behavior translated the Portuguese version of the protocol back to English. Finally, the principal investigator and the experts who translated the protocol to Portuguese met to discuss any potential discrepancies and a final version of the Portuguese version of the protocol was crafted. Data collection took place at two Brazilian higher education institutions located in southern Brazil. Twenty-eight undergraduate students underwent training prior data collection. Participants used the final version of the translated protocol to classify 96 pre-recorded video clips which depicted children performing eight FMS. The video clips had previously been classified by an expert in Motor Behavior who has extensive knowledge of the testing protocol. The results indicate a 'very good' (Altman, 1991) agreement between the classifications of participants and the expert with weighted kappa ranging between .82 to .86 ($M = .84$, $SD = .019$) for the locomotor subtest and between .84 to .93 ($M = .88$, $SD = .031$) for the manipulative subtest. Further studies are needed to establish inter/intra-rater reliability and criterion validity for the Brazilian version of the FG-COMPASS.

Funding Source: Center for Mexico and Latin America Studies Research Competition - CSUN

Application of Exploratory Structural Equation Modeling to Motor Evaluation: Improving the Construct Validity of the Test of Gross Motor Development - 2nd Edition

Garn, Alex C.; Webster, E. Kipling, Louisiana State University

Objective: The Test of Gross Motor Development (TGMD) is a popular evaluation tool of children's fundamental motor skills. Establishing construct validity in evaluation tools like the TGMD is essential in research and application because both are predicated on accurate measurement. This study illustrates the benefits of using exploratory structural equation modeling (ESEM) over confirmatory factor analysis (CFA) when examining construct validity in the TGMD-2. **Method:** Participants (N= 1268) from a representative sample were used in the analyses (Mage = 7.01 SD = 2.25, range 3-10; 51% female). First, factor structure of the TGMD-2 was tested and compared using CFA and ESEM. Second, measurement invariance by gender was explored to determine measurement equivalence between boys and girls. Finally, a multiple-indicator-multiple-cause ESEM examined the relation between age and the latent constructs of locomotor and object control skills. **Results:** The two-factor ESEM produced a better fitting measurement model, $\chi^2(43) = 147.22$, CFI = .98, RMSEA = .044, compared to CFA, $\chi^2(53) = 240.99$, CFI = .96, RMSEA = .053 ($\Delta \chi^2 = 93.77$, $\Delta df 10$, $p < .001$). The latent correlation between locomotor skills and object control skills was also reduced in ESEM ($r = .78$) compared to CFA ($r = .88$). Measurement invariance tests established the equivalence of factor loadings, intercepts, and variance-covariance estimates; however, latent mean differences revealed that girls performed better on locomotor skills (diff = .18, $p < .01$) and worse on object control skills (diff = -.58, $p < .001$) compared to boys. Finally, age was a strong predictor of both locomotor skills ($\beta = .81$, $p < .001$, $r^2 = .65$) and object control skills ($\beta = .73$, $p < .001$, $r^2 = .53$). **Conclusion:** ESEM generated a more precise measurement model compared to CFA and was completed in a fully a priori manner. This is likely a reflection of the restrictive independent clusters model assumptions of CFA, which force cross-loadings to be zero. ESEM has broad applicability to improving motor research and practice.

Predictive Validity of the Test of Gross Motor Development -3 for children with visual impairments

Haibach-Beach, Pamela S., SUNY Brockport; Brian, Ali; Taunton, Sally, University of South Carolina; Lieberman, Lauren, SUNY Brockport

The Test of Gross Motor Development-2 was validated for children with visual impairments. There is a new version of this assessment, the TGMD-3. The purpose of this study is to determine the predictive validity for the TGMD-3 with physical activity and health-related fitness (HRF) for children with visual impairments. This is a secondary analysis from a previous study that determined initial reliability and validity for the TGMD-3 with this population. Participants included children (N = 66) ages 9 – 19 years (Mage = 12.93, SD = 2.40) enrolled in a sports camp for children with visual impairments and are considered a convenience sample. The children's visual impairments ranged from blind to low vision. Participants were assessed on locomotor and object control skills from the TGMD-3 as well as HRF skills. Grip strength (right and left), push-ups, curl-ups, and mile-run following the FitnessGram manual all comprised HRF. A confirmatory factor analysis showed that five items for HRF loaded into one construct of HRF (Chi Square(62) = 79.29, $p = .290$, Chi Square/Df ratio = 1.28, RMSEA = .08; GFI = .83). Physical activity included moderate to vigorous physical activity collected during camp via accelerometers and seven-day physical activity recall assessed via questionnaire prior to camp. Predictive validity was determined using Pearson product moment correlations with ball skills, locomotor skills, physical activity, and HRF. Participants' TGMD-3 scores

assessed at the start of camp significantly predicted physical activity levels accrued by the end of camp, the week before camp, and also HRF ($p = .002 - .036$). Correlations ranged from $r = .34 - .41$ indicating weak to moderate associations. The results of the current study show the predictive validity for the TGMD-3 with regard to children with visual impairments.

Executive Function, Motor Skills, and School Readiness in Low SES Hispanic Pre-kindergarteners

Hamilton, Michelle L.; Liu, Ting; Matula, Kathleen; Plotts, Cindy, Texas State University

Executive function and motor skills may affect prekindergarten children's school performance. In addition, research has shown that low SES Hispanic preschoolers are delayed in motor skill performance (Goodway, Robinson, & Crowe, 2010; Hamilton, Liu, & ElGarhy, 2016; Liu, Hamilton, & Smith, 2015) and school readiness (Ahmad & Hamm, 2013; Wang, 2008) when compared to white and children from higher income families. Very little is known about Hispanic preschoolers executive functioning and how it relates to their motor proficiency and school readiness. The purpose of the study was to examine the relationships between executive function, motor proficiency, and school readiness for low SES Hispanic preschoolers. Thirty-five low SES Hispanic children aged 49 to 59 months ($M = 53.83$) from a state-funded prekindergarten participated in this study. Children were administered the School Readiness subtests of the NEPSY-2 (A Developmental Neuropsychological Assessment), the Peabody Developmental Motor Scale-2 (PDMS-2), and Bracken School Readiness Assessment-3 (BSRA-3). One-sample t-tests showed that low SES Hispanic preschoolers were significantly below average normative mean scores on three NEPSY subtests (i.e., Memory for Designs, Phonological Processing, and Sentence Repetition) and were below all the subtests average means for the PDMS-2 and BSRA-3 indicating that the preschoolers were behind their age-matched peers on executive functioning, motor proficiency, and school readiness. Pearson correlations revealed a significant correlation between the NEPSY-2 block construction subtest and PDMS-2 visual-motor integration subtest. Furthermore, a significant correlation was found between BSRA-3 quantity subtest and PDMS-2 fine motor quotient scores. These findings suggest that fine motor skills are related to low SES Hispanic preschool children's executive function and school readiness. Practitioners and educators are recommended to incorporate fine motor skills into the curriculum in their classroom to improve preschool children's school readiness.

Cortical activity patterns in infants with Down Syndrome during performance of functional motor skills

Harris, Micah; Baur, Katherine, University of Michigan; Nishiyori, Ryota, National Institutes of Health; Meehan, Sean K., University of Michigan

Motor skill development is delayed in infants with Down Syndrome (DS) compared to their typically developing (TD) peers. However, the neural substrates associated with delayed skill development are unknown. We used functional near infrared spectroscopy (fNIRS), an infant friendly method to assess cortex activity, to measure hemodynamic response in the primary motor cortex, prefrontal cortex, and cerebellum as TD and

infants with DS (5 to 24 months) performed goal-oriented reaching. Goal-oriented reaching involved reaches to body-centered objects presented in peripersonal space followed by a 20s rest period. Reaching trials were repeated until a minimum of 10 successful reaches were performed. Level of motor development was also assessed in both groups using the motor subtests of the Bayley Scale of Infant Development. In a subset of typically developing and DS infants daily physical activity (PA) was recorded for 7 days following the fNIRS session (Actigraph GT3X). We hypothesized that infants with DS would score lower on the Bayley Scale across all ages and that infants with DS would demonstrate less vigorous more more diffuse neural activity within each region of interest compared to their age-matched TD peers. We further hypothesized that average daily PA would be similar across group at each age. Consistent with our hypotheses preliminary data (31 TD and 10 DS infants) demonstrate significant lower Bayley scores for DS infants compared to their TD peers. Infants with DS also demonstrate smaller but more diffuse increases in hemodynamic activity during goal-oriented reaching compared to their TD peers. There were no differences in overall PA between groups. These results suggest that the less refined motor skills characteristic of DS is reflected in less refined cortical activation across cognitive and motor areas. Further, these delays may be a product of functional experience rather than overall PA. These results have important applications to pediatric rehabilitation of DS and other neuromotor development disorders.

Parents as Early Teachers of Motor Skill

Haywood, Kathleen M.; Salman, Ibtihal D., University of Missouri-St. Louis

Several investigations have noted that boys perceive their levels of motor/physical competence to be higher than girls perceive their levels to be, sometimes when there is no difference in actual skill competence (De Meester et al., 2016; Mcgrane, Belton, Powell, & Issartel, 2016; Robinson, 2010). Also, young children tend to have high levels of perceived competence. While parents are widely regarded as the earliest social agents to influence development of self-esteem, little is known about how parents actually teach their young children motor skills. This study was an exploratory, qualitative analysis of parental teaching sessions. Three mother-son dyads were video-recorded as mothers taught four skills, catching, kicking, dribbling, and jumping. The boys were 3.0 to 3.2 yrs of age. Physical demonstrations and guiding were noted and the mother's verbalizations were coded as: instruction (to act); instruction (on technique); positive reaction and praise, negative reaction or criticism; or feedback on technique. One hundred two actions and verbalizations were analyzed. Mothers used demonstrations and physical guidance, especially when teaching jumping and dribbling. Approximately 40% of verbalizations were instructions for action and 15% were instructions on technique. Nearly all of the reactions to action were praise. A theme of celebration emerged. Mothers' teaching of skill to these 3-yr-old boys would lend to a high perception of physical competence, providing a positive environment for learning skills. Future research on additional dyad combinations is planned.

The Athletic Skills Track: age- and gender-related normative values of a motor skills test for 4 to 12-year-old children

Hoeboer, Joris; Krijger-Hombergen, Michiel; Ongena, Guido; Stolk, Erik, The Hague University of Applied Sciences; Savelsbergh, Geert, VU University Amsterdam; de Vries, Sanne I, The Hague University of Applied Sciences

Introduction: The Athletic Skills Track (AST) is a reliable, valid and feasible motor skill test to assess children's motor skill level in a physical education (PE) setting. The aim of this study was to provide age- and gender-specific normative values for the AST among 4- to 12-year-old children. **Methods** In 2016, a total of 7,977 4- to 12-year-old children (4,036 boys and 3,941 girls) in The Netherlands performed an age-related version of the AST. The AST is a track, which consists of 5-7 fundamental movement skill tasks that should be completed as fast as possible; AST-1 has been developed for 4- to 6-year-old children, AST-2 for 6- to 9-year-old children and AST-3 for 9- to 12-year-old children. The test was conducted during a regular PE lesson. Age- and gender-related reference centiles were derived for each version of the AST using the Lambda, Mu, Sigma (LMS) method. Based on the reference centiles, Motor Quotients (MQ) were calculated based on the MQ values of the Karperkoordination Test for Kinder.

Results: All children completed the AST within 60 seconds. The boys completed AST-1 on average in 25.3 +/- 7.6 seconds, AST-2 in 30.6 +/- 7.3 seconds and AST-3 in 27.0 +/- 6.9 seconds. The girls completed AST-1 on average in 27.4 +/- 7.9 seconds, AST-2 in 33.0 +/- 7.9 seconds and AST-3 in 29.1 +/- 6.8 seconds. An independent sample t-test showed a significant difference between boys and girls in time to complete the track, except for the 4-year-olds on AST-1. Therefore, age and gender-related reference centiles were derived. The reference curves demonstrated an almost linear decrease in time to complete AST-1 and AST-2 with increasing age. The time to complete AST-3 remains relatively stable among 9- to 12-year-old boys and girls.

Conclusion: The present study provided age- and gender-related normative values for the AST among 4- to 12-year-old children. The normative values will help PE teachers to interpret the outcomes of the AST and act upon it. Future studies should gather data in countries with different PE and health policies.

Funding Source: PhD-grant for teachers from The Dutch National Science Organization (NWO)

Physical education versus free play in motor skill development of preschoolers

Howard-Shaughnessy, Candice, Troy University; Taunton, Sally; Brian, Ali, University of South Carolina; Sluder, Brandon, Troy University

Preschool physical education (PE) has not been widely investigated by researchers. While it is important for preschoolers to engage in physical activity as free play (e.g., exploratory play while on a playground), little is known about preschool PE (i.e., structured physical learning experiences) when delivered by a licensed PE teacher. The purpose of this study is to examine differences among preschoolers who engage in free play (FP) and preschoolers who engage in PE. Forty-seven preschoolers, ages 3-5 from two preschool site locations in the United States participated. The experimental group [n = 24; girls = 7 (29%)] participated in structured PE three times per week and FP two days per week, while the control group [n = 23; girls = 11 (46%)] participated in FP only, five days per week. Children in both groups were assessed prior to and after the 8-week intervention using the Test of Gross Motor Development Second Edition (TGMD-2).

Pretest-posttest results indicate significant group x time interactions for locomotor ($F(1,45) = .112, p = .004$), and object control skills ($F(1,45) = 40.095, p = .000$). Analyses confirm children who received PE showed higher locomotor skills ($M = 30.5, SD = 8.2$) and object control skills ($M = 30.39, SD = 8.04$) than peers who only received FP (locomotor $M = 21.70, SD = 6.3$; object control $M = 16.23, SD = 4.32$). School systems in the U.S. are beginning to have access to funding for preschool programs. As more and more preschool programs begin, it is important to know the benefits of various types of physical activity. Implications for policy and future research are noted.

Keep driving! The preliminary results of modified ride-on car (ROC) training and motivation in toddlers with disabilities

Huang, Hsiang-han, Chang Gung University, Guishan, Taoyuan, Taiwan; Huang, Hsuan-Wen, Saint Mary's Hospital Luodong, Yilan, Taiwan; Chen, Yi-Mei, Taoyuan Chang Gung Memorial Hospital, Taoyuan, Taiwan; Chen, Chia-Ling, Linkou Chang Gung Memorial Hospital, Taoyuan, Taiwan

Modified ride-on toy cars (ROCs) have been recently suggested as novel options for applying early power mobility training in toddlers with disabilities. The purpose of this two-group design study is to investigate the effects of using ROCs in the hospital environment on mobility and motivation in toddlers with disabilities. 20 toddlers with disabilities between 1 and 3 years were recruited from the hospitals in Northern Taiwan. The treatment group (13 participants, mean age: 17.9 months) received 9-week ROC training by an independent occupational therapist and caregivers (120 mins/per session, 2 sessions/per week). The control group (7 participants, mean age: 14.6 months) received an educational booklet for home program and continued their regular therapy. Chinese Version of Pediatric Evaluation of Disability Inventory (PEDI-C), Dimensions of Mastery Motivation (DMQ), and Goal Attainment Scale (GAS) were administered before and after 9-week intervention. Mann-Whitney U test / Wilcoxon test were used to compare the demographic data and the differences between/within the control and treatment group. There was no significant difference between groups at pre-test, including the gender, age, the average amount of regular therapy and training time received each week. After 9-week intervention, no significant difference on mobility and mastery motivation was found between two groups ($p > .05$). The comparison of GAS between the two groups showed a significant difference ($p = .04$). Within each group, the treatment group had significant improvements on mobility ($p = .00$), mastery motivation (cognitive/object persistence: $p = .02$; gross motor persistence: $p = .05$; mastery pleasure: $p = .02$) and GAS ($p = .00$). The control group only showed significant improvements on mobility ($p = .04$) and GAS ($p = .02$). This is the first study to investigate the influences of using modified ROCs on mobility and motivation. A future study with large sample size can be conducted to examine the components of this program, including the types of modified ROCs, the intensity and duration.

Are movement skills fundamental or foundational? Conceptualizing movement skill development for participation in physical activity

Hulteen, Ryan M.; Morgan, Philip J., University of Newcastle; Barnett, Lisa M., Deakin University; Stodden, David F., University of South Carolina; Lubans, David R., University of Newcastle

There is a positive association between competency in a range of fundamental movement skills (e.g., kick, catch, run) and physical activity. Yet, the term 'fundamental' may be inappropriate and not reflective of the full range of movement skills needed for participation in physical activity. More specifically, the term fundamental implies an essential need for physical activity participation. Alternatively, the term 'foundational movement skill' may broaden and better reflect the additional skills (e.g., squat, push-up, backstroke, cycling) that are important for participation in popular physical activities. Essentially, foundational skills provide an underlying base or support which maximizes opportunities for participation in physical activity. This presentation aims to describe a conceptual model which explains movement skill development across the lifespan. Previous models of movement development have acknowledged the importance of fundamental movement skills and their evolution to more complex and context-specific movement skills. However, in this newly proposed model, using the term 'foundational', provides both a direct (foundational skills lead to a lifetime of physical activity) and indirect pathway (via specialized physical activity skills) to a lifetime of physical activity. A proficiency barrier is placed within the model, which hypothesizes some minimum level of competency in foundational movement skills is necessary to continue on the path to a lifetime of physical activity. Additionally, attributes including one's level of fitness, balance and coordination may enhance or hinder an individual's movement skill development. Finally, a cultural lens is placed within the model to demonstrate how skills classified as 'foundational' may vary according to an individual's culture and/or geographic location. In conclusion, movement skill development should be viewed not only in relation to skillful performance, but also in terms of how various movement forms will support and maintain a lifetime of physical activity engagement.

Does competency in lifelong physical activity skills predict physical activity and health-related fitness in Australian adolescents?

Hulteen, Ryan M., University of Newcastle; Barnett, Lisa M., Deakin University; Morgan, Philip J., University of Newcastle; Robinson, Leah E., University of Michigan; Wrotniak, Brian H., D'Youville College; Lubans, David R., University of Newcastle

Background: Competency in a wide array of motor skills is positively associated with physical activity and health-related fitness. However, research in this area has predominantly focused on fundamental movement skills in children (5-12 years). Some skills, which may not fall under the umbrella of 'fundamental' may be important to learn in youth for long-term physical activity participation. The purpose of this study was to determine the associations between competency in skills used in popular lifelong physical activity (e.g., resistance training, yoga, and golf) and physical activity and health-related fitness in a sample of Australian adolescents. Methods: Participants (N=109, 55 males, 54 females; Mean age=15.82 years, SD=0.37 years) completed demographic (online survey), physical activity (questionnaire, accelerometers), health-related fitness (standing long jump, push-ups, back-saver sit and reach, body mass index, and three-minute step test) and lifelong physical activity motor skill competence (Lifelong Physical Activity Skills Battery) measures. Multiple regression models using motor competence as the predictor, and adjusting for age, sex and socio-economic status, were used to explain variance in physical activity and health-related fitness measures. Results: Skill competence was a significant predictor of subjective (beta=0.25, p=0.02, R²=0.17), but

not objective ($\beta=0.17$, $p=0.16$, $R^2=0.08$) physical activity. Motor competence was also a significant predictor of all aspects of health-related fitness, except flexibility ($\beta=-0.06$, $p=0.60$). Between 5-51% of variance in fitness scores were explained. Competency in lifelong physical activities appears to be a better predictor of health-related fitness than physical activity. Conclusion: Researchers are encouraged to explore the importance of competency in lifelong physical activity skills in further cross-sectional and experimental studies involving larger and more culturally diverse adolescent samples.

Developing New Protocols To Test Fundamental Movement Skills - A Necessity?

Issartel, Johann; McGrane, Bronagh; Belton, Sarahjane, Dublin City University

This study questions the validity of the current tools available to assess motor skill proficiency of adolescents. More specifically, this study examines whether fundamental movement skill proficiency can be measured with the currently available tools, that have been developed and validated over the years for the child population (e.g. MOT 4 - from Zimmer et al., 1987; Movement-ABC 2 from Henderson et al., 2007; KTK from Kiphard et al., 2007; TGMD-2 from Ulrich, 2000).

At present, trainers, educators and researchers are facing a generation of adolescents that do not possess the basic requirement to engage and/or enjoy sports specific skills (O'Brien et al., 2015). Our current tools were not designed to capture FMS proficiency for an adolescent population, as the lack of motor skill proficiency, for this age group, was not an issue for previous generations.

As a result of these skills not being developed proficiently during childhood, further investigation is required to discuss the appropriateness of extending the age bracket of current protocols, without any alteration of their content (i.e. test, protocol, measures, etc.). Responding positively to this point could lead to low levels of item discrimination indexes to differentiate participants' performance (e.g. items being either too easy or too difficult). On the other contrary, responding negatively would impede the potential for longitudinal studies.

This presentation will discuss the current state-of-the-art regarding protocols currently used by researchers measuring FMS proficiency of adolescents. The aim is to stimulate a discussion as to where the research community should go in the next 10 years taking into account societal changes. Do current children develop new motor skills that older tests have simply not been designed to capture? If there is a need to develop new tests, what would be the role of both product vs. process oriented measurements? How can we go about assessing the FMS developmental levels from childhood to adolescence?

A longitudinal analysis of fine motor skill proficiency in Primary School Children

Issartel, Johann; Gaul, David, Dublin City University

Introduction: Fine motor skills are an essential component of numerous activities of daily living such as feeding oneself, putting on clothes or brushing ones teeth (Henderson and Sugden 1992). As such problems in fine motor proficiency, as seen in individuals with Developmental Coordination Disorder (DCD), can have severe consequences on individuals quality of life, self-esteem, physical activity and academic achievement (Zwicker et al 2012). A previous cross sectional study by Gaul and Issartel (2016) found

that children's fine motor skill proficiency fell below the expected norms and children seemed not progressing at the expected rate. This study seeks to investigate the current rate and trajectories of fine motor skill development in primary school children. Methods A sample of 338 children between the ages of 7-12 were tested using the Fine Motor Composite of the Bruininks Oseretsky Test of Motor Proficiency 2nd Edition (BOT-2) on 3 occasions over a 2 year period. Children's height, weight and BMI were taken on each occasion.

Results: On average, for all age groups, children's overall standard score for fine motor composite fell below the specified normative values for this test. Interestingly, despite standardization for age and gender, differences were still found between groups ($p < .05$) with a progression of the overall fine motor skill proficiency level with time ($p < .05$) but not at the expected rate. In addition, weight status also influenced fine motor proficiency levels among children ($p < .05$).

Conclusion: Children's fine motor skill proficiency levels are falling significantly below those levels prescribed by normative values for the BOT-2. This is a worrying trend given the negative consequences associated with poor fine motor skill proficiency (Zwicker et al 2012). Future research needs to ascertain whether normative values/activities assessed are still applicable given the reduction in children's time spent engaged in fine motor task, physical activity in general, and increased time interacting with digital media devices in modern society.

Funding Source: Irish Research Council

Influence of High and Low Autonomy-Supportive Climates on Physical Activity in Children with and without Developmental Disability

Johnson, Jerraco Leontae; Miedema, Benjamin; Pangelinan, Melissa G.; Converse, Brooke; Bridges, Claire; Irwin, Jacqueline M.; Buchanan, Alice; Rudisill, Mary E., Auburn University

Participation in moderate to vigorous physical activity (MVPA) during childhood has been associated with numerous health outcomes in children, and may even help offset risks of secondary impairments due to lower physical activity levels in individuals with disabilities (Carlson, Taylor, Dodd, & Shields, 2013; Frey, Stanish, Temple, 2008; Ross et al., 2016). The aim of this study was to determine the efficacy of fully-inclusive motor skill interventions employing either an autonomy-supportive climate or direct-instruction (low autonomy) on MVPA in both typically developing (TD) and children with developmental disabilities (DD). Children ($n = 32$; TD = 18, DD = 14) ages 5-9 attended daily 60-minute motor skills sessions during a summer camp program. Participants attended a total of six sessions; three sessions of which the instructor delivered the lesson using an autonomy-supportive climate and three days in direct instruction. Physical activity was measured using accelerometers. Linear mixed effects models revealed that although children with disabilities exhibited less time spent in MVPA, compared to their typically-developing peers ($p = 0.002$), for all children, there was an increase in percent time spent in MVPA during the autonomy-supported climate compared to the direct-instruction climate ($p = 0.0256$). Although previous studies have found that autonomy-supported climates improve motor competence in children with disabilities, this is the first study to quantitatively assess the efficacy of autonomy-supportive climates on physical

activity levels in children with and without developmental disabilities that were fully-inclusive. These results are particularly relevant to practitioners and clinicians that aim to improve the health of children with developmental disabilities who are at a greater risk for secondary impairments due to lower levels of physical activity. Future studies should examine the effectiveness of autonomy-supportive climate interventions on physical activity levels of children with DD over a longer duration of time.

Triaxial physical activity in young children with and without motor coordination difficulties

King-Dowling, Sara; Wellman, Sarah; Le, Tuyen; Rodriguez, Christine; Timmons, Brian W., McMaster University; Cairney, John, University of Toronto

Children with motor coordination difficulties are less active than typically developing (TD) children. This is evident for both self-reported and objectively measured activity. However, the majority of this work has focused on children in middle childhood and adolescence, and little is known about when this activity deficit emerges. Furthermore, with new advances in technology, accelerometers are now able to capture activity in multiple axes, and therefore are able to give us a more holistic picture of daily movement. The purpose of this study was to determine if the activity levels in young children at risk for motor delays are lower than TD children across 3 different planes of movement. Four hundred and ninety-two children 4-to 5-years old were recruited as part of the Coordination and Activity Tracking in Children (CATCH) study. Motor skills were assessed using the Movement Assessment Battery for Children-2, with children scoring ≤ 16 th percentile considered to be at risk for motor coordination difficulties ($n=186$). Physical activity was measured using Actigraph accelerometers (wGT3X) worn around the hip for 7 days. In order to control for differences in wear time, average daily activity counts per minute (cpm) were calculated for each of the 3 axes. Activity differences in each plane between the 2 groups were analyzed using multivariate analysis of variance, with sex entered as a covariate. Although there was a significant multivariate effect of group (Pillai's trace =0.029, $F=4.17$, $p<.01$), follow-up univariate ANOVAs found no significant differences in activity cpm between groups in any of the 3 axes (axis 1, $p=.10$; axis 2, $p=.42$; axis 3, $p=.55$). Preschool children with motor coordination difficulties appeared to have overall differences in triaxial activity, however when axes were examined separately no differences were found. Following this cohort over time will allow us to determine if, or when, differences in activity in individual axes become apparent, and how these movement patterns influence trajectories of health and fitness.

Funding Source: Canadian Institutes of Health Research

Postural sway is repetitive in 6 month old infants at high-risk for ASD.

Kyvelidou, Anastasia; Motz, Zachary; Wickstrom, Jordan, University of Nebraska at Omaha

The prevalence of autism spectrum disorders (ASD) has increased dramatically in the last decade. Specifically, based on the Centers for Disease Control and Prevention Autism Developmental Disabilities Monitoring about one in 68 children has been identified with an autism spectrum disorder. The increasing occurrence of ASD creates an imperative need for clinicians to identify as early as possible ASD related deficits in

order for these children to receive access to early intervention services and possibly a greater chance to improve quality of life. We examined sitting postural sway in 19 infants at low- and 6 infants at high- risk for ASD (familial risk) at 6 months of age. Sitting postural control was evaluated using a simple paradigm where infants sit on a force platform while center of pressure data are acquired to describe body sway. Infants at high-risk were identified as those with a sibling clinically diagnosed with ASD, whereas infants at low-risk were identified as those with no familial history of ASD. We utilized traditional tools of COP analysis, such as root mean square (RMS) and range as well as non-linear tools such as Sample Entropy (SampEn) for both the medial-lateral (ML) and anterior-posterior (AP) directions of movement. Infants at high-risk for ASD presented significantly greater RMS and range values in the ML direction, suggesting greater excursions of postural sway in the ML direction. However, SampEn was significantly lower in the ML direction, suggesting that even though infants move to the extremes of their mediolateral stability, they achieve that by engaging in a very repetitive and periodic pattern of movement behavior. Significant differences were not observed in the AP direction. The question that remains, is whether this repetitive postural behavior persists during development, if it is related to diagnostic criteria for stereotyped movements and if it is unique to infants at high-risk for ASD or other developmental disabilities.

Funding Source: NIH

Engaging Teachers, Motivating Students: A Pilot Cluster Randomised Controlled Trial to Improve Fundamental Movement Skill Proficiency in Pre-Adolescent Girls

Lander, Natalie, Deakin University; Morgan, Philip, Newcastle University; Salmon, Jo; Barnett, Lisa, Deakin University

Background: Physical activity levels decline substantially during adolescence, and are consistently lower in girls than boys. Competency in a range of fundamental movement skills (FMS) may serve as a protective factor for the decline in physical activity typically observed in adolescent girls; yet, girls' mastery levels of FMS are low. Purpose: To evaluate the effectiveness of an intervention, focusing on authentic assessment and a mastery motivation learning environment, delivered by teachers, in improving girls' FMS. Method: Four all-girls Melbourne secondary schools were recruited and randomised into intervention or control groups. In total, 190 Year 7 girls (103 control/87 intervention, mean age 12.4 ± 0.3 years) completed baseline measures and post-test measures at 12 weeks. Six FMS (i.e., catch, throw, kick, jump, leap and dodge) were measured using the Victorian FMS Assessment instrument. Mixed models with post-test skill (i.e., locomotor, object control and total skill) as the outcome variable, adjusting for baseline skill, intervention and control status, and relevant covariates, as well as accounting for clustering at the school and class level, were used to assess the impact of the intervention. Results: At post-test there were significant intervention effects, and large effect sizes (Cohen's d) noted in locomotor ($p = 0.04$, $t = 5.15$, $d = 1.6$), object control ($p = <0.001$, $t = 11.06$, $d = 0.83$) and total skill ($p = 0.02$, $t = 7.22$, $d = 1.36$). Conclusion: A school-based FMS intervention focusing on authentic assessment and student-centered instruction significantly improved FMS competency in Year 7 girls.

Exploring Predictors of Children's Motor Competence within the Context of the Canadian Assessment of Physical Literacy (CAPL)

Law, Barbi; Confesor, Valaine; Richards, Devyn; Bruner, Brenda, Nipissing University

This study explored the relationship among components of children's physical literacy (PL) with a focus on motor competence, specifically object control and locomotor skills, as assessed by the Canadian Assessment of Physical Literacy (CAPL; HALO, 2014). Children from Northeastern Ontario ($n=1137$; 52% F; $Mage=9.76$, $SD=1.28$) completed the CAPL, a standardized protocol measuring physical competence, daily behavior, motivation/confidence, and knowledge/understanding of physical activity. Motor skills were assessed by the Canadian Agility and Movement Skill Assessment (Longmuir et al., 2015), a standardized obstacle course. Children's ability to meet skill-related criteria was used to create an average score (2 trials) for object control and locomotor skills. A 2(Gender) x 5(Age) MANOVA revealed main effects for age, Pillai's Trace=.239, $F(12, 3306)=23.86$, $p<.0001$, and gender, Pillai's Trace=.119, $F(3, 1100)=49.49$, $p<.0001$, on object control and locomotor skills. Boys scored higher for object control, while girls scored higher for locomotor skills ($ps<.05$). Regarding age, 8 year olds scored lower on object control than 9-12 year olds ($ps<.05$), and lower on locomotor skills than 10-12 year olds ($ps<.05$), but were not different from 9 year olds ($p>.05$). Multiple regression analyses were conducted to examine if the following measures positively predicted motor competence: age, gender, PACER, grip strength, plank, body composition, sit and reach, pedometer step counts, motivation/confidence, and knowledge/understanding. Scores on all measures predicted object control, $F(10, 774)=19.35$, $p<.0001$, $R^2=.202$; however, gender, motivation/confidence, sit and reach, grip strength, and PACER were the only significant contributors to the model ($ps<.05$). All measures predicted children's locomotor skills, $F(10, 774)=12.48$, $p<.0001$, $R^2=.140$; with only gender, PACER, sit and reach, and body composition contributing significantly ($ps<.05$). Findings suggest different components of PL are related to children's performance on object control and locomotor skills.

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Relations between anthropometrics and step-time parameters in infants' first year of walking

Lee, Do Kyeong, California State University Fullerton; Cole, Whitney, Max Planck Institute for Human Development; Adolph, Karen, New York University

The common practice for reporting walking skill is to normalize gait parameters by individual's leg length, thus controlling for differences in people's body dimensions. Unlike mature walking patterns that are highly related to leg length, infants' walking skill depends more on the duration of walking experience than on chronological age or body dimensions. Here, we examined the role of body dimensions in the development of walking skill under two conditions: in the standard over-ground gait test and during spontaneous walking during 20 minutes of free play. We observed 259 infants from 11.8-20 months of age (walking age = 0.1-10.3 months). In the standard gait, infants walked over a straight path on a pressure-sensitive mat. During free play, we assessed infants' natural gait when they happened to walk on the mat. In both conditions, we obtained

measures of step length, step width, speed, and cadence. Of course, leg length was highly correlated with infants' chronological age ($r(265)=.72$, $p<.001$) and walking experience ($r(263)=.60$, $p<.001$). Thus, we examined relations between leg length and gait after controlling for test age and walking experience. In standard gait, partial correlation shows a correlation between leg length and with step length ($r=.18$ to $.28$, $p<.01$). When subdivided infants based on walking experience partial correlations between leg length and gait are not significant. In natural walking bouts containing more than 4 consecutive steps, partial correlations show no relation between leg length and gait. With subdivision of walking experience, partial correlations between leg length and step length show significant in experienced walker with more than 8 months of walking experience ($r=.74$ to $.80$, $p<.001$). We propose that normalization technics should be carefully applied to infant walking proficiency. Depending on a range of walking experience and level of walking skills, absolute values are more straight to measure how and why infant improve walking skill. Also, a new focus on natural walking may lead to new insights into the development of walking.

The moderating effects of physical activity and global self-worth on the relationship between Developmental Coordination Disorder and internalizing problems

Li, Yao-Chuen; Graham, Jeffery D., McMaster University; Cairney, John, University of Toronto

School-aged children with Developmental Coordination Disorder (DCD) are at greater risk for physical inactivity, lower global self-worth, and internalizing problems, such as depression and anxiety. Based on the Environmental Stress Hypothesis (ESH) (Cairney, et al., 2013), recent research has shown that physical inactivity and lower global self-worth sequentially mediate the relationship between DCD and internalizing problems (Li, et al., in preparation). In other words, DCD leads to lower levels of physical activity, which in turn, leads to lower levels of global self-worth, and ultimately, a greater amount of internalizing problems. This research highlights two underlying mechanisms (i.e., physical inactivity and lower global self-worth) of internalizing problems in children with probable DCD (pDCD). However, as these two factors may also buffer (i.e., moderate) the adverse effect of pDCD on internalizing problems, further research is warranted. Participants were 1206 children aged 12-14 years (611 boys, 79 with pDCD). Children received assessments of motor coordination, physical activity, global self-worth, and internalizing problems. Consistent with previous findings, results showed that children with pDCD were less physically active, had lower self-worth, and experienced more internalizing problems compared to typically developing (TD) children ($p's <.05$). Furthermore, the moderated moderation (three-way interaction) effect of physical activity and global self-worth was also evident ($p <.05$). In other words, internalizing problems in both TD and pDCD groups decreased with concurrent increases in physical activity and global self-worth. However, when compared to TD children, increases in physical activity and global self-worth led to greater reductions in internalizing problems among children with pDCD. Overall, our findings support the ESH and highlight that, in addition to improving motor skills, interventions should also target both physical activity and global self-worth to mitigate potential mental health issues for children with motor difficulties.

The Relationship of Motor Proficiency, Nutrition Knowledge and BMI in Children with Autism Spectrum Disorder

Liu, Ting, Texas State University

Children with autism spectrum disorder (ASD) may not understand the serious health problems associated with lack of physical activity, excess body weight, and poor nutrition. There have been no reports in the literature regarding the combination effects of nutrition knowledge and motor proficiency in children with ASD. The purpose of this study was to examine the effects of children with ASD's motor performance and nutrition knowledge on BMI. A sample of 50 children with ASD (5- 12 years old) were recruited through advertisements and local schools to participate in this study. Children's height and weight data were collected for BMI. The Nutrition Knowledge Survey was then administered to assess each child's nutritional knowledge. The MABC-2 was administered after each participant completed the nutrition knowledge survey. Correlations were run to analyze the relationship between the motor performance and BMI, and the relationship between the nutrition knowledge and BMI. Many children (55%) with ASD were classified as overweight or obese. About 35% children's nutrition knowledge scores were at or below 50th percentile, 70% of children's MABC-2 percentile scores were in the "red zone" indicating significant motor delay, and 10% were in the "amber zone" indicating at risk of motor delay. A positive correlation was found for BMI and nutrition knowledge and a correlation was also found between nutrition knowledge and motor performance suggesting that nutrition knowledge and motor performance may be key factors influencing BMI and therefore interventions tackling both sides of the energy balance equation is necessary at the personal and environmental level. An effective strategy should involve a team of experts (physicians, physical therapists, occupational therapist, behavioral therapists, nutrition and physical education experts) collaborating among the families, care givers, and special educators to design effective treatment programs for children with ASD.

Mastery Motivational Climate: Examining the Relationship Between Time Spent and Number of Visits at Skill Stations with Changes in Skill Scores

Ljohnson, Jerraco Leontae; Hastie, Peter; Rudisill, Mary E., Auburn University

Studies of mastery motivational climates (MMC) have reported that providing students with opportunities to become self-directed can significantly increase skill attainment. However, none of these studies have examined the actual 'process' of what leads to improved performance. The aim of this study was to determine if the number of visits and total amount of time spent practicing at skill stations were correlated with improvements in that specific skill in a MMC. Eleven preschoolers attended biweekly 30-minute motor skill sessions over a ten-week period. Each time a child visited a station this attendance was recorded, as was the duration of that visit. Differences in pre-post TGMD-2 scores were also calculated for seven skills; running, jumping, overhand throwing, kicking, catching, dribbling, and rolling. Bivariate correlations were then calculated between the number of visits, time spent practicing, and change in pre and post skill score, per child. Of the seven skill stations, only the number of visits children had dribbling ($p = .042$) and total time spent at the dribbling station ($p = .014$) were significantly correlated with the difference in pre-post dribbling score. Nearly 30% of the

variance was shared between the number of dribbling visits and change in dribbling score, which is a moderately reliable prediction ($r = -.543$). Children who had less visits dribbling were more likely to have a greater decrease in dribbling score at post-test. About 43% of the variance was shared between the amount of time children spent dribbling and change in dribbling score, which is a moderately reliable prediction ($r = -.656$). Children who spent less time dribbling were more likely to have a greater decrease in dribbling score at post-test. Although significant correlations were only found for the dribbling skill, we must continue to examine the 'process' of children's behavior during a MMC intervention to determine what 'factors' lead to improved skill attainment. Replications of this study are needed with a larger cohort and older children in different settings.

Fundamental motor skills: A systematic review of terminology

Logan, Sam W.; Ross, Samantha M.; Chee, Keanu, Oregon State University; Stodden, David F., University of South Carolina; Robinson, Leah E., University of Michigan

Background: The evolution of terms within motor development has created ambiguity in terminology within the literature and across the various disciplines and sub disciplines of human movement. This article systematically examined how the term fundamental motor skills (FMS) is conceptualized, operationalized and measured in contemporary literature. The three aims of this review are to: (1) describe the use of the term FMS, including relative frequency and distribution of published articles across time and countries; (2) describe the quality of FMS definitions found within the research literature; and (3) describe how FMS are measured through process- and product- oriented motor assessments. **Method:** Inclusion criteria: (a) peer-reviewed article, (b) printed in English, (c) published between January 2000 and December 31, 2015, (d) presence of either the term 'fundamental motor or movement skill' in the title and/ or abstract, and (e) FMS were a measured outcome. A total of 121 articles met the inclusion criteria and were retained for data synthesis and analysis. **Results:** There has been an increase in the number of publications on FMS in recent years, with the majority of studies conducted in Australia ($n = 40$, 33%). Approximately 23% of studies ($n = 28$) did not provide any explicit definition of FMS. A majority of studies reported the use of a process-oriented measure ($n = 94$, 78%) compared to a product-oriented measure ($n = 19$, 16%) to assess FMS. **Conclusions:** We recommend that researchers provide a high-quality, operational definition of FMS within research publications. We also recommend that researchers ensure appropriate alignment between the term and operational definition used to describe motor competence, including fundamental motor skills, and the assessment used. Our recommendations are based on the desire to advance the clarity in communication when researchers globally examine motor competence, specifically assess FMS, or address another specific aspect of the motor domain.

Parental perception of potential Developmental Coordination Disorder and children's actual motor ability

Luciana, Ferreira; Vieira, Jose LL; Silva, Pamela N.; Rocha, Francielli F.; Cheuczuk, Francielle, Maringa State University; Cacola, Priscila M., University of Texas at Arlington

Developmental Coordination Disorder (DCD) is a condition defined by poor motor proficiency despite of any neurological issues. It is often stressed that timely identification of children with DCD is important for reasons of early intervention and prevention of the development of secondary academic, social, and emotional problems. Therefore, effective tools are needed for popular screening and pre-identification of children in need of further testing. The purpose of this study is to evaluate the potential of the Developmental Coordination Disorder Questionnaire (DCD-Q) as a parental screening tool for poor motor ability as defined by the Bruininks-Oseretsky Test of Motor Proficiency, 2nd ed. (BOT-2). A sample of 644 children with ages between 6 and 10 years were evaluated with both instruments. Of those, 199 (31%) were classified as 'probable' DCD according to the DCD-Q. BOT-2 results indicated that most children were categorized as 'Average' or 'Above Average' (76%), with 24% scoring 'Below Average'. Chi-square analysis showed a significant relation between these variables, $p < .001$. However, it is important to note that 11% of the sample considered as 'probably not DCD' (48 children) was categorized as 'Below Average' for motor proficiency. Most of this sample was composed by girls ($n = 33$). Results also demonstrated a variation for areas of motor proficiency, with 59% of the sample considered as 'probably not DCD' scoring below average on Fine Motor Integration and 33% scoring below average on Fine Motor Precision. Taking together, the results show a relatively good ability of parents to perceive their children's motor skills, despite the potential for overestimation of motor abilities of boys. They also indicate the lack of agreement on the instruments on the categories involving fine-motor skills. While is possible that parents do not know their children's fine motor skills as much as their gross-motor skills, it is necessary to consider an evaluation or addition of fine-motor items in screening tools for motor difficulties.

Changes in motor performance of young children: A three-year longitudinal study

Luciana, Ferreira, UEM; Santos, Viviane A.P.; Vieira, Jose LL, Maringa State University; Cacola, Priscila M., University of Texas at Arlington

Children with low motor ability are less able to participate fully in many sports and recreational activities, which can influence their physical and mental health later on in life. Because of that, assessment of motor performance is recommended, especially at a young age. However, little is known about the stability of motor performance in the early years. Therefore, we aimed at investigating changes in motor performance in children for three consecutive years, starting at age three. Twenty seven children (11 females, 16 males) were assessed with the Movement Assessment Battery for Children, 2nd ed. (MABC-2). Repeated measures analyses of the total score and categories of the test revealed a stability of general motor performance across the years ($p > .05$). However, a look into the categories revealed a significant improvement of Manual Dexterity from age 3 to 4 ($p < .05$), a significant decrease in Balance from age 3 to 4 ($p < .05$), and no significant changes in Aiming & Catching across the three evaluations. Taken together, the results show that while general performance may be similar across the years, an individual exploration of the components of motor performance reveal that there are significant changes in specific areas of motor development. While the improvement in Manual Dexterity is expected, there is no reasonable explanation for the decrease in Balance ability. At an age where intervention is essential for good motor skill development, it is

important to determine what components need special attention from instructors. These findings highlight the importance of identifying and supporting children with potential motor problems when young, as well as suggest that specific components of motor performance, such as balance, need special attention at a young age.

Parent report of their child's fundamental movement skill competency. A paediatric occupational perspective

Maher, Stevie J.; Barnett, Lisa M., Deakin University

Background. Paediatric Occupational Therapists are concerned with assessment of children's motor skill performance. Parent report of children's fundamental movement skill competence could provide valuable information to the therapist. This study investigated whether parent reports of children's fundamental movement skill competence was associated with children's actual movement skill competence. **Method.** A convenient sample of 109 children aged 7 to 9 from 5 schools and one parent/guardian in Australia were recruited. The parent version of the pictorial scale of 'Perceived Movement Skill Competence' (PMSC) and the Developmental Coordination Disorder Questionnaire (DCDQ) were completed by parents, while the children's actual motor competence was assessed using the Test of Gross Motor Development 3rd version (TGMD-3). Pearson correlation coefficients were conducted to analyze relationships. A series of linear regression models determined whether proxy report was predictive of children's actual skill after adjusting for confounders, i.e. object control items (separate models for PMSC and DCDQ) as predictive of object control performance (TGMD-3) and the same process for locomotor items. **Results.** Parent reports when using the PMSC and DCDQ had weak correlations with children's locomotor ($r = 0.21$, $r = 0.30$ respectively) and moderate correlations with object control competence ($r = 0.45$, $r = 0.41$). When divided by sex there were no correlations for girls' locomotor competence. After adjustment, parents were still able to report on children's object control skills using either the PMSC or the DCDQ (42%, 40% of variance). Parents were able to report on children's locomotor skill (6% of variance) when using the DCDQ locomotor items; whereas PMSC locomotor items were ns ($p = 0.070$). **Conclusions.** Whilst parents have a general ability to recognize children's motor competence, they are more accurate with object control skills. This suggests parents could be taught more about movement skills and how to better recognize their child's good and poor locomotor skill competency.

Characteristics of temperament and motor performance in Brazilian boys

Martins, Aline O.; Copetti, Fernando, Universidade Federal de Santa Maria; Valentini, Nadia C., Universidade Federal do Rio Grande do Sul

Rothbart's approach of child temperament indicates behavior of responses to situations, which are considered to be stable and long lasting, reflecting how the child socializes with the environment. This interaction probably predisposes the child's engagement diversity and time to movement activities, which are important for the development of motor skills. The present study aimed to verify if child temperament characteristics would be associated with motor performance in preschool. Children ($N=81$ boys, $M=6.56$,

SD=0.49 years) were assessed using the Test of Gross Motor Development-2 (locomotor, object control, and gross motor coefficient) and the Children's Behavior Questionnaire, that is comprised of 15 dimensions of temperament (activity level, anger/frustration, approach, attentional focusing, discomfort, falling reactivity & soothability, fear, high and low intensity pleasure, impulsivity, inhibitory control, perceptual sensitivity, sadness, shyness and smiling & laughter). The data were analyzed by linear regression, with significance of $p=0.05$. Three models were performed with motor performance as outcome. The model between the temperament characteristics and the subscale of locomotion obtained R^2 adjusted of 0.065 and did not present significance in any variable. The subscale of object control presented adjusted R^2 of 0.149 and significance for the pleasure characteristics in high intensity pleasure ($p=0.048$) and activity level ($p=0.010$), with Beta of 0.261 and 0.345, respectively. The gross motor coefficient model presented adjusted R^2 value of 0.115 and significance for activity level ($p=0.016$), with Beta of 0.329. It was concluded that the characteristics of temperament related to the level of exposure in gross motor activities as well as the pleasure in performance new, intense and complex activities were associated with motor performance.

An analysis of prospective reaching in 9-months-old infants using eye-tracking

McMahon, Emalie G., University of Tennessee, Knoxville; Wiener, Rebecca F.; Dimercurio, Abigail, University of Tennessee Knoxville; Connell, John P., University of Tennessee, Knoxville; Corbetta, Daniela M., University of Tennessee Knoxville

Decades of research on the development of reaching led to the conclusion that infant reaching is visually guided and prospective (von Hofsten, 1993, 1996). However, a recent longitudinal study using eye-tracking found that novice reachers do not look at the to-be-reached object location prior to reaching for it until 5 weeks after reach onset (Corbetta et al, 2014). This led these authors to propose an embodied account hypothesis for infant reaching stating that vision maps onto the reaching action and not the reverse as thought before. The current study aims to further investigate the role of vision in infant reaching with more experienced 9-month-olds.

Fifteen infants were presented with objects within reach. Infants' visual fixations on the object were recorded at 120 Hz via an eye-tracker from object presentation until object acquisition. The location of visual fixations on the object in relation to arm movement onset and object contact were coded to determine if infants fixated the part of the object to be touched either before, during, or after the reach. Four distinct look-reach patterns were identified: (1) prospective look: the infant fixated the object area to be touched prior to reach initiation, (2) catch-up look: the infant fixated the object area to be touched while the reaching movement had already been initiated, (3) trailing look: the infant fixated the location of hand-object contact only after the hand had touched the object, and (4) untargeted look: the infant never looked at the object area they contacted.

Preliminary analyses performed on nearly half of the infants indicated that the majority of them never fixated the object location they ended up contacting with their hand, and only in a small number of trials, infants fixated the location of first touch before reach onset. These early findings challenge the long-held assumption that infants look where they reach. The fact that even 9-month-olds contacted the object target without prior looks to where they directed their hand support the embodied account hypothesis.

Impact of a psychomotor program intervention on children presenting writing disabilities

Melo, Filipe, University of Lisbon; Sieres, Rita, CERCISA

Drawing and writing are fine motor tasks presenting constraints on spatial accuracy. Difficulties in such skills, are recognizable problems often associated with a decrease in motor coordination, interfering with daily living activities and/or academic achievement.

The purpose of this study was to analyze the impact of a psychomotor intervention on the graphomotor skills of children with and without writing disabilities. Our sample was composed of thirty right handed children (20 boys and 10 girls, aged 9 years +/- 3 month) from the fourth degree of the elementary School Cycle. Children were evaluated in terms of visual-motor Integration (Beery VMI), Motor Coordination (Motor Coordination Test - VMI supplementar Test), Manual Strength/Pressure and Speed of Writing (Software MovAlyser for Handwriting). Half of these children presented writing disabilities.

In order to analyze the presence of hypothetical differences in psychomotor performance, the subjects were divided in two groups: an Experimental Group (EG), which attended a psychomotor intervention program; and a Control Group (CG) that didn't attend any special intervention. For intra-group analysis, three groups were considered: Group A (experimental group without writing disabilities), Group B (experimental group with writing disabilities) and Group C (control group with writing disabilities).

The results showed that all the children with writing disabilities submitted to a psychomotor intervention showed significant improvements in most of the evaluated areas. These results seem to support the importance of psychomotor intervention in children with learning disabilities.

The Role of Growth and Maturity Status on Head Impact Biomechanics among Youth Football Players

Monsma, Eva V.; Yeargin, Susan, University of South Carolina; Kingsley, Payton, Ochner Sports Medicine; Mihalik, Jason, University of North Carolina; Mensch, Jim, University of South Carolina

FOCUS COPY - The Role of Growth and Maturity Status on Head Impact Biomechanics among Youth Football Players. Little is known about how youth subconcussive head impact tolerances are related to physical size and maturation. This study examined the effects of age, anthropometric and maturational status variability on head impact biomechanics among 34, 9 to 13 year old recreational youth football players in South Carolina. Boys were categorized by Center for Disease Control standards, independent variables were: age, height, mass, Body Mass Index (BMI) category, and estimated peak height velocity (PHV). Anthropometrics were measured following Lohman's protocol. Participants wore a head impact sensor on their mastoid process which measured linear (g) and rotational accelerations (rad/s²). Results indicated older and post-PHV boys had a greater linear ($F=17.72$; $P=0.001$; $F=9.09$, $P=0.002$) and rotational acceleration ($F=10.74$; $P=0.001$; $F=5.57$, $P=0.0183$) than younger and pre-PHV boys. Rotational, but not linear acceleration differed by height groups with lowest impacts found for the tallest boys, whereas both linear and rotational accelerations by weight differences favored

average and heavy boys. Overweight boys had the greatest linear ($F=5.25$; $P=0.011$) and rotational accelerations ($F=4.13$; $P=0.26$) means. Obese boys did not have sequential results compared to other BMI categories perhaps due to league rules, player position, or lack of momentum produced. At this age, taller boys heads are above their peers, and thus sustain lower impacts.

Healthy young children can intentionally couple postural sway with stimuli of differing complexity

Motz, Zachary, University of Nebraska at Omaha; Hatzitaki, Vassilia, Aristotle University of Thessaloniki; Mukherjee, Mukul, University of Nebraska at Omaha; Siu, Ka-Chun, University of Nebraska Medical Center; Kyvelidou, Anastasia, University of Nebraska at Omaha

Continual changes in the environment require humans to modify their body orientation incessantly to maintain balance. Humans couple their posture with external stimuli, which aids in adapting to environmental changes. Postural sway has been shown to have an inherent variability, and previous research has shown that young adults and older individuals can couple their posture to a complex visual stimulus (1,2). However, there is significantly less literature regarding how strong or how effectively children couple their posture to external visual stimuli, especially when asked to do so intentionally. Thus, the purpose of this study was to examine if, and how well, healthy children can track (with their whole body) visual target cues that differ in degree of complexity during voluntary sway in the medio-lateral (M/L) direction compared with healthy adults. 23 healthy children 5-12 years of age (mean age=7.7 years old) and 12 healthy adults 19-35 years of age (mean age 23.8 years old) participated in the study. Participants stood on two adjacent force plates with a screen in front of them displaying two dots at eye-level. A green-dot was the participant's COP, that they controlled by swaying side-to-side and a red-dot was the visual cue that moved in one of three conditions (periodic, chaotic, or random). Participants were instructed to keep the green-dot on top of the red-dot as best as they could by swaying left and right. The degree of COP-target coupling was quantified using Cross-Approximate Entropy (Cross-ApEn) and Coherence. The results show that children can track visual cues of differing complexity. Additionally, we found that adults had stronger coupling than children on most trials, and similar to previous studies of healthy young adults. These results may give insight into the mechanisms of sensory-motor coupling across development. The present paradigm could also provide a framework to examine sensory motor deficits in various populations.

The relationship between Supine-to-Stand and health-related fitness in young adults

Nesbitt, Danielle R., University of South Carolina; Molina, Sergio L., Missouri Western State University; Robinson, Leah E., University of Michigan; Brian, Ali; Stodden, David F., University of South Carolina

Background: A component of living a healthy, physically active lifestyle is the acquisition and sustainability of motor competence (MC). MC is suggested to be a causal mechanism that promotes positive lifespan trajectories of physical activity, health-related fitness (HRF), and weight status. However, lack of an appropriate lifespan MC measures

makes it difficult to track the strength of associations between MC and HRF variables across the lifespan. Therefore, the purpose of this study was to examine the predictive utility of process- and product oriented assessments of supine-to-stand (STS) as a predictor of the HRF and physical activity variables in young adults. Methods: A convenience sample (N = 79; girls = 31) of eighteen to twenty-five year-olds (M = 20.9, SD = 2.0) participated in the study. Body composition measurements included height, weight (used to calculate BMI), and body weight status. HRF was measured using the Fitnessgram (PACER, curl-ups, and pushups) and moderate-to-vigorous physical activity (MVPA) levels were assessed using Actigraph GT3X+ accelerometers. Grip strength was measured using a dynamometer. Participants performed five trials of the STS task and their average STS time was measured using Dartfish Software. Results: Pearson's correlations demonstrated inverse associations with STS time for pacer ($r = .53$, $p < .001$), pushups ($r = -.24$, $p = .05$) and MVPA ($r = -.48$, $p = .01$) but no significant association was present for curl-ups ($r = -.20$, $p = .05$). Regression analysis revealed that MVPA ($R^2 = .13$, $F(2, 26) = 5.431$, $p < .01$) accounted for 13% of the variance in STS time while controlling for sex. Confirmatory factor analysis results showed that pacer, pushups, curl-ups, and grip strength loaded into one factor HRF (GFI = .99; RMSEA = .04). Regression analyses revealed that STS time predicted 42% of the variance in HRF when controlling for sex and BMI ($F = 61.91$, $p < .001$; $\eta^2 = .42$). Conclusion: Overall, findings provide evidence that supports STS time may be an important assessment of functional motor competence in young adults.

A Mastery Climate Cognitive-Motor Skills Intervention: Impact on academic and motor performance, perceptions of competence, and BMI of children living in social vulnerability

Nobre, Galuber C.; Valentini, Nadia C., Universidade Federal do Rio Grande do Sul; Rudisill, Mary E., Auburn University

The objective of this study was to verify the impact of a mastery climate intervention program on academic and motor performance, perceived competence, and nutritional status of children living in socioeconomic vulnerability. Method: 211 children from 7 to 10 years old, were randomly assigned to Intervention Group (IG: $n = 117$) and Comparison group (CG: $n = 94$) were assessed using the Self-Perception Profile for Children, the Test of Gross Motor Development-2, the Body Mass Index (BMI), and the Test of Academic Performance. The mastery climate cognitive-motor skill intervention was conducted during 36 sessions, 3 times/ week/12 weeks, each session comprises 60 minutes of academic activities related to each child grade (reading, writing and mathematics), 20 minutes of recess and 60 minutes of motor skill practice. Results: At the post-intervention the IG presented a significantly increases and higher performance compared to the CG in locomotor and object control skills; perception of academic and physical competence and social acceptance; and, reading and arithmetic's regardless of gender and age (p values between 0.031 and < 0.001). Specifically, only the older children (9-10 years of age) in the IG significantly increased the perception of behavioral conduct ($p < 0.001$). There were no significant differences in the perception of children's own physical appearance in both groups ($p = 0.336$ and < 0.117 , respectively). On the other hand, the analysis showed significant increases in body mass and BMI in both groups ($p < 0.001$). Conclusion: the Mastery Climate Cognitive-Motor Skills Intervention

positively impact motor and academic performance and the majority of the dimensions of the self perception of competence of the children in situations of social vulnerability reinforcing the role of programs of this nature in aiding learning of efficient movement patterns, cognitive abilities and in the construction of a realistic and positive perception of one's own competences.

Postural control in the elderly of different age groups

Nogueira Lahr, Silvana L.; Martins, Cristiane A.; Benda, Rodolfo N., Federal University of Minas Gerais

Changes in systems responsible for postural control are observed in lifetime, also in the elderly, due to developmental alterations reflecting in distinct motor behavior. As the age advances in elderly, changes increase even in these people. We investigate changes in postural control (corporal oscillation magnitude) during senescence, with elderly of different age groups. Sixty participants were set in four groups: young adults (YA), young old (YO), old (O), and oldest old (OO). They had to stand in a force platform with the together feet. We measured the mean velocity of displacement of the center of pressure (COP) in the anterior-posterior direction as well as in the lateral-lateral direction. In the anterior-posterior direction, a one-way Anova registered higher oscillation of elderly groups upon YO. No differences among elderly groups were observed. In the lateral-lateral direction, O and OO presented the same oscillation and both presented higher oscillation of YA and YO. No differences were observed between YA and YO. As the age advancing, elderly people changes the strategy adopted to reach the goals of tasks, in this case, stay in quiet stand posture with together feet. New movement patterns emerged in order to adapt to the new demand of task, according to characteristics of the own body, in this case, an elderly body.

Acquisition of the Anti-Phase Pattern in Bimanual Coordination: Role of Frequency of Oscillation

Pacheco, Matheus Maia, The University of Georgia; Brakke, Karen, Spelman College

The acquisition of new movement patterns in rhythmic bimanual coordination is said to be built upon two pre-established patterns of oscillation of the limbs: in-phase (mirror-like movements, 0° relative phase) and anti-phase (opposite, 180° relative phase). These patterns represent competitive tendencies (intrinsic dynamics) that must be overcome for new patterns to be stabilized. Characterization of the acquisition of in- and anti-phase patterns is still missing in the literature, and represents the goal of the present study. We hypothesized that children decrease the competition between intrinsic dynamics and task requirements when exploring different parameters of the movement. Specifically, we tested the idea that toddlers would explore low frequencies of limb oscillation to perform the anti-phase pattern.

We collected data from 8 toddlers performing a drumming task under three different conditions. In two conditions an experimenter modeled either the anti-phase or in-phase pattern for the child. In the third condition, no model was present. In all conditions, a metronome was played at 2.66 Hz. The order of conditions was varied and engagement continued as long as the child cooperated. Data were collected monthly from 15 to 27

months of age. To test the hypothesis of exploration of low frequencies we adjusted a sigmoidal function relating the occurrence of anti-phase patterns (per month) to the accumulated occurrence of in-phase patterns in low frequencies for each individual. The results show that relatively stable anti-phase patterns occur around the 20th month of life while the in-phase pattern was already stable at earlier ages. The average fitting value of the sigmoidal function was $R^2 = 0.40$ with five toddlers showing values above of 0.30 (moderate effect size). Therefore, we have initial support for the hypothesis that toddlers may explore the frequency of oscillation as a way to decrease competition between intrinsic dynamics and task requirements when learning to perform the anti-phase pattern.

Measuring School-Day Physical Activity using Ankle Accelerometry in Preschoolers: A Pilot Study

Palmer, Kara K.; Colabianchi, Natalie; Chinn, Katherine M.; Robinson, Leah E., University of Michigan

Background: Recent work by Pate et al (2015) states that preschoolers should accumulate at least 3 hours of activity across the day (i.e., approximately 15 min/hr). The purpose of this pilot study was to determine whether preschoolers' were achieving the recommended level of physical activity during the school day. **Methods:** Preschoolers (N = 24) from a single center were instructed to wear an Actigraph GT3X+ accelerometer on their dominant ankle for 7-consecutive days. Data were collected at 1-second epochs. School hours were considered 8:00am to 5:00pm. Wear time criteria was set at two weekdays with at least 6 hours of valid wear time during school hours. Non-wear time was determined using the Choi et al's algorithm (2010). Cut points were derived from Crouter et al's (2014) ankle cut points for youth and were used to categorize physical activity as light, moderate, vigorous or moderate to vigorous (MVPA). Total physical activity was calculated by adding light activity and MVPA. **Results:** Wear compliance was high with preschoolers wearing the device for an average of 8.8 hrs/day (SD = .3, range: 7.7 - 9.0 hrs) for 4.5 days (SD = 1.0, range: 2 - 5 days). Results show that during school hours preschoolers engaged in 9.2 min/hr (SD = 1.3, range: 6.7 - 12.0min/hr) of light, 6.0 min/hr (SD = .9, range: 4.7 - 7.8min/hr) of moderate, 4.3 min/hr (SD = .8, range: 2.7 - 5.5min/hr) of vigorous, and 10.3 min/hr (SD = 1.5, range: 5.0 - 7.6min/hr) of MVPA. Preschoolers accumulated an average of 19.5 min/hr (SD = 2.4, range: 15.4 -

23.7min/hr) of total physical activity. **Conclusion:** Preschoolers in this study met or exceeded physical activity recommendations. In addition, ankle accelerometry seems to be an effective tool to measure school day physical activity in this population. Future studies should continue to advance the use of ankle accelerometry in preschoolers' by creating cut points specifically for this population as well as comparing ankle data to other placements.

Spontaneous movements during caregiver contact as an early window into ASD

Patel, Priya P., Michigan State University; Padmanabhan, Malavika; Hajiaghajani, Faezeh; Biswas, Subir; Lee, Mei-Hua, Michigan State University

The purpose of this study is to measure infant's active spontaneous movements during interaction with their caregiver. Given that autism in childhood presents as differences in social interaction, our hypothesis is that infants with ASD will show a smaller change in

spontaneous movements in the presence of caregiver contact compared to typically developing (TD) infants. To address this hypothesis, we used an innovative two-body networked sensor system that is capable of detecting both active and passive movements. This system comprises of two wearable wireless sensors (one on infant and one on the caregiver). Infants were tested in the lab for 5 visits spaced 2 weeks apart at 10,12,14,16, and 18 weeks of age. In each visit, the infant was outfitted with the markers and the sensor system, and we observed the spontaneous movement of the infant in three conditions: (i) no interaction, (ii) interaction with no physical contact, and (iii) interaction with physical contact. We use a machine learning (i.e., Support Vector Machine) based classifier to analyze the combined sensor data from an infant and his/her parent. Correlation between the sensor data was used as a feature to find similarities between the sensor readings, which are then used by the classifier for detecting when an interaction took place. When the classification is applied on an individual basis, accuracy above 80% was achieved consistently. Our preliminary data showed that indeed it is possible to detect infant-caregiver interaction with high accuracy using combined data from sensors mounted on both the individuals. The sensor system is unique in that not only does it allow to characterize spontaneous movements of the infants, but for the first time, it also allows us to characterize how these movements change when the infant interacts with the caregiver.

Preschool teachers' readiness for promoting gross motor competence and physical activity in young children: An observational study

Pennell, Adam; Brian, Ali; Schenkelberg, Michaela; Sacko, Ryan, University of South Carolina

Early childhood educators have an integral role in developing gross motor competence and physical activity participation in preschool-aged children. Although these professionals are expected to implement and support national motor and physical activity recommendations, concerns of awareness and discipline-specific preparedness have been raised. The purpose of this descriptive study is to determine if early childhood educators in South Carolina have completed formal physical education or motor/physical activity-based coursework, if they are aware of the Active Start Guidelines, and to detail their self-perceived motor competence. A voluntary sample of employed early childhood educators (N = 102) completed the study survey. Survey results identified that 11.8% had completed a physical education (or similar) course, 22.5% were aware of the Active Start Guidelines, while the educators self-perceived motor competence was low (2.4; SD = 0.86). The results indicate that many early childhood educators in South Carolina may face multiple constraints which could impede their ability to foster gross motor competence and physical activity participation in preprimary settings.

Investigating Expert vs. Rater Consensus Agreement, Inter and Intra-Rater Reliability of Two Fundamental Movement Skills for the Locomotor Subscale of the FG-COMPASS

Perez, Lino; Ovande, Jr., Ovande, California State University Northridge

The Furtado-Gallagher Computerized Observational Movement Pattern Assessment System (FG-COMPASS) is an observational rating scale using sequential decisions to assess fundamental movement skills. The current version of the test has three locomotor and 5 manipulative skills. This study aimed to assess expert-rater agreement and inter/intra rater reliability of two new scales to be added to the locomotor subtest. We hypothesized that the proposed rating scales for vertical jumping and galloping would have high (weighted kappa .7 or higher) consensus agreement between the participant ratings and the standard as well as high inter and intra-rater reliability. This study was divided into two phases. In Phase I, sixty children between the ages of 5 and 10 were filmed performing the skills of galloping and vertical jumping. An expert in Motor Behavior classified the videotapes using the newly created rating scales. Next, eight video clips were selected for training purposes and 24 video clips for testing purposes. In Phase II, thirty undergraduate students served as raters and underwent a training session prior the testing session. Participants were instructed not to classify the video clips based on the apparent age of the children as skill levels were distributed across all age levels. Further, to avoid guessing, participants were not told how many videos of each level they would be rating. Unlike the training sessions, participants did not receive feedback during testing sessions. Data collection for this study is underway and the results will be available prior the poster presentation.

Gender differences in the association between motor competence and executive function: does perceived or actual competence matter?

Pesce, Caterina; Marchetti, Rosalba; Masci, Iliara, Italian University Sport and Movement Foro Italico

Emerging evidence suggests a close interrelation between the developmental trajectories of motor coordination and executive functions, which play an antecedent role in effective self-regulation of physical activity. The aim of this explorative study was to assess whether (1) children's perceived motor competence is associated with executive function and (2) given the existence of gender differences in locomotor and object-control skills, gender also moderates their association with executive attention and planning. Hundred and thirty-two male and female children aged 6-10 years performed the Tests of Gross Motor Development-2, completed the Pictorial Scale of Perceived Movement Skill Competence, and were then assessed two times, one year apart, either with the attention scale (n=66), or the planning scale (n=66) of the Cognitive Assessment System. Bivariate correlations performed on the whole sample did not yield significant results. Moderation analyses by gender showed differential results for locomotor and object control skills. Males' perceived competence in object control skills

was weakly, but significantly correlated with planning ($r=.29$) and attention actually ($r=.20$) and one year later ($r=.24$). However, only the correlation with planning remained significant after computing first-order partial correlations to partial out the covariation with actual object control skill and age. Instead, females' perceived competence in locomotor skills was significantly correlated with attention and planning both actually ($r=.22$ and $.41$) and one year later ($r=.41$ and $.30$), also after partialling out the effects of actual locomotor competence and age. Results suggest that executive functions in childhood are selectively associated with perceived motor competence in those skills males and females are, and perceive to be, more competent in. A unique association of perceived motor competence with actual and later executive function efficiency, with potential implication for gender-specific educational strategies, seems to exist only for females' locomotor skills.

Adolescent girls can report on their object control skill not their locomotor skill

Rogers, Vaimanino; Barnett, Lisa M.; Lander, Natalie J., Deakin University

Background: Actual fundamental movement skills (FMS) and physical self-perception are two important correlates of physical activity (PA). However, FMS, physical self-perception (and PA levels) among adolescent girls are low. Therefore, this study aimed to investigate the relationship between physical self-perception and actual FMS in adolescent girls. To explore this relationship further, the association between actual FMS and two sub-domains of physical self-perception (namely perceived sports competence and perceived FMS) were investigated to identify whether the association becomes stronger when examining the association actual FMS has specifically with perceptions of FMS. Methods: Cross-sectional data were collected from girls ($n = 173$, mean age $12.4 \pm .34$ SD) located in Melbourne, Australia. The Physical Self-Perception Profile and the Perceived Movement Skill Competence Scale were used to assess physical self-perceptions. Actual FMS were measured using the Victorian FMS assessment. Pearson's correlations initially assessed the relationship between perceptions and actual FMS. General linear models were then used, with the perception variables as the outcome, actual FMS as the predictor and adjusting for potential confounders. Results: A positive moderate and significant correlation was found between actual FMS and physical self-perception (.30), perceived sports competence (.39) perceived FMS (.27) and perceived object control (.38). There was no correlation between actual and perceived locomotor skills (.11). After adjusting for language spoken at home, actual skill remained significant in each model, except for locomotor skill. Conclusions: Pre-adolescent girls have differing perceptions according to their FMS competency, highlighting that perceptions are multidimensional. These findings will help to inform interventions aiming to improve PA participation among a demographic that are very at risk of physical inactivity.

SEMG analysis during landing in children with autism spectrum disorder: A case study

Rosales, Marcelo R.; Romack, Jennifer L.; Angulo-Barroso, Rosa M, California State University Northridge

Autism spectrum disorder (ASD) is a condition that can possibly affect a child's motor skills. Extensive literature exists describing the motor skill deficits that exist in children with ASD, however minimal attention has been given to the neuromuscular components of movement. The purpose of this study was to explore the timing and duration of muscle activation in children with ASD and compare them to children with typical development (TD). Six children ages 3-4.5 years (3 ASD; 3 TD) were asked to

hang from a horizontal bar placed at an individually calculated height and asked to drop and land on two Kistler force plates. Vertical reaction force was used to randomly turn on a light, signaling to the participant to run to the left (L), right (R), or to stay (S) in place. Five trials in each light condition were collected. sEMG signals (Delsys) were recorded on the gastrocnemius (G), tibialis anterior (TA), rectus femoris (RF), bicep femoris (BF), and erector spinae (ES) for both sides of the body. Results, in general, showed that children with TD had earlier activation of muscles and later deactivation during impact regardless of L, R, and S condition. These activation patterns yielded longer muscle activation durations, especially in the G, TA, and BF for children with TD. When examining conditions separately, the previous results came from the R and L conditions, since there were no differences between the 2 groups for the S condition. These results would indicate that children with ASD are able to land effectively when no body transport is required. However, when the landing task becomes more complex and requires body transport, children with ASD had lower EMG activity. Prior studies in adolescents and adults would indicate that lower muscle activation would be a less effective strategy. Further studies should examine other motor skills and replicate this study on a larger scale, in order to understand the neuromuscular differences in children with ASD.

Motor competence in children from an Asian-Australian background compared to children from an English-speaking (European) background

Rudd, James, Liverpool John Moores; Strugnell, Claudia A., Deakin University; Telford, Rohan M.; Telford, Richard D., University of Canberra; Olive, Lisa S.; Barnett, Lisa M., Deakin University

Background. Children's motor competence levels are lower than desirable in many countries but racial and ethnic differences in relation to motor competence have had little attention. This study aimed to examine the correlates of motor skill in a Cultural and Linguistically Diverse (CALD) Australian sample. A total of 276 children (males = 132 and females = 144) from 9 to 11 years participated. Most (65%, n = 179) reported speaking a language other than English at home. **Methods.** Children were divided into two samples based on language: 1. English-European [EE] (n = 97) and 2. South-Western and Central Asian [Asian] (n = 156). Data from 13 mostly Samoan participants were excluded as they did not fit these groups. Height, weight and skill (Test of Gross Motor Development-2) were measured directly and sex, age, language and perceived competence (PSPP-CY) were self-reported. Independent sample t-tests assessed age, BMI, skill and perception differences by sex and CALD group. Hierarchical linear regression examined influence of sex (Step 1), age (Step 2), BMI (Step 3) and physical self-perception (physical self-worth, sport athletic ability and physical condition) (Step 4) on locomotor and object control skill for both CALD groups. **Results.** For object control, EE boys outperformed Asian boys ($p < 0.001$). EE boys were higher in condition perception. EE girls had higher BMI than Asian girls. In the final hierarchical locomotor

models similar locomotor variance was explained [16% - EE, 15% - Asian]. BMI (decreasing) predicted skill for both groups. For Asian children, physical condition (positive) was significant. The object control models explained similar object control variance [43% - EE, 40% - Asian]. Sex (boys) was a predictor for both groups. For Asian children, age (decreasing) was a predictor. Conclusions. BMI and sex are important predictors of motor competence confirming previous research. There were some CALD differences highlighting the need to consider children's background in terms of opportunity for development of skill and positive perception.

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The Developmental Sequences for Forceful Kicking

Sacko, Ryan S., University of South Carolina; Utesch, Till, University of Muenster; Cordovil, Rita, University of Lisbon; De Meester, An, Ghent University, Belgium; Eggelbusch, Moritz, University of Muenster; Bott, Tim, The Citadel; Stodden, David F., University of South Carolina

Objectives: Understanding the process of human movement is important and kicking is one of the most widely developed skills due to the world-wide impact of football/soccer. However, developmental sequences of forceful kicking have not been adequately described and validated. The purpose of this study was to explore potential developmental sequences for forceful kicking using a pre-longitudinal screening method. Methods: A total of 8 potential component sequences were developed based on hypothesized punting sequences, biomechanical principles and expert ratings. Data was derived from videotapes of 255 children (boys n=116), ages 4-11 years. Kicking data were collected from 2012-2016 from the Midwest, Southwest and Southeast regions of the United States. Children performed five kicks with maximal effort. Video data were collected using digital cameras. The mode of the five kicks was used for data analysis. Component level probability curves) for each kicking component sequence across age were evaluated using the threshold based General Partial Credit Model within the item response theory framework. A developmentally valid order was initially assumed in case of accurate order of sequences within each component. Results: In general, levels for most components increased across childhood. Due to a lack of empirical evidence from modeling, some components (e.g., non-developmental differentiation between component 3 and 4 in follow through and component 1 and 2 in knee flexion) were merged to reflect the lack of difference between identified levels or removed (ball contact, itemfit $p < .05$). Seven sequence progressions (approach, support location (plant foot), knee action, trunk action, knee flexion, arm action, and follow through) met model requirements ($rel = .88$, itemfits $p > .05$). Conclusion: This study provides sufficient cross-sectional evidence for seven developmental sequences that adequately describe the development of kicking using cross-sectional data across childhood. Longitudinal data is needed to provide further validation for these sequences.

Associations of Product and Process Oriented Motor Competence with Energy Expenditure

Sacko, Ryan S., University of South Carolina; Utesch, Till; Eggelbusch, Moritz, University of Muenster; Stodden, David F., University of South Carolina

Objectives: An understanding of how motor skill performance levels relate to energy expenditure is an important, yet relatively unexplored topic that may better inform physical activity (PA) interventions. **Purpose:** To determine relationships between process- and product-oriented motor competence (throwing and kicking) performance levels and METS (metabolic equivalence of task) in young adults. **Methods:** 20 men (age $m=23.9$) and 20 women (age $m=24.0$) participated in a within-subjects design and completed three nine-minute experimental sessions. Participants performed throwing, striking and kicking (in a blocked schedule) at three different conditions (i.e., 6s, 12s and 30s trial intervals). Participants were instructed to perform all skills with maximum effort. Participants process- (component developmental sequences) and product-oriented (throwing and kicking speed) skill levels, were assessed using digital video and a radar gun (Stalker), respectively. In addition, metabolic response (METs) during each interval trial condition was assessed using a COSMED k4b2 portable gas analyzer. Individual throwing and kicking component modes were translated into z-scores and summed for each skill for data analysis. Speed and METs measures were z-transformed controlling for sex. **Results:** Polynomial regressions with response surface analysis (e.g., Edwards, 2002) revealed moderate positive associations among process-oriented MC levels and METs in all three trial interval conditions (kicking: $.441 < b1 < .662$, $p < .01$; throwing: $.328 < b1 < .368$, $p < .01$). Stronger associations were shown for shorter trial intervals (i.e., 6s, 12s). Small to moderate associations between throwing speed and METs in each trial conditions were found ($.221 < b < .381$; $.01 < p < .10$). **Conclusion:** Individuals' movement quality (process) demonstrated greater associations with metabolic response than performance product (speed), especially with higher intensity skill practice (i.e., 6 vs. 12 sec intervals). Examining children's metabolic response to different intensities of skill practice is warranted.

The effect of physical activity on perceived competence: A meta-analysis

Salazar, Pamela; Jimenez, Judith, University of Costa Rica; Morera, Maria, National University

The purpose of this work was to use the aggregate data meta-analytic approach to examine the effect of physical activity (PA) on perceived competence. A literature search was conducted based on ten electronic database searchers and cross-referencing. A total of 14 studies met the inclusion's criteria: (1) experimental design, (2) physical activity intervention, (3) assess perceived competence as dependent variable, (4) report statistical data. Effect size (ES) were calculated for the within group comparison ($ES = (M_{post} - M_{pre}) / SD_{pre}$). Ninety ES were calculated for two groups: (1) intervention group (organized PA) or (2) control group (no PA, free play, or regular PE classes), representing 854 participants (males and females) with ages between 3 and 67 years. Results showed that the intervention group significantly improved its perceived competence ($ES=1.40$; $p<0.001$; $CI= 0.54$ to 2.25 ; $n=58$; $Q=780.54$). While, control group ($ES=0.06$; $p<0.79$; $CI = -1.12$ to 1.25 ; $n=32$; $Q=75.59$) did not improved its perceived competence. In conclusion, results suggest that organized physical activity's interventions improved the perceived competence, nonetheless no physical activity, free play, and even regular PE classes do not influence self-perception. It is important to continue the studies based on which teaching methods are more effective to improve perceived competence through physical activity.

Relationship between motor proficiency and executive functioning in children

Sartori, Rodrigo C., Universidade Federal do Rio Grande do Sul and Pontifícia Universidade Católica do Rio Grande do Sul; Valentini, Nadia C., Universidade Federal do Rio Grande do Sul; Fonseca, Rochele, Pontifícia Universidade Católica do Rio Grande do Sul

Regarding that motor behavior control is based on a complex and inter-active network of neural structures, motor proficiency difficulties are susceptible and relate not only to motor cortex areas, but also to areas of cognitive processing. In this study, we aimed to analyze the relationship between motor proficiency and executive functioning in children. Participants (N = 80) were 8 to 9 years-old children from public schools. Method: The Movement Assessment Battery for Children-2 and age-appropriate tests of executive functions (working memory, cognitive flexibility and inhibition) were used. Background variables (age, socioeconomic status) and potential moderators (nonverbal IQ) were controlled. A multiple linear regression model was conducted using structural equation models to analyze the associations between motor proficiency and the verbal inhibition, motor inhibition, visual working memory, verbal working memory and cognitive flexibility. The normality of the variables was evaluated by the asymmetry (sk), and univariate and multivariate kurtosis (ku) coefficients. Possible multicollinearities were investigated using VIF (Variance Inflation Factor), $VIF > 5$ were considered as indicators of multicollinearity. Normality tests indicated that no variables had values of $|Sk| > 3$ and $|Ku| > 10$. D2 values did not indicate the presence of uni and multivariate outliers. No variable presented FVC indicative of multicollinearity ($FIV < 5$). In the final model, positive and significant associations between motor proficiency and visual working memory ($b = .479$; $C. R = -2.34$, $p = .019$), motor proficiency and cognitive flexibility were found ($b = .548$; $R = 2.382$, $p = .017$), and a negative association between motor proficiency and verbal inhibition ($b = -.45$, $C.R = -2.796$, $p = .005$) were found. The association between executive function and motor proficiency highlighted the importance of consider these relation when planning evidence-based intervention for children with motor difficulties.

Multiple roads lead to San Diego: Effects of a motor skill vs. fitness intervention on motor skill development and executive function in kindergarten children

Schott, Nadja; Schuhmacher, Benjamin; Holfelder, Benjamin, University of Stuttgart

Background: Complex motor activities are appealing because they offer not only improvements in motor skills, but possibly positive changes in executive function. However, many interventions reduce physical activity to its physiological components such as aerobic endurance or strength, therefore ignoring the potential of complex motor skills on motor and cognitive development. Therefore, the purpose of this study was to examine the effects of a motor skills training vs. a physical fitness training on motor skill development and executive function in kindergarten children. Method: Children in the two intervention groups (n = 29; 15 boys, 14 girls, 4-6 years) participated either in a 26-week

physical fitness or motor skill training program for 60 min, twice a week. Children in the control group (n = 15; 10 boys, 5 girls, 4-6 years) followed their normal routine. The Movement Assessment Battery (MABC), the Motor Skill Pass (MSP) and the Trail-Making Test for young children (Trails-P) were used to assess motor and cognitive performance. Results: Overall, scores on the MABC were improved for all groups, but not significantly. However, children in the motor skills intervention group improved significantly their scores on the MSP, but not the fitness intervention group. Significant improvements were also found for the motor skills intervention group for response suppression as well as the distraction condition. Conclusion: In conclusion, the motor skill intervention led to improvements in motor skills and executive function compared to the physical fitness intervention. Activities that offer challenging situations via complex motor skill acquisition can induce remarkable changes in motor and cognitive development in young children.

Enhanced Object Manipulative Skills Physical Education Programming for Third Grade Girls in a Canadian Elementary School

Sheehan, Dwayne, Mount Royal University; Sheehan, Sonia, Foundations for the Future Charter Academy; Johnson, Emily, Mount Royal University

The fundamental movement skills (FMS) of 550 FFCA middle school students in fifth and sixth grades were assessed between 2012- 2015. Results from this study, coupled with evidence based motor development literature, demonstrate that girls are falling behind when it comes to developing object manipulation skills (OMS) such as throwing, catching, dribbling, striking, and kicking. A follow up intervention was designed to measure the acute impact of an all-girls OMS program as well as the retention levels by doing follow up measures 2 months after the intervention concludes. Pre-adolescent children in grade three (n=80) were recruited to eliminate the confounding developmental variable of puberty. Children taught by physical education specialists who are trained in teaching FMS showed higher levels of perceived competence than those taught by instructors with no such training (Breslin, Murphy, Mckee, Delaney & Dempster, 2012). Perceived motor competence is more predictive of physical activity participation in young girls (ages 7-9) than actual motor competence (Khodaverdi, Bahram, Khalaji & Kazemnejad, 2013). It has been shown that children with higher perceived competence are more likely to participate in sport and recreation activities outside of school hours, likely leading to future participation in healthy, active living (Carroll & Loumidis, 2001). This study measured perceived motor competence both before and after the intervention using the Physical Self Perceptions Profile for Young Children (Welk & Eklund, 2005). This project used a 'pre-post test' methodology to evaluate change with the girls participating (within subject design), as well as the relative change compared to the boys in the same grade (between subjects design). Validated product and process orientated motor proficiency measurement tools such as the Test of Gross Motor Development (TGMD-3) and the Bruininks-Oseretsky Test of Motor Proficiency (BOT-2) were utilized to ensure that any change is reliably measured. Final results will be available at the 2017 NASPSPA conference.

Funding Source: Alberta Government

Longitudinal growth rates and gross motor proficiency in Canadian middle school boys and girls

Sheehan, Dwayne; Lienhard, Karin, Mount Royal University

Growth rate during the period of adolescent maturation is an indicator of biological maturity and affects gross motor skill (GMS) proficiency. The aim of this longitudinal study was to investigate the relationship of peak height velocity (PHV) and GMS's in boys and girls before, during, and after their adolescent growth spurt. We assessed 82 Canadian middle school boys (N=38) and girls (N=44) over a time period of five years. All participants attended a publicly funded charter school that offers physical education (PE) taught by PE specialist teachers on a daily basis. Students were in fourth grade at the time of enrollment. Height and weight were assessed every quarter, whereas GMS's were evaluated once a year (Q2) using the Bruininks-Oseretsky test of motor proficiency (BOT-2). GMS sub scores were assessed for bilateral coordination, balance, running speed/agility, and strength. These sub categories were combined to provide a GMS composite score. Results of this study indicated that PHV occurred at a younger age in the girls (11.3 +/-0.4 years) than the boys (13.4 +/-0.3 years). However, growth rate during PHV was greater in the boys with height increases of 3.3 +/-1.3 cm/quarter as compared to the girls (2.0 +/-0.7 cm/quarter). GMS's were similar between the boys and girls and within the average range (1SD) for North American norms. However, the mean scores for this sample were consistently above the expected average, with total GMS ranging between 103.1 and 113.3 (norm score=100). Boys experienced a more pronounced growth spurt and at a later stage than the girls, which is in consistent with previous studies. GMS proficiency was above the norm compared to North American standards. This finding may be related to the commitment by the schools to employ physical education specialists who offer this subject on a daily basis. This study further supports the need for a quality daily physical education experience for every child. It also provides important evidence about the impact of PHV on GMS during the adolescent growth spurt.

Funding Source: Government of Alberta

Effectiveness of motor skill interventions across different socio-economic environments

Taunton, Sally A.; Brian, Ali S., University of South Carolina; Howard-Shaughnessy, Candice H, Troy University

Children from low socioeconomic settings (LSS) are often at risk for delays in FMS. However, little is known with regard to children in the United States who are not from disadvantaged settings. The purpose of this study is to examine the FMS of young children from LSS and not low socioeconomic settings (NLSS) before and after a 6-week motor skill intervention. Children ages 3-5 (N = 47; girls = 27, LSS = 24; Mage= 4.8, SD = .57), were recruited from two early childhood centers in the United States one which was located in a LSS and other in a NLSS. We assessed children in both the LSS and NLSS conditions prior to and after the six-week intervention using the Test of Gross Motor Development Second Edition (TGMD-2). There were no significant differences between conditions for locomotor skills ($t(45) = -8.13, p = .42$). However, the NLSS condition reported significantly higher object control scores than that of the NLS condition ($t(45) = 2.16, p = 0.36$) at the pretest. An ANOVA with repeated measures

results revealed a main effect for time in both locomotor ($F(1,47) = 0.12$, $p = .913$) and object control ($F(1, 47) = 3.65$, $p = .062$) skills. Also, analysis revealed a group x time interaction in locomotor ($F(1, 47) = 1.817$, $p = .184$, $\eta^2 = 0.12$) and object control skills ($F(1,47) = .585$, $p = .449$, $\eta^2 = 0.12$). There were no significant differences between groups in locomotor ($t(45) = -8.13$, $p = .42$) or object control ($t(45) = 1.13$, $p = .261$) skills between conditions at the posttest. Results indicate that children regardless of socioeconomic status increased in both locomotor and object control skills after receiving a structured motor skill intervention. Replication is needed for children not from LSS to better understand FMS of children throughout the United States.

Capturing Infant Naturalistic Use of Postures Using Network Analysis: A Longitudinal Study

Thurman, Sabrina L.; Corbetta, Daniela, University of Tennessee Knoxville

Locomotor development provides infants with new means to explore and also extends the range of behaviors infants previously had available. Here, we investigated how infants position themselves and transition through various postures during free play sessions and across locomotor development in the first two years.

Thirteen infants were observed biweekly in 10-min free play sessions held in a laboratory, from 6 to about 17 months. The room contained toys, a couch, and a small set of stairs. Changes in locomotor skills were captured with Touwen's Group III Neurological Assessment Scale. Infant postures (laying down, sitting, on all fours, squatting/kneeling, creeping, standing/bending over, cruising, and stepping) were video-coded continuously using The Observer XT. We grouped data into 4 time blocks centered around creeping and walking onsets, each containing 3 sessions: pre-creeping, novice creeping, experienced creeping/pre-walking, and walking. We determined for each time block how often each infant switched from one posture to another during play and mapped those data using Social Network Analysis and Visualization software. We assessed changes in posture network densities and centrality with ANOVA and Friedman tests.

Over time, the network density between postures increased significantly ($p < .000$). Therefore, infants showed more variability in the range of postures displayed within sessions and as a function of locomotor development. Despite this variability, one posture was most centrally utilized depending on the infants' locomotor level. This posture was 'sitting' for pre-creeping sessions ($p < .000$), was 'on all fours' for creeping sessions ($p < .000$), and was 'squatting/kneeling' for both pre-walking and walking sessions ($p < .000$). These data are the first to show that as infants acquire new locomotor milestones, their repertoire of postural skills expands, meaning that infants are able to exploit whatever full range of postures they have available at any developmental time. Infants continue to rely on prior skills during play, despite acquiring new ones.

The Impact of the Summer Success Program on Children's Motor Competence and Perceived Motor Competence

Tsuda, Emi; Famelia, Ruri; Goodway, Jacqueline D., The Ohio State University

This pilot study examined the impact of a Summer Success (SS) Program on preschoolers fundamental motor skill competence (FMSC) and perceived motor competence (PMC). The 4-week SS Program targeted disadvantaged preschoolers at risk for educational failure who had no prior preschool experience and were going to kindergarten in the Fall. The overall program aimed to develop literacy, math, social-emotional skills and FMSC. Participants were 23 preschoolers recruited from a low-income neighborhood (female $n=11$; $M=61$ mo., $SD=5.3$). As part of the SS Program, preschoolers received the SKIP fundamental motor skill program for 30 mins, 12 sessions over 4 weeks (270 min). Preschoolers were pre and posttested on: 1) FMSC: Test of Gross Motor Development-2 (Ulrich, 2000) using both the locomotor (LOC) and object control (OC) subscales, and 2) PMC: Physical Competence subscale of the PSPCSA (Harter & Pike, 1984) and the PSPMSC (Barnett et al., 2015). At the pretest children were developmentally delayed in FMSC (GMQ% $M=11.83\%$, $SD=21.63$). Two factor (Time X Gender) split plot ANOVAs (locomotor, OC) analyzed pre-to post changes in raw scores of FMSC and PMC and gender effects. Children improved significantly from pre-to-posttest on LOC (16.57% to 28.70%) skills ($F[1,21]=18.43$, $p<.001$, $\eta^2=.46$ [a large effect]) with no main effect of gender ($p=.99$) and no interaction effect ($p=.80$). OC skills (13.45% to 20.48%) also significantly improved from pre-post ($F[1,21]=13.73$, $p=.001$, $\eta^2=.40$ [a large effect]) with a main effect of gender ($F[1,21]=5.06$, $p=.04$, $\eta^2=.19$ [a medium effect]), but no interaction effect ($p=.26$). No significant improvement was observed in PMC (PSPCSA $p=.19$, PSPMSC $p=.11$). The SKIP program clearly impacted FMSC in a relatively short period of time but did not appear long enough for changes in PMC. A limitation of this pilot study was lack of a control group. Overall, these data show promise that the SS Program can improve FMSC in a vulnerable population of children and provides evidence for a future larger scale evaluation of the program.

Examining the Relationship between Changes in Motor Competence and Physical Activity Levels after a 3-month Fundamental Motor Skill SKIP Program

Tsuda, Emi; Goodway, Jacqueline D.; Centelles, Aina Cid; Woodson, Rebecca R., The Ohio State University; Valdez, Yadira H.; Famelia, Ruri, The Ohio State University

This study: (a) examined pre-to-post changes in fundamental motor skill competence (FMSC), perceived motor competence (PMC), and school day moderate to vigorous physical activity levels in min (SD-MVPA) after completion of a 3-month SKIP fundamental motor skill program and, (b) the relationship between changes in FMSC and SD-MVPA. A total of 46 children ($Age=46.15$ mo., $SD=7.67$; girls $n=22$) were recruited from an urban preschool. The children received the SKIP program 20 min, 2/week across 3 mon. (18 sessions). Children were pre- and post-tested on FMSC, PMC, and SD-MVPA. FMSC was assessed by the TGMD-2 (locomotor [LOC] & object control [OC] subscale; Ulrich, 2000), and PMC was assessed by the Physical Competence subscale of the PSPCSA (Harter & Pike, 1984) and the PSPMSC (Barnett et al., 2015). SD-MVPA was measured by accelerometers and mins in MVPA averaged

for 5 school days. ANOVAs with repeated measure indicated that the children improved from pre-to posttest in LOC ($F[1,45]=26.4, p<.001, \eta^2=.37$) and in OC ($F[1,45]=14.25, p<.001, \eta^2=.24$) skills; no statistically significant improvement was found in PMC (PSPCSA $p=.69$; PSPMSC $p=.60$) or SD-MVPA ($p=.68$). In addition, a correlational analysis examined the associations between changes in FMSC (LOC & OC) and SD-MVPA (change=post-pretest data) to examine if changes in these variables were related to each other. The result indicated that changes in LOC skills were significantly correlated with changes in SD-MVPA ($r=.35, p=.018$). No correlation was found between OC changes and SD-MVPA changes ($p=.85$). Further, stepwise regression analyses examined if changes in SD-MVPA predicted the changes in LOC scores, and vice versa. The result showed that the changes in LOC scores explained 14.1% of the variance in changes in SD-MVPA ($F[1,44]=7.22, p<.001$). The changes in SD-MVPA predicted neither LOC or OC skills changes. The result of this study indicated that the 3-month SKIP program was effective in developing FMSC. Further, the changes in LOC may lead to changes in SD-MVPA and as such may be a mechanism for intervention.

The relationship between physical activity and motor development in infants with and without Down syndrome

Ulrich, Dale A.; Pitchford, Edward A.; Ketcheson, Leah R., University of Michigan

OBJECTIVE: Research provides growing evidence that a positive relationship exists between physical activity (PA) and motor development (MD) in children and adolescents. The theory behind this relationship is that when a child moves, they have more opportunities to learn how to coordinate and control their limbs needed for acquiring goal directed motor behaviors. The primary purpose of this study was to determine whether the relationship between PA and gross and fine motor development is present during infancy.

METHODS: Thirty three families volunteered their non-walking infants for participation in this study. Twenty two infants were typically developing (TD) while 11 had a diagnosis of Down syndrome (DS). Infants ranged in age from one month to 12 months (mean of 6.57 mo). All infants wore an Actigraph GT3X-BT triaxial accelerometer on their right ankle and right wrist for seven days. Data were manually cleaned to remove activity counts not produced by the infant based on parent logs. Gross and fine motor development was assessed by using the Bayley Scales of Infant & Toddler Development (2006). **RESULTS:** Group differences (TD, DS) in physical activity counts averaged over the seven days were not significant. TD infants displayed a slightly higher gross and fine motor raw score. Not surprising, in both groups, legs were less active than arms. As expected, age was significantly correlated with both PA and MD and was therefore used as a control variable in the partial correlation analysis of PA and MD employing all 33 infants. PA at the wrist and ankle were significantly related ($r=.51$). There was a significant relationship ($r=.41, p=.019$) between PA at the wrist and fine motor raw scores. There was also a significant relationship ($r=.39, p=.028$) between PA at the ankle and gross and fine motor raw scores.

CONCLUSION: Based on this study, it appears that in infants with and without DS, the relationship between PA and MD emerges during infancy. How to increase PA in infants is an important question for child development and public health.

The importance of accuracy in overweight and underweight children's perceived motor competence for future physical activity

Utesch, Till; Dreiskaemper, Dennis; Naul, Roland; Geukes, Katharina, University of Muenster

Perceived (PMC) and actual motor competence (MC) are important factors for future physical activity (PA) behavior and consequently decreases obesity (cf., Stodden et al., 2008). However, competencies and related self-perceptions can diverge, especially in childhood (e.g., Hay, 2005; Helmke, 1999). A child which scores high in PMC does not necessarily show high MC and vice versa, especially in unhealthy weight groups, because these children may receive stigma-guided feedback in sports and their social experiences. This study examines the accuracy of PMC in relation to actual MC as a meaningful influencing factor for children's PA behavior. MC (product-oriented object control) and PMC were assessed in 3rd grade or primary school ($M(\text{age}) = 9.21$, $SD = .52$). Weight status was categorized based on WHO recommendations ($n = 55$ underweight, $n = 494$ normal weight, $n = 130$ overweight, $n = 36$ obesity; Cole et al., 2012). In their 4th grade, the children's physical activity behavior was measured. Polynomial regression with response surface analysis was conducted controlling for sex, age, and performance level. A quasi DIF approach was used to examine weight status effects. Overall, the polynomial regression revealed an additive accuracy effect. This means, children with higher MC levels and higher PMC show higher PA. Additionally, children perceiving their motor competence more accurately show higher PA. Quasi DIF analysis revealed different effects for weight groups. The effect is higher for underweight and overweight children, but the effect is lower for normal weight children. These findings indicate, although PMC is often described to mediate the relationship between MC and PA, that self-perception accuracy does affect this relationship rather than the level of PMC. An accurate self-perception increases physical activity behavior. Hence, promoting actual MC should be linked to providing realistic feedback, especially in unhealthy weight groups.

Differences in Early Cognitive and Motor Neurodevelopment by Risk Factors and Underlying Outcomes of Intervention in Brazilian Infants

Valentini, Nadia C.; Saccani, Raquel C.; Pereira, Keila Ruttnig, Universidade Federal do Rio Grande do sul

Different pathways of cognitive and motor development are observed across infancy as a consequence of organic and environmental risk factors. Differences in infancy cognitive and motor skills by risk factor among infants from birth to 18 months from Brazil were examined. Infants were assessed at family? homes, pediatric clinics, governmental basic health-units, public and private day cares. The sample comprised approximately 1,500 infants who had premature and full term birth and no main health complications, allowing the focus of the study on disparity in cognitive and motor

neurodevelopment among infants without main physical health constraints. Health professionals, master and doctoral students, were trained in administering the Bayley Scale of Infant Development, Scale of Children Development, Alberta Infant Motor Scale, and a check list of medical report. Parents completed the Daily Activities Scale of Infants, the Affordances in the Home Environment for Motor Development, the Knowledge of Infant Development Inventory and a demographic questionnaire. Differences in cognitive and motor scores considering risks factors for neurodevelopmental problems as well as intervention impact in cognitive and motor function were evaluate. We also examine the extent to which household demographic and child and family? socioeconomic characteristics explain these differences and the intervention impact. Great gaps in infants' cognitive and motor neurodevelopment by environment opportunities; and, parental knowledge and practice were found. The intervention had highest impact in younger infants. The results highlighted the importance of screen and interventions preventive policies to reduce socioeconomic risks for preventing disparities in infant neurodevelopment.

A Delphi poll investigation to establish the content of a teacher-oriented assessment of children's fundamental movement skills

van Rossum, Tom, Sheffield Hallam University; Morley, David; Richardson, David; Foweather, Lawrence, Liverpool John Moores University

Children's competence in performing fundamental movement skills (FMS) is positively associated with physical activity levels, health-related fitness and healthier weight status (Stodden et al, 2008). The early years of a child's schooling provide a meaningful environment for children to learn FMS (Morgan et al, 2013). Furthermore, it has been recommended that teachers become more involved in the process of assessing children's FMS (Morley et al., 2015), to support children's development of these skills more effectively. However, traditional movement assessment tools are unsuitable for use by teachers in the PE curriculum (Giblin, Collins & Button, 2014). The purpose of this study was to generate expert consensus to establish the content of a FMS assessment for children aged 4-7 years old, intended for use by teachers of PE in the early years of a child's education. A three-round Delphi technique was used with an international panel of 46 academics and practitioners who had significant experience in children's movement assessment and development. Quantitative responses were obtained in Likert-scale and multiple-choice formats. Consensus was formed regarding the number of stability (n=4), object control (n=5) and locomotor (n=5) tasks required to assess the FMS of children aged 4-7 years old, and the order of importance of movement tasks within each of these categories was decided. Participant responses indicated that a developmental stage approach, rather than a chronological age approach, should be adopted to differentiate the scoring criteria for each task. Furthermore, experts recommended that three process-oriented behavioural criteria per task would be most valuable. These findings present an assessment model which allows early childhood teachers to measure the FMS competence of children aged 4-7 years old. Considering the shortage of teacher-oriented movement assessment tools, this protocol may be attractive to teachers as it enables them to better understand and support children's movement development.

Gross Motor Skills in Toddlers: Prevalence and sex differences

Veldman, Sanne L.C.; Sousa-Sa, Eduarda; Jones, Rachel A.; Santos, Rute; Okely, Anthony D., University of Wollongong

Introduction: Gross motor skills are a vital component of a child's development as they are seen as the building blocks of movement and advanced motor behaviour. Gross motor skills prevalence studies have been conducted in children aged 3 to 18 years, but no studies have been conducted in younger children. Therefore the aims of this study are to describe the current level of gross motor skill development of children aged 1 to 2.5 years and to describe how these development levels differ by sex, age and socioeconomic status.

Methods: 336 toddlers (Mage = 19.8 + 4.1 months, 155 girls) were recruited through childcare services in NSW, Australia. Gross motor skills were assessed using the Peabody Developmental Motor Scales Second Edition (PDMS-2). Reporting of prevalence was done using the standard scores, sex differences were examined using t-tests and linear regression analysis was computed to assess the association between gross motor skills and socio-demographic factors. The significance was set at $p < 0.05$.

Results: In total, 23.5% of the children scored below average, 69.6% of the children scored average and 6.8% of the children scored above average for the gross motor quotient. For the different subtests the number of children that scored below average were 34.5%, 10.4% and 0.3%, respectively for locomotion, object manipulation and stationary. The only significant sex difference found was in object manipulation, where boys scored higher than girls ($p = 0.014$). Age was related to gross motor skill development and after adjusting for sex and age, both middle and high SEIFA Index (Australian Socio-economic Indexes) were associated with lower gross motor skill development. No associations were seen for mothers education, employment or family income.

Discussion: Gross motor skill development is below average in almost a quarter of the toddlers (23.5%) in this sample and sex differences are seen for object manipulation. Analysis revealed age and SEIFA index were related to gross motor skill development.

Examining the impact of SKIP training for teachers on children's motor development in the Foundation Phase.

Wainwright, Nalda N., University of Wales Trinity Saint David; Goodway, Jacqueline D., The Ohio State University; John, Amanda A.; Edwards, Kirsty A.; Piper, Kate A., University of Wales Trinity Saint David

The Foundation Phase in Wales is a play-based, holistic school curriculum for children aged 3-7 years with an emphasis on the use of the outdoors to promote physical literacy and learning, and where traditional subjects like Physical Education no longer exist. Prior

research suggests that while the Foundation Phase promotes locomotor skills through play, teachers lacked the knowledge to support the development of object control (OC) skills. Thus, this study examined the impact of a teacher led SKIP fundamental motor skill (FMS) program on children's locomotor and OC skills. Participants were children aged 3-6 years assigned to a SKIP condition (n=142) and Comparison condition (n=85). The SKIP group engaged in 10 weeks of the SKIP FMS program as part of their typical Foundation Phase curriculum taught by their classroom teacher who had received a two-day training on SKIP. All children were pre-and-posttested on the Test of Gross Motor Development-3. Two ANOVA with repeated measures on Total, and OC (ball) raw scores resulted in a significant interaction effect for Total ($p<.001$; $\eta^2=.62$) and OC ($p<.001$; $\eta^2=.44$) skills. The SKIP group improved their Total Score from 21.02 to 41.89, and OC skills from 6.94 to 17.69. However, the Comparison children made little change (Total=26.58 to 26.92, OC=6.17 to 7.00). An ANCOVA on locomotor posttest scores (covariate was locomotor pretest scores as they were different $p<.01$) resulted in a significant effect for group ($p<.001$; $\eta^2=.40$). It was concluded that a short teacher training program on the SKIP curriculum resulted in significant improvements in FMS for children in the SKIP teacher's classes. Furthermore, the early childhood teachers (n=14) who received SKIP training were able to apply the knowledge and understanding from SKIP to the Foundation Phase context and develop pupils physical learning in holistic, child-centered learning opportunities. This work serves to inform national policy in Wales to lay the foundations of physical literacy.

Funding Source: Welsh Government

Establishing the Microsoft Kinect as a fundamental movement skill observation tool

Ward, Brodie J.; Rosenberg, Michael; Thornton, Ashleigh L.; Lay, Brendan S., University of Western Australia

In recent years, progressions in the field of motion capture technology have created more portable and reliable depth image capture; once a feature exclusive to expensive laboratory based systems. The Microsoft Kinect sensor provides opportunity for marker-less, 3-dimensional depth capture, and its use for the capture and assessment of kinematic information has been gaining traction of late. However, implementing the system to capture fundamental movement skill (FMS) performance, and using data to observe and assess FMS post hoc, has not been undertaken. The aim of this study was to compare FMS assessment, by human raters, using the Test of Gross Motor Development-2, between skills presented in traditional video format, and a visual representation of the digital kinematic data captured by the Kinect presented as a point light display (PLD). We hypothesised that TGMD-2 scoring would be similar between video and the Kinect produced PLD. Fifty-five assessors scored 16 performances of 4 FMS using the Test of Gross Motor Development-2, with skills presented in both traditional video and PLD formats. Assessment scores were analysed comparing the percentage agreement between responses on video and PLD within assessors. Initial results showed mean agreement between video and Kinect data to be 64.84%, and were much lower than expected. Analyses of duplicated performances to which the participants were blinded, found mean agreement to also be fairly low within each of the

presentation mediums (video 78.61%, PLD 71.31%) suggesting that low agreement rates may not be completely due to limitations of the Kinect system. Data analyses are ongoing, with more comprehensive results to be presented at the conference. This is a vital step towards understanding whether data captured by the Kinect sensor is sufficient for the observation and assessment of FMS and establishing the foundation for successfully implementing the system for the rapid, objective assessment of FMS.

Influence of body composition on actual and perceived motor competence in children

Webster, Elizabeth K.; Huck, Lydia L.; Molina, Lila V.; Tso, Katie, Louisiana State University

Background: The purpose of this investigation is to examine whether body composition, specifically fat percentage (Fat%), may influence actual and perceived motor competence in children. Methods: Fifty-one students ($M = 6.49 \pm 1.59$ yrs, Range = 4 - 9 yrs; 45.1% male) completed the Test of Gross Motor Development - 3rd edition (TGMD-3), the Pictorial Scale of Perceived Movement Skill Competence for Young Children (PMSC), and body composition measures (Tanita SC-3315 Body Composition Analyzer). The sample was separated into high and low Fat % groups for analysis; independent t-tests were used to examine group differences for TGMD-3 and PMSC total raw scores, as well as locomotor (LM) and ball skill (BS) subscales. Results: There were no age differences between the High and Low Fat% groups; no sex differences were found for any variable. There was a significant difference between students in the high Fat% and low Fat% group for total PMSC ($t = 2.218$, $p = 0.031$) and total TGMD-3 ($t = 2.383$, $p = 0.021$). For the motor subscales, a significant difference was only found for the TGMD-3 LM skills ($t = 2.645$, $p = .011$). Conclusion: While age was equivalent for each group, differences in Fat% impacted total perceived and actual motor competence. Children with higher Fat% exhibited lower levels of self-perception of movement competency and lower movement quality for a range of fundamental motor skills. However, actual LM skills were the only significant difference found between groups. Those with lower Fat% performed better in the actual LM subscale, but there were no differences in the perceived LM subscale. These differences may highlight morphological constraints for actual motor competence that may not manifest in the perceived domain. Future work may target separating motor competence subscales for interventions to continue to bolster both perceived and actual motor competence. Particularly in children with higher Fat% which may influence actions or perceptions of movement, particularly in the LM domain.

Relationship between Cognitive Level and Sitting Posture in Infants at low and high risk for ASD

Wehrle, Lauren; Wickstrom, Jordan; Motz, Zachary; Kyvelidou, Anastasia, University of Nebraska at Omaha

Autism Spectrum Disorder (ASD) is a developmental disorder that affects social competencies and behavior. The current increase in diagnosis rate creates a need for the identification of ASD-related deficiencies early. The average age of diagnosis is around four years of age, although early signs of atypical behavior

indicate the possibility for an earlier diagnosis. Early motor behavior has been directly linked with communication, cognitive and social development. Previously we have identified that infants at high-risk for ASD exhibit dissimilar postural control strategies, which might serve as an indicator of early signs of ASD. However, we have not established whether there is a relationship between perceptual and cognitive skills and postural control. Thus, the purpose of this study was to examine the relationship between sitting postural control measures and cognitive behavior in infants at low-risk (no family history of ASD) and high-risk (had a diagnosed sibling) for ASD. All infants (19 low-risk, seven high-risk) sat on a force plate for 10 seconds. Overall development was assessed using the Mullen Scales of Early Learning (MSEL), which assesses cognitive and motor ability. The sum of the scores for the visual reception, fine motor, receptive language, and expressive language scales on the MSEL are considered a representation of cognitive level. A strong negative correlation ($r = -0.549$, $p = 0.15$) was found in infants at low-risk between their cognitive score on the MSEL and their average amount of side-to-side sway (as measured by the root mean square in the medial-lateral direction). Thus, the more advanced the children's cognitive level, the less they moved side-to-side while sitting. The infants at high-risk did not have a significant correlation between any measures of sitting postural control and the MSEL scales. This result may suggest that infants with more advanced cognitive levels may be able to perceive that side-to-side motion which could lead to falling and are able to adjust their posture to maintain an upright position.

Funding Source: NIH

6-8-Year-Old Children's Posture is Similar While Viewing Social and Non-Social Stimuli

Wickstrom, Jordan; Averhoff, Alyssa; Wehrle, Lauren; Kyvelidou, Anastasia, University of Nebraska at Omaha

One in 68 children in the United States is currently diagnosed with Autism Spectrum Disorder (ASD). ASD is characterized by social, emotional, motor, and perceptual deficits. Interestingly, children with ASD prefer to visually examine non-social images over socially relevant images, whereas children with typical development prefer to view social over non-social images. This is an important distinction because preferential attention to social features is considered critical for the development of motor skills. Several studies have reported movement-related deficits in children with ASD such as in standing, sitting, and walking. Interestingly, neural foundations involved in perceiving social images have been found to coincide with brain areas associated with developing motor skills. Based on this information, we hypothesized that children diagnosed with ASD compared to children with typical development would show different patterns in standing posture when viewing social images (i.e. people) compared to non-social images (i.e. geometric shapes). We examined seven children with typical development

and one child diagnosed with ASD. Participants stood on a force plate as we measured center of pressure and watched an eight-minute video. The first two minutes consisted of viewing a fixation cross (baseline for posture), and the final six minutes involved alternating 30-second segments of viewing social images, a fixation cross, and non-social images. Contrary to our hypothesis, our results yielded no significant differences in posture measures by stimulus type. This may be because we only had one child with ASD to compare to the group with typical development. Future research is needed with a larger sample size to confirm these findings. However, should this finding hold with a larger sample size, it may be that standing posture is already developed by age six and relatively unaffected by viewing stimuli at this time. Applying this protocol earlier in life when children are developing their early motor skills may yield the expected results

Influence of reaching on 7-month-old infants' visual attention

Wiener, Rebecca F.; Corbetta, Daniela, University of Tennessee Knoxville

Visual attention is critical for action planning. For infants, it is a crucial component for successful reaching. For example, research has shown that infants generally fixate objects before reaching for them (Williams et al., 2015) and will fixate a particular part of an object before contacting it (Corbetta et al., 2014). Other research has shown that infants' attention to scenes may also depend on the stimulus complexity (Ruff & Turkewitz, 1975; Kidd et al., 2012). Here we investigate to which extent infants' attention to a hand held object in a 3D scene is driven by an action goal and is modulated by object complexity.

In study 1, 36 7-month-old infants were encouraged to look at an object held out of reach for 6sec. In a reaching group (RG), the object was then moved forward for the infant to reach for it. In the non-reaching group (NRG), infants were not given the chance to reach for the objects. Objects also varied in shape complexity. We analyzed gaze patterns to the objects and scene via eye-tracking. Both looking and looking away behaviors were coded. Results showed that the RG looked marginally more at the object than NRG. Additionally, NRG looked away from the scene more than RG. The less complex objects were attended significantly less. This implies that planning to reach elicits more visual attention to the object and scene and that object complexity can modulate attention to the scene.

Study 2 further examined the role of action planning on infants' visual attention using a within subject design. Fifteen infants were presented with the same non-reaching procedure (NRP) as in Study 1 until they became bored or fussy, and then they were presented with the reaching procedure (RP) up to 11 trials. Results showed that over the course of NRP infants significantly decreased their attention to the scene and increased their looking away. However, following RP, infants regained attention to the scene significantly. These findings confirm that having an action goal promotes visual attention to a scene, even in 7-month-old infants.

Comparing Functional Movement Skills between Children with and without Autism Spectrum Disorder

Wu, Sz-Yan; Powell, Christie; Jensen, Jody L., University of Texas at Austin

Purpose: Our aim was to identify the Functional Movement Skills (FMS) gap between children with and without an Autism Spectrum Disorder (ASD). The working hypothesis is that children with ASD, even with independence in activities of daily living (ADL), still struggle with sport and recreational activities due to insufficient FMS competence. **Methods and Results:** We recruited 17 children (8 boys and 9 girls aged 9.8 +/- 1.5 years) without ASD and 14 children with ASD (13 boys and 1 girl aged 9.5 +/- 1.8 years). All subjects performed the Bruininks-Oseretsky Test of Motor Proficiency, 2nd ed., Short Form (BOT-SF) and three FMS tests: single leg hopping for distance (HopD), 6 m single leg hopping for time (HopT), and 20 s one-leg standing with eyes open and closed (OLS). ASD children scored significantly lower on the BOT-SF ($p < .001$) and Limb Symmetry Index for the HopD ($p = .037$) and HopT ($p = .037$). The RMANCOVA showed ASD to have poorer hopping skills even when controlling for age ($p = .001$). A significant interaction was found between the OLS condition and group ($p = .003$) showing children with ASD, relative to the TD group, to produce much greater error in the eyes-closed situation. A simple linear regression was used to analyze the independent variables of Age, Group and BOT-SF in explaining FMS outcomes. BOT-SF alone was not a significant predictor in any of the three models. There were Age effects on the HopD ($p = .015$) and OLD eyes-closed compared to OLS eyes-open ($p = .049$), and a Group effect on HopT ($p = .017$). **Conclusion:** We replicated previous findings that children with ASD have a marked motor deficiency. Importantly, the BOT-SF does not adequately represent FMS ability. Competence in ADL does not equate to functional competence for more challenging movement tasks.

Physical activity levels and body mass index of children and adolescents with asthma diagnosis

Zacaron, Daniel, Centro Universitário da Serra Gaúcha - FSG; Dias, Caroline Pieta, Universidade Federal do Rio Grande do Sul - UFRGS; Roncada, Cristian, Centro Universitário da Serra Gaúcha - FSG

Asthma is a high prevalence chronic disease which affects mainly children. However the physical activity practice performed with adequate intensity and duration by asthmatic individuals improves physical capacity and reduces dyspnea, which may result improves adherence to drug treatment. The aim of this study was to investigate the physical activity levels and body mass index (BMI) of asthmatic children and adolescents (aged 8-16 years) in pediatric pulmonology treatment at ambulatory in Porto Alegre/Brazil. Physical activity questionnaire was applied for measure physical activity levels, height (m²) and weight (Kg) were measured and body mass index (BMI) was calculated (kg/m²) and transformed into z-scores. Informed consent term and assent term were signed for responsible and participants, respectively. The study was approved by the Ethics Committee of PUCRS. Descriptive statistics were used for data analysis and absolute and relative frequency were calculated using SPSS software. Participants included 69 children (10.58 +/- 2.29 years), which 41 (59.4%) were male. The physical activity evaluation showed that only 17 (28.8%) were classified with active of which 13 (76.5%) were less than 2 hours daily in front of a screen (television, video game or computer). The health perception scale (from excellent to bad), 40 (58%) consider their health good and only 7 (10.1%) consider excellent. In addition, 51 (73.9%) reported having practiced some physical activity during the test week, with soccer being the most practiced sport (42%). In the BMI evaluation 34 (49.2%) of the subjects had a BMI above normal (21.7% overweight and 27.5% obesity). In conclusion, asthmatic children and adolescents do not present physical activity levels and body mass index adequate which may aggravate the disease.

The relationship between fundamental motor skills and levels of physical activity is mediated by children perceived competence?

Zanella, Larissa W.; Bandeira, Paulo F.; de Souza, Mariele Santayana; Nobre, Glauber C., Universidade Federal do Rio Grande do Sul; Sartori, Rodrigo, Universidade Federal do Rio Grande do Sul and Pontifícia Universidade Católica do Rio Grande do Sul; Valentini, Nadia C., Universidade Federal do Rio Grande do Sul

Objective: To investigate the relation between motor proficiency and level of physical activity mediated by children perceived competence. **Methods:** 97 children (43 boys and 54 girls; Age: M = 6.37, SD = .57) from public schools in southern Brazil were assessed with Test of Gross Motor Development-Second Edition, the Pictorial Scale of Perceived Competence and Acceptance for Young Children and the Self-Perception Profile for Children. The levels of physical activity were assessed using pedometers during physical education sessions. A causal model of the relationship between fundamental motor skills (locomotor and object control) and the levels of physical activity mediated by the children perceived competence was conducted. The Mplus 7.0 program was used. The significance of the regression coefficients was estimated by the maximum likelihood method. The significance of the direct, indirect and total effects were evaluated using the Sobel method. **Results:** The total model explains 30% of the variability of the level of physical activity. Motor performance had significant overall effect on the levels of physical activity ($\beta = .29$; $p = .03$), direct ($\beta = .12$; $p = .04$) and indirect ($\beta = .17$; $p = .04$) effects mediated by perceived competence. **Discussion:** The competence in fundamental motor skills is important for increase the levels of physical activity in school physical education classes for Brazilian children, this relation is optimized by positive perceptions of competence.

Effect of table tennis practice on timing control in 10-12 year old children

Zheng, Lixin, Shandong University of Technology

It has been demonstrated children are less accurate as compared with adults in coincidence timing tasks, especially when the velocities of the moving object vary from trial to trial (Bard, Fleury, & Gagnon, 1990; Benguigui et al., 2008). Most of the studies have the same results that children respond earlier at slower speeds and later at fast speeds. Accordingly, it is of significance to study the perceptual motor development in children. Recent studies reported that sports practice improves the accuracy of time judgement tasks, for example basketball (Nakamoto et al., 2015) and tennis (Lobjois et al., 2006). Thus, current study aimed to examine the effect of practicing table tennis on the accuracy of coincidence timing tasks in children. 60 children aging from 10 to 12 were recruited for this experiment. 30 of them had table tennis training for more than 2 years (Group 1) and 30 of them had no experience of table tennis or similar kind of training. A 4 meter long horizontal trackway made up of light-emitting diodes was used to simulate the linear motion of objects. The moving object moved from left to right at constant velocities (slow 5 m/s, fast 10 m/s). Participants were required to press a button when the moving object arrived at the target point 3.6 m away from the start position. Participants performed 20 trials for each velocity. Constant error and variable error of time to contact were measured from each trial. A mixed-model ANOVA (2 Group by 2 Velocity) was used for statistical analysis. Our results revealed a significant main effect for group ($p < 0.03$) and a group by velocity interaction ($p < 0.02$) in constant error. More specifically, children who had table tennis training were overall more accurate compared to those without such kind of experience. The interaction indicated that Group 1 was more accurate than Group 2 only when the target's velocity was fast. We conclude that table tennis training may help children improve their perceptual motor ability.

Motor Learning and Control

External focus of attention and autonomy support have additive benefits for motor performance in children

Abdollahipour, Reza, Palacky University Olomouc; Nieto, Miriam Palomo, Universidad Politecnica de Madrid; Psotta, Rudolf, Palacky University Olomouc; Wulf, Gabriele, University of Nevada Las Vegas

The purpose of this study was to examine the combined effects of external focus instructions and autonomy support on motor performance of children. In addition, we sought to provide evidence for an increased focus on the task goal under the external focus condition by using an inattentional blindness manipulation. Thirty-six children (mean age: 8.5, SD: 1.3 years) were asked to perform a bowling task with their dominant hand. In a within-participant design, each participant performed 8 trials under external focus (path of the ball), internal focus (hand), or control conditions. In each attentional focus condition, they performed half of the trials under a choice (autonomy support) condition, in which they were able to choose among 4 bowling balls, and a no-choice condition (white ball). Both attentional focus and choice/no choice conditions were performed in a counterbalanced order. The external focus instruction resulted in greater bowling accuracy (i.e., more pins knocked down) than internal focus and no instructions (control). Furthermore, choice resulted in more effective performance than no choice. Thus, both factors had additive benefits for performance. There was some evidence for an increased task focus in the external condition. The present results show that, within the same individuals, instructions to adopt an external focus and providing them with a small choice contributed independently to enhance motor performance in children.

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Recurrence Quantification Analysis of Gait Coordination in Children: With and Without Footwear.

Applequist, Bryon C.; Motz, Zachary; Kyvelidou, Anastasia, University of Nebraska at Omaha

Gait patterns are characterized by the coordination of the limbs into organized movements to create locomotion, via the interaction with the surface or environment. Proper gait coordination is realized when the movements of numerous segments of the lower body are combined in a manner that is well timed, smooth, and efficient, and results in motion of the body. Children experience disturbances to their gait coordination during development and appear to have less coordinated gait than adults. Footwear provides a constraint at the foot/environment interface that the individual must organize around to maintain proper coordination during gait. Footwear could have a large influence on gait coordination in children. This study investigated the effect of footwear on gait coordination in children. Children with an average age of 7.2 years old participated in a single data collection session. Reflective markers were placed at specific anatomical locations of each participant's lower limb and trunk. Self-selected comfortable walking speed was determined. Three-dimensional kinematics were acquired for one three-minute trial per condition at 60Hz using motion capture software. The conditions included the participants walking on the treadmill while wearing running footwear (Nike Free 5.0) and barefoot. To obtain a measure of gait coordination, the magnitude of the joint flexion/extension angles for ankle, knee, and hip of both right and left legs collectively was calculated. Recurrence Quantification Analysis was performed

on the calculated magnitude time series for each condition. Compared to barefoot, %Determinism, Mean Line, and Max Line were all greater while wearing footwear. The increase of these parameters, points to more regular, less variable, and less complex gait coordination pattern while wearing footwear. It is unknown what long term changes footwear could be imposing on the gait coordination of children. Future research should aim to investigate the implications of changed gait coordination patterns on stability and balance in children.

Assisted Cycle Therapy (ACT) Improved Leisure Physical Activity but Not Sleep in Older Adults with Down Syndrome

Arnold, Nathaniel E.; Ringenbach, Shannon D.; Parker, Luke; Holzapfel, Simon D.; Lopez, Corinna; Szeto, Monica, Arizona State University

Previous research has found improvements in motor and cognitive measures following Assisted Cycle Therapy (ACT) in adolescence with Down syndrome (DS). Our study investigated whether we would find improvements in older adults with DS on measures of leisure physical activity (i.e., GLTEQ) and sleep, which are early indicators of Alzheimer's disease (AD) in persons with Down syndrome. This study consisted of eight participants with Down syndrome (i.e., Mchronological age = 39.20 years, Mmental age = 6.01 years, 5 female, 3 male) that cycled for 30 minutes 3 x/week for eight weeks either at their voluntary cycling (VC) cadence or approximately 35% faster with the help of a mechanical motor during ACT. Our results were consistent with our prediction that leisure physical activity maintained or improved after ACT but decreased after VC. This may be due to increased exercise self-efficacy and positive feelings after ACT. Our results were not consistent with our prediction that sleep would benefit from both VC and ACT. One explanation is that we did not pre-screen for sleep disorders that may have confounded our results. Future research should focus on recruiting more participants and using both objective and subjective measures of sleep and physical activity to improve the generalizability of the results.

Learning effects of auditory feedback on Fitts task

Asher, Stuti; Hatfield, Brent C.; Shea, John B., Indiana University Bloomington

Hatfield, Wyatt, and Shea (2010) demonstrated that auditory feedback regarding the arrival of a cursor at the target in a standard Fitts task can reduce task index of difficulty (ID). The purpose of the present experiment was to investigate the relative permanence of the facilitation effects of auditory feedback reported by Hatfield et al. (2010). All participants (N = 32) performed Fitts task at 3 index of difficulty (ID) levels of 7.2 mm (low), 6.3 mm (medium), and 4.6 mm (high). The experiment consisted of two phases for each of which participants moved a cursor 40 times back and forth (20 cycles) between targets at each ID level on a Wacom graphics tablet. Participants were randomly assigned to 4 groups (n = 8). These groups either received an auditory signal when the cursor entered the target area (AF) or did not receive an auditory signal when the cursor entered the target area (NAF) during Phases 1 and 2 of the experiment. The groups were the auditory feedback-auditory feedback (AF-AF), auditory feedback-no auditory feedback (AF-NAF), no auditory feedback-no auditory feedback (NAF-NAF), and no

auditory feedback-auditory feedback (NAF-AF) groups. Movement time (MT) measures were calculated for each group at each ID level for Phase 1 and 2 of the experiment. Analyses showed there was an increase in MT across all 3 ID levels in both Phases 1 and 2. MT was higher for the groups not receiving auditory feedback as compared to the ones receiving auditory feedback for Phases 1 and 2. MT remained highest across all 3 ID levels for the NAF-NAF group and lowest for the AF-AF group. Transferring from auditory feedback during Phase 1 to no auditory feedback during Phase 2 led to an increase in MT. Finally, there was a decrease in MT when participants remained in the same auditory feedback condition across phases. These findings replicate those of Hatfield et al. (2010) showing the facilitative effect of auditory feedback on performance, but also that this effect does not persist when auditory feedback is withdrawn.

Diving Deeper Into Essential Oils

Avans, Diana E; Dacquay, Cedric; Carter, Keri, Vanguard University

Essential oils are used for therapeutic and medicinal purposes by a variety of cultures. Studies have been conducted on the effectiveness of aromas on cognitive performance, perceived physical workload, and pain responses (Herz, 2009). Aromatherapy was found effective in reducing pain, depression, anxiety and stress in a sample of older adults (Shuk & Tse, 2014). This study tested the claims made by 21drops' Focus essential oil blend extending a previous study by Martinez, Ishizu, & Avans (2016) where significant effects were found with simple RT and FiveChoiceMT in a young adult sample to a sample of middle-aged working adults (N= 26, M = 52 yrs.). They were randomly assigned to treatment or control. Three computerized cognitive tests designed by Cambridge Cognition were used; Match to Sample Visual Search (MTS) a matching test, with a speed/accuracy tradeoff; Reaction Time (RTI) measures time to visual target when the stimulus is either predictable (simpleRT) or unpredictable (choiceRT); and Rapid Visual Information Processing (RVP) a visual sustained attention test. After the pre-test, the researchers applied the oils (treatment or placebo, randomized order) to the groups in a circular motion, five times each to the temples, side of the neck and the back of the neck according to the focus' protocol. The participants were asked to inhale deeply after the application. All participants were then re-tested. Mann-Whitney U was used to compare the groups on the components of the 3 tests. There was no significant difference between the focus oil and the placebo on cognitive performance. Three of the tests approached significance: simple RT ($p=0.08$), simple MT ($p=0.08$), FiveChoice MT ($p=0.06$), MTSmRT ($p=0.06$). Our results showed that the essential oil had little effect on concentration/attention when applied as instructed, although we did have positive results relating to reaction /movement time. We recommend a more structured replication of this study with the separate testing sessions and possibly longer term use and repeated cognitive measures.

Utilizing a Proprioceptive Priming Technique to Enhance Start Mechanics in Sprinting

Balendran, Rumes, California State University, Long Beach; Gill, Gabriel, California State University Long Beach; Becker, James, Montana State University; Vargas, Tiffany; Nakajima, Mimi; Wu, Will, California State University Long Beach

Proprioceptive priming is a technique used to enhance task intrinsic feedback. Currently, few research studies have examined the effectiveness of proprioceptive training on sprint performance. The block clearance and first two steps of the sprint are critical to overall success of the sprint action. The purpose of this study was to investigate the influence of proprioceptive priming on the kinematics of the sprint start. It was hypothesized that the proprioceptive priming strategy would enhance sprint start kinematics and outcome performance. Male and female collegiate sprinters performed two baseline trials, then two proprioceptive priming trials with at least two minutes of rest between each trial. Stride rate, stride length, ground time, air-time, and peak toe height were measured for step1 and step2. Segment angles were measured for the rear lower leg at ankle cross and at take-off along with the trunk forward lean angle for step1 and step2. Kinematic measures were compared to the 'ideal' values from Mann, 2013. Results of the study showed that there was a significant decrease in peak toe height post-intervention for block clearance. In addition, stride rate, air-time, and ground time changed toward the ideal. Based on the results of the study, proprioceptive priming reduced peak toe height for all phases. Furthermore, it improved segment angles closer to the ideal for peak performance. These results suggest that proprioceptive priming has the potential to improve sprint start mechanics and performance. This study provides an insight to the advantages of proprioceptive feedback as a training tool but further research should assess its effect on learning.

Error estimation enhances skill acquisition when learners do not control their feedback schedule

Barros, Joao A.; Nestor, Jacob; Mendoza, Robert; Torres, Lesley; Dillon, Natalie; Venegas, Mark, California State University Fullerton

Allowing learners to decide when to receive feedback improves the acquisition of motor skills (Wulf, 2007). The benefits of self-controlled feedback have been attributed to psychological factors (Chiviacowsky, & Wulf, 2007) and to the increase in cognitive engagement during self-controlled feedback conditions (Sanli et al., 2013). If the benefits of self-controlled feedback are indeed associated with higher cognitive engagement, learners without control over their feedback schedules engaged in activities that increase cognitive engagement, like error estimation, should experience similar skill acquisition compared to learners allowed to choose their feedback schedule. Therefore, the purpose of this study was to verify the impact of error estimation on a yoked feedback condition. Thirty-three undergraduate students volunteered for the study. They were quasi-randomly assigned to either self-controlled (SC), traditional yoked (YK) or yoked with error estimation (YE) feedback conditions. The task required participants to throw a beanbag with the non-dominant hand to a target placed 3 meters away. Points were awarded for each throw based on the distance to the center of the target. Participants completed 6 blocks of 10 practice trials. They were only allowed to see the target in between blocks. Participants received feedback on three trials in each block according to their feedback condition. After 24-hr, participants completed a 10 trial retention test and a 10 trial transfer test with the target placed 4 meters away. No feedback was provided during retention or transfer testing. Performance was analyzed through separate 3 (Group: SC/YK/YE) x 6 (Block) mixed model analysis of variance (ANOVA) with

repeated measures on Block for the Acquisition phase and the Retention and Transfer phase. Results indicated improvement in performance during acquisition ($p < .01$), and that participants in the YE condition outperformed participants in the YK condition during retention and transfer testing. No other differences were identified.

The effects of attentional focus in the preparation and execution of a standing long jump

Becker, Kevin A., Texas Woman's University; Couvillion, Kaylee F.; Fairbrother, Jeffrey T., University of Tennessee Knoxville

While empirical evidence suggests an external focus of attention leads to superior motor performance when compared to an internal focus (Wulf, 2013), high level athletes have reported using an internal focus (Porter & Wu, 2010), or some mixture of thoughts reflecting an internal and external focus (Fairbrother et al., 2016). Professional figure skaters also report shifting between different types of focus during the preparation, execution, and evaluation of skills within routines (Bernier, et al., 2016). An area previously unexplored is whether an internal focus during movement preparation is as detrimental as using it during execution. The purpose of the present study was to determine how an internal and external focus during the preparation and execution of a standing long jump impact the distance jumped. Participants ($N=22$) with no formal training in the standing long jump completed two jumps in a no instruction control condition (CON), followed by two jumps in each of four experimental conditions presented in a counterbalanced order. Two traditional conditions used an external focus (EF) and internal focus (IF) in both preparation and execution of the skill. Two additional conditions involved shifting from an internal focus in preparation to an external focus in execution (I2E), and an external focus in preparation to an internal focus in execution (E2I). The dependent variable was distance jumped (cm), and the data was analyzed using a univariate ANOVA with repeated measures on condition. Sidak post-hoc tests were used for comparisons between conditions. The main effect of condition was significant, $p < .001$. EF and I2E both resulted in significantly longer jumps than CON (p 's = .007, .032). EF was also farther than IF ($p = .018$), and I2E trended toward being farther than IF ($p = .068$). The results replicate previous findings suggesting an external focus benefit during execution. More importantly though, it appears an internal focus during preparation is not necessarily problematic provided the performer shifts to an external focus for execution.

Effect of Foreperiod Regularity on Fractionated Reaction Time

Benedict, Ronald J.; Lai, Qin, Wayne State University

Fractionating reaction time (FRT) chronometrically separates central from peripheral processing, allowing for analysis of variables that may have an effect on either. The purpose of this study was to determine the effect of foreperiod (FP) regularity on the components of FRT. 22 healthy college students signed an informal consent prior to the study. They responded to a visual stimulus in a simple reaction time task where the FP condition (regular or irregular) alternated by block. The duration of the regular FP was 2500 ms, and the irregular FP was one-of-four randomly generated and equally presented times of 1000, 2000, 3000, and 4000 ms. All participants completed 6 blocks of 8 trials. FRT and surface electromyography (sEMG) data were collected digitally through the E-Prime 2.0 software and BIOPAC MP100 System, which were fully integrated and time synced. Employing a counter-balance of condition, participants responded with a rapid thumb press on a key of Serial Response Box for all trials. The sEMG signals were recorded from the abductor pollicis brevis. Results demonstrated significantly shorter times during the regular FP for RT and premotor time (PMT) relative to the irregular. A significant interaction existed between condition and sequence of FP administration for RT, $F=8.14$, $p<.01$ and PMT, $F=9.24$, $p<.01$. Specifically, beginning testing with a regular FP produced the shorter RT and PMT, while beginning testing with an irregular FP produced the longer RT and PMT. A sex difference between FP conditions was not significant for RT, however, females demonstrated a significantly shorter PMT ($p<.05$). Motor time (MT) was not significantly different for all analysis. Importantly, this work suggests a critical first-exposure effect during acquisition and may be useful in developing new training protocols in sport as well as therapy and re-learning. Lastly, the finding that females demonstrated significantly shorter PMT's suggests a favorable sex bias for females when the task requires switching between high and low predictability of stimulus occurrence.

Trajectory analysis of pointing movements: how many trials are needed for reliable data?

Blinch, Jarrod, Texas Tech University; Chua, Romeo, University of British Columbia; Kim, Youngdeok, Texas Tech University

A powerful tool in motor behaviour research is trajectory analysis. A vital issue that has not been investigated is how many trials are needed for a reliable measure of the trajectories. The purpose of the present study was to estimate the minimum number of trials required to achieve the conventional level of reliability for trajectory analysis. We analysed the basic measurements of movements (reaction time, movement time, constant error) and two common methods of trajectory analysis, kinematic landmarks and percent time, within the framework of generalisability theory. Generalisability-studies were used to decompose the total variance of these variables into the percent contributions from person, trial, and the person by trial interaction. Decision-studies were

then used to determine the minimum number of trials required to achieve the conventional level of reliability ($G \geq .80$). More trials were needed for reliable reaction time data in simple reaction time tasks (10 trials) than choice tasks (6 trials). One might think that because simple reaction time is shorter and, typically, less variable than choice reaction time that it would have less person by trial variance, but the opposite was true. We were surprised that movement time required only 3 trials whereas constant error required 47 trials. The time and magnitude of positive peak acceleration, peak velocity, and negative peak acceleration required five trials or less to achieve the desired level of reliability. As for the percent time trajectories, the number of trials required slowly increased from 4 trials at 10% to 12 trials at 80%. The number of trials then double from 80 to 90% and doubled again from 90 to 100% (23 trials at 90% and 47 trials at 100%). The change in the absolute variances throughout the movements was indicative of online control in the latter half of the movements. Online control was beneficial to home in on the targets but it caused the large increase in the number of trials required to achieve minimum reliability at 90 and 100% of the movements.

Training and transfer of visual anticipation in skilled cricket batsmen

Brenton, John; Muller, Sean; Dempsey, Alasdair, Murdoch University

Visual anticipation skill differentiates players across the skill continuum and enables the capability to cope with high time constraints in striking sports. Literature investigating methods for training and transfer of visual anticipation is scant particularly in skilled players. The purpose of this on-going study is to determine the value of perceptual-only and perceptual-motor training to learning and transfer of visual anticipation in skilled cricket batsmen. A pre- and post-test design with transfer tests was employed. Batsmen from two elite level clubs were randomized into three groups. A perceptual-only group ($n=7$) received temporal occlusion point-light display training. A perceptual-motor group ($n=7$) received the same point-light display training, but were also required to bowl what they viewed. A control group ($n=7$) participated only in the testing phases. The intervention groups received two training sessions per week over a four week period. The point-light displays were temporally occluded at and after ball release to progressively challenge learning. Feedback was available through an un-occluded replay of the point-light training trial or by perceiving the outcome of the bowled balls trajectory. The pre and post-tests consisted of a video-based temporal occlusion test of a fast bowler, whilst the transfer tests included different fast and slow bowlers. All tests included occlusion conditions prior to ball flight. During test and training phases participants responded to the videos with a simulated sport-specific motor response. Preliminary analysis indicates that both intervention groups, but not the control group, improved anticipation from below to above chance level from pre to post-tests. Only the perceptual-motor group performed above chance across all temporal occlusion conditions in the transfer tests. These findings will be discussed in relation to the common-coding and motor system simulation theoretical frameworks, with practical application for players and coaches.

Does the dimension (2D or 3D) of a visual presentation influence RT and MT in an imitation task?

Buchanan, John; McCulloch, Austin; Muthukumaraswamy, Sivakumar; Banerjee, Amarnath, Texas A&M University; Robson, Nina, California State University Fullerton

This study investigated the imitation of arm actions as a function of the visual environment. Participants ($n = 21$, females = 14) viewed a stick figure representation of four different actions: 1) index finger pointing, 2) forming a fist, 3) wiggling of the fingers on the horizontal plane, and 4) rhythmic flexion-extension of the forearm on the horizontal plane. The actions were presented as a 2D stimulus on a standard computer monitor (21") or participants wore an Oculus Rift headset, where the image was presented in 3D. The participants' task was to view and imitate the actions. The design was within subject with participants performing in the 2D and 3D settings with visual setting counterbalanced across participants. Each action was imitated 4 times and the actions were presented randomly in each setting. Each trial started with a beep followed by the presentation of the action. When the action was complete a second beep sounded. Participants were instructed to perform the action upon hearing the second beep. Reaction time (RT) and movement time (MT) were computed. The four actions were identified correctly on every trial. The analysis of the RT data found that participants took on average 212 ms longer to react to the pointing action compared to the other three actions ($p < .001$). There was no difference in RT based on the 2D and 3D settings ($p = .39$). The finding that RT was not different between the two visual environments was important. This experiment was an initial test of a rehabilitation protocol designed for upper-limb training in stroke patients and the RT results suggest that visual dimension does not influence action identification or preparation processes. The analysis of the MT data found that MTs were 900 ms longer in the 3D setting compared to the 2D setting ($p < .001$), and that MT was longest when imitating finger wiggling, with no difference between the other actions. In the 3D setting, vision of the arm was blocked and this may explain the MT difference. Future work will explore the use of visual feedback within the 3D environment.

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Infants' attraction for water: A dangerous play

urnay, Carolina, Edith Cowan University; Cordovil, Rita, University of Lisbon; Button, Chris, University of Otago; Croft, James, Edith Cowan University

Drowning and falling are the second and the third highest causes of accidental death in children in the European Union (MacKay & Vincenten, 2012). Studying how infants interact with water and upon high surfaces has a clear practical importance. In this study, we assessed infants' perception and behavior near water surfaces and potential falls using a 'water cliff' and a 'real cliff' (75 cm high). Thirty-eight infants aged 8.5 to 14.7 months (11.50 ± 1.53), with crawling experience between 3 days and 5.8 months (1.82 ± 1.48) were placed on a platform, once with a real cliff and once with a water cliff, in a random order. Infants had the opportunity to freely explore the platform while their mothers were calling them. Some infants moved immediately to the cliff, but others explored the whole platform and showed avoidance behaviors, such as shaking the head as a 'no' sign or retreating from the edge of the cliff (Burnay & Cordovil, 2016). The number of falls, time to approach the cliff, and 'latency to fall' (i.e., time between reaching the platform edge and the end of the trial, due to fall or time limit) were analyzed. The infants went over the edge of the water

cliff and the real cliff a similar number of times (14 and 13, respectively), suggesting that, despite the differences between air and water, infants perceived both the sudden drop-off and the water similarly. However, exploratory behaviors differed: infants retreated and spent more time away from the edge of the real cliff (22% of 'latency to fall' time, SD = 31.6, n = 36) than from the water cliff (5% of 'latency to fall' time, SD = 16.5) ($Z = -3.18$, $p < 0.001$). Moreover, when new crawlers were analyzed separately, they approached the water cliff faster (19.5 s, SD = 18.3; n = 17) than the real cliff (63.0 s, SD = 70.1; n = 19) ($Z = -1.99$, $p = 0.046$), clearly indicating less cautious behavior near water and more enticement toward the water surface. If infants are attracted toward water more than air, they may be at greater risk of immersion, and thus drowning accidents.

Does scaling sports equipment facilitate implicit motor learning?

Buszard, Tim; Whiteside, David, Victoria University; Reid, Machar, Tennis Australia; Masters, Rich, University of Waikato; Farrow, Damian, Victoria University

Scaling sports equipment for children leads to more success and more desirable movement patterns. Evidence also suggests that scaling equipment reduces attention demands when executing skills, which might encourage a more implicit style of learning. Our experiment tested the hypothesis that scaling equipment facilitates implicit motor learning. Thirty-two beginner tennis players aged 6 to 9 years performed a forehand hitting task. The aim of the task was to hit the ball so that it landed on a 0.5m x 0.5m target. A scoring system was used to measure hitting accuracy. Participants were stratified randomly into a SCALED group and a FULL-SIZE group. The SCALED group used a 21 inch tennis racket and a low compression ball, while the FULL-SIZE group used a 27 inch tennis racket and a standard tennis ball. Participants performed 11 blocks of 20 practice forehands across two-days, with pre- and post-tests conducted before and after practice. The post-test included a dual-task condition, wherein participants concurrently performed a forehand and counted aloud. Following practice, participants were also asked to verbally recall the strategies that they used to hit the ball. Three-dimensional joint kinematics were captured using an 12-camera VICON system operating at 250Hz. Results showed that both groups significantly improved from pre- to post-test ($F_{1, 30} = 7.24$, $p = .01$); however, there was no Group x Time interaction ($F_{1, 30} = 3.81$, $p = .06$). Neither group displayed a significant performance decline in the dual-task test ($F_{2, 60} = 0.01$, $p = .99$), but the FULL SIZE group did verbally recall having used more rules to perform the task than the SCALED group. Movement kinematic data (forthcoming) will provide further evidence of the effect of equipment on performance. While the results offer some support that scaling equipment encourages implicit motor learning, evidence linking full size equipment with explicit learning was weak. Discussion will focus on individual differences that might influence implicit-explicit learning in addition to the equipment being used.

Optimizing motor learning: Matching individual differences in working memory capacity to different learning interventions

Canal-Bruland, Rouwen, University of Jena; Kishna, Kevin; der Zande, Jesse van; der Kamp, John van, Vrije Universiteit Amsterdam

There is a long-standing debate about which learning intervention to acquire new motor skills is best. Traditionally, explicit interventions (e.g., verbal instructions) are applied to facilitate learning. However, implicit interventions (e.g., using analogies) are shown to be effective too. While explicit interventions aim at the accumulation of declarative knowledge, and hence rely on working-memory (WM) capacity, implicit interventions are directed to the automatic accumulation of procedural knowledge, and hence do not (or to a much lesser degree) rely on WM capacity. However, Baddeley and Hitch's (1974) distinction between the temporary storage of verbal and visuospatial information, the phonological loop and the visual sketchpad, has received little attention in relation to the effectiveness of explicit and implicit learning interventions. Here, we examined whether benefits resulting from different learning interventions are related to either verbal or visuospatial WM capacities. To test this, 103 school children (mean age = 13 years) were assigned to four different intervention groups (explicit instructions, analogy instruction, differential practices, control group). Administering a pre-, post-, and retention-test design, children in the different intervention groups practiced shot putting across three sessions. To assess verbal and visuospatial WM capacity, the listening and spatial recall tests of the AWMA (Alloway, 2007) were applied. Results revealed that verbal WM capacity predicted performance improvements following explicit interventions. Instead, visuospatial WM capacity predicted performance improvements following analogy instructions. No such relationships were found for the differential practice group. The results confirm that performance improvements resulting from different learning interventions are predicted by either verbal or visuospatial WM capacities. This finding indicates that no motor learning intervention per se is superior, and that learning interventions should cater for individual differences in, for example, WM capacity.

Gaze direction and foot sensation influence foot placement during goal-directed stepping

Celestine, Shyrece D.; Donze, Victoria G.; Bellingham, Nicholas J.; Buie, Keenan J.; Hondzinski, Jan M., Louisiana State University

Sensory feedback from vision and the lower limbs can decrease standing sway, improve postural control, and assist with accurate foot placement when stepping. Additionally, diverting gaze away from targets and stepping with reduced foot sensations decreases upper limb accuracy during goal-directed reaching movements. People with reduced foot sensations may depend more on vision when attempting to perform goal-directed tasks accurately because of their compromised somatosensory system. These findings suggest that peripheral vision associated with diverting gaze may also influence accurate foot placement on targets and possibly more so for people with reduced foot sensations. Thus, the purpose of this study was to determine whether diverting gaze or having reduced plantar sensations would influence step accuracy. Barefooted young adults with intact plantar sensation and older adults with varied levels of plantar sensation began with feet 28 cm apart and stepped toward floor targets located at a comfortable step distance. Gaze was directed on or eccentric to target location (left/right 28 cm). Records of foot movement offered insights to step accuracy. Center of pressure recordings during performances offered insights to imbalance (weight shift toward stepping foot) and unloading (weight shift toward stance foot) phases of anticipatory postural adjustments.

Foot placement was most variable for each subject when gaze was directed eccentrically and for older adults with reduced plantar sensation. In fact, having reduced plantar sensation resulted in greater foot placement variability than being older or having gaze directed eccentrically. The imbalance phase was often shortest for older adults, while the unloading phase was often shortest in older adults with sensory reductions, probably to reestablish a two-footed, more stable stance quickly. Sensations of the feet are a greater determinant of stepping accuracy than gaze direction and age. The data support previous research on the importance of somatosensory feedback for accuracy during goal-directed stepping tasks.

The Effects of attentional focus on limb loading in individuals following anterior cruciate ligament reconstruction

Chan, Ming-sheng M.; Lin, Paige E.; Hernandez, Emily L.; Fisher, Beth E.; Sigward, Susan M., University of Southern California

The purpose of this study was to investigate the effects of attentional focus on loading symmetry in individuals post anterior cruciate ligament reconstruction (ACLR). Five individuals 98 +/- 16 days post-ACLR were asked to perform bilateral stand in 4 conditions: natural (N), instructed (IN), and prioritizing focus on response (RT) and loading symmetry (LS). There was no instruction to loading in N, but an instruction to load symmetrically in IN. In focus prioritization conditions, participants performed an upper extremity response task (UE) while standing and prioritized focus on RT and LS, respectively. The task required participants to tap illuminated targets as fast as possible on a light board and maintain LS. LS was quantified as a ratio of ground reaction force impulses between surgical and nonsurgical limbs. RT was determined as the time between target illumination and tap by participants. Repeated measures one-way ANOVA with post-hoc paired t-tests were used to determine the effects of focus on LS and paired t-test was used to compare RT ($\alpha = .05$). Results: LS improved when participants attended to LS in instructed condition compared to natural condition (N: .90 +/- .07 vs IN: .95 +/- .09, ES: 1.1). Compared to instructed condition, LS decreased when they performed the UE task and attention was prioritized to RT (IN: .95 +/- .09 vs RT: .85 +/- .09, ES: .66). However, loading was more symmetrical when they performed the UE task and attention was prioritized to LS compared to when attention was prioritized to RT and natural condition (LS: 1.01 +/- .09 vs RT: .85 +/- .09, ES: 1.8; LS: 1.01 +/- .09 vs N: .90 +/- .07, ES: .96). When considering RT, RT decreased when focus was prioritized to LS (RT: .57 +/- .03s vs LS: .64 +/- .04s, ES: 2.3). It is suggested that individuals post ACLR improve limb loading symmetry during bilateral standing when they focused on loading. However, maintaining limb loading symmetry during bilateral standing required additional cognitive resource as evidenced by decrease symmetry when focus was directed to a secondary task.

Hedonic states in sequence learning: A comparison of pre-learning pleasure states induced by focused-attention meditation and sustained attentional task.

Chan, Russell W.; Immink, Maarten A.; Lushington, Kurt, University of South Australia

Through their influences on cognitive control processes, hedonic states are able to

modulate motor sequence learning and representation. For example, positive hedonic states are thought to promote flexible attention control policies that benefit sequence learning. As meditation induces positive hedonic states, the present experiment tested if meditation imparts benefits for sequence learning and if this benefit is associated with increased pleasure. Prior to a serial reaction time task (SRTT) with a repeating second order conditional sequence, 56 meditation naive participants completed either focused attention meditation (FAM), a sustained attention task (ATT) or rested as a control condition (CON). The attention task condition was included to contrast if meditation benefits sequence learning through increased attention control instead of pleasure. Relative to resting baseline, pleasure scores did not change following FAM and CON, while pleasure was significantly lower following ATT. Relative levels of pleasure preceding SRTT were found to positively correlate with sequence-dependent learning although, groups demonstrated comparable improvements in reaction time as well as sequence-dependent learning in the SRTT. These results indicate that with inexperienced meditators, meditation does not promote positive hedonic states any greater than a period of rest. In addition, a single session of meditation or completion of a sustained attention task do not appear to provide any greater benefits for sequence learning than a period of rest. Further research is needed to investigate if a period of meditation training is needed in order for increase positive hedonic states to be established by a session of meditation so as to benefit sequence learning.

Does the Part Sequence Cuing Effect Exist in Recalling a Serial Motor Skill?

Chen, David D.; Polic, Nicola; Lam, Kevin; Togia, Brelani, California State University Fullerton

Studies using lists of words indicate that people will do more poorly when queued with a subset of the words in the list and instructed to recall the remaining items from a previously studied list than controls who are instructed to recall as many words as possible without any cuing (Slamecka, 1968; Nickerson, 1984). This part-list cuing effect originally identified in studies of words has not been tested using motor skills. The current study used a serial motor skill consisting of a sequence of 15 random movements in order to test if a part-sequence cuing effect would occur. Forty-four volunteering participants were assigned randomly to one of the three groups: 1) control, 2) sequential cuing (SC), and 3) random cuing (RC). The cuing task consisted of three randomly selected movements from the original sequence. Testing occurred in three phases: 1) acquisition, 2) distraction, and 3) recall. Participants viewed the serial skill on a PC monitor for three consecutive times during acquisition. In the distraction phase, participants performed arithmetic calculations on a laptop computer for 5 min. In the recall phase, all participants were instructed to recall the skill in the correct order. Control participants were told to recall as many movements as possible. SC participants were shown a 3-movement subsequence video before recall while RC participants were shown three movements randomly taken from the primary serial motor skill. Dependent variables included the number of movements recalled in the correct order from beginning and from anywhere in 2-movement units. The recall phase was recorded on video. The experiment lasted about 30 minutes. Two one-way ANOVAs on two data sets showed no significant effects ($p > .10$). The results did not confirm the presence of the part-sequence effect in recalling the serial motor skill. Future research should use a slightly modified protocol to reflect the differences between motor skills and verbal skills.

Examining the role of interhemispheric inhibition of primary motor cortex on subsequent consolidation of sequence learning

Chen, Jing; Kim, Hakjoo; Johnson, Brandon; Wright, David L., Texas A & M University

Numerous studies have identified the primary motor cortex (M1) as a critical neural site for motor sequence learning. Previous work has revealed that anodal stimulation of contralateral M1 immediately after practice can enhance test performance when compared to sham condition. In most cases, the electrode montage used to accomplish this outcome involves the cathode placement on the ipsilateral supraorbital location or shoulder. However, M1 excitability is not only impacted by contralateral anodal stimulation but can be modulated by cathodal placement at ipsilateral M1 which exerts inhibition of contralateral activity. As a first examination of the potential role of ipsilateral M1 for consolidation following training, the present experiment used three stimulation protocols using 1 mA with 5 x 5 cm electrodes: a) bi-hemisphere with anodal tDCS over contralateral M1 and cathodal tDCS over ipsilateral M1, b) bi-hemisphere with cathodal tDCS over contralateral M1 and anodal tDCS over ipsilateral M1, and c) uni-hemisphere with anodal tDCS over contralateral M1 and cathodal tDCS placed on ipsilateral shoulder. Our expectation relative to (c) was that (a) would enhance test performance, and (b) would be associated with relatively poorer performance. Thirty-six right handed young adults practiced an 8-element motor sequence with their left hand. Following training, each subject was exposed to one of the stimulation protocols (a-c). Approximately two hours later, participants return to lab and were administered a retention test. Preliminary examination of these data revealed anodal stimulation was associated with significant consolidation. Both bi-hemispheric and uni-hemispheric anodal stimulation provide a small but positive influence on performance after the 2-hr interval suggesting minimizing inhibition at ipsilateral M1 had little impact.

The role of primary motor cortex on consolidation during motor sequence learning

Chen, Jing; McCulloch, Austin; Park, Inchon, Texas A&M University; Buchanan, John J., Texas A & M University; Kim, Taewon, Texas A&M University; Wright, David L., Texas A & M University

Primary motor cortex (M1) is a key neural participant during motor sequence learning. Tecchio et al. (2010) revealed that the application of anodal transcranial direct current stimulation (tDCS) at contralateral M1 immediately following training facilitated subsequent test performance compared to a sham control. It was argued that tDCS supported important consolidation processes critical to offline improvement of the practiced sequence. However because the test phase was administered only 15-min after tDCS application, one cannot rule out the possibility that performance facilitation was a result of known tDCS after-effects rather than on consolidation. The present experiment addressed this issue by extending the work of Tecchio et al. by utilizing a 2-hr delayed retention test following the administration of anodal, cathodal, or sham stimulation. If consolidation is influenced by this non-invasive stimulation protocol then test performance should be superior for the anodal compared to other stimulation

conditions. Thirty-six right handed young adults experienced two sets of five blocks with the same finger tapping series (3-1-4-2-4-1-3-2) using their left hand. During each block, subjects are required to repeat the finger tapping series as accurately as possible and as fast as possible in 30 seconds. Following training, participants were exposed to 15-min of 1.5 mA anodal or cathodal stimulation or a sham protocol. Approximately two hours later, participants return to the lab and completed a retention test. Initial assessment of the data revealed the novel finding that cathodal stimulation imparted a significant disruptive effect on test performance suggesting important offline processes occur in a brief temporal window following practice and this cognitive activity can be influenced by exogenous non-invasive brain stimulation.

Temporal comparative feedback facilitates motor learning in children

Chiviacowsky, Suzete; Harter, Natalia M., Universidade Federal de Pelotas

Acting in order to satisfy people's self-evaluation goals, temporal comparison describes the set of opinions and abilities that constitutes an individual self-description at different points in time (Albert, 1977). Higher learning and self-efficacy levels have been observed in adult participants who received general feedback informing them that their performance had gradually improved across blocks of practice, compared with participants who were informed that their performance had slightly degraded over time (Chiviacowsky & Drews, 2016). The present study tested the influence of temporal-comparative feedback on the learning of a throwing task in 10-year-old children. Two groups of participants, a positive temporal-comparative (PTC) feedback group and a control group, received veridical feedback about their accuracy scores after every other practice trial (50% of practice trials). In addition, after each block of 10 trials, the PTC group was given feedback suggesting that their average performance was better than it was in the previous block. A retention test was performed one day after the practice phase to observe learning effects. The results demonstrated that PTC feedback enhances the learning of a throwing task in children. Greater accuracy was observed on the retention test for the positive temporal comparison group relative to the control group. The findings highlight the important motivational role of feedback in motor learning and provide the first evidence that positive temporal comparison enhances the learning of motor skills in children.

Comparing the Influence of Cognitive, Sensorimotor, and Limbic Triggers of Freezing of Gait in Parkinson's Disease

Chow, Rebecca, Wilfrid Laurier University; Tripp, Bryan, University of Waterloo; Almeida, Quincy J., Wilfrid Laurier University

Freezing of gait (FOG) is arguably one of the most debilitating motor symptoms of Parkinson's disease (PD). The underlying mechanism of FOG remains inconclusive, however studies have identified different triggers for FOG which target the upstream cognitive, sensorimotor, and limbic domains independently (Maidan et al., 2015; Ehgoetz Martens et al., 2013; Ehgoetz Martens et al., 2014). Thus there is potential for these

independent underlying mechanisms of FOG to lead to different potencies of producing FOG. Others would argue that that one type of manipulation might trigger more FOG regardless of the upstream domain most involved. This study aimed to compare cognitive, sensorimotor, and limbic triggers of FOG, in order to identify which has the greatest influence on severity of FOG. Seventeen individuals with idiopathic PD who also experience FOG completed a gait task in three different conditions which challenged the cognitive, sensorimotor, and limbic domains independently. These respective conditions included walking: (1) while digit-monitoring as a dual-task (COG), (2) in complete darkness (SENS), and (3) on an elevated walkway (ANX). The mean frequency and mean total duration of FOG episodes across all trials were compared between conditions using a one-way repeated measures ANOVA. A main effect of condition was demonstrated for both the frequency ($p=0.0055$) and total duration ($p=0.019$) of FOG episodes. Post hoc analysis for frequency revealed that the SENS condition had a significantly greater number of FOG episodes compared to the COG ($p=0.01$) and ANX conditions ($p=0.016$). Regarding duration of FOG episodes, post hoc analysis indicated that the SENS condition only had a significantly greater duration of FOG compared to the COG condition ($p=0.021$), but not ANX. These findings appear to indicate that walking in complete darkness (i.e. challenging proprioception) could have the most robust influence on severity of FOG, and may be a critical underlying mechanism to consider in the development of therapeutic interventions.

Local stability of center of mass improves from a 10-minute trip-training session

Cone, Brian L.; Kuznetsov, Nikita A., University of North Carolina at Greensboro; Lockhart, Thurmon E., Arizona State University; Rhea, Christopher K., University of North Carolina at Greensboro

Recent evidence from fall prevention research has suggested that those at a higher risk of falling would benefit from a training program that involves repeated trips and/or slips. While several biomechanical variables have shown improvement from these sessions, there is a lack of information on how these repeated perturbations might affect the stability (resistance to change) of an individual. The purpose of this study was to measure how a 10-minute trip-training session affects the local dynamic stability of the center of mass (COM), which indicates how well the locomotor system responds to intrinsic variability during gait. This project utilized the short-term maximum Lyapunov exponent (LyE) to examine how the stability of the COM changed before and after 10 minutes of repeated trips. Young, healthy adults ($N=28$, 23.1 ± 3.7 years) completed a 10-minute trip-training session at preferred walking speed on an ActiveStep treadmill. A trip was induced every 100-200 steps via a sudden belt deceleration followed by a rapid belt acceleration to the pre-trip velocity, resulting in ~10 trips per participant. Full-body kinematic data was captured at a sampling rate of 200 Hz. COM was calculated via a 13-segment model and the COM acceleration was derived from the position-based time-series. LyE used the COM acceleration time-series to calculate the rate of divergence during gait, with a lower value indicating improved stability. LyE values were calculated from the first and last 50 steps of the session. There was a significant decrease in the short-term LyE from the first 50 steps ($3.65 \pm .424$) of the session to the last 50 steps ($3.47 \pm .367$) of the trial ($p=.014$). These results suggest that the trip-training session improved the locomotor system's resistance to small local perturbations that can be due to internal or external stressors.

Expecting to teach enhances motor learning and information processing during practice

Daou, Marcos; Lohse, Keith R.; Miller, Matthew W.; Rhoads, Jence, Auburn University

There is some evidence that people learn academic (declarative) information better when studying with the expectation of having to teach, but this has not been demonstrated for perceptual-motor skills, which also rely on declarative information but more heavily on procedural knowledge. To address this possibility, we conducted a series of three experiments wherein participants studied golf instructions and practiced putting with the expectation of having to teach another participant how to putt or the expectation of being tested on their putting. Learning was assessed with delayed posttests (1-day and/or 7-days later), wherein all participants were tested on their putting. The first experiment (N = 56) revealed expecting to teach enhanced motor learning, but did not elucidate the mechanisms underlying the effect. The second experiment (N = 56) replicated the first experiment's results and revealed expecting to teach increased information processing, as reflected by lengthened motor preparation time preceding practice putts. However, it was still unknown whether this increased motor preparation time explained the effect of expecting to teach on motor learning. In the third experiment (N = 80) we attempted to answer this question. Specifically, we limited motor preparation time preceding practice putts for half of the participants who were expecting to teach and half of the participants who were expecting to test, in order to see if the expecting to teach advantage for motor learning disappeared for participants whose motor preparation time was limited. Results revealed the effect of expecting to teach on motor learning was eliminated for both participants whose motor preparation time was limited and those participants whose motor preparation time was not. However, expecting to teach still yielded a motor learning benefit that was directionally consistent with the first two experiments. Taken together, the three experiments indicate expecting to teach enhances motor learning, and suggest the underlying mechanism may be related to motor preparation during practice.

Anticipatory awareness of action in adults diagnosed with Developmental Coordination Disorder

Deconinck, Frederik J.A., Ghent University, Belgium; Verhaeghe, Aron; Degroote, Laurent, Ghent University, Belgium

Anticipatory awareness refers to the phenomenon that individuals judge the initiation of an action as being prior to the actual time of initiation of that action. Research shows that this awareness of action is critical for motor control, more in particular for planning and building efference copies of action. The aim of the current study was to investigate anticipatory awareness in individuals with DCD, who are known to have difficulties with motor planning. To this end, twelve young adults, 18-25 years of age, who were diagnosed with DCD in childhood and twelve adults without motor problems performed a classic Libet task with two different conditions. The first required participants to watch a rotating clock hand on a computer display, and to press a key whenever they felt like it.

Then, they were asked to recall and indicate the location of the clock hand at the moment of initiation of their finger movement. In the second condition, the pursuit task, participants tracked a rotating clock hand that disappeared automatically after a random period of time. Now the instruction was to indicate the location of the clock hand when it disappeared. The results of condition 1 indicated that individuals with DCD marked the time of initiation to be 22 ms after the actual key press, which was not significantly different from the judgement by individuals without DCD (16 ms). When the task was to indicate the moment of occlusion of a target, the participants with DCD appeared to perform better than their peers. Controls judged the location occlusion to be 30 ms after the actual location, whereas this was only 3 ms in individuals with DCD. These findings indicate that, in contrast to previous reports, neither of the two groups demonstrated anticipatory awareness in a simple Libet task. Yet, individuals with DCD fail to show motion prediction in the pursuit task, which reflects a feedforward processing deficit. It is remarkable that this fundamental ability, which is a prerequisite for many motor tasks, seems to be lacking in individuals with DCD, even in adulthood.

Increased autonomy facilitates learning in a self-control protocol

Deel, Nicole M.; Geddes, Helen M.; Aiken, Christopher A., Alma College

Previous research has shown a benefit to providing learner-control over some aspect of the learning environment (see Wulf, 2007). The underlying mechanism for this effect is not entirely understood. One potential explanation suggests that allowing control enhances the autonomy of the learner which may facilitate the effect on motor skill learning (Chiviakowsky, 2014). The purpose of the present study was to directly investigate the effects of increased autonomy in a self-control protocol. 30 individuals participated in the study and practiced a golf putting task. Individuals were required to putt a colored golf ball to the center of a target that was 4m away. The target had eight concentric circles. The center circle was 20cm in diameter and each sequential circle increased in diameter by 40cm. Acquisition consisted of 50 trials (10 blocks of 5) where participants were allowed to choose the color of the golf ball during practice from one of five colors. Individuals were quasi-randomly assigned to either a high (HA) or low (LA) autonomy group. HA chose the color of the ball prior to each practice trial (50 total choices) whereas LA chose the ball prior to each practice block (10 total choices). Participants then filled out a modified Basic Need Satisfaction (BNS) survey to measure autonomy. 24 hours following acquisition, individuals performed a 5 trial retention test with a white golf ball and then a 5 trial transfer test from a distance of 5m. During acquisition the groups improved their putting performance from the beginning to the end of practice ($p < .05$) but did not differ significantly from one another ($p > .05$). HA had significantly better performance during the transfer test ($p < .05$) but not during retention ($p > .05$). Results of the questionnaire did not reveal a significant difference between the groups ($p > .05$). The results from this study suggest that increasing autonomy during practice through an increase in choice facilitates motor skill learning. It also appears that the BNS is not sensitive enough to find differences in autonomy with such a small change.

Focus of attention in trained distance runners

Diekfuss, Jed A.; Luther, Morgan B.; Yamada, Masahiro; Raisbeck, Louisa D., University of North Carolina at Greensboro

The benefits of using an external focus of attention compared to an internal focus of attention have been documented in trained distance runners (Shucker et al., 2009). However, little research has examined the focus of attention distance runners typically adopt or where these strategies are derived from. The purpose of this study was to describe the focus of attention used by distance runners in practice and competition and better understand where these strategies are adopted. Sixteen distance runners (32.1 ± 10.0 yrs.) who run at least 20 miles per week (37.7 ± 10.8 miles per week) completed a questionnaire pertaining to their focus of attention (adapted from Diekfuss & Raisbeck, 2016). The questions we examined for this project were: 1) which of the following do you typically focus on while training for a competition? 2) which of the following do you typically focus on while competing? 3) when looking for training tips and advice, where do you typically seek information? Each question had four possible answers derived from previous literature and descriptive statistics were used to quantify the findings. For question 1 (focus during training), 56.3% of the participants reported an internal focus, 18.8% an external focus, and 25.0% reported both. For question 2 (focus during competition), 33.3% reported an internal focus, 26.7% reported an external focus, and 40% reported both. For question 3 (training tips), 80.0% reported 'coach or training partner,' 20.0% reported 'magazines,' and zero participants reported 'academic journal articles or textbooks'. These results suggest that the beneficial effects of an external focus of attention have not been fully adopted by our sample of distance runners. Further, it seems that most training advice comes from word of mouth via coaches, training partners, etc. We suggest a need for disseminating research to the public to aid in a shift towards the most appropriate forms of attentional focus in distance runners.

The effects of an external focus of attention on brain activation during acquisition and retention

Diekfuss, Jed A.; Slutsky, Alexis B., University of North Carolina at Greensboro; Grooms, Dustin R., The Ohio State University; Schmitz, Randy J.; Raisbeck, Louisa D., The University of North Carolina at Greensboro

The motor learning benefits of using an external relative to internal focus of attention (FOA) are well documented. However neural correlates of FOA to skill acquisition and retention are poorly understood. The purpose of this study was to investigate brain activation differences of a lower extremity gross motor movement using an external FOA during acquisition and retention. Participants ($n = 9$) were randomly assigned to external FOA or internal FOA and completed 45° knee extension/flexion movements laying supine in a MRI scanner for 4 blocks of 30 seconds interspersed with 30 second rest blocks. This sequence was repeated four times for acquisition and was completed once for retention five minutes later. For the acquisition blocks, participants were instructed to 'squeeze their quadriceps' during the internal FOA or to 'focus on a target' positioned 3 inches above their tibia during the external FOA. For the retention blocks, no FOA instruction was provided and the target was removed for the external FOA. A second level fixed-effects unpaired samples t-test was used to contrast brain activation between external and internal FOA during acquisition and retention phases. For acquisition, there

was significantly greater brain activation in the precentral gyrus ($z = 10.26$, $p < .001$), occipital pole ($z = 6.45$, $p < .001$), and frontal pole ($z = 4.74$, $p < .001$) during the external FOA. For retention, there was significantly greater brain activation in the postcentral gyrus ($z = 7.87$, $p < .001$), lateral occipital cortex ($z = 6.45$, $p < .001$), and frontal pole ($z = 4.51$, $p < .001$) during the external FOA. Our results revealed that the precentral gyrus, the primary motor area, was activated during acquisition, but the postcentral gyrus, an area associated with movement planning, was activated during retention for the external FOA. Our data suggest that although similar brain regions, such as the occipital pole and frontal pole, are active during acquisition and retention for external FOA, but more neural planning is required when external FOA instruction is removed.

Offline process during initial acquisition of motor sequences is not an artifact of fatigue

Du, Yue; Clark, Jane E., University of Maryland, College Park

Many have suggested that the initial acquisition of motor sequences in adults is driven by online learning, as expressed by progressively decreased reaction time (RT) as an individual continuously performs the serial reaction time (SRT) task. However, when the sequence was more complex (i.e., a probabilistic sequence), RT deteriorated online, but subsequently improved following a two-minute break, indicating an offline learning process (Du et al., 2016). To date, the most common hypothesis for this offline phenomenon is the emergence of fatigue and reactive inhibition that accumulate when an individual continuously performs the task and dissipate after a rest, yielding an illusory offline RT enhancement. To test whether the offline process observed during sequence learning resulted from fatigue and reactive inhibition, we asked one group of adults ($n=10$; massed training) to perform the SRT task that had six learning blocks of 120 trials each and a 2-minute break between blocks. To weaken the possible fatigue and reactive inhibition that build up within each block, the other group of adults ($n=10$; spaced training) was given an additional 20-second break after each 24 trials within the learning blocks. Both groups learned the sequence and to a comparable level as revealed by the acquisition of stimulus transitions with higher probabilities. Consistent with our previous study, RT deteriorated online and improved offline in the massed training group. In the spaced training group, although RT did not increase within blocks, there were still offline RT improvements after 2-minute breaks. Remarkably, only the stimulus transitions of higher probabilities that were learned by participants exhibited the offline RT improvement while RT to stimulus transitions of lower probabilities did not change after the 2-minute break. These results suggest that fatigue and reactive inhibition are not the primary resource underlying the offline process during probabilistic motor sequence learning. Rather, the offline RT improvements are likely to result from active learning mechanisms.

Physiological stress differentially impacts target detection of men and women

Duarte, Antonio F.A., Brazilian Army Physical Training Center; Fawver, Bradley, University of Utah; Wright, Allison; Beatty, Garrett F.; Janelle, Christopher M., University of Florida

Control of selective visual attention is crucial to target detection, particularly when

mentally or physically stressed. In such conditions, autonomic nervous system (ANS) modulation, which is known to differ between men and women, may play an important role in the stress response, attentional alterations, and resulting target detection performance (TDP). We investigated gender differences in postexercise cardiac autonomic modulation as indexed by heart rate variability (HRV) and TDP. Male (M; $n=16$; 20.9 ± 1.6 yrs) and female (F; $n=16$; 20.2 ± 0.9 yrs) participants completed a 5 min computer-based visual search task (VST) under resting conditions (Rest) and after a 30s Wingate bike test (Post-Ex), in different sessions. The VST required participants to identify whether a target (T-shape) was present or absent among L-shaped distractors, in an array of 48 symbols. R-R intervals were recorded to estimate sympatho-vagal balance [LF/HF = low(LF)/high (HF) frequency power of HRV] before (Baseline) and during the VST. In each session, HRV variation from Baseline to VST was calculated as the LF/HF percent change ($\%LF/HF$). Male participants showed similar Rest and Post-Ex $\%LF/HF$ ($388 \pm 156\%$ vs. $432 \pm 129\%$; $p=0.99$), whereas females showed an increase from Rest to Post-Ex ($537 \pm 232\%$ vs. $1218 \pm 281\%$; $p=0.02$). Female participants also demonstrated higher Post-Ex values compared to males ($p=0.04$). Considering VST performance, greater increases in $\%LF/HF$ from Rest to Post-Ex session were associated with increased % variation of VST incorrect responses (Male: $r=0.67$, $p=0.005$; Female: $r=0.59$, $p=0.001$). Male participants had a similar % of mistakes in Rest and Post-Ex ($6.0 \pm 2.0\%$ vs. $6.8 \pm 2.1\%$; $p=0.79$), while females increased mistakes following exercise ($7.1 \pm 2.0\%$ vs. $12.1 \pm 2.2\%$; $p=0.04$). In conclusion, a short and intense bout of physical activity can promote higher autonomic activation in females compared to males, which is associated with an increased number of target-identification mistakes during a VST.

Gait Decline in Healthy Aging: Does Accounting for Physical Activity Level the Playing Field?

Ducharme, Scott W.; van Emmerik, Richard E.A., University of Massachusetts, Amherst

The locomotion literature reports various gait parameters change with age. For example, preferred walking speed (PWS) decreases, while stride time and step width variability increase. These changes are traditionally associated with reduced stability and system control. In addition, the structure of variability (i.e., fractality) has been shown to decrease in older adults. However, most studies have reported cohorts of different ages but fail to consider levels of physical activity (PA). It is feasible that PA, rather than age, correlates to gait decline. Method: Fifteen young (age 29.9 ± 5.6 yr, 169.9 ± 10 cm, 74.3 ± 10.3 kg) and 13 older (age 64.5 ± 2.8 yr, 167.8 ± 9.4 cm, 75.8 ± 9.4 kg) adults were recruited. All participants self reported achieving at least 150 minutes per week of moderate to vigorous intensity PA. Participants walked at their PWS, at half their PWS, and in an asymmetric manner, whereby the dominant leg moved at PWS and the other leg at half-PWS. Participants also wore an activity monitor for one week to objectively quantify PA levels. Coefficient of variation (CoV) and detrended fluctuation analysis determined the magnitude and structure (i.e. fractality), respectively, of variability. RESULTS: No differences between age groups were observed for PWS, stride time fractality, or the CoV of stride time, step width, stance or swing phase timing for any condition (all $p > .05$). Further, when older adults were separated into high and low PA

categories, the more active adults yielded lower CoV for stride time (4.49% vs. 6.32% for less active, $p=.04$) and stance time (5.4% vs. 7.6%, $p=.03$) during slow walking, similar to the CoV of the young (stride time: 4.29%; stance time: 4.9%, $p's >.05$). Discussion: When recruiting physically active adults, no differences exist between 21-40 and 60-70 year olds for various gait measures. The lower CoV in the more active older adults indicate greater controllability and possibly stability. It is plausible that a prolonged sedentary lifestyle contributes to the diminished gait features often observed in older adults.

Volleyball Match Analysis from an Information Processing Perspective: The Importance of Set Time

Fairbrother, Jeffrey T.; Cornelius, Hanna R.; Couvillion, Kaylee F., University of Tennessee Knoxville

Match analysis has become an increasingly common tool for sports organizations seeking competitive advantage. Often, it consists of video analysis of game play to identify player and team statistics thought to be of tactical importance. Some researchers have begun to match analysis data to examine relationships between in-game performance behaviors and game outcomes (e.g. Pena & Casals, 2016). Little effort, however, has been devoted to understanding how match analysis can provide insight into performance demands of key skills and the preparation of athletes with respect to those demands. The purpose of the current study was to use match analysis to examine in-system volleyball play in selected international-level women's games from an information processing perspective. A total of nine games including over 280 points were analyzed to identify in-system plays, the elapsed time for each action associated with the play, and the outcome of the play. For the purposes of this analysis, in-system play was identified when a pass, set, and hit occurred in immediate succession. Chi square analyses of the number of points and rallies resulting from in-system play revealed a significantly lower than expected number of points won when the in-system team's set was of longer duration than the delivering action that brought the ball into play. This was true when examining the delivering action was a serve ($p < .05$) or another type (e.g., hit, pass, touch, or block; $p < .05$). Correlation analyses on elapsed time of ball flight for in-system actions did not reveal clear relationships among components. These findings are consistent with the notion that elapsed setting time is important in the outcome of in-system play. Longer set times afford more time for the opposing team to anticipate the impending hit and respond in ways that decrease the likelihood of the hit resulting in a point. Further research is needed to determine if training for in-system play should emphasize faster setting, even at the expense of longer passing times, to produce more frequent favorable outcomes.

Recalling a fearful experience impacts movement initiation based on the spatial congruency of imagined threat stimuli

Fawver, Bradley, University of Utah; Hass, Chris J.; Coombes, Stephen A.; Janelle, Christopher M., University of Florida

A variety of performance contexts require individuals to draw upon previous experiences to properly execute motor actions, and behavioral responses are known to be more efficient when there is a match, or congruency, between the motivational qualities of an emotional stimulus and distance altering characteristics of the movement being executed. However, the extent to which contextual factors interact with emotion-induced motivational orientations to influence approach and avoidance behaviors remains unspecified. The purpose of this study was to determine the impact of recalling an emotional experience on forward gait initiation behavior that was conceptualized as either an approach or avoidance movement based on the location of imagined stimuli. Participants (N=29) completed tone-initiated forward gait trials during a baseline period and in two experimental trial blocks after recalling a previous fearful memory in which the fearful stimulus was located either in front or behind them. Facilitation/inhibition of gait behavior was assessed through responses to the gait initiation cue, the magnitude of center of pressure movements prior to stepping, and subsequent step kinematics. When the location of the fear stimulus in their memory was in the posterior direction compared to the anterior direction, participants initiating forward gait exhibited expedited reaction times ($p < .01$), greater displacement and velocity of center of pressure (all p 's $< .05$), and greater step length and velocity (all p 's $< .05$). Results provide support for the theoretical position that motivational orientations to approach and avoid are contextualized based on affective congruency, which includes the spatial orientation of emotional stimuli.

Assessment of postural sway during different attention focus states in post-surgery ACL tears

Ferguson, Natalie L., Utah State University; Cone, Brian L., University of North Carolina at Greensboro; Rhea, Christopher K., University of North Carolina Greensboro; Studenka, Breanna E., Utah State University

The structure of variability in the human neuromotor system can be indicative of its health and function (Stergiou & Decker, 2011). More regular variation in gait is found in those with an ACL injury compared to those without (Decker, et al., 2011). Postural control is less well studied in those with ACL injury. Many things may influence postural control including where attention is focused during a task. Focusing on something outside the body makes performance on a balance task more automatic, whereas focusing on the body induces less automatic control (Wulf, et al., 2003; Wulf, 2013). We tested the influence of attentional focus on both linear and non-linear aspects of postural

sway post ACL injury. Participants stood on a force plate in four conditions: standing as still as possible, keeping the injured knee as still as possible, keeping the uninjured knee as still as possible, or keeping a laser beam as still as possible. Linear measures of CoP sway included path length, medial-lateral and anterior-posterior standard deviation and velocity of the resultant vector. Non-linear measures included sample entropy for medial-lateral sway, anterior-posterior sway, and average displacement of the center of pressure from the mean. A 2 group (injured vs. non-injured) by 4 task (no focus, focus on injured knee, focus on uninjured knee, external focus) ANOVA was run to compare groups and tasks. Those in the ACL group had significantly more irregular (i.e., higher sample entropy) anterior-posterior sway and average displacement than the non-injured group. The ACL group also had significantly greater standard deviation of sway and more irregular average displacement during the external focus task compared to the internal focus tasks. These results lend support for the potential influence of attentional focus in rehabilitation settings.

Cortical motor gamma oscillations reflect coordination task demands.

Ferrandino, Josie; Jensen, Jody, University of Texas at Austin; Fuchs, Armin; Kelso, Scott, Florida Atlantic University; Cheyne, Douglas, The University of Toronto; Ferrari, Paul, The University of Texas at Austin

Cortical oscillations in the high-gamma (65-90Hz) frequency band are modulated by movement task parameters. Gamma oscillations synchronize in the contralateral primary motor cortex (M1) during self-initiated and cued voluntary movement. However, much remains unknown about the role of motor gamma in motor control. To further probe this line of questioning, we used magnetoencephalography to investigate gamma-band responses in subjects performing self-paced movements as well as synchronized (on-beat) and syncopated (off-beat) auditory-motor coordination tasks at different rates. These coordinative tasks are known to dissociate task difficulty across rate of performance, with increasing rate leading to higher performance variance in syncopated versus synchronized coordination. Neuromagnetic signals were recorded using a 151 channel CTF MEG machine (VSM Medtech Ltd., Coquitlam, BC Canada) from 7 subjects while performing index finger movement tasks at rates of 0.5, 0.75 and 1.25Hz. Movement dynamics were recorded via an MEG compatible pressure transducer connected to the ADC channels of the MEG machine. MEG Beamformers were used for source localization of gamma band responses in each subject and a virtual sensor representing the cortical motor activity for each trial was calculated. Time-frequency plots were calculated using a morlet-wavelet. Peak gamma was defined as the largest value in the movement cycle between 65 and 90Hz. High gamma was detected within 300ms post movement peak in all conditions at all rates in the contralateral M1. In self-paced and synchronized conditions performance increased and gamma power decreased as a function of rate. Conversely for syncopated tasks, behavioral performance decreased and gamma power only slightly reduced or remained stable with rate increase. Data suggest motor-gamma oscillations may reflect a mix of movement parameters as well as higher level cognitive-motor operations. To the extent that task performance reflects task complexity, motor gamma power may index the engagement of neural operations for movement guidance.

Symmetry of intra-limb variability response differs between internal and external foci

Fietzer, Abbigail L., University of Southern California; Koyama, Yumiko, Kyoto University; Kulig, Kornelia, University of Southern California

Variability is inherent in movement and may help protect against injury (Hamill, Palmer, VanEmmerik, 2012). Uncontrolled manifold analysis (UCM) provides a window into neuromotor control by parsing variability into task-relevant (Vort, disallows vertical leg length consistency) and-irrelevant (Vucm, allows vertical leg length consistency) subspaces. Lohse et al. found increased shoulder angle variability despite decreased dart strike variability under external focus in a dart-throwing task (Lohse, Sherwood, Healy, 2010; Lohse et al., 2014). Though not UCM studies, these results correspond to increased Vucm and decreased Vort in UCM terms. The purpose of this study was to examine the effects of adopting internal and external attentional foci on variability structure during unipedal hopping. 23 healthy subjects hopped in place at 2 Hz \times 25x under no directed focus, internal and external foci on each limb. UCM analysis was performed at each percent of stance, with Vucm, Vort and IMA (normalized difference between Vucm and Vort, a measure of vertical leg length stabilization) averaged within 7 equal bins. Bin-average difference between no directed focus and the external and internal focus conditions for Vucm, Vort and IMA were compared with repeated measures ANOVA (2 limb \times 7 bin, $\alpha = 0.05$). When shifting from no directed focus to internal focus, preferred kicking limbs increased Vucm ($p < 0.01$, $\eta^2_p = 0.30$) and Vort ($p = 0.02$, $\eta^2_p = 0.23$) more than stance limbs, but both limbs responded with similar changes in vertical leg length stabilization (IMA, $p = 0.50$, $\eta^2_p = 0.02$). When shifting from no directed focus to external focus, kicking and stance limbs behaved more symmetrically. They similarly increased Vucm ($p = 0.38$, $\eta^2_p = 0.04$) and Vort ($p = 0.97$, $\eta^2_p < 0.01$), and responded with similar changes in IMA ($p = 0.47$, $\eta^2_p = 0.02$). Results suggest attentional focus manipulation alters variability structure, with preferred kicking and stance limbs showing a more symmetrical response to external (vs. internal) focus manipulation.

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Changing the Type of KR Affects the Learning of a Line-drawing Task

Fisher, Kevin; Gregorski, Megan; Bundy, Michaela, Central Michigan University

Augmented feedback is information which is inherently unavailable to a learner that must be provided by an outside source such as an expert or technical display and may be broadly divided into Knowledge of Performance (KP), which relates to movement quality, and Knowledge of Results (KR), which relates to a movement outcome (Schmidt & Lee, 2013; Sigrist, Rauter, Riner, & Wolf, 2013). KR is generally regarded as a critical element in skill acquisition and has been examined with variables such as type, timing, precision, and amount (Salmoni, Schmidt, & Walter, 1984). In a study by Trowbridge and Cason (1932), the influence of different types of feedback was examined in a line-drawing task. Individuals who were presented with higher levels of feedback precision outperformed those who were presented with distracting feedback (nonsense syllables)

or none at all. The present study sought to extend the results of Trowbridge and Cason (1932) by comparing the effects of different types of KR on learning a line-drawing task. Participants ($n = 48$) practiced drawing a 3-inch line on a digital tablet under one of four feedback conditions: None (CTRL), Vague (VGE), Precise (PRCS), and Visual (VSL). After 24 hours, participants completed retention and transfer (drawing a 6-inch line) testing. For acquisition, a repeated-measures ANOVA revealed a main effect for block in ACE and VE ($p < .01$), indicating improved accuracy and consistency with practice. Follow-up pairwise comparisons indicated that all feedback groups outperformed the CTRL group ($p < .05$). During testing, results showed a main effect such that accuracy and consistency during retention was better than transfer ($p < .01$). Follow-up pairwise comparisons indicated significantly better performance for the VSL group when compared with the CTRL group ($p = .021$). These findings suggest that performance may improve through precise verbal or visual feedback and that the latter medium may be an effective alternative to feedback that is presented verbally and perceived via audition.

Examining visual and attentional focus influences on golf putting performance

Forbes, Michael A.; Ste-Marie, Diane M., University of Ottawa

Visually focusing on the hole versus the ball in golf has shown some positive effects on putting performance (Heath et al., 2008), yet the reason for these benefits have not been tested. Considering the benefits of adopting an external focus, the purpose here was to examine whether attentional focus mechanisms contribute to said positive effects. Thirty experienced golfers were assigned to either a Visual-Ball Focus (VBF) or Visual-Hole Focus (VHF) group. Following warm-up putts, 48 experimental putts, divided equally into 16 putts across three conditions: control (C), task-relevant (TR), and task-irrelevant (TI), were performed. In the C condition, participants putted under single-task conditions, maintaining their assigned visual focus. In the other two conditions, participants putted under dual-task conditions and were instructed to focus on their wrist angles upon hearing a tone (TR), or to identify an irrelevant sound (TI). A questionnaire, designed to represent equal proportions of the 'distance' effect (Wulf, 2013; i.e., internal, proximal external, or distal external focus), served as a manipulation check to determine the attentional focus adopted under each condition. Analysis of the manipulation check for the C condition data only showed a significant interaction of Group and Attentional Focus $F(2,56) = 4.5$, $p = .01$. Post-hoc showed that participants had a significantly higher proximal external focus in the VBF group compared to the VHF group, whereas the VHF group was significantly higher than the VBF group for distal external focus. Additionally, an analysis with all three putting conditions indicated that participants had significantly higher internal focus for TR trials, as compared to TI or C trials. Despite these attentional focus findings, no significant differences were found for any of the putting performance measures. In conclusion, these results suggest that visually focusing on the hole results in a more distal external attentional focus in a golf environment than that of a ball-focus, but this does not translate to performance benefits.

A Novel Approach to Enhancing Upper Extremity Coordination in Children with Autism Spectrum Disorder

Gamez, Alejandra S., The University of Texas at El Paso; Wang, Chaoyi, Shenzhen University; Manning, Rhonda; Boyle, Jason B., The University of Texas at El Paso

With current estimates concluding 1 in 68 children being affected, Autism Spectrum Disorder (ASD) is regarded as one of the most rampant forms of disability globally. Although typically diagnosed through social impairment and repetitive stereotypical behavior, recent work in the last decade has shown distinct motor impairments across the autism spectrum. These motor deficits can be gross or fine in nature and can be seen not only in reaching and grasping, but also in the kinematic composition of the actual movement. For example: decreased velocity, decreased accuracy, irregular movement smoothness, etc. Thus, the goal of the following study was to further the understanding of the kinematic components of goal directed upper limb movement in participants with ASD and to investigate the adaptability of their limb movements after undergoing exposure to a sine wave tracking task. A custom-built bi-manual arm bar apparatus was used, which allowed frictionless bimanual flexion and extension of the limbs in the horizontal plane. Positional data of the limbs displacement was integrated into a custom built graphic user interface platform that relayed information regarding the position of the participant's limbs on a projection screen. The task involved tracking a sine wave template as well as a speed-accuracy trade-off (Fitts) task that involved moving a cursor between two targets of varying sizes and separation distances. Data analysis examined kinematics before, during, and after both tasks. Variables of interest were: Movement time, peak velocity, % time to peak velocity, slowing parameters, end point accuracy and harmonicity. The tentative findings from this study conclude that children with ASD respond just as well to the tracking task as normal developing, by executing post-training movements of higher velocity with smoother displacement profiles.

The effects of high and low contextual interference on the learning of three variations of a golf chipping task

Genter, Alec M.; Aiken, Christopher A., Alma College

Increasing the amount of contextual interference (CI) during practice has been shown to facilitate motor skill learning (Shea & Morgan, 1979; Ste-Marie et al., 2004). Typically, the group that practices with lower CI performs better during practice but worse during retention and/or transfer testing. Likewise, the group that practices with higher CI performs worse during practice but better on retention/transfer. One applied setting where low CI practice still remains constant is golf. To our knowledge Porter et al. (2007) is the only study to investigate the effects of various CI levels on a golf task, where participants learned a putt and pitch. The purpose of the current study was to investigate the effects of high and low CI on three different golf chip shots. 32 participants with no formal golf experience were recruited from the college community. Participants were randomly assigned to either a low (blocked) or high (random) CI condition. Participants chipped towards a circular target with seven concentric rings that increased from 40cm to 300cm in diameter. Individuals stood 4m from the center of the target and practiced chipping from three different lies (normal, uphill, and downhill). The low CI group completed all trials of one task variation before performing the next task variation. The high CI group completed the trials for the three variations in a random

order. Participants performed a total of 54 trials during acquisition (18 trials of each task variation). Following a five minute break, individuals performed a 6-trial blocked and 6-trial random transfer test. Results suggest that both groups improved from the beginning to the end of acquisition ($p < .05$) but the groups did not significantly differ from one another. During the random transfer test the random group performed significantly better than the blocked group ($p < .05$). Our results provide further evidence for the application of increased CI in an applied sport setting. Further research needs to focus on how to best educate sport coaches on how to restructure practice to facilitate learning.

Effects of mental practice in motor performance and control during predictable perturbations in an aiming task

Gomes, Thabata V.; Benda, Rodolfo N; P Andrade, Andre G., Universidade Federal de Minas Gerais; Harrison, Henry, University of Connecticut; Portes, Leonardo L.; Ugrinowitsch, Herbert, Universidade Federal de Minas Gerais

The present study investigated the effects of mental practice on adaptation to predictable perturbations. Forty-eight undergraduate students were distributed in three groups ($n=16$): mental practice (MP), physical practice (PP), and control group (CG). Participants performed in pre-exposition phase 200 trials of an aiming task that required tracing a line as fast and accurate as possible to reach a target. The MP participants should imagine task execution while the PP participants performed the task physically. All groups took part of exposition phase, when 18 perturbations were pseudo-randomly inserted throughout 126 trials. In perturbations trials, the target changed its position to two different locations when the participant was informed about the direction of the perturbation before start the trial. Exposition phase was analyzed in 6 blocks of 3 trials, comparing blocks of pre-perturbation, perturbation, and post-perturbation conditions. Results of perturbation showed that PP was faster than MP and CG, while MP and CG had similar movement time. The PP e MP showed similar accuracy and both were more accurate than CG. PP and MP presented similar reaction time and both were faster than CG. All groups presented similar time to peak velocity, while PP presented shorter time after peak velocity and smaller number of corrections than MP and CG. Together, results still suggest that while the PP used accurate pre-planning as predominant mechanism of control, the MP used on-line feedback as predominant mechanism of control to make corrections over pre-planned actions. It is important to note that PP used the extra time after peak velocity in order to have similar number of PP correct trials, the MP used the extra time after peak velocity to make more corrections. In sum, PP presented best performance than MP, which was better than CG; all groups showed different performance and control measures in perturbation trials, showing the effects of practice over the mechanisms that control motor skills.

Self-controlled Feedback: When and Why Subjects Ask for Feedback

Gonin, Madeleine; Hatfield, Brent, Indiana University; Shea, John B., Indiana University Bloomington

Research in the area of self-controlled feedback suggests that learners ask for feedback after successful trials. Typically, these experiments are limited to using only a yoked

group for comparison, and a clear definition for success is not provided. Additionally, the number of Knowledge of Results (KR) requests and reasons for these requests are constrained, possibly masking reasons for KR requests. This study addresses experimental design limitations, provides an operational definition of success and offers a more comprehensive interpretation of why subjects ask for feedback. Subjects completed a simple button-pressing task in 900 ms and were randomly assigned to one of four groups. One group received KR (execution time) on all acquisition trials while another group received KR on every 5th trial. Subjects in the self-controlled group could ask for KR at any time and as often as they wanted to while members of the yoked group received KR based on schedules set by their self-controlled counterparts. Subjects in the self-controlled group had to provide a reason for their KR request. After 40 acquisition trials there was a 10 min retention interval followed by a 10 trials without KR. Separate repeated measures ANOVAs using Absolute Constant Error (ACE) and Variable Error (VE) showed significant differences in acquisition but failed to reach significance in retention. Utilizing the fourth spread of the 100% KR group a measure of success was determined for subsequent analyses. Thematic content analysis was performed on the verbal data provided by the self-controlled group, resulting in four distinct themes for KR requests. A chi-square was performed on these themes as they relate to a successful trial. The null hypothesis that response categories are independent of a successful trial was rejected, suggesting subjects did not ask for feedback only after successful trials, but instead asked for feedback for a variety of reasons throughout the experiment.

Investigating the mechanisms underlying the effects of an incidental choice on motor learning

Grand, Kirk F.; Daou, Marcos; Lohse, Keith R.; Miller, Matthew W., Auburn University

The present study sought to determine whether motivation and augmented feedback processing explain the effect of an incidental choice on motor learning, and to examine whether motivation and augmented feedback processing predict motor learning, regardless of (controlling for) whether an incidental choice is provided. Accordingly, participants were assigned to one of two groups, choice or yoked, then asked to practice a non-dominant arm bean bag toss towards a target. The choice group was allowed to choose the color of the beanbag with which they made the toss, whereas the yoked group was not. Motivation and augmented feedback processing were indexed via the Intrinsic Motivation Inventory and electroencephalography, respectively. Results showed that an incidental choice failed to enhance motor learning, motivation, or augmented feedback processing. Additionally, neither motivation nor augmented feedback processing predicted motor learning. However, motivation and augmented feedback processing were correlated, and both factors predicted changes in practice performance. Thus, results suggest the effect of incidental choices on motor learning may be tenuous, and fail to shed light upon the mechanisms underlying the effect, if it is robust. Finally, results indicate motivation and augmented feedback processing may be more closely linked to changes in practice performance than motor learning.

Stimulus-response compatibility during sequence learning under high and low contextual interference

Greaves, Danielle; Immink, Maarten A.; Thewlis, Dominic, University of South Australia; Wright, David L., Texas A&M University

Explanations for the contextual interference (CI) effect focus on motor planning or memory development although the role of CI might also extend to early motor processes associated with response selection. The present experiment adopted the Simon effect heuristic to compare sequence learning under high and low CI conditions with and without stimulus-response spatial conflicts. This allowed investigation as to whether increased spatial mapping demands during practice alter the CI effect and also afforded an opportunity to determine the extent to which practice CI influences reliance on stimulus-response mapping. Fifty-six participants practiced a discrete sequence pressing task under either random (high CI) or blocked (low CI) practice schedules and under either compatible or incompatible stimulus-response conditions. Incompatibility significantly increased sequence completion durations under high CI practice but had no effect on performance under low CI conditions. In addition, amongst the participants who experienced incompatibility during practice, high CI conditions exhibited significantly larger Simon effects in most practice blocks. Delayed retention performance did not reveal a significant main effect of compatibility or any interaction between compatibility and CI conditions. In addition, previous exposure to incompatibility during practice resulted in significantly smaller Simon effects during retention but this effect did not interact with CI conditions. Stimulus-response incompatibility neither enhances nor deteriorates sequence learning under high and low CI conditions and so appears to be a performance variable to which high CI practice is sensitive. Although low CI practice appears to minimize reliance on stimulus-response mapping, this practice condition still renders response selection processes to be less influenced by spatial conflicts during retention at levels comparable to high CI practice.

Development of a computational method to assess high-level motor planning during the performance of complex actions

Hauge, Theresa C.; Katz, Garrett; Huang, Di-Wei; Reggia, James; Gentili, Rodolphe, University of Maryland College Park

Although prior work has examined the cognitive-motor processes underlying upper-limb performance, most of these efforts have focused on the sensorimotor level and fairly simple actions. However, most daily actions require complex cognitive-motor planning since their structure includes various sub-actions. Thus, there is a need to develop methods to analyze complex action sequences to inform high-level motor planning, complementing analyses that inform the sensorimotor level. Here, we propose a computational method generic enough to compare complex tasks executed by different performers including humans and humanoid robots. This method is based on sequence comparison methods used in linguistics and genomics where the atomic elements (nodes) are the individual actions composing the complex action sequences. Using our method, the action sequences performed by humans and a robot during imitation generated qualitative (graphical representations) and quantitative (metrics to assess similarities between participant sequences) analyses. First, a humanoid robot had to learn a disk-drive dock maintenance task using a demonstration shown in a virtual environment. After learning, the robot generalized the task to new initial states by inferring the intentions of the demonstrator. Second, human participants had to imitate the same task shown in a video with minimal instruction. Most human trials successfully imitated the demonstrated goal, although specific differences existed between the demonstration, humans, and humanoid robot actions. This suggests that different strategies were used for achieving the same goal. Specifically, our method identified identical and modified sequences; unique sequences executed by humans, the distribution of trials among sequences, and levels of similarity between actions imitated by humans, the robot, and the demonstrator. This method is promising for examining high-level motor planning in humans during motor performance and learning of complex actions as well as for informing human-robot dynamics.

Kinematic Dissimilarity Influences the Perceptual Discriminability of Linearly Morphed Deceptive and Non-Deceptive Team Handball Penalties

Hem, Fabian, Justus-Liebig-University Giessen; Troje, Nikolaus F., Queen's University; Munzert, Joern, Justus-Liebig-University Giessen

Anticipation is an important skill for coping with the challenges in competitive sport. Quite frequently, athletes attempt to deceive their opponents in order to manipulate anticipatory processes. Real and deceptive actions typically display a degree of spatiotemporal dissimilarity in terms of motion trajectories and temporal dynamics. Until now, research demonstrated that athletes are highly sensitive to deception (e.g., Canal-Bruland & Schmidt, 2009; Jackson et al., 2006). However, there is currently no research that examines how spatiotemporal dissimilarity influence the discriminability of deceptive movements under temporal constraints. We addressed this question in the context of handball penalties. Based on the motion data of 1,580 penalty throws by novice and elite field players (Helm et al., 2016), realistic 3D motion avatars were generated as our experimental stimuli. Linear morphing between averaged non-deceptive and deceptive throws produced a set of different stimuli by increasing the degree of spatiotemporal dissimilarity in throws. In our experimental task, novice ($n = 20$) and expert ($n = 20$) handball field players were asked to decide as quickly and accurately as possible whether observed throws were either deceptive or non-deceptive. In general, results replicate findings showing a superior expertise performance in discriminating throws based on its kinematics when responding after stimulus offset ($p < .01$). In addition, these findings were extended by showing that discriminability significantly increased as a function of spatiotemporal dissimilarity. However, results indicate significant decreases in discriminability for early response times, ($p < .05$). In general, we conclude that stronger kinematic dissimilarities facilitate discriminability, because matching the perceived motion patterns against the representation of a deceptive (non-deceptive) throw produces a more distinct classification. The decrease in perceptual discriminability for early responses is suggested to be due to a lack of sufficient early kinematic information in throws.

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Changes in functional exercise capacity mediate the relationship between assisted cycling cadence and gross motor adaptive behaviors in adolescents with Down syndrome

Holzapfel, Simon D.; Ringenbach, Shannon D.; Cook, Megan R.; Pandya, Sachin, Arizona State University

People with Down syndrome show deficits in adaptive behaviors pertaining to motor domains. These deficits in motor function limit activities of daily living and independence.

Assisted cycling interventions, where the cycling cadence is augmented by an electric motor, have been associated with improvements in motor control in persons with Down syndrome and in other populations. Here we examined whether faster cycling cadences are associated with greater improvements in gross motor adaptive behaviors and whether this relationship is mediated by changes in executive function, depression, fine motor control, or functional exercise capacity (6MWT). Participants with Down syndrome, aged 18 +/- 5 years (mean +/- SD), completed eight weeks of Assisted Cycling Therapy (ACT) and were assessed before and after the 8 week intervention on the measures mentioned above. The results indicated a significant positive relationship between cadence and improvements in gross motor adaptive behaviors ($R^2 = 0.31$). This relationship was mediated only by changes in functional exercise capacity ($R^2a = 0.35$, $R^2b = 0.22$). ACT cycling cadence related positively to changes in functional exercise capacity (6MWT) and changes in functional exercise capacity related positively to changes in gross motor adaptive behaviors. The relationship between cadence and gross motor adaptive behaviors was fully mediated by functional exercise capacity. Faster ACT cadences have a positive effect on functional exercise capacity and these positive effects appear to translate into improved gross motor adaptive behaviors. Possible underlying mechanisms include an improvement in cardiorespiratory fitness or organizational changes in the central nervous system that allowed for better gross motor control.

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Lower extremity motor function improved after cycling in stroke survivors

Holzapfel, Simon D.; Szeto, Monica; Ringenbach, Shannon D.; Lopez, Corinna, Arizona State University

Lower extremity function is vital for activities of daily living, especially in stroke survivors. An innovative exercise modality, Assisted Cycling Therapy (ACT), has been shown to improve lower leg function in adolescents with Down syndrome. This is among the first studies to examine the acute effects of ACT in stroke survivors. Twenty-three participants (Mean age = 60.3 +/- 15.9 years, 17 male, 6 female) who were 95.7 +/- 87.2 months post-stroke performed one 25 minute session of each ACT, Voluntary Cycling (VC) and No Cycling (NC) in counterbalanced intervention sequences. Lower extremity function was measured using the Lower Extremity Motor Coordination Test (LEMOCOT) pre and post each intervention session. The results showed that the paretic lower extremity improved after ACT, but not after VC or NC. Lower extremity function in the non-paretic leg improved after ACT and VC, but not after NC. These results suggest that ACT resulted in greater corticospinal excitability which resulted in improvements in global motor function.

Exoskeleton augmentation does not compromise user safety during performance of common industrial tasks

Hondzinski, Jan M.; Ikuma, Laura; Queiroz, Marcio de; Wang, Chao, Louisiana State University

Activities common in industrial jobs can cause injuries to the back/lower limbs and account for a significant percentage of work-related musculoskeletal disorders (WMSDs). A potential resolution to current ineffective interventions involves exoskeleton

application which augment user strength, endurance, and/or mobility. Successful exoskeleton use cannot compromise user safety. We determined if people wearing a lower-body Bionex exoskeleton could perform common industrial tasks without altering kinematics that may increase risk for WMSDs. Three males (age: 19-22 years; height: 165-188 cm; mass: 61-106 kg) performed 3 tasks: kneel-step forward, kneel for 5 s, then stand, 3 times on each leg; squat-lift a weighted box from the floor to waist level, back to floor 4 times in 20 s; and stair climb-step up and down an 8-inch step 15 times holding a weighted box, with and without exoskeleton use (EXO, NONE). Kneel: Step distance with EXO ranged from -17 cm to +6 cm greater than NONE. Hip and knee flexion with EXO often exceeded NONE. Greater knee flexion helped explain shorter step distance. Hip flexion counter-movements often preceded standing. Squat: Hip flexion led or equaled onset of knee flexion when lowering, while knee extension led or equaled onset of hip extension when lifting. Subjects flexed the hip less with EXO (6-32 deg < NONE). Two subjects also flexed the knee more with EXO (3-24 deg > NONE), while one subject flexed the knee 4-9 deg less with EXO than NONE. Performances with EXO approached that of the semi-squat technique, considered a preferred technique for weighted lifting/lowering. Compared to NONE, subjects decreased or matched lateral trunk flexion with EXO. People should avoid lateral trunk flexion to avoid injury when squatting with a load. Climb: With EXO, knee flexion of the trail leg when stepping up was greater than NONE and offered more foot clearance. Hip and knee kinematics with EXO often mimicked those without it. Kinematic alterations that did exist did not compromise user safety and may encourage use of good technique for some tasks.

Is the ability to learn encoded in the resting brain?

Hooyman, Andrew; Kutch, Jason; Babikian, Sarine; Winstein, Carolee, University of Southern California

Why do some people acquire a novel motor skill with relative ease and efficiency, while others struggle and eventually fail? There are reports of individuals who are unable to learn even after extensive practice (Brooks et al. 1995). Our long-term goal is to discover a simple, accurate and reliable brain biomarker of motor learning capability; this would promote development of personalized training programs to foster motor learning in athletic and rehabilitation settings. Our primary aim in this study is to determine if resting-state electroencephalography (rs-EEG) can be used to classify motor learning capability in non-disabled individuals. rs-EEG is a low cost imaging technology that is easily applied and can provide rich data (64 x 64 spatial grid) about intercortical connectivity. Methods: Fifteen non-disabled adults (8 females, mean age 26.6 +/- 2.7 yrs) participated. We used a discovery learning task to discriminate discoverers and non-discoverers of the rule (i.e., movement strategy) that governed task success. We adapted the Brooks' (1995) task--the objective is to use a thumb joystick to move a cursor from a start box to a stop box in < 3 sec. Unknown to the participants, the coupling of joystick to cursor movement is determined through rate control, not typical position control. Based on performance over 200 practice trials, participants were classified as discoverers (n = 11) or non-discoverers (n = 4). Prior to practice, 5 min of rs-EEG was acquired using a 64 lead EEG cap. We used a decision tree analysis to predict classification group. Results: 27% of participants were classified as non-discoverers. The prefrontal cortex temporal

lobe rs-EEG connectivity index most strongly predicted behavioral classification. Cross validation achieved an 80% overall classification accuracy, 81% sensitivity and 75% specificity. Given the high accuracy and sensitivity, we plan to replicate these findings in a larger sample of healthy adults, and extend this line of inquiry to a disabled population of chronic stroke survivors.

Fixation in sequence learning occurs with previous practice involving random and complex but not simple sequence structures

Immink, Maarten A.; Chan, Russell W.; Greaves, Danielle, University of South Australia; Shcherbakova, Olga, Saint Petersburg State University

Fixation, the difficulty in adapting cognitive processes to meet task changes, has received little attention in sequence learning literature. This is surprising given the degree to which humans must continuously adapt to changing sequential structures. In this experiment, we investigated whether learning a sequence was impeded by preceding practice with sequences involving either a random, simple or complex structure. Learning of a novel complex sequence in a serial reaction time (SRT) task was compared to a control group which did not receive previous practice. Across 12 SRT blocks, those who previously practiced complex and random sequences demonstrated less overall RT improvement than the control group. To distinguish sequence-dependent learning from general practice effects, RT performance was compared between block 12 and block 13, where a random sequence was introduced. Previous practice with random and complex sequences was detrimental for sequence-dependent learning as compared to the control group while it was benefitted by previous practice with the simple sequence. These findings indicate that fixation can result from previous exposure to randomized or complex sequence structures. Prior practice with a random sequence encourages fixation on stimulus-oriented planning processes which subsequently precludes use of introduced sequence information. Prior practice with a sequence structure promotes response-oriented planning and sequence complexity determines the extent to which this planning becomes sequence-specific. Following simple sequences, response-oriented planning can be readily adapted to the acquisition of more elaborate sequence structures. However, complex sequences require increased sequence specificity and so response-oriented planning processes become more fixated to learned sequence structures and consequently there is less flexibility to acquire a novel complex sequence.

Prefrontal cortex activation during sequence learning under high and low levels of contextual interference: A two-channel near-infrared spectroscopy study

Immink, Maarten A., University of South Australia; Marino, Frank; Pointon, Monique, Charles Sturt University; Wright, David L., Texas A&M University

The contextual interference (CI) effect, where high CI conditions suppress practice performance but then enhance delayed test performance, appears to extend beyond motor planning to also involve executive processes. As this implies a role for prefrontal cortex (PFC) activation in the CI effect, the present experiment utilized two-channel near-infrared spectroscopy (NIRS) to measure bilateral PFC changes in oxygenated (O₂HB)

and deoxygenated (HHB) hemoglobin while 26 participants practiced bimanual key-pressing sequences under either random (high CI) or blocked (low CI) conditions and completed a 24-hour delayed retention test. Sequence completion performance in practice and retention aligned with the CI effect. Despite practice performance differences, high and low CI practice conditions exhibited equivalent bilateral increase in O2HB and reduction in HHB relative to resting baseline. Retention results indicated a significant negative correlation between right PFC O2HB and sequence completion duration along with low CI exhibiting significant O2HB reduction in the right PFC. High and low CI practice conditions appear to rely on comparable levels of bilateral PFC activation, however, performance differences and PFC hemodynamics at retention suggest that CI conditions employ dissimilar executive processes during sequence learning. Activation deficits demonstrated by low CI conditions during retention were limited to the right PFC suggesting that executive processes such as action updating, motor inhibition, and memory retrieval are not appropriately developed during sequence learning under low CI conditions. Moreover, the extent to which practice results in increased right PFC O2HB during retention appears to be an important determinant for long-term sequence performance.

Allocentric perception of model image during right-and-left spatial discrimination tasks

Ishikura, Tadao, Doshisha University

Although Ishikura (2016) reported that the relation of the egocentric spatial self-orientation of the observers becomes the main right-and-left discrimination point of reference for perceiving the model image, he indicated that the observation conditions were insufficient for concluding that the observers judged based on an egocentric criterion. Therefore, this study aimed to examine the speed of the right-and-left discrimination while raising a hand and event-related potential (P300) for evaluating cognitive load, comparing four observational conditions. Seventeen university students observed the following: a) the front reverse orientation model (FR), which presented poses from the model's front; b) the back no reverse orientation model (BN), which presented poses from the model's back; c) the front no reverse orientation model (FN), which presented poses from the model's front and reversed the left-right orientation, as a mirror image; and d) the back reverse orientation model (BR), which presented poses from the model's back and reversed the left-right orientation. The participants were asked to press the key (right or left) corresponding to the arm raised by the doll (the FN and BR observation in relation to the reverse). We predicted that the response time and P300 amplitude would demonstrate a preference toward 'BN and FN less than FR and BR' if influenced by allocentric spatial physical self-orientation. Conversely, a preference toward 'BN less than others' if influenced by the egocentric spatial orientation. The results showed that the response time was faster for BN and FN than for others, and the differences in the P300 amplitude between the four models was not significant. Therefore, the finding of Ishikura (2016) was not supported, it was suggested that the relation of the allocentric spatial orientation between the model and observers influence the main right-and-left discrimination point of reference for perceiving the model image.

Autonomy facilitates repeated maximum force productions

Iwatsuki, Takehiro, University of Nevada, Las Vegas; Abdollahipour, Reza; Psotta, Rudolf, Palacky University, Olomouc; Lewthwaite, Rebecca, Rancho Los Amigos National Rehabilitation Center; Wulf, Gabriele, University of Nevada, Las Vegas

Performer autonomy (or self-control) has consistently been shown to enhance motor learning, and it can also provide immediate benefits for motor performance (Halperin, Chapman, Martin, Lewthwaite, & Wulf, 2016). Autonomy is therefore a key variable in the OPTIMAL theory of motor learning (Wulf & Lewthwaite, 2016). It is assumed to contribute to goal-action coupling, thereby yielding effective and efficient performance. The purpose of the present study was to examine whether providing autonomy support by giving performers choices would enhance movement efficiency, as measured by the ability to maintain maximum force levels. Participants (N = 30) were asked to repeatedly produce maximum forces with a hand dynamometer. After 2 initial trials with the dominant and non-dominant hand, stratified randomization was used to assign participants to one of two groups, choice or yoked control groups, with equal initial maximal force. Choice group participants were able to choose the order of hands (dominant, non-dominant) on the remaining 6 trials (3 per hand). For control group participants, hand order was determined by their respective choice group counterparts. Initial maximum force levels, averaged across both hands, were similar for the choice (40.6 kg) and control (40.7 kg) groups. However, on subsequent trials, maximum forces decreased significantly in the control group (39.3, 38.5, 37.9 kg), whereas choice group participants were able to maintain maximum forces across trials (40.5, 40.6, 40.5 kg). In a 2 (group) x 4 (trial) analysis of variance, the interaction of group and trial was significant, $F(3, 84) = 3.31$, $p < .05$. We interpret these findings as evidence that performer autonomy promotes movement efficiency, perhaps through optimized recruitment of motor units. The results add to recent findings showing greater maximum forces resulting from choice (Halperin et al., 2016) and are in line with the view that autonomy facilitates the coupling of goals and actions (Wulf & Lewthwaite, 2016).

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Effects of simultaneous self-control of knowledge of results (KR) and practice schedule in learning a serial motor skill of Taekwondo

Januario, Marcelo S.; Ugrinowitsch, Herbert; Lage, Guilherme M.; Portes, Leonardo L.; Figueiredo, Lucas S.; Benda, Rodolfo N, Universidade Federal de Minas Gerais

The effects of self-controlled knowledge of results (KR) and practice schedule have been investigated separately, although both interact during the learning process. We investigated the effects of KR and practice under self-controlled schedule simultaneously in motor learning. A superior performance of a self-controlled group is expected, based on a greater involvement of mechanisms of information processing as well as motivational increment in controlling two factors simultaneously during learning a complex task. Twenty four college students ($M = 23.5 \pm 3.2$ years; 16 men), novice in the task, took part of the experiment. Participants should perform 48 trials of a displacement with a taekwondo kick (bandal-tchagui) at the end, in three different target times (1,400, 1,600, or 1,800 msec.) during the acquisition phase. Learning tests were

performed with 10 trials, with a target time of 1,600 msec. on the retention test and 2,000 msec. on the transfer test. Participants of the self-controlled group (SC) could choose to receive both the KR and the target time to be performed, with 16 trials of each. Participants of the yoked group (Y) were exposed to the same configuration chosen by the SC. Absolute (AE), constant (CE) and variable (VE) errors were used as performance measures, and relative timing as control measure. During the acquisition phase, both groups reduced performance measures but SC had lower error in all performances measures in retention test and lower absolute and constant error in transfer test. Both groups increased the relative timing of all components during the acquisition phase. In the retention test, SC had higher relative timing in the component 1 and lower relative timing in the component 2 than Y. In the transfer test, SC presented lower relative timing in the component 2 than Y. These findings revealed a best performance in tests of the SC, distinct structures of control between groups and reinforced both explanatory hypotheses: Deeper information processing and motivation increasing.

Targeted memory reactivation during a daytime nap to improve sensorimotor skill performance

Johnson, Brian P.; Westlake, Kelly P, University of Maryland School of Medicine

Background: It is evident that memories are 'replayed' throughout the course of sleep to strengthen neural networks involved with each memory. To take advantage of and enhance this critical process, non-invasive methods of sensory stimulation during sleep have been developed. The most widely used method is known as targeted memory reactivation (TMR), which involves classical conditioning of an auditory cue paired with task performance at the time of initial motor skill acquisition, followed by replaying the same cue during sleep. Application of TMR during sleep, but not wake, activates the brain regions involved with initial skill acquisition leading to increased functional connectivity within related brain networks and task-specific finger-sequence performance in healthy young adults. Our previous work has demonstrated that TMR throughout the first two slow wave cycles of sleep across an entire night enhanced non-dominant arm throwing accuracy. **Purpose:** To determine whether TMR throughout an entire daytime nap is sufficient to enhance non-dominant arm throwing accuracy. We hypothesize that replaying the same auditory cues experienced during UE motor training will improve throwing accuracy compared to receiving sham cues between sessions. **Methods:** The training protocol involves (1) repetitive throwing of a small ball using the non-dominant UE to five unique visuospatial targets, and (2) auditory cues distinctively paired with each target. Spatial metrics of throwing accuracy are collected at four time points (baseline, post initial training session, post one hour sleep interval, and post second training session). **Results:** Preliminary results from two pilot test volunteers suggests that auditory cues enhanced spatial accuracy across the one hour sleep interval. Further participant recruitment, data collection and analysis are planned. Results of this research are expected to serve as a step towards a follow up study to enhance upper extremity training protocols in individuals post-stroke.

Funding Source: Departmental Funds

Influence of Attentional Focus on Balance Performance

Jusko, Elizabeth, Central Washington University; Kupper, Christian, Westfaelische Wilhelms Universitaet-Muenster; Zentgraf, Karen, Westphalian Wilhelms-University; Roemer, Karen, Central Washington University

External attentional focus has shown to be beneficial for balance performance compared to internal focus. Both foci can be seen as two endpoints on a spectrum. However, it remains unclear where on the spectrum internal distinguishes itself from external focus. Controlling an object perceived to be a body part could be considered a special case of internal focus, while controlling an object perceived to be at a distance—even though attached to the body—could be perceived as external focus. Conceptually, this explorative study expands the two-dimensional internal vs. external classification to a spatial continuum by adding a proximal and distal focus, respectively. It is hypothesized that distal compared to proximal focus will result in better balance performance during various single leg stance (SLS) tasks.

A repeated measures design was used ($n=18$; 9 m, 9 f) to investigate effects of proximal and distal focus on balance performance in SLS tasks (hop, step, y-test). Balance performance was quantified by multiscale entropy (MSEN) measures across multiple time scales and overall complexity index (CI) of the center of pressure (COP) trajectory. Statistical analysis employed generalized mixed model and repeated measures ANOVA. The complexity index of the hop was higher for distal ($4.33 \pm .23$ SE) than proximal ($3.98 \pm .25$ SE) focus ($p=.015$). Significant effect of focus on MSEN was found for the hop ($F(1,17)=4.153$, $p=.049$). No other task revealed an impact of focus on MSEN measures. In conclusion, there may be an effect of proximal and distal focus on specific balance performance tasks. Distal focus could to be advantageous, similarly to that of external focus.

However, more distinct focus manipulation might give further insight on the boundary between internal and external focus, more specifically, proximal and distal focus.

Funding Source: Graduate Studies and Research at Central Washington University

Does complex skill practice transfer to simpler skills for the weaker arm after stroke?

Kantak, Shailesh, Moss Rehabilitation Research Institute

Rehabilitation is based on the premise that motor skills can be relearned through practice. Motor learning research has traditionally focused on adaptation and sequence learning, with little focus on how patients with stroke use their paretic (weaker) arm to learn complex skills that require optimization of speed-accuracy tradeoff, similar to real-world activities. Also little is known if complex skill practice with the paretic arm transfers to simpler unpracticed tasks. In the present work, we used a laboratory-based complex arm skill to characterize the practice-dependent immediate and long-term changes (i.e., learning) in the paretic arm performance in patients with stroke. Skill learning was quantified as the change in speed-accuracy tradeoff from baseline to one day and one-month post-practice. Motor transfer was assessed as the change in goal-directed reaching performance from two baselines to one day and one-month post-practice. Importantly, we used kinematic analyses to determine if performance changes were a result of improved motor control (recovery) or compensation. Paretic arm practice

improved speed-accuracy tradeoff for the complex skill that was retained over a period of one month, similar to control participants. Importantly, complex skill practice, but not repeated testing alone, reduced movement time, time-to-peak velocity, number of submovements and increased peak velocity during performance of the unpracticed simpler goal-directed reaching task. These transfer benefits were retained over a month. Improvements in the unpracticed reaching task strongly correlated with those in the practiced complex motor skill. Our work suggests that patients with stroke preserve the ability to learn and retain complex skills with their paretic arm. Given limited number of tasks that can be practiced during therapy, training complex tasks may have an added advantage of transfer to improved simpler tasks. Importantly, improved performance is associated with better motor control, i.e. recovery of the paretic arm, a finding extremely important to rehabilitation.

Evaluating how a partner's practice schedule impacts one's own practice behaviours and motor learning outcomes

Karlinsky, April; Hodges, Nicola J., University of British Columbia

Allowing learners to practice with a partner and choose how to schedule practice are manipulations shown to benefit motor learning. Here we studied dyad practice to determine whether and how alternating turns with a partner impacts self-directed practice scheduling and learning outcomes. The task was to practice three, 5-keystroke sequences, each with a different movement time (MT) goal. Participants were paired and assigned to be either Partner 1 (P1) or 2 (P2). P1s had a blocked, random, or self-directed schedule, while all P2s self-directed practice. This resulted in 6 groups, with the self-directed P1 group unable to observe their P2 partner ($n = \sim 15/\text{group}$). Day 1 comprised a no-KR pretest, paired acquisition session where partners switched turns every 9 trials (72 trials each, 24 trials/sequence), and no-KR posttest. Day 2 comprised two retention tests (no-KR & with KR). All tests were completed alone and participants also responded to the Intrinsic Motivation Inventory and customized questionnaires. Participants improved with practice, and based on switching schedules, the self-directed P2s showed both partner-dependent and their own error-dependent practice. Random P2s switched on 45% of trials vs. $\sim 23\%$ for blocked and self-directed P2s ($p < .001$). P2s were also influenced by the content of their partner's practice (matching sequences more with a random than blocked partner). For both partners, random practice resulted in better timing accuracy than blocked practice in the posttest and KR-retention test ($ps < .05$). These data give evidence that self-directed practice behaviours and to a lesser degree learning outcomes are modulated by vicarious practice experiences related to the partner's practice schedule.

Examination of interpersonal distance in karate combat

Katsumata, Hiromu; Daitoku, Hiroya, Dito-Bunka University

Interpersonal distance between two athletes in combat sports is one of critical factor to determine win or lose. For instance, in karate, an attacker needs to approach within a distance to an opponent such that his punching or kicking movement can reach the opponent body. However, approaching to such a distance means that he will also give

the opponent a chance to attack against him. Therefore, perception of the interpersonal distance and control of attacking movement based on the distance perception are very important and interesting issue to be addressed for understanding successful offense and defense in karate. The present study attempted to capture the characteristic of attacking movement in karate by focusing on the interpersonal distance. To this end, we used two high-speed cameras to record offensive and defensive movements, sampled at 300 Hz, of 239 matches by 15 karate athletes. Based on the kinematic data of two combatting athletes, the interpersonal distance at the each moment of initiating attacking and defending movements as well as the kinematics of the approaching movement by the attacker were analyzed. The kinematics of how the interpersonal distance reduced implied that there was a critical distance, within which attacking movement was initiated. Furthermore, the attackers who initiated the attacking motion relatively far from the opponent showed higher probability of win. In other words, attacking from relatively near distance from the opponent was counter-attacked by him. For perceiving the interpersonal distance, a visual angle, which can be described by the tangent of the height of athlete eye position from the ground and the distance to the opponent, can be a possible source of visual information. The variability of the visual angle measure at the moment of attacking and defending movement was significantly lower than that of the interpersonal distance measure, which suggests that the visual angle can be more reliable visual information.

Motor control and balance bikes

Kavanagh, Jennifer; Issartel, Johann; Moran, Kieran, Dublin City University

Cycling is a milestone for children. Learning any new skill requires practice to effectively interact with the environment and detect information to allow for correctly timed responses. Cycling a bike is no exception to the practice rule so much so that industry has evolved around aiding the process. Balance bikes are popular precursors to traditional bikes as its believed that skills learned are transferable between bikes. However, there is no empirical evidence to support this statement. Thus, this study investigates if balance bikes lead to improvements in performance through practice and if so what is the nature of the associated learning. Two groups (intervention, control) of 45 children (3.6 ± 0.7) were assessed pre and post an 8 week intervention where the intervention group had access to balance bikes. Assessment of childrens ability on balance bikes was measured by steer and roll angular velocities obtained through tri-axial inertial sensors attached to the bike. Usage was measure through mounted counters. Visual observation of graphed distance was used to split the intervention group into 3 usage groups. ANOVAs were run to compare change in ability between the two groups and the three usage groups across the two time points. The intervention group improved significantly more than the control group in steer and roll angular velocities ($p=.02$ and 0.2). There was a significant difference in steer and roll angular velocities between the usage groups ($p=.03$ and 0.4). Post-hoc analysis indicated a significant difference for all variables between low and high groups and medium and high groups. A dramatic leap in performance outcome was observed between medium and high usage groups (13% vs 101%). This would suggest that once a certain amount of practice was achieved, improvements in motor skills on balance bikes reflect the emergent properties

of the motor behavior. Further research can now investigate (i) if improving performance on a balance bike transfers to learning to cycle a traditional bike and (ii) if fundamental motor skills are subsequently improved.

The Influence of Integrated Feedback on Interpersonal and Intrapersonal Coordination

Kennedy, Deanna; Shea, Charles H., Texas A & M University

Interpersonal coordination dynamics have traditionally been investigated using relative phase patterns of in-phase and anti-phase. Numerous investigations have demonstrated that bimanual tasks which require frequency relationships other than 1:1 are difficult and some ratios are nearly impossible to perform without extensive practice. Recent findings, however, have demonstrated that an individual can produce a variety of complex bimanual patterns within a few minutes of practice when provided integrated feedback. The present experiment was designed to determine if two people could effectively coordinate a complex interpersonal coordination pattern when provided integrated feedback as well. Participants (N=10/5 pairs) were required to produce a 1:2 pattern of force using (1) their right limb coordinated with a partners left limb, (2) their left limb coordinated with a partners right limb, and (3) both limbs (intrapersonal control). All conditions were counterbalanced. A Lissajous display was provided to guide performance. The Lissajous display involved a goal template and a cursor indicating the forces produced with both effectors. The cursor moved from left to right as force was produced with the right effector and from bottom to top as force was produced by the left effector. The template illustrated the specific pattern of force requirements needed to produce the goal coordination pattern. The results indicated very effective temporal performance of the bimanual coordination patterns for all three conditions. This result provides additional evidence for the robust utility of integrated feedback displays in facilitating complex patterns of coordination. In addition, the results indicated distortions in the left limb that could be associated with the initiation of force by the right limb in the intrapersonal condition but similar distortions were not observed in the left limb during the interpersonal conditions. This result is consistent with the notion that neural crosstalk may be responsible for the interference observed in complex intrapersonal bimanual tasks.

Dynamical Degrees of Freedom in Abdominal Surface Electromyography

King, Adam, Texas Christian University

The redundant degrees of freedom (DOF) in human movement challenges how the central nervous system unites the many motor components into functional synergies. Previous investigations have focused on biomechanical analyses (i.e., joint space) to address the DOF problem but much less is known on the neurophysiological mechanisms underlying the formation of synergies. Also, most methodological approaches fail to account for the dynamic structure of electromyographic (EMG) activity. Thus, the current experiment examined the dynamic coupling of three muscles during select abdominal movements under varying resistance levels to determine the possible existence of neuromuscular synergies. In 19 healthy, physically-active, young

adults, surface EMG (sEMG) activity from three abdominal muscles (rectus abdominus-RA, external oblique-EO, and transverse abdominus-TA) was recorded during two exercises (traditional sit-up and reverse crunch) that were performed in bodyweight (BW) and loaded (4.54 kg) conditions for 2 repetitions. The sEMG signals were paired to create three coupling pairings that were examined through Cross- Approximate Entropy (Cross-ApEn) to examine the degree of time-dependent co-variation. The coupling strength revealed through Cross-ApEn showed relatively high degrees of independence in the EMG pairings with exercise altering the coupling strength of the RA-TA and EO-TA pairings ($p < 0.05$). Load did not significantly alter the coupling strength in the muscle pairings. The findings suggest low degrees of functional synergies in these three muscle pairings and additional investigation is needed under different task constraints and with control conditions to better understand the functional organization of EMG activity of abdominal muscles. The findings highlight the use of time-dependent analyses to reveal dynamical degrees of freedom associated with the organization of control in EMG activity.

Enhancing Dancing: Examining the Potency of Action Observation

Kolar, Melissa B.; Newman-Norlund, Roger D., University of South Carolina

Research supports the idea that action observation (AO) - based training can be an effective component of physical training and rehabilitation. While much is known about the benefits of AO for simple movements, less is known about the utility of AO-based training for complex, whole body movements. The purpose of this study was to (i) assess the reliability of the X-box One Kinect game Dance Central Spotlight (DCS) as a measure of whole-body motor performance (i.e. dance) and (ii) to determine whether action observation prior to action execution would improve an individual's performance on a complex whole-body motor task. Thirty-one right-handed, healthy adult females ($M=21.09$, $SD=2.76$) with little to no dance experience completed three thirty-second trials of repetitive arm flapping in synchrony with a metronome to assess the reliability of the scoring system used in DCS. We measured test-retest reliability using the intraclass correlation coefficient (ICC (1,1)). The ICC was 0.719 (95% CI 0.541-0.850), indicating that DCS can be used to obtain reliable measures for complex whole-body motor skills such as dance. Participants were then randomly assigned to observe one of two chosen dance sequences. After participants observed the assigned dance sequence four times, we used the Kinect device to quantify the accuracy with which participants reproduced the observed dance and the novel dance sequence. We observed a trend towards better performance for the observed dance as compared to the novel dance ($t(30) = 1.732$, $p = 0.094$). We believe that the effects of AO were weakened by high inter-subject variability in dance performances. In future studies, we will use a within-subjects crossover design with a washout period to better capture differences in performance for observed and novel dances.

Thinking outside the block: External focus shortens reaction times in collegiate sprinters.

Kovacs, Attila J.; Miles, Garrett F.; Ross, Kimberly; Reineke, Rebekka, University of Wisconsin - La Crosse; Baweja, Harsimran S., San Diego State University

The time taken to react to a starting gunshot can have a dramatic effect on the outcome of a short-distance running race. While, focusing attention on an external cue has been shown to enhance skill acquisition and performance (Wulf, 2013), track and field coaches tend to provide instructions to their athletes that promote an internal focus of attention (Porter et al., 2010). Nevertheless, the effects of different attentional foci on reaction times remain unclear. Therefore, the purpose of this study was to investigate the influence of instructions promoting external versus internal focus on reaction time during a track block start. Ten collegiate track sprinters (ages 18-23) completed three separate testing sessions 2 days apart. Reaction times were assessed as the participants were instructed to propel themselves out of the starting blocks as fast as possible under three different conditions: i) external focus (EF) where subjects focused on pushing the blocks away; ii) internal focus (IF) where subjects focused on extending the knees; and, iii) no focus instruction (NF). Muscle activity was recorded from the vastus lateralis and gastrocnemius medialis muscles. Subjects exhibited significantly shorter reaction times during the EF condition (Mean = 0.209 s, SD = 0.027 s) compared with the IF condition (Mean = 0.230 s, SD = 0.024 s). Muscle activity also indicated a shorter pre-motor reaction time under the EF condition. Our findings indicate that adopting an external focus improves reaction time during block starts. This improvement likely originates from a reduction in movement preparation time. These findings have the potential to contribute to the development of new coaching techniques when the aim is to improve the reaction time of athletes.

Application of Representative Learning Design for assessment of common practice drills in tennis

Krause, Lyndon M.; Farrow, Damian, Victoria University; Reid, Machar, University of Western Australia; Buszard, Tim, Victoria University; Pinder, Ross, Australian Paralympic Committee

The main goal of practice is to acquire skill that translates directly to improved competition performance (Davids et al., 2013). Representative Learning Design is a framework for assessing the degree to which practice drills simulate the performance environment (Pinder et al., 2011). When practice replicates the performance environment, practiced skills are more likely to transfer to competition (Pinder et al., 2015). This study assessed the degree to which four common practice drills represented tennis matchplay. In pairs, ten elite junior male tennis players (13.5 ± 0.96 yrs old) performed four, 4-minute practice drills and a 2-set tennis match. All practice drills were competitive in nature (tie-break format) and started with an underhand feed crosscourt. Drill 1 constrained both players to only hit cross-court forehands, Drill 2 constrained players to a single pattern of play (crosscourt-crosscourt-line), Drill 3 constrained the returning player to only crosscourt shots and Drill 4 both players were unconstrained. Three-dimensional ball and player movement data was collected using an 8-camera HawkEye system (HawkEye innovations, 2015). A total of 1152 shots (525 points) and 1384 shots (1018 points) were analysed from practice drill and matchplay scenarios respectively. Preliminary independent t-tests revealed significant differences between practice tasks (all four tasks combined) and matchplay across a range of shot and movement variables (all $P < 0.05$). Players hit more shots (2.2 v 1.3 shots/rally), covered greater distances (10.1 v 7.2 m) and hit fewer backhands (40 v 49%) and fewer shots

down-the-line (13 v 24%) in drills compared to matchplay. These results highlight that common practice drills are not characterized by shot and movement behavior typical of matchplay as they promote more 'cooperative' rather than 'combative' behavior suggesting more careful design of practice appears to be needed. Discussion will focus on the extent to which each individual practice drill represents matchplay across targeted shot and movement variables.

Convergent validity of metrics provided by a portable gait assessment protocol

Kuznetsov, Nikita A., University of North Carolina at Greensboro; Robins, Becca K., Temple University; Jakiela, Jason; Lojacono, Chanel; Ross, Scott, University of North Carolina at Greensboro; MacPherson, Ryan, Cincinnati Children's Hospital; Long, Ben, ReverbNation; Haran, Jay, Naval Submarine Medical Research Laboratory; Wright, William G., Temple University; Rhea, Christopher K., University of North Carolina, Greensboro

Detecting changes in neuromotor function after TBI is difficult in field-based settings and requires subjective judgment due to limited access to laboratory equipment. To this end, we have begun designing a sensor-based test protocol utilizing Android phones to measure dynamic balance during a stepping-in-place task as a surrogate of gait. The aim of the current study was to evaluate the convergent validity of our protocol in comparison to Balance Error Scoring System (BESS), Sensory Organization Test (SOT), and Community Balance and Mobility Scale (CB&M) as these tests have been previously used to characterize balance deficits after a concussion. Young adults with self-reported concussion history (N=10 <40 days post-injury and N=7 >12 months post-injury) performed the stepping-in-place task at a prescribed stepping pace in the following conditions: (1) eyes open (EO), (2) eyes closed (EC), and (3) while continuously rotating their head about the yaw-axis (HS). Results showed that stride time variability was negatively correlated with the total CB&M score in the EO ($\rho = -.55$, $p = .02$) and EC ($\rho = -.61$, $p < .01$) conditions, suggesting that higher temporal variability in keeping the stepping tempo is associated with worse performance on CB&M, a subjective test of dynamic balance designed for high-functioning individuals with brain injury. Greater stride time variability in the EO and EC conditions was also associated with greater number of total BESS errors ($\rho = .50$, $p = .05$; $\rho = .50$, $p = .05$, respectively). Smaller stride time variability in the EO and EC conditions was associated with better scores on SOT-1 (eyes open, fixed surround and surface) and SOT-4 (eyes open, fixed surround, and sway-referenced surface). These results suggest that stride time variability during stepping-in-place shows convergent validity with both dynamic and static balance tests. The protocol could be used as an additional portable sensor-based assessment of balance function in individuals with suspected mild traumatic brain injury.

Self-reported attentional focus strategies of collegiate baseball and softball players

Lane Hartmann, April V.; Becker, Kevin A.; Mann, Mark D.; Nichols, David L., Texas Woman's University

Experimental research suggests an external focus optimizes motor performance, but skilled athletes report using primarily an internal focus (Porter & Wu, 2010), thoughts inducing both an internal and external focus (Fairbrother et al., 2016), and even shifting

between focus types throughout competition (Bernier et al., 2016). Since attentional focus in sport appears quite complex, research must expand to consider the use of other focus types (e.g., holistic, analogy, clear mind). The purpose of the present study was to determine how likely collegiate baseball and softball players are to use different focus types represented in experimental literature, and to identify emergent themes from open-ended responses about how focus is directed during batting. Sixty-two collegiate baseball (n=22) and softball (n=40) players completed an online survey about their focus while batting during a game. Survey questions consisted of demographics, questions related to each of 6 focus constructs identified from experimental research (internal, external-implement, external-target, holistic, analogy, and distraction), and an open-ended question asking about how the athlete chooses to focus while batting. A repeated measures ANOVA indicated a main effect of focus type ($p < .001$), with an external-target and holistic focus being more likely to be used than any other focus type (p 's $< .05$). When separated into tertiles based on batting average, those with the highest batting average were also more likely to use a holistic focus than the middle and lower group ($p < .05$). Analysis of open-ended responses produced seven themes: external focus (56.8%), internal focus (8.5%), psychological state (13.1%), clear mind (8.5%), competitive outcomes (6.2%), situational awareness (3.8%), and kinesthetic (3.1%). The results suggest that while batting, skilled performers frequently use an external focus of attention. Of additional interest is the diversity of other responses. Experimental research should consider how other emergent focus types such as competitive outcomes impact motor performance.

Variation of motor practice involves greater cognitive effort than repetition: an EEG study

Lelis-Torres, Natalia; Ugrinowitsch, Herbert; Apolinario-Souza, Tercio; Benda, Rodolfo; Lage, Guilherme M., Universidade Federal de Minas Gerais

Explanatory hypotheses proposed in behavioral studies assumed that less repetitive practice schedules, such as random practice, seem to demand greater cognitive effort than more repetitive types of practice organization, such as constant and blocked practice. All of these hypotheses emphasize the enhanced demand to memory processes promoted by less repetitive practice schedules. In the present study, we investigated the cognitive effort involved in random and constant practice schedules with an electrophysiological approach. Twenty-one participants practiced a sequential key-pressing task (keys: 2, 8, 6 and 4) with two goals: learning the relative timing dimension (22%, 44% and 33% of the absolute timing) and learning the absolute timing dimension. Sixty trials were performed in a constant practice schedule (absolute timing goal = 900ms), and sixty trials were performed in random order (three absolute timing goals = 700, 900, 1,110ms). Two electroencephalography- (EEG) based measures of cognitive states were used: (a) task engagement (sensory processing and attention resources) and (b) mental workload (working memory load). The means of task engagement, mental workload, relative error and absolute error during practice were compared (60 constant trials versus 60 random trials). The results showed that random practice induced greater cognitive effort than constant practice when task engagement was analyzed. Throughout practice, both task engagement and mental workload decreased more in the constant practice condition than in the random practice condition. Random

practice produced higher level of relative and absolute errors than constant practice. These EEG findings are novel, and the increased demand for sensory processing in random practice opens a new exciting field of study in practice organization.

Peripheral Component of Reaction Time on the Lower Extremity Related to Fall Risk in the Female Elderly

Li, Zongtao, Qufu Normal University; Lai, Qin, Wayne State University

The main purpose of this study was to determine whether the temporal deterioration of central or peripheral processing was related to fall-risk increase in the female elderly. In addition, the relationship of muscular strength on the lower extremity and information processing speed was analyzed. Female elderly ($n=34$, Age: 65-84 yrs) with right foot preference signed an informal consent prior to the study. They were classified into fall group ($n=15$) and non-fall group ($n=19$) based on their fall history and fall-risk index. Central and peripheral temporal components was fractionated from reaction time (RT) as premotor time (PMT) and motor time (MT) through the surface EMG. Participants stood on a customized platform that tilted toward left when a trap door was moved. The surface EMGs were collected from Tibialis Anterior (TA), Gastrocnemius (GN) and Peroneus Longus (PL) activated in response to a postural perturbation created by trap door move without anticipation (trial 1) and with anticipation (trial 2 & 3). After that, peak extensive force (PEF) in the lower extremities was measured through 3 fast deep squats on a force platform. A 2 (Groups) \times 3 (Trials) ANOVA with repeat measure on Trials revealed that the fallers produced longer MT in the muscles of TA, $F(1,32)=4.59$, $p<.05$, and GA, $F(1,32)=5.01$, $p<.05$, but no difference in PMT, relative to the non-fallers. Also the analyses showed that PMT was decreased in TA, $F(1,64)=3.5$, $p<.05$, from Trial 1 to Trial 2 & 3. Pearson's correlation showed strong relationship between MT and left PEF (or total PEF) in the lower extremity for all participants ($p<.01$). A stepwise regression found left peak extensive force was a reliable predictor for motor time on the muscles of TA, GN, and PL. In summary, this study indicated that slower motor time on the lower extremity might contribute to fall-risk increase in the female elderly. Weaker explosive strength on the lower extremity especially the non-dominant leg was highly related to slower neuromuscular recruitments.

Increasing the Precision Demands of a Finger Force Production Task Leads to Reductions in Task-Relevant Motor Variability

Liddy, Joshua J.; Haddad, Jeffrey M.; Ambike, Satya, Purdue University

The nervous system exploits motor abundance by directing variability along task-irrelevant dimensions (uncontrolled manifold-UCM), thereby suppressing task-relevant variability orthogonal (ORT) to the UCM and stabilizing performance variables. Several studies have incorporated well-defined tasks, e.g. producing a prescribed total force with multiple fingers. These tasks have unique solutions which place strict limits on ORT, in theory, requiring greater control effort. However, many behavioral goals have numerous solutions. These ill-defined tasks are characterized by inequality constraints, and should tolerate greater variance in ORT. This study examined changes to the structure of motor variability while manipulating the precision demands of a finger-force production task. Six

healthy, young adults pressed on two force transducers with their index fingers. Maximum voluntary contraction (MVC) was assessed during 3 6 s trials. Participants performed two conditions requiring the sum of their two finger forces (FT) to be 10% of MVC. A small $\pm 0.25\%$ MVC or large $\pm 1.00\%$ MVC target was displayed on a screen with a cursor representing FT. Participants were instructed to maintain the cursor in the target. 12 20 s trials were performed per condition. Vertical forces from each sensor were collected at 1000 Hz and low-pass filtered at 20 Hz. UCM analysis was performed on the last 15 s of each trial to determine UCM variance (VUCM), ORT variance (VORT), total variance (VTOT), and the synergy index (DVz). One-way ANOVAs were conducted on each variable. No significant differences were observed for VUCM ($F=0.47$, $p=0.50$) or VTOT ($F=0.48$, $p=0.49$). VORT tended to decrease for the small target ($F=3.53$, $p=0.07$). DVz showed a significant increase ($F=5.01$, $p=0.03$) for the small (2.48 ± 0.17) compared to the large target (1.94 ± 0.17). Decreasing target size reduced VORT without changing VUCM, thereby increasing the synergy index, DVZ. As hypothesized, the nervous system appears to tolerate less ORT variability in response to greater precision demands leading to greater stability of FT.

Adaptive changes in running kinematics as a function of head stability demands and their effect on shock transmission

Lim, Jongil; Busa, Michael A.; A. van Emmerik, Richard E.; Hamill, Joseph, University of Massachusetts at Amherst

Head stabilization during locomotion affords a consistent visual base during ambulation by facilitating optimal conditions for vestibular and visual function. Head stabilization in response to altered stride parameters and running speed has been well established; the inverse, how the body adapts and attenuates impact shock to different visual task or head stability demands is less clear. This study aimed to identify adaptive changes in running kinematics and impact shock transmission as a function of head stability requirements. Fifteen strides from twelve recreational runners were collected during preferred speed treadmill running. Head stability demands were manipulated through real-time visual feedback that required head-gaze orientation to maintain within boxes of different sizes, ranging from 21 to 3 degrees of visual angle with 3-degree decrements. The main outcome measures were tibial and head peak accelerations in the time and frequency domains (impact and active phases), shock transmission from tibia to head, stride parameters, and sagittal plane joint kinematics. Increasing head stability requirements resulted in decreases in the amplitude and integrated power of head acceleration during the active phase of stance. During the impact portion of stance tibial and head acceleration and shock transmission remained similar across visual conditions. In response to increased head stability requirements, participants increased stride frequency $\sim 8\%$ above preferred, as well as hip flexion at impact; stance time and knee and ankle joint angles at impact did not change. Smaller hip extension and ankle plantar-flexion, and greater knee flexion at toe-off likely contributed to reducing the vertical displacement of the center of mass with increased head stability demands. These adaptive changes in the lower limb indicate facilitation of active control of head orientation without incurring additional impact loadings in response to different visual task constraints.

Enhancing the pushing performance among expert hockey players through an external focus of attention

Lin, Ching-er; Lee, Hsing-Lin, National Taichung University of Education

The purpose of the study was to examine the effects of pure and dynamic focus of attention on expert hockey player. Eighteen male senior high school hockey athletes (mean age = 16.5, SD = 0.8 years, training experience = 3.9, SD = 2.1 years) were recruited to participate in the study. The task required participants pushing to the target with their dominant at the distance of 9.1 meter. The target was set on the upper left corner of the goal (height = 2.14 meter, width = 3.66 meter). Quarter concentric circles from 15cm to 150cm were drawn around the target and the scores were from 100 to 0. Each participant completed 5 pushes in pure (i.e. external focus) and dynamic experimental conditions (i.e. internal-external focus and near-far focus). All participants completed 15 trials in testing session. Pushing score and variable error were calculated for each condition. Data were analyzed by one-way repeated measures ANOVA. The results showed that (a) the pushing scores of external focus (mean score = 35.89, SD = 8.33) was significant higher than the internal-external dynamic focus (mean score = 26.78, SD = 11.44) and the near-far dynamic focus (mean score = 25.89, SD = 12.28). (b) The variable error of external focus (mean distance = 34.53, SD = 9.94 cm) was significant lower than the internal-external dynamic focus (mean distance = 50.15, SD = 15.14 cm) and the near-far dynamic focus (mean distance = 45.31, SD = 15.45 cm). The findings of the study indicate that directing pure external focus rather than internal-external dynamic focus and near-far dynamic focus not only improves pushing accuracy but also results in lower movement variability on expert hockey players.

Insufficient reporting of control therapies in stroke rehabilitation trials: A systematic-review and meta-analysis.

Lohse, Keith; Pathania, Anupriya; Wegman, Rebecca, Auburn University; Boyd, Lara A., University of British Columbia; Lang, Catherine E., Washington University School of Medicine in St. Louis

Background: Thorough and complete reporting of methods in clinical trials is essential not only for the reproducibility of research, but for clinical interpretation and implementation of experimental methods. In the present analysis, we used the Centralized Open-Access Rehabilitation database for Stroke (SCOAR) to explore the reporting of both experimental and control interventions in randomized controlled trials for stroke rehabilitation.

Method: SCOAR was constructed from a systematic review undertaken in 2014 that identified 215 independent studies, totaling 489 independent therapy groups. Using a mixture of qualitative and quantitative methods, we conducted an in-depth text-based analysis of how experimental and control therapies were being described. In particular, experimental and control groups were scored by independent coders according to the Template for Intervention Description and Replication (TIDIER) criteria.

Results: Linear mixed-effect regression controlling for groups nested within studies

revealed that experimental groups had significantly more words dedicated to the description of their procedures, 272.3, than did control groups, 154.8 ($p < .01$). Similarly, experimental groups had significantly more references in the description of their procedures, 1.60, than did control groups, 0.82 ($p < .01$). Experimental groups scored also significantly higher on the total TIDIER score, 7.27, than the control groups, 5.13 ($p < .01$). Particularly troubling was the poor reporting for "conventional" therapy control groups, which scored 5/12 on average for the TIDIER checklist.

Conclusions: Control treatments for stroke motor rehabilitation trials are under-described relative to experimental treatments, and these descriptions are especially poor for "conventional" therapy control groups. Poor reporting of controls is a threat to internal validity and generalizability of clinical trial results.

Virtual reality obstacle crossing success rate is affected by walking speed and age

LoJacono, Chanel T.; Rhea, Christopher K, University of North Carolina at Greensboro

Obstacle crossing is vital to safe ambulation. Our previous research showed that virtual reality obstacle crossing training results in improved real obstacle negotiation in terms of foot placement and clearance over the obstacle in both younger and older adults. However, the success rate (percentage of cleared vs. contacted obstacles) differed between older and younger adults. The purpose of this study was to examine the relationship of walking speed and the percentage of successful obstacle crossings within the virtual environment. Younger healthy adults ($n=20$, 22.5 ± 3.7 yrs) and older healthy adults ($n=20$, 55.6 ± 6.0 yrs) crossed a 10cm virtual obstacle for a total of 25 trials (5 practice trials and 20 virtual obstacles). The virtual obstacle was shown on a projection screen and appeared to move toward the participants as they walked on a treadmill. During the virtual training, a performance counter showed total number of successful and failed obstacle crossings. Success rate was determined via successful obstacle crossing divided by the 20 crossing attempts. Walking speed (m/s) was self-selected via a standardized protocol. Pearson's correlations were run for each the younger and the older adult groups. For the older adults, there was a significant negative correlation between speed and pass rate, $r=-0.569$, $p<0.01$. For the younger adults, there was a non-significant association shown in the opposite direction with a positive correlation between speed and pass rate, $r=0.339$, $p=0.143$. These results suggest that walking speed may significantly decrease the older adults' ability to successfully cross virtual obstacles. This may be a result of a decreased ability to quickly modify limb trajectories and a generally slower response speed which comes with aging. The positive correlation shown by the younger adults may be due to their enhanced ability to respond to perturbations during gait and quicker response speed.

The effects of self-control on the learning of a graphical aiming task

Luzar, Ben W.; Cameron, Laura G.; Aiken, Christopher A., Alma College

Research has shown that allowing control over some aspect of the learning environment facilitates learning (Wulf, 2007). One area that has yet to be explored in the self-control (SC) research is the effect of SC on the acquisition of a graphical aiming task.

Therefore, the purpose of the present studies was to investigate SC on the learning of a timed graphical aiming task. 32 individuals practiced an aiming task that required them to draw from one target to another while avoiding stationary barriers in exactly 5000ms. A WACOM Intuos Pro tablet was used which required them to draw on a horizontal surface while viewing a vertical screen. Acquisition (ACQ) consisted of 60 trials with a 6 trial retention and transfer test administered 24 hour later. 16 individuals controlled the amount of feedback (SC) and 16 received feedback based on a SC participant (YK). Absolute Constant Error (ACE), Variable Error (VE), Reaction Time (RT), Normalized Jerk (NJ), and Pen Pressure (PP) were collected and analyzed using various ANOVAs. Results suggest that both groups improved from the beginning to the end of ACQ with lower ACE, VE, and NJ ($p < .001$). No significant differences were observed between groups during ACQ, retention, or transfer for ACE, VE, RT, or NJ ($p > .05$). YK did have less average PP during each testing phase ($p < .05$). In the second experiment we modified the task by having individuals use a WACOM Cintiq which allowed them to draw on the screen. 28 participants (14 SC and 14 YK) practiced a graphical aiming task that required them to perform the task in exactly 4000ms. Individuals decreased VE, NJ, and PP during ACQ ($p < .05$). No significant differences were observed between groups during ACQ ($p > .05$). SC did have lower VE during retention but YK had lower VE during transfer ($p < .05$). It appears that the self-control effect did not facilitate learning in either of the studies. These results are similar Alami (2013) that did not find a SC effect with an aiming task. Research needs to continue to investigate the effects of self-control on a graphical aiming task.

What are talent scouts 'identifying' when searching for talent?

Mann, David L., Vrije Universiteit Amsterdam; Timmerman, Ewout, Victoria University; Veerman, Sophie J.; Schmidt, Anouk, Vrije Universiteit Amsterdam

There are rich incentives for sporting organisations to scout for and identify talented athletes from a young age. However, talent scouting remains inherently subjective, with very little known about the factors on which talent scouts base their judgements. Therefore, the aim of this study was to uncover the performance parameters that most pervasively influence the selections of talent scouts. Fifteen experienced field-hockey scouts and/or coaches watched videos of small-sided Under-14 games, and ranked players on the basis of their potential in the game. To determine the factors that influenced their judgements, we introduced a new paradigm where rankings were correlated with the performance of the children on 15 test parameters of hockey-specific technical and tactical skill, anthropometrics, and physical conditioning. The relative age and maturation of the players were also measured. Results revealed that selections were significantly correlated with performance on 10 out of 15 of the test parameters ($ps < .05$). Instead, though, of selections being based on the hockey-specific or other performance-related parameters, selections were most strongly related to the relative maturation of the athletes ($r = .38$; $p < .001$). In fact, after controlling for the relative age and maturation of the children, only four significant parameters remained (height, body weight, BMI, shuttle test). Exit questionnaires revealed that scouts thought they were selecting those who would be most agile, but instead they were actually selecting the shortest, heaviest, and slowest children (after controlling for age and maturation).

Subjective judgements of talent are pervasively influenced by factors not necessarily related with long-term performance, with scouts selecting children largely on the basis of their maturation rather than on parameters related to talent. This new paradigm has the potential to better understand and improve judgements of talent, helping to enhance talent identification, and reduce any unintentional discrimination on the basis of a child's age or maturation.

The use of a dynamic orthosis in a child with unilateral spastic Cerebral Palsy: effects on gait kinematics

Martins, Elisabete; Cordovil, Rita; Oliveira, Raul, Universidade de Lisboa; Pinho, Joana, Escola Superior de Saúde do Alcoitão; Vaz, Joao, Universidade de Lisboa

Hemiplegia is a form of spastic Cerebral Palsy in which one side of the body is affected, resulting in an atypical body posture and abnormal gait patterns. The purpose of this case-report was to provide a descriptive analysis of the immediate effects of a dynamic orthosis, the TheraSuit® (TS), in gait kinematics. A 5.88 years old child with left spastic hemiplegia, level II (GMFCS) and gait classification type III, was instructed to walk at a self-selected pace along a 10m walkway in two conditions: 1) BL (Baseline); 2) TS (wearing the TS). Two video-digital cameras (Basler piA1000-48gc GigE) and six infrared cameras (VICON T10), sampled at 100 Hz were used. Spatiotemporal parameters and lower limb joint angles were determined. For the spatiotemporal parameters, the TS reduced gait cadence (BL: 156 +/- 10.1 steps/min; TS: 132 +/- 3.4 steps/min). While the TS showed few changes in terms of the spatiotemporal parameters, the lower limb joint kinematics looked to be more affected towards a more functional gait pattern. The joints' motion looked to be altered throughout the gait cycle. At the initial contact, the TS showed i) a reduction of dorsiflexion on non-paretic side (BL: 10.2 deg +/- 3.4; TS: 9.2 deg +/- 1.5) and plantarflexion on paretic side (BL: -5.8 deg +/- 1.1; TS: 9.3 deg +/- 1.4); ii) a reduced knee flexion angle in both limbs; iii) a reduced hip flexion in the non-paretic limb. During the stance phase, the child was able to decrease the flexion pattern by showing more knee extension in the paretic limb and greater hip extension in both limbs. In the swing phase, a decrease in knee and hip flexion in the non-paretic limb was also verified. This case-report shows that TS seems to be able of changing gait kinematics toward a more functional gait pattern (i.e., reducing hip and knee flexion and the amount of plantarflexion). It was particularly clear at a distal level (i.e., ankle). The TS might be an interesting tool to implement in physical therapy programs. However, further investigation is required to better understand its short and long term effects.

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Preparation of timing structure involves two distinct sub-processes

Maslovat, Dana; Chua, Romeo, University of British Columbia; Klapp, Stuart T., California State University East Bay; Forgaard, Christopher J.; Franks, Ian M., University of British Columbia

The current study used a precue paradigm to examine the processes involved in the preparation of response sequencing and timing initiation for multi-component

movements. Participants performed a reaction time (RT) task involving a three key-press sequence with either a simple timing structure (isochronous; 300 ms between each key-press) or complex timing structure (non-isochronous; 200 ms between key-press 1 and 2, 400 ms between key-press 2 and 3). Conditions involved a precue that provided information about all features of the movement (simple RT), no features of the movement (choice RT), sequencing only, or timing structure only. When sequencing was precued, RT decreased significantly as compared to choice RT ($p = 0.004$), indicative of advance preparation of the order of elements. When timing was precued, RT decreased significantly compared to choice RT when the timing structure was simple ($p = 0.020$), suggesting some aspect of timing preparation can occur prior to the go stimulus. However, even when the timing structure was known in advance, RT was still affected by timing complexity ($p = 0.017$), confirming some aspect of timing preparation cannot occur until after the onset of the stimulus and thus occurs during the RT interval. To explain these findings, we propose a two component model of timing preparation in which the selection of the appropriate timing structure occurs in advance but implementation of this timing must occur following the go signal. These results support and extend previous findings regarding the independence of the processes associated with response sequencing and timing initiation and provide novel information pertaining to the preparation of timing for complex responses.

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Effects of the combinations of constant-variable practices in the learning of the volleyball serve

Matos, Cintia O.; Benda, Rodolfo N.; Cruz, Madson P.; Costa, Cicero L.A.; Ferreira, Arthur M.; Lage, Guilherme M.; Ugrinowitsch, Herbert, Universidade Federal de Minas Gerais

Previous researches showed that combining practice schedules improves the learning of both movement pattern and parameters of a motor skill. In general, these studies combined constant and random practices. However, few studies tested this question with complex tasks and the results are ambiguous about the learning of both aspects of the skill. The purpose of this study was to investigate the increment of practice variation performed after constant practice on the learning of both movement pattern and parameters. We expect that the lower practice variation of a complex task may improve the learning of the movement pattern and parameters. The sample consisted of 44 volunteers aged between 12 and 14 years old without experience in the task. The task required to perform the volleyball tennis serve. All the volunteers performed a pretest whose score was adopted to counterbalance the participants into four groups: constant-blocked (CBG), constant-serial (CSG), constant-random (CRG) and constant (CG). During the acquisition phase, the participants performed 252 serves divided into 6 sessions. In the first half of acquisition phase all groups performed the serves from one position of the court. In the second half, excepted to the CG, the task was performed from three different positions organized in accordance to the group. The retention test was performed 72 hours after finished the acquisition phase. The results showed that CBG, CSG and CRG improved the movement pattern. Moreover, a detailed analysis showed that these same groups improved the ball throwing component. In addition, the

CBG and CRG also increase the movement pattern consistency. At last, only the CG improved the parameterization. In conclusion, none combination of practice led to learning of both aspects. It is possible that learning complex tasks, the modifications from practice variation improves cognitive demand on movement pattern to perform the task and constant practice makes possible to improve attention demand on parameters adjustment.

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Perceptual-Motor Recalibration Provides a Window into Motor Skill Transfer

Mayo, Anthony M.; Anderson, David I., San Francisco State University; Rieser, John J., Vanderbilt University; Kruse, Brenna; Pick Jr, Herb L., University of Minnesota

Recalibration of perceptual-motor organization is essential for the maintenance of successful behavior in the face of ever-changing environmental conditions and task constraints, as well as morphological changes that result from training, injury, or growth and maturation. Understanding the limits of recalibration can provide important insights into the limits of transfer in motor performance and learning. In a landmark series of experiments, Rieser, Pick, Ashmead, & Garing (1995) showed that the generalizability of perceptual-motor recalibration in walking, throwing, and turning in place was determined by the performer's functional goals. They provided a model of perceptual-motor organization that predicted sets of actions across which recalibration was more or less likely to transfer. The current experiment tests aspects of Rieser et al.'s model. Participants stepped at their preferred speed in a circle to turn a T-bar while on a motorized turntable that was either stationary or moved at 5 revolutions per minute in the same or opposite direction as stepping (8 participants in each condition), resulting in a match or mismatch between biomechanical effort and the perceived rate of stepping. They did so with and without vision. The results clearly demonstrated that preferred stepping speed was influenced by perceived speed in addition to biomechanical effort. When vision was available, participants stepped significantly slower than baseline when the turntable rotated in the same direction as stepping, $t(7) = 5.4$, $p < .05$, and significantly faster than baseline when the turntable rotated in the opposite direction, $t(7) = -2.9$, $p < .05$. Without vision, participants stepped significantly slower than baseline when the turntable rotated in the same direction as stepping, $t(7) = 4.9$, $p < .05$, but at the same speed when the turntable rotated in the opposite direction, $t(7) = -0.9$, $p > .05$. These findings are discussed relative to the insights that the plasticity of this type of perceptual-motor organization can reveal into the transfer of motor performance and learning.

The role of vision and attentional focus in performing a balancing task

McNamara, Scott W.T.; Becker, Kevin A., Texas Woman's University

Recent research has considered whether the presence of vision influences attentional focus effects. In a vertical jump (Abdollahipour et al., 2016), and a golf putt (Land et al., 2013), an external focus created a performance advantage even when vision was obstructed. For these discrete tasks it appears attentional focus effects are independent of vision, but with a continuous task it may be difficult to continually engage with an

external focus when exteroceptive feedback (e.g., vision) is absent. The purpose of this study was to determine if attentional focus effects differ in sighted and blindfolded conditions when performing a continuous balancing task. Participants ($N = 22$) balanced on a stability platform on two separate days with one day being sighted and the other blindfolded. Each day, they completed a familiarization trial followed by trials inducing an internal and external focus. Vision and focus conditions were each presented in a counterbalanced order. The dependent variable measured was root mean square error (RMSE). A 2×2 ANOVA indicated that participants had lower RMSE in sighted conditions than blindfolded ($p < .05$), but scores did not differ between focus conditions regardless of vision ($p > .05$). A visual examination of the data suggests that the familiarization trial was not adequate for stabilizing performance, and focus effects may have been non-significant due to a practice effect. Future research should consider using a longer familiarization period or utilizing a less novel task to determine how attentional focus impacts balance performance in the absence of vision.

Attentional focus effects in children with visual impairments

McNamara, Scott W.T.; Becker, Kevin A.; Silliman-French, Lisa, Texas Woman's University

Extensive research in motor learning suggests that an external focus (i.e., focusing on movement effects) leads to better motor performance and learning than an internal focus (i.e., focusing on body movements; Wulf, 2013), but no research to date has tested this effect in children with visual impairments (VI) [Wulf, 2013]. Wulf (2013) suggests attentional focus effects are independent of vision, while other researchers have suggested vision may play a mediating role (Hodges & Ford, 2007). The purpose of this study was to compare how an internal and external focus of attention impact the performance of a balancing task in children with VI. Eighteen children with VI, between the ages of 8 to 18, were separated into a moderate VI group ($n = 11$) and a profound VI group ($n = 7$) and performed a balancing task on a Stability Platform. All participants engaged in a familiarization trial, and then performed the task with an internal focus and an external focus in a counterbalanced order. The dependent measure used was root mean square error (RMSE). A 2×2 mixed-model ANOVA indicated a significant interaction between vision and attentional focus ($p = .04$). Based on the follow-up tests, the moderate VI group had significantly lower RMSE while using an external focus than an internal focus ($p = .04$). The profound VI group did not differ between focus conditions ($p > .05$), but trended toward having lower RMSE with an internal focus. Based on the results, attentional focus effects may be dependent on the severity of VI, and the functionality of ambient vision is proposed as a potential mechanism. Those with moderate VI seem to benefit from an external focus, but further research is needed to clarify the optimal attentional focus for those with profound VI.

Women Balance Control and Gait adaptations related with heels height

Melo, Filipe, Faculty of Human Kinetics; Crisostomo, Rute S., Instituto Politécnico de Castelo Branco - Escola Superior de Saúde

In modern society, many women wear high-heeled shoes presenting different appearances and designs, reducing the area of support compared with barefoot, and

increasing the difficulty of maintaining balance, and the risk of falling. A good postural control is essential for the success of daily activities as well as fall prevention. This study aimed to compare balance and gait control of women experienced in wearing a specific type of shoes on a regular basis, when wearing shoes with different heels height they are not so used to wear. We examined 36 women aged between 21 and 53 years (30.25 ± 8.24) divided into three experienced groups: a) flat heeled shoes (FH); b) thin high heeled shoes (TH); and c) wide high heeled shoes (WH). Postural control was analysed during three tests using Computerized Dynamic Posturography methodology: i) Weight Bearing test; ii) Limits of Stability Test (LOS); and iii) Walk Test (WT). Our analysis was only centred on the anterior-posterior directional control. The control parameters analysed, concerning the movement of the centre of pressure (COP) and gait parameters, were: weight distribution during three squat positions (0°, 30° and 60°), reaction time, movement velocity, end point excursion, maximal excursion, directional control, step width, step length, and gait speed. The results show that the experienced group in wearing thin high heeled shoes was affected in terms of postural control when wearing flat heeled shoes. These results were attested by high correlations observed between the time spent standing wearing high heeled shoes and the end point excursion and the maximal excursion forwards when wearing flat heeled shoes. Heel's height compel people to assume strategic adaptations like smaller leaning amplitude and step widening, in order to compensate for this loss of control. Our findings are consistent with the proposition that the risk of falls can be related with a change in the type of shoes people wears.

Variability of Ball Positioning in Basketball Bounce Passes

Meyer, Ben, Shippensburg University

Basketball players must be proficient at skills such as shooting, dribbling, and passing in order to have a well-rounded game. A large body of research exists for elements of shooting such as technique and shooting percentages. However, less is known about the skill of passing. Schmidt's law states that the larger the force applied to a ballistic movement, the larger the variability of possible outcomes. The purpose of this study was to analyze the variability of bounce pass ball positioning across a range of distances. It is hypothesized that the variability (as measured by standard deviation) of bounce pass positioning will decrease as the distance between passer and receiver is increased.

Six undergraduate student recreational basketball players participated in the study. A Spalding indoor/outdoor NBA Tack-Soft ball was used for all attempts on an indoor hardwood court. Participants performed three bounce passes from each of three distances (passer to receiver toe-to-toe distances of 3m, 6m, and 9m). The position of the ball was determined at the time of release from the passer, at contact with the gym floor, and upon contact with the receiver. Measurements were computed from video footage using Logger Pro software. The bounce position was computed as a percentage of toe-to-toe distance. Differences between measures were tested for statistical significance using ANOVA (criterion of $p = 0.05$).

Participants landed their bounce passes at 48%, 51%, and 80% from the 3m, 6m, and

9m toe-to-toe distances. The respective standard deviation values were 11%, 15%, and 4%. The 3m and 9m conditions showed significant differences, but the 3m and 6m conditions did not differ significantly. The results of this project indicate that for a small sample of undergraduate recreational basketball players, variability decreases as pass distance increases. This result differs from what is predicted by Schmidt's law. Future studies should utilize a larger sample and explore additional variables such as height, experience, skill level, and ball/surface characteristics.

The observation of three different model types show the same levels of consolidation in the learning of a novel motor skill

Moore, Clara; Ste-Marie, Diane M., University of Ottawa

Recently, there has been interest in consolidation and observational learning. Trempe et al. (2011) found that consolidation occurs following observation alone, although the behavioral outcomes were different than those occurring following physical practice alone. Model type has been known to influence motor skill learning and it has been shown that combining two model types, termed mixed-modeling, leads to better learning of a motor skill rather than observing one model type alone (Rohbanfard & Proteau, 2011). Here we question whether these findings can be explained by differences in consolidation. Thus, the purpose of this experiment was to investigate how different model types affect the amount of consolidation that occurs following an intermixed physical and observational practice. Participants learned a spatiotemporal motor task and were randomly assigned to one of three observation groups: 1) skilled model, 2) unskilled model, and 3) mixed-model (observing a skilled and unskilled model). All participants came in for three separate days of testing; the first day began with a baseline test, followed by an acquisition session and an immediate retention test (10-min delay). During acquisition, participants performed three physical practice trials of the skill and then watched two videos of the specific model type performing the skill, this pattern was repeated to give 90 trials of practice (54 physical, 36 observational). Day two began with a 24-hour retention test, followed by a second acquisition session and another immediate retention test. Day three occurred one week later and included a final retention test and a transfer test. Analysis of variance showed that learning of the task occurred across blocks within a session, as well as across the days of training. We did not replicate Rohbanfard and Proteau's results, however, as there were no significant differences in physical performance between groups over acquisition or in retention/transfer. These results suggest that similar levels of consolidation occurred across all models.

Effector transfer effects in motor simulation during action prediction

Mulligan, Desmond; Chan, Brennan; Kuehne, Mareike; Hodges, Nicola J., University of British Columbia

There is significant evidence that when people are involved in action prediction they engage their motor system to aid in prediction accuracy. This has been termed motor simulation. This simulation process appears to be specific to the observer's physical (motor) experience with the observed action. In our own work, we have shown that after

physical practice throwing darts with the right-arm (in right-handers), observer's prediction accuracy improves significantly, but is impaired when they also perform a simple secondary motor task with their right-arm. No such interference is seen when they perform the same secondary task with their left-arm (Mulligan et al., 2016). This speaks to a high degree of specificity in action prediction, based on both: a) what people see and b) what they have been trained to do. To further test the specificity of such simulation processes and the presence or absence of transfer in simulation across limbs, we tested the prediction accuracy of left-handers after practice throwing with their left-arm. In a first study, left-handers did not show any pre to post-test improvements in prediction accuracy when watching a right-handed thrower (irrespective of any secondary motor tasks). This provides evidence that simulation-related effects are not general in nature and that the trained task does not transfer, at a perceptual-level, to watching and making predictions about the non-trained limb. We are also testing the prediction accuracy of left-handed individuals, trained to throw with their left-arm, watching videos that have been flipped to appear as left-handed throwing. If the interference effects are specific to both the type of practice and the stimuli, then we should see pre-to post-test improvements in prediction accuracy. However, we would now expect that interference effects would only be present for the left-arm secondary task. These data are expected to add to our general understanding of the specificity/generalizability of motor simulation effects and the conditions, if any, under which transfer across limbs should be expected.

Comparison of Visual Fixation Patterns of Collegiate Female Volleyball Players in Serve Reception Passing

Murray, Nicholas, East Carolina University; Simpson, Jaclyn E., George Mason University; Whittier, Tyler; Raedeke, Thomas D., East Carolina University

Successful performance of interceptive tasks (such as return of serve in volleyball) require the performer to capture appropriate anticipatory information prior to and during the flight path of the approaching object. The stability of the visual search (e.g., Quiet Eye) impacts how an athlete uses visual information to guide the execution of interceptive actions. While there are several visual search variables, quiet eye (QE) duration has reliability distinguish both expertise and performance success. Quiet Eye duration has been proposed to reflect the organization of neural networks controlling a planned motor response and is affected by task difficulty as well as the corresponding movement complexity. However, it is still unclear the nature and role of quiet eye within interceptive tasks especially concerning elite and sub-elite performers. The purpose of the current study is to investigate the visual search patterns of elite, good, and average (N = 18) female Division-I volleyball passers during the anticipatory and reactive phases of serve reception. A secondary purpose of the study was to identify the relationships between search patterns used and accuracy of the serve reception pass. Participants then were divided into three sub groups based on their team's Rating Percentage Index (RPI) and the athlete's personal passing average from the previous fall season. Time to final fixation location, quiet eye duration, and ratings of success were the dependent measures. Overall, results demonstrated differences ($p < .05$) in Time to final fixation location and quiet eye duration between elite, good, and average Division-I volleyball passers as well as differences for ratings of performance success. The results are discussed in light of the quiet eye duration, interceptive tasks, and visual motor control.

Errorless learning and analogy instruction: Comparing implicit learning methods

North, Jamie S.; Warren, Sam; Runswick, Oliver R., St Mary's University, Twickenham, London

When executing a motor skill in a high-pressure situation, a decrement in performance is often observed. Anxiety can cause performers who have learned via explicit instruction to reinvest in previously stored declarative knowledge and regress towards a more conscious state of motor control often exhibited by novices (Masters, 2002). Implicit learning has been shown to reduce this performance breakdown but there has been little research comparing the relative effectiveness of alternative implicit learning methods. We used a golf-putting task to compare errorless learning, analogy instruction, and explicit instruction methods to ascertain which would result in superior learning and retention under pressure. We hypothesised that, under pressure, both implicit methods would result in more accurate putting performance relative to the explicit group, and that the errorless learning group would be more accurate than the analogy instruction group due to the reduced opportunity to accrue declarative knowledge. Three separate groups of novice golfers completed a pre-test putting task five feet from the hole and then received 100 acquisition trials with either, explicit instructions, an analogy instruction (move the club in a pendulum like motion), or errorless learning conditions (trials one foot from the hole). Immediately following acquisition a post-test was performed, followed by retention tests under non-anxious and anxious conditions 48 hours later. All groups improved putting accuracy with the explicit instruction group showing superior performance at post-test. However, both implicit learning groups performed more accurately in the anxiety based retention test than the explicit group, with no difference found between the errorless and analogy learning groups. Results support previous findings that show implicit learning is effective in minimizing skill breakdown under conditions of high-anxiety and both the use of analogies and errorless learning are equally effective strategies to promote implicit learning.

Identifying the critical relative motion information to recognize patterns in dynamic displays consisting of multiple objects

North, Jamie S., St Mary's University, Twickenham, London; Hope, Ed, Liverpool John Moores University; Williams, A. Mark, University of Utah

In domains where performers operate under strict temporal and spatial constraints, the ability to perceive patterns between features in the environment has been proposed as an important perceptual process which underpins successful anticipation (Abernethy, Baker, & Cote, 2005). In sport there is evidence that accurate pattern recognition is achieved by processing relative motions between display features (Williams, North, & Hope, 2012). It is proposed that experts, through rich cognitive knowledge structures, can direct attention to only the most critical information in complex displays. A fundamental challenge though is to identify the minimal set of features (and their relations) which allows accurate pattern recognition. We aimed to identify the minimal essential information required to recognize patterns in stimuli consisting of multiple dynamic features. In an initial viewing phase, we presented skilled and less-skilled

soccer players with point light display stimuli representing attacking patterns of play. In the recognition phase, participants made recognition judgments to stimuli in three conditions that were edited to only show the relations between a select few features. Skilled participants were more accurate in recognizing stimuli when presented with relative motions between central attacking players, which increased further still when the ball was included against which these relationships could be judged, however there was no difference between skill levels when relations between two peripheral features were presented. Our findings provide evidence to suggest that skilled performers can perceive and recognize global patterns on the basis of encoding localized relative motion information. Specifically, the relative motion between centrally located attacking players provides the minimal essential information to recognize patterns in dynamic displays containing multiple objects.

Between and Within-Conditions Trade-Off in a Movement Speed-Accuracy Task

Pacheco, Matheus Maia, The University of Georgia; Hsieh, Tsung-Yu, National Taiwan Normal University; Newell, Karl M., The University of Georgia

Previous models of movement speed-accuracy trade-off (SAT) have been shown to be either limited or incorrect. Typically they describe the spatial variable error (VEs) that results from the given criteria of movement time (MT) and movement amplitude (A). However, these models under emphasize the systematic bias in spatial (CEs) and temporal error (CEt) and the variable error in time (VEt). It is possible to find individual differences in the resulting function in the literature that might result from the covariance of both space and time variables. The present study tested this possibility.

Twelve individuals performed 18 conditions in a discrete line drawing task: 1 target size (1 mm), 3 A and 6 MT (5 cm: 250, 300, 450, 650, 1000, and 1500 ms; 20 cm: 300, 450, 650, 1000, 1500, and 2000 ms; 40 cm: 450, 650, 1000, 1500, 2000, and 2500 ms) - around 4 conditions per day, 100 trials per condition. We fitted a Linear Mixed-Effect model (LME), allowing for individual differences, and performed a backward method (using the Bayesian Information Criterion) to observe whether CEt and CEs were necessary to explain VEs and VEt. The full model included A (or MT for VEt), speed criterion (S), their interaction, CEt and CEs. The random effects were modelled using a Diagonal Matrix. The LME showed that CEt ($t(191)=3.21$; $p<.01$), CEs ($t(191)=2.07$; $p<.05$), S ($t(191)=10.55$; $p<.01$), and A and S interaction ($t(191)=6.53$; $p<.01$) were necessary to explain VEs ($R^2=0.93$) (CEt, CEs and S varied significantly between individuals - $p<.05$). Also, the LME showed that CEt ($t(191)=0.86$; $p=.39$), MT ($t(191)=10.18$; $p<.01$), S ($t(191)=3.87$; $p<.01$), and the MT and S interaction ($t(191)=3.36$; $p<.01$) were necessary to explain VEt ($R^2=0.88$) (CEt, MT, S, and MT and S interaction varied significantly between individuals - $p<.05$).

In sum, for both VEs and VEt, the bias measures of error were required to describe the data at the individual level. This supports the hypothesis of a within-condition trade-off in addition to the between-condition trade-off previously reported in the literature.

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Movement-related cortical potentials of the bilateral deficit in dominant left- and right-handers

Panzer, Stephan, Inst of Sport Science; Leinen, Peter, Saarland University; Shea, Charles H., Texas A & M University

Performing an action at a maximum speed or with a maximum strength with two limbs simultaneously leads to a lower performance than the sum of unimanual performances. This is characterized as bilateral deficit. In most experiments dominant right-handers were involved. The main purpose of the present study was to determine the relevance of hand dominance on the bilateral deficit phenomenon. Therefore we examined movement-related cortical potentials (MRCP: divided into readiness potentials; negative slope; motor potentials) from the motor cortex area (C3; C4) and reaction times (RT) performed unilaterally and bilaterally from dominant left- (N= 8) and right-handers (N= 8). Participants of each group were instructed to respond as quickly as possible to a stimulus by pressing the keys of a response box assigned to the respective fingers (100 trials in each condition; order counterbalanced). As expected RTs were slower for the bilateral condition compared to the unilateral regardless of whether participants were left- or right-hand dominant. However, for dominant right-handers the amplitudes of the readiness potentials, the negative slope and the motor potentials of C3 and C4 revealed a non-significant difference in the bilateral condition. This pattern of results did not occur for the left-handers. For the unilateral conditions the symmetry disappeared and an asymmetry occurred with larger potentials in the contralateral hemisphere regardless of hand dominance. The behavioral RT data demonstrated a bilateral deficit for left- and right-handers. The MRCP results suggest that for dominant right-handers the bilateral deficit is caused by a mechanism of interhemispheric inhibition which may result in a decrease of an action performed at a maximum speed with two fingers simultaneously.

Effects of single-task practice of dual-task performance limitations in sequence learning

Panzer, Stephan; Lindemann, Hanna, Saarland University; Shea, Charles H., Texas A&M University

An experiment was designed to determine effects of a dual-task performance limitations on sequences learning after practicing a movement sequence under single-task condition. A 16-element movement sequence was practiced during acquisition under a single-task condition. On day two retention and transfer tests were administered. After the retention test participants were randomly assigned to a dual-task vocal or a dual-task manual transfer condition. In both dual-task conditions a combination of a sequence learning and a Psychological Refractory Period (PRP) paradigm was used. In the PRP paradigm, participants were required to respond to two closely spaced stimuli S1 and S2 separated by a variable stimulus onset asynchrony (SOA), with responses R1 and R2. Participants were instructed to respond to each stimulus as quickly as possible. In this situation the initiation of R2 is delayed. When SOA is decreased the delay of the initiation of R2 is further increased. The delay for R2 is due to the PRP effect, because there is an overlap between completion of R1 and R2 processing. Reducing the SOA resulted in a bigger overlap between the completion of the two processes for R1 and for R2. Accordingly, interference is attributed to a single central bottleneck involving decision processing in the response selection stage, and not in the response execution

stage. The reaction time task was the primary task and the 16-element dynamic arm movement sequence was the secondary task. Both tasks were separated by a variable SOA. In the dual-task vocal condition participants had to react by voice to the stimulus of the primary task, while in the dual-task manual condition a key-press was required. The results indicated that after practicing the sequence under a single-task condition dual-task interference occurred only under the vocal task when the SOA was short. This finding suggests that after practicing under a single-task condition dual-task performance limitations are specific to the response modality.

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Ataxia-related challenges in control of compensatory stepping during balance perturbation in patients with cerebellar disease

Park, Jin-hoon; Lim, Changha, Korea University

Purpose: The cerebellum plays a critical role in control of balance and locomotion. Dysfunction of this neuronal structure results in cerebellar ataxia (CA), a substantial decline in limb coordination and balance control which often increases risk of falling. At present, there is a lack of studies on ataxia-related stepping impairments during balance perturbation. The purpose of the present study was to analyze and evaluate the compensatory stepping characteristics in patients with CA. Methods: We tested 10 patients with cerebellar disease and 10 age- and sex-matched normal controls. Reactive stepping kinematics were measured using a lean-and-release posterior balance perturbation applied by means of a horizontal lean-control cable with a load equivalent to 1-5% of the participant's body weight. Results: Results showed that compared with normal controls, CA patients demonstrated the followings: increased step numbers, delayed total response time, increased response distance, increased horizontal displacement of COM, higher foot clearance, and increased initial step distance. However, no significant differences between groups were found in vertical displacement of COM, step reaction time, initial step response time, and lateral foot displacement. Conclusion: These results indicate that stepping patterns of CA patients were characterized by multiple steps, higher variability of lateral motion, and delayed recovery responses. Taken together, the findings suggest that CA patients were not able to resist posterior balance perturbation sufficiently with their initial step and used more conservative but costly recovery stepping strategies.

Off-line consolidation in learning a novel bimanual coordination skill

Park, Incheon; McCulloch, Austin; Buchanan, John J., Texas A&M University

Off-line learning and consolidation is the phenomenon of continuing improvement in skill without more practice. Studies using sequential motor skills have provided evidence that motor memory is resistant to interference and forgetting (consolidates) after a long enough delay. To investigate if bimanual coordination skill learning goes through off-line consolidation processes, we used an interference task with two different time delays. Participants trained with a 90 deg relative phase pattern with concurrent Lissajous feedback to drive rapid training. Participants were then asked to recall the 90 deg pattern after a 2 or 6 hour delay without the Lissajous feedback. An interference task of training

with a 45 deg pattern with Lissajous feedback was introduced before the recall of the initial 90 deg pattern. Movement accuracy (AE) and time-on-task (ToT, +/- 45 deg) measures were computed to compare performance across blocks. The 2 and 6 hour groups were characterized by rapid decreases in AE and ToT in block 1 training (10 trials, 30 sec each) with the 90 deg pattern: 2-hr AE = 14.9 deg, 6-hr AE = 14.3 deg; 2-hr ToT = 73%, 6-hr ToT = 71%. After the delay, each group showed rapid improvement in block 2 training (10 trials, 30 sec each) with the 45 deg pattern: 2-hr AE = 14.5 deg, 6-hr AE = 19.3 deg; 2-hr ToT = 82%, 6-hr ToT = 71%. Block 3 (5 trials, 30 sec each) was performed right after block 2. For the 2-hr delay group, interference in producing the 90 deg pattern without Lissajous feedback was found, AE = 40.5 deg and ToT = 49%. Both of these values were significantly different from the block 1 means of the 2-hr group. For the 6-hr delay group, consolidation of the 90 deg pattern without Lissajous feedback was found, AE = 16.6 deg and ToT = 78%. These values were not different from the block 1 means, yet were different from the block 3 means of the 2-hr group. These findings show that bimanual skill learning is consolidated like sequential motor skill learning and shows that the disadvantage of significant guidance can be overcome with extended time delays.

Alteration of gait characteristics during music listening: The role of emotion and rhythm

Park, Kyoung Shin; Lee, Hyekeun, University of Florida; Fawver, Bradley, University of Utah; Hass, Chris J.; Janelle, Christopher M., University of Florida

Evidence indicates that the rhythmic components of music are important for realizing the motoric benefits of music interventions, but the corresponding role of emotion in these interventions has been largely ignored. Substantial evidence supports that music evokes strong emotional responses and that affective states closely interact with motor behaviors. We sought to delineate the roles of emotion and rhythm in alterations of spatiotemporal gait parameters when listening to music. Twenty-four healthy young adults completed gait trials while listening to (1) experimenter-selected consonant music, (2) rhythm-preserved, pitch-distorted counterparts of consonant music (dissonant), (3) participants' favorite music, and (4) rhythm-preserved, pitch-distorted counterparts of participants' favorite music (unfavorite). Univariate analyses of variance and posthoc tests showed that participants' favorite music elicited more pleasant feelings such as happiness, pleasure, and pride (all p 's < .001, η^2 = .757 - .862) and facilitated cadence (p < .001, η^2 = .260), gait velocity (p < .001, η^2 = .388), stride length (p < .001, η^2 = .458), and stride tempo (p < .01, η^2 = .230) compared with other music conditions. While consonant and dissonant music brought about modest changes in emotional states and gait parameters, unfavorite music substantially disrupted emotional states and all gait parameters. Moderated regression analyses further revealed that the impact of musical rhythm on gait velocity was significantly boosted (p = .001) when pleasant emotions were high (+ 1SD). However, musical rhythm did not affect gait (p = .515) at low levels of pleasant emotions (- 1SD). Implications are discussed for the moderating role of musical emotion on motor functions of individuals with affective and motor dysfunction.

Athletics and expertise; how movement influences memory

Peach, Sidney B.; Winkers, Chelsea A., Edgewood College

It is well known that expertise influences memory. Examining chess experts suggests that expertise is developed through domain specific knowledge structures, which are formed through extensive and continual exposure to domain specific stimuli (Bilalic, Langer, Erb & Wolfgang, 2010). With years of domain specific learning, athletes form an expertise in their sport. The conditions within which they gain their experience may create the ideal environment to learn. The purpose of this study is to examine how active and passive learning influences athletes and non-athletes across three domains: athletic expertise, kinesthetic, and verbal. Each learning domain contained an active and passive condition, each having learning and recognition phases. Active conditions involved walking through basketball plays, obstacle courses, or hearing word lists read aloud while passive conditions involved just viewing the stimuli. We hypothesized that basketball players would have better recall for their domain specific learning, and that active learning conditions would lead to better memory in both groups across all conditions. We analyzed memory recall using a 3x2x2 repeated measures ANOVA on the proportion of correctly recalled items across conditions and groups. Consistent with our hypothesis, there was a significant main effect of group ($F_{1,40}=11.55, p<.01$) with the basketball players recalling more items than non basketball players across conditions. Post-hoc tests revealed that this basketball advantage was driven by the active basketball condition ($t_{40}=-3.737, p<.005$). Contrary to our prediction, there was no main effect of active vs. passive memory condition ($F_{1,40}=2.686, p=ns$). Interestingly, we found a significant main effect of experimental condition ($F_{2,39}=18.582, p<.001$), with the verbal condition leading to the best recall followed by basketball, then kinesthetic conditions. These findings revealed the importance of domain specific learning in understanding the benefits of athletic expertise as translating beyond performance in a game and into the cognitive realm.

Examining Student Engagement and Learning in a Mobile Technology Enhanced Motor Behavior Class

Petranek, Laura J., Boise State University

Researchers have shown that minimal use of iPads have enhanced student perceptions of motivation and engagement to learn (Diemer et al., 2013; Nguyen et al., 2014, Rossing et al., 2012). What is missing in the literature are student perceptions while using mobile technology in a Kinesiology course for a semester. The purpose of this study was two-fold: (1) determine student perceptions of engagement (POE) and learning (POL) of motor behavior content while using iPads and (2) identify any changes in POE and POL over a semester when iPads were intentionally used daily. Thirty-four undergraduate students in a motor behavior course were recruited to participate and received an iPad as part of a University-wide mobile initiative. The instructor embedded interactive activities along with motor behavior content for individual/group experiences (e.g., quizzes, polls, drawing-boards) by using an educational app on the iPad every day for 15-weeks. POE and POL were assessed using a 5-point Likert scale (1 = strongly disagree and 5 = strongly agree) five weeks into the course and again at the end of the

term. Average scores were similar for POE and POL at the beginning of the semester ($M=3.74$, $SD=.92$, POE; $M=3.89$, $SD=.81$ POL) and at the end ($M=3.90$, $SD=.67$, POE; $M=3.97$, $SD=.81$ POL). POE and POL were also strongly correlated at the beginning of the semester ($r=.64$, $p<.01$) and at the end ($r=.67$, $p<.01$). Similar results have been reported by Diemer et al. (2013). A repeated measures MANOVA was non-significant ($p=.76$), indicating no significant change over time in students' POE or POL. These results are encouraging, POE and POL scores remained fairly high and consistent over time. The current findings suggest the delivery of motor behavior content is possible with an iPad in an interactive, applied, and meaningful way and may offer an alternative to traditional lecture. Future research needs to include instructor perspectives to better understand how best teaching practices when integrated with mobile technology can impact students' perspectives of engagement and learning.

Concussion Prevention and Coaching Pedagogy: Coaches' Perspectives

Petranek, Laura J., Boise State University; Bolter, Nicole D., San Francisco State University; James, Julie, Boise State University

Among youth younger than 19 years old, sport- and recreation-related concussions resulting in emergency room visits have increased 62% from 2001-2009 (CDC, 2011). Today all states have laws aimed to reduce these numbers and protect youth sport participants (Baugh, et al., 2014; Valovich McLeod, et al., 2015). Although concussion education requirements vary from state to state (Harvey, 2013), some studies have shown positive changes in coaches' knowledge about concussions. For example, coaches reported an increased ability to identify concussions and sharing knowledge from concussion education with players, parents, and other coaches (Covassin, et al., 2012). However, less is known about any changes coaches make during practice and games as a result of increased concussion awareness and education. Our purpose was to explore coaches' instructional strategies used in youth sport related to concussion prevention. Twenty youth sport coaches representing six different sports (hockey, soccer, football, lacrosse, gymnastics, track & field) participated in a telephone interview. Open-ended questions focused on any changes made to address concussions with players in practices (e.g., drills) and/or games. Coaches reported 1-35 years coaching experience, working with boys and girls ages 5-18, at competitive and recreational levels. Most participants (85%) reported receiving concussion education. An inductive content analysis of interview transcripts resulted in 6 higher-order themes represented by 22 lower-order themes. Coaches' perceptions of concussion risk depended on sport type, age/competitive level, and gender. Changes reported by coaches included reinforcing proper technique, reducing intensity and frequency of contact, increasing communication with athletes, and following concussion protocol. Coaches felt additional coach and parent education and accountability of the referees was needed. Future researchers should examine the implications of changes in coaching practices and whether they indeed reduce risk for concussions.

Effects of task and contextual constraints on place kicking performance at the 2015 Rugby World Cup

Pocock, Chris, St Mary's University, Twickenham, London; Bezodis, Neil E., Swansea University; Davids, Keith, Sheffield Hallam University; North, Jamie S., St Mary's University, Twickenham, London

Place kicks in Rugby Union present opportunities to score points without the spatiotemporal dynamics of open play, but are typically executed under varying task and contextual performance constraints within competitive environments. The average success percentage of place kicks in international Rugby Union (2002 - 2011) was 72%, however, success percentage dropped to 61% in instances when the match outcome hinged on success of a single place kick (Quarrie & Hopkins, 2015). To further the current understanding, we analyzed place kick performance from the 2015 Rugby Union World Cup under different task and contextual constraints. Data were collected from television broadcasts for each place kick. In addition to recording the outcome of each kick, contextual information recorded included time of the kick in the match, score margin at the time of the kick, and the outcome of the kicker's previous kick. The recorded task constraints included distance (m) and lateral angle (deg) to the goalposts. A binomial logistic regression model revealed that distance ($p < .001$) and angle ($p = .001$) to goalposts were significant predictors of place kick outcome. Furthermore, the success percentage of kickers who had missed their previous kick was 7% lower than kickers who had scored their previous kick, and the success percentage of place kicks was 8% lower than the tournament average in the final 10 minutes before half-time. Our findings highlighted the influence of varying task difficulty on success percentage of place kicking and the role that contextual constraints may have on elite kickers during competitive sports performance. Future research should investigate the interaction of key constraints on place kicking performance and could consider the experiential knowledge of kickers and coaches to help achieve this. These findings could help performance analysts, sport scientists and coaches to design practice environments which successfully simulate the relevant demands of competitive performance environments.

Stabilization and structural variability in a throwing task

Profeta, Vitor; Carello, Claudia, University of Connecticut

Understanding stabilization of performance in different motor tasks is an important step towards comprehending transfer among them. Performance stabilization is accompanied by modification of the structure of variability of kinematic variables, changes that have been demonstrated to provide a useful window for investigating motor control and learning. We investigated the process of performance stabilization, and its associated structural variability modification, using the virtual skittles task developed by Sternad and colleagues. The simulation involves a ball (3 cm) that is tethered to a post (8 cm) and thrown (i.e., swung) onto a target (3 cm). Performance is evaluated by the minimal distance between the ball's trajectory and the target position; it is represented in an action space composed of the set of independent variables that determine the position of the ball relative to the target at every instant. Twenty-four participants were assigned randomly to three groups. Each group was characterized by having defined by different target conditions. For Group 1 (G1), the target was positioned 20 cm to the right and 50 cm above the post. For Group 2 (G2), the target was placed 12 cm to the right and 35 cm above the post. Finally, for Group 3 (G3), the target moved back and forth from 20 cm on the left to 20 cm on the right and 50 cm above the post. Its velocity followed a

a sinusoidal wave with cycles of 6.28 s. Participants in each group performed 10 blocks of 70 trials. For each block of trials, several measures were obtained: Tolerance, noise, and covariation costs (structure of the variability of kinematic variables measures) and average error. Growth Curve Analysis was applied to each time series of ten points per measure. Analyses indicated that G1 produced lower performance than G2 and G3 at the beginning of practice, although their learning curve profiles were similar. In addition, variability costs decreased in all groups over practice blocks, with the tolerance cost presenting larger values.

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A single session of external focus balance training changes resting-state brain connectivity.

Raisbeck, Louisa D.; Diekfuss, Jed A.; Slutsky, Alexis B., University of North Carolina at Greensboro; Grooms, Dustin R., The Ohio State University; Schmitz, Randy J., University of North Carolina at Greensboro

An external focus of attention is theorized to alter resting-state brain connectivity (Wulf and Lewthwaite 2016). This study examined the influence of an external focus of attention on resting-state brain connectivity following a single-session of balance board training. Ten healthy subjects (28.0 +/- 2.6 yrs.) completed resting-state brain connectivity scans using functional magnetic resonance imaging (fMRI) before and after a single session of balance training on a multidirectional balance board. An inertial measurement unit was attached to the center of the board to quantify time in balance. Participants were randomly assigned to either an external or internal focus condition completing five blocks of five 30 sec trials of standing on a multidirectional balance board. Participants in the internal focus condition were asked to 'focus on keeping their feet level,' whereas those in the external focus condition were asked to 'focus on keeping the board level.' A 2 (attentional focus) x 5 (trial block) mixed ANOVA assessed differences in time in balance. Independent samples t tests with a false discovery rate correction for multiple comparisons determined differences in resting-state brain connectivity. Performance results revealed a significant main effect for time in balance with the external focus demonstrating significantly longer time in balance compared to the internal focus, $F(1, 7) = 4.33$, $p = .04$. Resting-state connectivity results revealed that the external focus displayed significantly greater connectivity between the right cerebellum and the left and right lateral occipital cortex and occipital fusiform gyrus post training (all $t(8)$, $p < .001$). Using external focus acutely increases correlated brain activity between an area important to motor control (cerebellum) and areas important to vision and recognition (lateral occipital cortex and occipital fusiform gyrus). These findings are evidence of the importance external focus of attention in integrating neural functionality of vision and autonomic motor control.

Balance practice with an internal focus increases resting-state connectivity in brain regions associated with balance.

Raisbeck, Louisa D.; Diekfuss, Jed A.; Slutsky, Alexis B., University of North Carolina at Greensboro; Grooms, Dustin R., The Ohio State University; Schmitz, Randy J., University of North Carolina at Greensboro

The self-invoking trigger hypothesis (Mckay et al., 2015), suggests that an internal focus (IF) engages self-regulatory processes, which leads to poorer motor performance. The neural component of this hypothesis is not well understood. The purpose of this study was to determine if IF instruction influences resting-state brain connectivity following balance training. Ten healthy subjects (28.0 +/- 2.6 yrs.) completed resting-state functional magnetic resonance imaging (fMRI) before and after balance training. Participants were randomly assigned to either an external focus (EF) or IF condition completing five blocks of five 30 sec trials of standing on a multidirectional balance board. Internal focus instructions were 'focus on keeping your feet level,' while EF instructions were 'focus on keeping the board level.' An accelerometer attached to the center of the board quantified time in balance. A 2 (attentional focus) x 5 (trial block) mixed ANOVA assessed differences in time in balance. Independent samples t tests with a false discovery rate correction for multiple comparisons determined differences in resting-state brain connectivity. Classical attentional focus effects for motor performance was confirmed as performing with an IF demonstrated significantly less time in balance compared to EF, $F(1, 7) = 4.33$, $p = .04$. Resting-state connectivity results revealed that the internal focus condition resulted in significantly greater connectivity between the third lobule of the vermis and left and right cerebellum (all $t(8)$, $p < .05$). The third lobule of the vermis is a location that has been associated with descending control systems and the cerebellum is associated with postural stability. Results show that adopting an IF during balance tasks facilitates correlated brain activity among these brain regions and may indicate that the executive system is less efficient. These data complement the self-invoking trigger hypothesis and add to our understanding of attentional focus on motor and cognitive function.

Temporal correlations of support surface movement affect the control of center of pressure velocity

Rand, Troy; Mukherjee, Mukul, University of Nebraska at Omaha

Interacting with changing environments is a key feature of postural control. Center of pressure velocity (COPv) can be used to explore postural responses to environmental changes. The COPv exhibits two scaling behaviors, persistence on the short time-scale and anti-persistence on a longer time-scale. The crossover point where these scaling regions change indicate the period of the COPv oscillation, or how much time it takes the COPv to increase and decrease before changing directions. Little is known about how the COPv oscillation period changes during different postural demands. The goal of this research was to investigate the postural response to support surface translations of different temporal correlations and average movement velocities. Twenty participants stood on the Neurocom balance manager while the support surface was translated in the anteroposterior direction with no temporal correlation (white noise), moderate temporal correlations (pink noise), and high temporal correlations (sine wave). Each type of waveform was translated at six different movement velocities. The time-scale where the COPv switched from persistent to anti-persistent was measured using custom code based on detrended fluctuation analysis. As the velocity of movement increased, the time-scale of COPv oscillations increased for sine wave, decreased for pink noise, and

did not change for white noise movements. This indicates that when the movement has a high temporal correlation and the average movement velocity is increased, the COPv has a greater oscillation period. When there was no temporal correlation the increase in movement velocity did not result in a change to the oscillation period. However, when the temporal correlation is moderate and movement velocity is increased, the COPv oscillation period decreases. From a motor learning or rehabilitation perspective this information can be used to tailor training paradigms to elicit the desired response.

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Dyslexic children can modulate body sway in reading conditions

Razuk, Milena; Barela, Jose Angelo, Cruzeiro do Sul

The aim of the study was to verify the effects of reading and fixation tasks on body sway in dyslexic children. Twenty dyslexic and 18 non-dyslexic children were asked to stand upright in front of an LCD monitor, 60 cm away and at eye level. All children performed three experimental conditions: reading task (silent reading of a text project on the monitor); reading Landolt task (all letters of the reading task being replaced by close circles and some Landolt's rings) and children were asked to scan each stimulus in a reading-like fashion from the left to the right and count the amount of Landolt's rings; and fixation task (gaze in a white circumference of 1.5 cm). The experimental conditions were repeated three times, lasting 30 seconds each. Body sway was obtained through Optotrak IREDs, at a sampling rate of 100 Hz, placed on the participant's back, in the anterior-posterior (AP) and medial-lateral (ML) directions. Mean sway amplitude, area, mean velocity and predominant frequency were calculated. Dyslexic children showed larger area, higher mean velocity and lower predominant frequency than non-dyslexic children. In the reading and Landolt tasks, dyslexic children decreased magnitude of body sway, in the AP direction, compared to the fixation task. Interesting, non-dyslexic children did not show any condition effect on body sway. These results indicate that dyslexic children are able to modulate body sway in performing reading and Landolt tasks, suggesting that the stimulus projected on the monitor was used as additional sensory cues to improve postural control system functioning.

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Examining a motor learning paradigm: To teach or not to teach

Rhoads, Jence A.; Daou, Marcos; Dyke, Ford B.; Lohse, Keith R.; Miller, Matthew W., Auburn University

Prior research has suggested the expectation of teaching augments motor learning. Further, the expectation of teaching and actually teaching, by way of video explanation, has been shown to enhance learning of academic information. However, this paradigm has yet to be examined in the motor learning realm. Based on the extant literature, the expectation of teaching and actually teaching should be advantageous for learning a motor skill. Thus, the present study investigated whether preparing to teach and actually teaching enhances motor learning. On Day 1 of the experiment, 84 participants completed a pretest of the motor task (golf putting) to determine baseline skill level, and then were assigned to one of four groups. Two groups studied and practiced the task

with the expectation of teaching the skill via video demonstration at the end of practice, while the remaining two groups studied and practiced without this expectation. Following skill acquisition, half of the participants who expected to teach performed a 2-min video demonstration of golf putting, which was recorded by the experimenter (prepared/teach group). The other participants who expected to teach simply practiced for an additional 2-min (prepared/no teach group). Similarly, half of the participants who did not expect to teach performed a 2-min video demonstration (unprepared/teach group), while the other half engaged in additional practice (unprepared/no teach group). Participants completed a posttest on Day 2 of the experiment. To evaluate motor learning, posttest radial and bivariate variable error were assessed, controlling for these variables at pretest. Results did not reveal an effect of expecting to teach, teaching, or an interaction between these variables. Thus, results failed to support the current hypothesis. However, participants may need to experience direct social interaction (i.e., actually teach another participant or confederate) in order to receive a significant learning advantage. Further research warrants the investigation of this social interaction hypothesis.

Transferability vs. specificity of decision-making skill in sport

Roca, Andre, St Mary's University, Twickenham, London; Williams, A. Mark, University of Utah

In sport, the adaptations that occur during development of the perceptual-cognitive skills and processes involved when making decisions are crucial to performance (Williams & Ford, 2008). However, little is still known about whether decision-making skill acquired in one sport can transfer to facilitate performance in another sport. We examine whether decision-making skill transfers between sports that share some characteristics, or whether it is sport specific. Skilled adult soccer players ($N = 20$) completed a video-based temporal occlusion decision-making test involving sequences from soccer (11 vs. 11), basketball (5 vs. 5), and tennis (1 vs. 1). The Test film stimuli were projected onto a large video screen and participants were required to decide on which action to execute for each offensive-play situation. Response accuracy was recorded as a measure of performance. Response accuracy was significantly higher ($p < .001$) in the soccer decision-making task ($M = 85.2\%$, $SD = 6.1$) compared to the basketball ($M = 76.0\%$, $SD = 7.8$) and tennis tasks ($M = 55.3\%$, $SD = 7.2$). Furthermore, players' accuracy was higher ($p < .001$) in the basketball compared to the tennis task. Findings suggest that there is some positive transfer of decision-making performance between soccer and basketball, suggesting that at least some aspects of decision-making may be more generic and transferable between sports that are more similar in nature. Additionally, players showed greater decision-making accuracy for their primary sport than for any of the other sports, providing support for specificity of learning. With respect to practical implications, this study supports the proposal that participation in sports that share some characteristics may augment development of decision-making ability; however, acquired practice through engagement in a related sport will not produce better or even comparable decision-making performance than acquired through practice in the primary or main sport.

Contextual Information in Anticipation Performance: A Novel Test of Cognitive Load Theory

Runswick, Oliver R.; Roca, Andre, St Mary's University, Twickenham, London; Williams, A. Mark, University of Utah; McRobert, Allistair P., Liverpool John Moores University; Bezodis, Neil E., Swansea University; North, Jamie S., St Mary's University, Twickenham

The ability to anticipate is essential when performing under severe time constraints. Skilled sports performers use kinematic information from opponents' movements and sources of contextual information (e.g., score, field positions) to facilitate anticipation. Few researchers have investigated the relative importance of these two information sources and, in particular, how context may affect anticipation. We tested the predictions of Cognitive Load Theory (CLT; Sweller, 1988), which has rarely been applied to motor skills, to examine how context affected cognitive load and anticipation. The CLT suggests that context will increase cognitive load in novices but not experts and that increased load is detrimental to performance. Nine skilled and nine novice cricket batters faced bowlers on a life-size screen in four conditions that manipulated access to context and a secondary task. Trials were occluded immediately prior to ball release and anticipation measured by marking predicted location the ball would have passed the stumps on scaled diagrams (McRobert et al., 2009). Secondary task performance, verbal reports, and mental effort scores were recorded. Skilled batters showed better anticipation accuracy ($p < 0.05$) and both groups performed better with context ($p < 0.05$). In dual task conditions, both groups showed an increase in mental effort scores but improved anticipation accuracy (both $p < 0.05$), while secondary task performance was maintained ($p > 0.05$). Verbal reports revealed both groups referred to kinematic information in the absence of context. When context was provided, skilled performers reported statements relating to sequencing and game information in addition to kinematic information, while both groups reported using information concerning opponent positioning. Findings suggest that CLT may not transfer to perceptual-motor skills by showing mental effort was not affected by context in either skill group and the addition of a secondary task actually improved performance.

Can young healthy adults walk randomly?

Russell, Daniel M., Old Dominion University; Thomas, Kathleen S., Norfolk State University; Morrison, Steven, Old Dominion University

Traditionally, variability in human movement was assumed to approximate a white noise process. However, more recent research has revealed structure in this variation. Structure in a time series can be detected by the scaling exponent (α) of a detrended fluctuation analysis (DFA), with $\alpha > 0.5$ indicating persistence in a sequence, while $\alpha \leq 0.5$ reveals antipersistence and $\alpha = 0.5$ in particular specifies a stochastic white noise process. In healthy adults walking, stride-to-stride variation displays structure ($0.5 < \alpha < 1$). Research has shown that even when asked to move randomly, structure remains in the sequence of movements, but this has not yet been examined in walking. Twelve young healthy adults walked on an instrumented treadmill under instructions to walk normally or randomly. Participants performed two five minute trials under both conditions. The spatiotemporal parameters of step time, length, speed and width were determined from foot pressure data. DFA was computed on every trial for each dependent variable. No significant differences in α were observed between the two trials performed under identical conditions, indicating

the results were stable. Walking under normal conditions resulted in persistence in the sequence of step time, length, speed and width ($0.5 < \alpha < 1$). When asked to walk randomly, α decreased significantly for all measures, except step width. Step time continued to show persistence ($\alpha > 0.5$), while step length revealed an anti-persistent structure in many trials ($\alpha \leq 0.5$) and the sequence of step speed was anti-persistent for all random trials ($\alpha < 0.5$). In agreement with previous research, there were limits in the ability of participants to produce step times without any evidence of structure in the sequence. Contrary to previous research, which found limits in the ability to move randomly, young healthy adults can intentionally produce a random sequence of step lengths and step speeds while walking on a treadmill.

Seeing is believing? The efficacy of feedforward modeling using mirror reversal

Rymal, Amanda M., California State University San Bernardino; O, Jennt; Cesena, Michael Ryan, California State University East Bay; Harrison, Desiree, California State University San Bernardino

One relatively new type of self-model involves viewing the self at performance levels not yet achieved (i.e., via edited video; feedforward; FF; e.g., Ste-Marie et al., 2012). Within the FF technique, one mirrors video of a skill being performed with the dominant limb, thus creating a FF-mirror reversal showing non-dominant limb performance (FF-MRD). It has been found to be an effective method for skill learning, FF-MRD holds great practical significance, for example, in sports wherein certain skills must be performed with both limbs (e.g., soccer, martial arts) as well as in clinical settings (e.g., developing daily-living skills using a non-dominant limb). Research examining the efficacy of FF-MRD is sparse. In this quasi-experiment, we examined the effects of FF-MRD modeling on basketball free throw (FT) performance. Participants ($N = 53$) were divided into two groups: FF-MRD ($n = 26$) and Control (CC; $n = 27$). Participants completed 10 FTs with the non-dominant hand, over four sessions. FF-MRD videos were viewed prior to FT trials during the intervention phase (sessions two and three). Following data cleaning procedures, a 2 (group) \times 4 (trial) RM-MANOVA ($p = 0.05$) was conducted. The main effect of group approached significance ($PT = 0.17$, $F(4, 48) = 2.39$, $p = 0.06$, $\eta^2 = 0.17$, power = 0.64). Inspection of the profile plot (condition \times trial) showed visually marked differences between groups for trials 2 and 3 (intervention phase), but highly similar baseline and retention performances. Inspection of the between-subjects (ANOVA) test results revealed a significant difference between groups during trial 3 ($F(1, 51) = 4.87$, $p = 0.03$, $\eta^2 = 0.09$, power = 0.58); the FF-MRD group ($M = 10.58$; $SD = 5.14$) performed significantly better than the CC group ($M = 7.67$; $SD = 4.45$). These results provide partial support for the efficacy of FF-MRD, and will be discussed in the context of social learning theory and ecological (a.k.a. representative) research design methodology. Strengths and weaknesses of the current design, as well as future research directions will also be discussed.

Postural control adaptations in people who participate in boarding sports

Sansom, Jennifer K.; Lomond, Karen V., Central Michigan University

Participants in boarding sports regularly challenge their postural control system to maintain stability in dynamic, chaotic environments. However, literature examining this

population is lacking. Our goal was to determine if, because of repeated exposure to diverse environmental challenges, “boarders” have developed distinctive postural control adaptations. We tested 9 experienced “boarders” (B: 22.00(1.58) y/o) and 6 controls (C: 22.00(2.10) y/o) using a dynamic posturography system to measure reactive and proactive balance responses. Limits of Stability (LOS), Adaptation (ADT), Motor Control (MCT), and Rhythmic Weight Shift (RWS) were tested. Results show that B demonstrate greater and more controlled backward excursion for LOS than C, approaching significance for End-Point Excursion Backward (EPE-B) EPE-B [F(1,14)=3.48,p=0.083] and Maximum Excursion Backward (MXE-B) [F(1,14)=3.79,p=0.072]. Also, emerging trends show that B used ~10% less force to overcome induced postural instability during ADT testing with increased weight distribution symmetry and lower response variability during MCT translations. Both groups showed similar strategies during RWS testing. Our preliminary results suggest that people who regularly participate in boarding sports develop, with experience, unique adaptations for postural control during reactive and proactive balance activities. These unique adaptations may provide valuable insights that facilitate development of effective, novel interventions for individuals with balance impairments.

Inter-team coordination tendencies of goal-scoring possessions in open play: an exploratory analysis of the 2014 FIFA World Cup winner team

Santos, Rodrigo, Universidade Federal de Vicosa; Duarte, Ricardo, University of Lisbon; Teoldo, Israel, Universidade Federal de Vicosa

Goal scoring is regarded as the ultimate indicator of offensive success in soccer. Hence, the investigations that analysed patterns that emerge from goal-scoring possessions frequently apply different approaches. The study aimed to examine the emergent inter-team coordination tendencies from goal-scoring possessions in open play of the 2014 FIFA World Cup winner team, through the analysis of teams' numerical relations within the effective play-space. We hypothesized that in goal-scoring possessions Germany generate more numerical uncertainty in sub-areas of play closer to opponents' goal. We analysed 6457 frames (unit of analysis) from 11 video sequences of goal-scoring possessions. Teams' numerical relations within sub-areas of play were examined in each offensive sequence through Shannon's entropy. The uncertainty of numerical relationships between the teams across sub-areas was also calculated. Entropy measures indicated that the uncertainty of teams' numerical relations was higher within the German Central Offensive (opponents' Central Defensive) sub-area (1.86 bits) in comparison with the remaining sub-areas of play. These results suggest that goal-scoring possessions in open play apparently generate different patterns of inter-team coordination when compared to analyses of an entire match, which might not be able to reveal important patterns that emerge from key moments.

Effects of External and Internal Focus of Attention on Dart Throwing

Sarhan, Aiman; Lai, Qin, Wayne State University

Previous studies have reported the advantages of adopting an external focus of attention over internal focus or no focus when learning new motor skills. However, how combined

techniques of different focus affected learning was little known. Thus, the main aim of this study was to compare the mixed techniques with the internal and external focus modes in order to optimize instructional method in a dart throwing task. 24 college students (age: 18 to 35) signed an informal consent prior to participating in the experiment. All participants were healthy, injury-free and without any dart throwing training or experience. They were randomly assigned to one of two groups: internal to external focus (IF-EF), and external to internal focus (EF-IF). The task was to throw darts on a dartboard from two distances; 2.5 and 3 meters. IF instruction was 'look at the bull's eye then focus on your elbow movement and your fingers releasing the dart', whereas EF cue was 'look at the bull's eye and focus on hitting it.' The first visit consisted of 2 pre-acquisition blocks and 8 acquisition blocks followed by 2 retention blocks administered 48 hrs. after acquisition. Each block was consisted of 5 darts. 3D acceleration of the wrist on the throw arm was measured by BIOPAC MP100 System during acquisition. A mixed ANOVA with repeated measure on attentional focus revealed interaction between sequence and focus ($p < .05$). Simple mean effects showed performance significantly increased from pre-acquisition (non-focus) to acquisition with EF-IF, but performance decreased from pre-acquisition to acquisition with IF and then increased with EF. The present findings showed that external focus benefited motor performance but interacted with sequence of different focus administration. It appeared that a mixed technique with IF-EF produced more skill acquisition than the other mixed technique with EF-IF. Further, there was no interaction between attention focus and throwing distance even though the results indicated that distance affected arm acceleration.

Tactic knowledge in Handball

Schack, Thomas, Bielefeld University; Lex, Heiko, Rostock University; Froebel, Tobias; Vogel, Ludwig, Bielefeld University

The role of tactics in team sport has been acknowledged to be a crucial factor in high-level and amateur sport. Therefore, the knowledge about tactical situation seems to be a substantial basis for coordinated interaction in sport teams. The current study investigates the memory structure of tactical situations in handball experts and compared them to amateurs. 15 experts and 15 amateurs participated at the experiment. To measure the representation structure, we applied the Structural Dimension Analysis of Mental Representation (SDA-M) for 12 tactical situations in handball. Pictures of the four handball-specific tactical concepts (transition to attack, transition to defense, taking over, and back court-pivot cooperation) served as stimuli. The results show significant differences between experts and amateurs. Handball experts possess a hierarchical organized representation of tactical knowledge with functional clustering of game specific situations. However, amateurs represent tactical knowledge less organized. Furthermore, the experts' representations were, in comparison to the amateurs, more similar between persons. The findings are in line with a previous study in soccer (Lex et al., 2016). The results suggest that tactical knowledge in long-term memory might be a basis for appropriate joint actions in handball. The results will be discussed in terms of applied and theoretical implications for team sports.

Preseason postural control as a function of sport type, age and sex

Schleich, Kristen; Duffy, Donna M.; Ross, Scott E, University of North Carolina at Greensboro; Goble, Daniel, San Diego State University; Rhea, Chris K., University of North Carolina at Greensboro

The likelihood of a concussion is related to an athlete's exposure to head trauma, which varies by sport. Four categories of sport type have been created, defined by the likelihood of head trauma during play: 1) collision sports (e.g., football, rugby, ice hockey), 2) contact sports (e.g., soccer, basketball, lacrosse), 3) limited contact sports (e.g., volleyball, softball, baseball), and 4) non-contact sports (e.g., cross country, crew, cycling). Since a change in postural control is a cardinal sign of a concussion, preseason assessments of postural control are recommended to document baseline performance to determine whether a disparity in performance exists after a suspected concussion. However, it is currently unknown how sport type, sex, and age may affect preseason postural control. Identifying whether these factors influence postural control will assist researchers and clinicians determine appropriate groupings to make return-to-play decisions. This project examined the influence of sport type, sex, and age on preseason postural control collected with a portable force plate (Balance Tracking System, BTrackS, San Diego, CA) on 13-24 year old athletes (N=5577). The dependent variable was the average path length of center of pressure (COP) during three trials of static stance with eyes closed and feet shoulder width apart. A 4 sport type (collision, contact, limited contact, or non-contact)--2 sex (male or female)--2 age groups (13-17.9 year olds or 18-24 year olds) ANOVA was used. The three-way interaction was not significant ($F(3, 5574) = .839, p > .05$). However, the age 'sex interaction was significant ($F(1, 5576) = 36.36, p < .001$). Follow-up analyses showed no difference between the 13-17.9 yr old males (22.5 +/- 0.4 cm) and females (23.8 +/- 1.2 cm), but a large difference between the 18-24 yr old males (29.6 +/- 0.3 cm) and females (22.1 +/- 0.7 cm). Female postural control remained stable across 13-24 year olds, while male postural control was significantly worse in the older participants, indicating that age and sex can influence postural control.

Motor-cognitive interference in dual task mobility: allocation of resources in PD patients

Schott, Nadja; Klotzbier, Thomas; Pley, Christina; Uhl, Anna-Lena; Sanftmann, Beate, University of Stuttgart; Almeida, Quincy J., Movement Disorders Research & Rehabilitation Centre, Wilfrid Laurier University, Waterloo;

Background. Gait disorders are considered a typical clinical feature in Parkinson's disease (PD). The analysis of gait under dual-task conditions may be helpful in distinguishing motor phenotypes within PD. Although several studies have shown dual-task (DT) mobility deficits in PD, the effect sizes are variable and strongly rely on the nature of the motor and cognitive task. While type and complexity of various cognitive tasks have been examined, it remains unclear how PD patients perform when an important component of the motor task is changing directions while walking. This study aimed to elucidate how PD patients manage dual-task mobility when the postural requirements of component tasks differ, as in linear walking and walking with turns. Furthermore, we aimed to demonstrate that dual-task gait with turns can be a tool to

distinguish PD with postural instability gait difficulties (PIGD) from tremor dominant (TD) subtypes. Methods. A convenient sample of 45 PD subjects (69.3 \pm 8.5 years, 10 females; 27 PIGD, 18 TD) and 20 control subjects (72.4 \pm 5.5 years, 13 females) participated in the study. We employed a dual-task (DT) paradigm, to assess the relative effects of executive function tasks (working memory, inhibition, cognitive flexibility) on gait during walking with and without turns. Spatio-temporal gait parameters were assessed using the APDM Mobility Lab™ system (Mobility Lab, APDM Inc., Portland, OR). Results. PDs (PIGD) had more pronounced mobility decrements than TD PDs and healthy older adults during straight-ahead walking and turns but only when the secondary task engaged complex cognitive elements (n2p: .100-.279). Conclusion. Participants with PD, specifically with postural control/gait impairment, had poor gait performance, particularly under dual tasking in the walking with turns conditions. Our findings suggest that dual-task assessment specifically during turns can help to differentiate PD subtyping, revealing a motor signature in PD. This is important considering these subtypes have different long-term prognoses.

Effects of mental fatigue on gait during downhill walking

Schott, Nadja; Klotzbier, Thomas, University of Stuttgart

Background. Fatigue-related impairment may be an underlying cause or major contributor to production errors, accidents and falls in occupational settings. Prolonged periods of demanding cognitive activity such as delivering mail or working at assembly lines induces mental fatigue; a psychobiological state characterized by feelings of tiredness and lack of energy. Some studies have demonstrated the negative impact of mental fatigue on cognitive function and physical performance, but no study has examined the effects of mental fatigue on gait. The aim of the present study was to determine whether mental fatigue would change spatio-temporal gait parameters during downhill walking. Methods. A total of 39 healthy young participants (age 22.4 \pm 2.2 years, 16 women) were evenly categorized into two groups: low and high mental fatigue. Mental fatigue was induced by performing a 30-min mental fatigue-inducing 0- or 2-back task session. Subjective energy/fatigue ratings were obtained using Part II of the Mental and Physical State and Trait Energy and Fatigue Scales. The participants walked for 2x1min on a treadmill while wearing APDM 6 Opal inertial monitors. Spatial and temporal gait parameters were assessed at two treadmill inclinations (0° level, 9° downhill) at 5 km/h. Results. In all participants, we observed a significant increase in feelings of mental and physical fatigue and a decrease in mental and physical energy. This indicates that continuous cognitive operation induces mental fatigue. Furthermore, there was a significant increase in variability of spatial and temporal gait parameters during downhill walking. Conclusion. Based on the findings from the present study, we can conclude that mental fatigue is a risk factor for production errors, accidents and falls, and therefore, can help to design countermeasures to prevent accidents caused by low visual sustained attention. In order to prevent these situations, interventions, such as providing frequent rest breaks, could be applied in the workplace to avoid prolonged exposures to cognitively demanding activities.

Combined assessment of cognitive workload under various levels of challenge during dual-task walking

Shaw, Emma, University of Maryland; Rietschel, Jeremy C., Veteran's Health Administration; Hendershot, Brad D.; Pruziner, Alison L., Walter Reed National Military Medical Center; Miller, Matthew W., Auburn University; Hatfield, Bradley D.; Gentili, Rodolphe J., University of Maryland

Previous efforts to assess cognitive workload during locomotion have largely focused on movement kinematics and questionnaires alone. However, such an assessment may not always be reflective of the cognitive resources necessary to successfully walk within a real-world environment. Previous studies have suggested that electroencephalography (EEG) biomarkers can assess cognitive workload. Specifically, EEG spectral content and component amplitudes of the event-related potential (ERP) waveform may index mental effort and attentional reserve, respectively. While few studies have evaluated upper-extremity performance by measuring changes in ERPs and spectral content, none have employed a combined approach to assess changes in cognitive workload during locomotion. Therefore, the current study aimed to examine whether simultaneous variations in spectral content and ERPs could collectively assess cognitive workload during dual-task walking. EEG was recorded from twelve uninjured healthy individuals as they performed a cognitive task of varying difficulty (easy/hard), while seated or walking on a treadmill in a Computer Assisted Rehabilitation Environment at Walter Reed National Military Medical Center. The results revealed that the changes in attentional reserve and mental effort could collectively evaluate the level of cognitive workload under varying demands as a result of changes in task difficulty (easy/hard) and performance conditions (seat/walk). The present study provides support for the utility of EEG as an objective assessment of cognitive workload during locomotion within an ecologically valid environment. More importantly, this work can inform cognitive workload for individuals with musculoskeletal and neurologic conditions that affect gait for future applications. This work was supported by the DoD Defense Health Program (NF90UG) and the DoD-VA Extremity Trauma & Amputation Center of Excellence. Views expressed are those of the authors and do not reflect the official policy or position of the Departments of the Army, Navy, or Defense, or the U.S. Government.

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Motor performance and mental workload assessment during practice of reaching movements in a context of team dynamics

Shuggi, Isabelle M., University of Maryland College Park; Shewokis, Patricia A., Drexel University; Herrmann, Jeffrey W.; Gentili, Rodolph J., University of Maryland

While many studies have investigated mental workload during motor performance, its assessment during the learning of a new motor skill performed under different conditions of practice is somewhat more restricted. Thus, this study examines the cognitive-motor processes underlying motor practice by analyzing the changes in mental workload and performance during an arm reaching task performed in a social context of team dynamics. Participants had to move a virtual robotic effector to reach targets as fast and straight as possible while satisfying the task constraint of collision avoidance between the end-effector and the workspace boundaries. Participants practiced the reaching task

either alone (PA group) or with a synthetic teammate (PT group), which regulated the arm velocity to assist the participants in respect to the task constraint. The results revealed that both groups similarly improved their performance during practice. However, compared to the participants of the PA group, those from the PT group: i) reduced the likelihood of collisions along with achieving greater performance consistency and ii) revealed a larger level of mental workload while the synthetic partner was perceived as interfering with their performance. A possible explanation would be that as the synthetic teammate changed the arm velocity in particular regions close to the workspace boundaries, participants were forced to learn a piecewise visuomotor map. Piecewise maps made the task more challenging, which elevated the level of mental workload and contributed to the negative perception of their teammate. The analysis of motor performance and mental workload suggest a combination of both adaptive and maladaptive team dynamics. This work represents a first step in the investigation of underlying human cognitive-motor processes during motor learning in a social context of team dynamics and has the potential to inform human-robot interactions.

Changes in mental workload and motor performance during practice of reaching movements performed under different levels of challenge

Shuggi, Isabelle M.; Oh, Hyuk, University of Maryland, College Park; Shewokis, Patricia A., Drexel University; Gentili, Rodolphe J., University of Maryland, College Park

A large body of work has focused on assessing mental workload that can inform attentional resource allocation during human cognitive-motor behavior. While numerous studies have examined mental workload during motor performance, there has been a relatively limited effort to investigate mental workload in motor learning. Namely, no study has examined the changes in mental workload in relationship to the rate of motor improvement during practice while also considering individual variability. Thus, this study aimed to examine the changes in mental workload and motor performance resulting from the practice of a novel reaching task under various levels of challenge. The participants were required to learn to control a virtual robotic arm to reach targets randomly located in a 2D workspace through a human-machine interface. Participants were assigned to one of two groups, requiring performance of the task at a high or low level of challenge which was defined as the velocity at which the robotic arm moved to reach targets. An assessment of mental workload and motor performance was conducted for both groups. This was done by employing a traditional group-level analysis as well as a cluster analysis to identify specific individual patterns of cognitive-motor response. Both group-level and cluster-level analyses revealed that for all participants: i) motor performance was enhanced during practice, and ii) as their level of mental workload increased an overall degradation of performance along with a delay in motor improvement was observed. When considering the optimal challenge point framework, these findings support the notion that the functional task difficulty: i) is dependent on the nominal task difficulty and potentially on the individual's information processing capabilities; as well as ii) it could be assessed by the level of mental workload, which when too elevated can degrade the performance and delay motor

The effect of practice on muscle activity in recumbent stepping

Siekirk, Nicholas; Galen, Sujay; Pardo, Victoria; Lai, Qin, Wayne State University

Muscle recruitment becomes more efficient as a result of task-specific training. Although the muscle activity of recumbent stepping has been studied previously, it remains unclear if an individual alters recruitment as they acclimate to the stepping motion. The purpose of this study was to measure the change in EMG activity between minute (min) 2 and min 4 of a 5 min stepping bout. EMG was measured bilaterally at 6 separate lower extremity muscles during five different stepping protocols (self-selected level 1 [SSL1], self-selected level 8 [SSL8], +20% self-selected [SS+20], -20% self-selected [SS-20], and 80 steps per min resistance level 1 [80SL1]). 22 healthy male and female adults (aged = 23.52 +/- 4.23 years) signed an informed consent prior to the study. Self-selected cadence was established during 10 mins of stepping with a RPE between 12 and 16. Participants then performed all 5-min protocols in randomized order with 5 min of rest between each. Due to parametric violations, mean EMG (mEMG) and peak EMG (pEMG) were analyzed with non-parametric tests. A 1 x 4 Friedman test was conducted to determine statistical significant difference in mEMG and pEMG between min 2 and min 4 of stepping in each muscle. Following a statistically significant Friedman test ($p < .05$), a post hoc Wilcoxon Signed Rank test (WSRT) was conducted. Participants' self-selected cadence was 126.80 +/- 17.87 steps/min. WSRT showed a significant reduction in mEMG activation at min 4 in 5 muscles (rectus femoris [RF], vastus medialis oblique [VMO], semitendinosus [ST], tibialis anterior [TA]) at 80SL1, VMO at SS+20% and RF and VMO at SS-20, ($p < .01$). WSRT showed a significant reduction in pEMG activation of VMO at min 4 in all protocols, but higher pEMG at min 4 in ST in SSL1 and SSL8, soleus in SSL1 and TA in SS+20. Results indicate a higher level of learning, as measured by the reduction of mEMG during min 4 at protocols below the subject's self-selected pace. At a significantly lower cadence, it is presumed that a new motor pattern was acquired to adapt to the stepping demands.

Benefits of Distributed Practice over Massed Practice in Learning and Memory Consolidation

Song, Yonggwan; Park, Jin-Hoon, Korea University; Cheon, Sung Hyeon, Kangwon National University; Reeve, Johnmarshall, Korea University

The processing of a motor memory continues long after the completion of a practice repetition, a phenomenon known as memory consolidation. The purpose of the present study was to examine how distributing practice sessions a cross days influenced the learning and stability of a coordination movement as compared with practice sessions within days. In experimental 1, a bimanual coordination (i.e., inter-limb) task that required a 90-deg phase offset was practice in three sessions of 7 blocks each. In the massed practice condition practice sessions were separated by 10 min rest; in the distributed practice condition practice session were separated by 24 hour rest. The results indicated that distributed practice showed more consistent performance than massed practice during acquisition and retention (standard deviation of RP). In Experiment 2, an intra-limb coordination task that required a 90-deg phase offset was practiced in three sessions of 7 blocks each using either massed practice or distributed practice sessions. The results showed that distributed practice more accurate performance than massed practice (i.e. mean of RP). Distributed practice showed more accurate and more stable

performance during the retention test than did massed practice, suggesting that distribution of practice over a relatively long period of time (day) is important factor for the enhancement of learning and memory consolidation in the production of bimanual and intra-limb coordination task.

Rhythmic auditory stimulation to alter fractal gait characteristics in older adults

Stout, Ruth D., Moses Cone Hospitals; Rhea, Christopher K., University of North Carolina at Greensboro

Rhythmic auditory stimulation (RAS) has become a source of treatment for clinical populations that uses sound or music to entrain movement. Traditionally, the auditory cues are metronomic (i.e., periodic and non-variable) in quality and have not been shown to improve fall-risk. Healthy adults typically exhibit variable (i.e., fractal) characteristics in their gait, a trait that becomes more random in clinical populations and is thought to be related to fall-risk. Thus, providing a traditional non-variable RAS cue may not be a best practice to enhance mobility and reduce fall risk. An RAS cue that offers fractal variation represents a biologically inspired way to improve gait, but it is unknown how well older adults can synchronize to a fractal auditory cue while walking or whether the newly developed fractal characteristics will be retained after a single session of training. Nine older adults (79.2 ± 4.89 yrs) participated in a single 30 minute testing session that was separated into three 10 minute walking phases. The first and third phases consisted of walking on a treadmill at a self-selected speed with no auditory cue (pre-test and post-test phases). The second phase presented a fractal auditory cue [detrended fluctuation analysis (DFA) $\alpha = 0.98$] that consisted of alternating tones to synchronize the heel-strike of the right and left feet during treadmill walking (training phase). The fractal patterns of the participants' stride time during each phase was analyzed with a repeated measures ANOVA. A main effect for phase was observed, ($F(2,16) = 6.9, p = .007$). DFA α of stride time increased significantly from the pre-test (0.77 ± 0.06) to the training phase (0.89 ± 0.09), and remained elevated in the post-test phase (0.84 ± 0.09). The results indicate that the underlying patterns of gait for older adults have a plastic quality that may be enhanced with fractal gait training.

Fear of falling for older and stroke-involved adults

Stout, Ruth D., Moses Cone Hospitals; Rhea, Christopher K., University of North Carolina at Greensboro

Fear of falling is related to higher fall-risk in healthy older adults—a relationship that is exacerbated in stroke survivors. However, factors that influence the fear of falling are not well understood. This study examined the role of balance, strength, and flexibility on the fear of falling on healthy older adults ($N=20, 63.4 \pm 8.9$ yrs) and stroke survivors ($N=8, 58.6 \pm 7.8$ yrs, 36 ± 25.5 months post-stroke). All participants were community dwelling and walked with no assistive device. Fear of falling was measured using the Activities-Specific Balance Confidence (ABC) Scale. Balance was assessed with the Timed Up and Go (TUG) and the Berg Balance Scale (BBS). Strength of the hip extensors, abductors, quads, hamstrings and plantar-flexors was measured using a hand-held dynamometer. Flexibility was assessed as the total range of motion of hip

extension and dorsiflexion using a hand-held goniometer. Limbs were matched for uninvolved to dominant of healthy adults. A multiple regression analysis was used to determine the relationship between the TUG, BERG, strength and flexibility to ABC, after considering group (stroke versus healthy). The group R^2 was .257 for strength, with only dominant leg strength being significant for all groups, ($F(1,26) = 4.508$, $p = .004$). For balance testing, an $R^2 = .284$ was observed for group, with BERG and TUG adding total R^2 of .85, ($F(1,26) = 43.77$, $p < 0.001$). For flexibility, an $R^2 = .284$ was observed, with total R^2 of the groups of 0.42, ($F(1, 26) = 6.1$ to 4.9 , $p = .003$ to $.007$). Thus, we conclude that the BERG and TUG are most likely to represent a true fall-risk, and that the strength of the dominant limb is the most influential in balance control. Also, flexibility was significant for measuring fear of falls and fall-risk, and should be rehabilitated on all adults.

Experience with event timing does not alter emergent timing: further evidence for the robustness of event and emergent timing

Studenka, Breanna E.; Pope, Megan; Cummins, Daisha, Utah State University

Event timing refers to movements that utilize an internal clock whereas emergent timing refers to movements that do not (Robertson et al., 1999; Zelaznik et al., 2002). Although, typically, these two modes of timing are thought of as mutually exclusive, some evidence suggests that experience with event timing might lead to its use during a typically emergently timed task. Significant correlations were found between tapping and circle drawing when circle drawing followed several trials of tapping (Studenka et al., 2012; Zelaznik & Rosenbaum, 2010). In addition, musicians with more general practice using event timing exhibited a correlation between tapping and circle drawing (Baer et al., 2013), suggesting that prolonged practice at event timing may prime a person to its use during a typically emergently timed task. The aim of these experiments was to determine if experience with one mode of timing influenced the mode of timing adopted on a subsequent task. Four experiments were conducted, two with a younger (18-30) and two with an older (55-90) population. For one set of experiments, participants performed one block of circle drawing as a baseline, then six blocks of tapping, followed by a final block of circle drawing. For the other set of experiments, participants performed one block of tapping as a baseline, then six blocks of circle drawing, followed by a final block of tapping. Lag one autocorrelations were calculated for each block of trials as a measure of the use of event timing. We hypothesized that acute experience with event timing would bias an individual to use event timing. We further hypothesized that experience with emergent timing would bias an individual to use non-event timing. Neither hypothesis was supported; instead we support the robustness of event and emergent timing as separate timing modes.

Dynamics of Interception in defender versus attacker

Tsutsui, Kazushi; Shinya, Masahiro; Kudo, Kazutoshi, The University of Tokyo

The pursuit and interception of moving targets plays a major role in a variety of sports, such as football, rugby, and basketball. In particular, defenders have to catch the attackers making erratic and evasive maneuvers. Studies of intercepting moving target

have suggested that human uses a constant bearing (CB) strategy, a time-optimal solution to catch targets, combining information of position with velocity. We examined whether defenders faced with such erratic attacker also use CB. Specifically, we addressed these questions by studying 1 vs. 1 task. We analyzed the pursuit trajectories and compared the locomotor directions of the defenders with CB model's prediction. A comparison of the empirical and modeling data indicated strong correlation ($r = 0.76$, $p < 0.001$). Moreover, cross-correlation analysis revealed that the tau, time delay of correlation coefficient being maximum, had a strong correlation with mean response time (RT) ($r = 0.92$, $p < 0.001$). These results suggest that defenders repeat the CB strategy in response to attackers' erratic movements during 1 vs. 1 task. Interestingly, the defender's behavior is similar to the pursuit strategy used by some animals such as dragonflies or dogs.

The Effects of Distribution of Practice on the Learning of a Motor Skill

Ugrinowitsch, Alessandra, Centro Universitario Belo Horizonte

The distribution of practice has been investigated until 1980's and after this decade there are a few studies investigating this subject. The effects of the distributed practice have shown better effects for the learning of continuous motor skills and massive practice for discrete motor skills. This study investigated the effects of distribution of practice on the learning of a serial motor task. Thirty university volunteers of both sexes took part of this study. The task required pressing a specific sequence of buttons on the numeric keyboard with a time target of 900 ms. The volunteers were randomly divided into Massive Group and Distributed Group for practicing 90 trials during acquisition phase. The massive group practiced with 3 sec. intertrials interval and the distributed group practiced with 15 sec. After each trial the feedback about the direction and magnitude of error was provided in milliseconds on a screen in front to the keyboard. On the next day the participants performed 10 trials of two retention tests, one massive and another distributed, in a counterbalanced order but feedback was not provided. The results from acquisition phase showed that performance accuracy of both groups increased from beginning to end of practice but with no difference between them. The two groups showed similar performance consistency, which did not changed with practice. During massive retention test, the massive group showed higher performance accuracy and consistency than the distributed group. During distributed retention test, both groups showed similar performance consistency and accuracy. Our results show that for serial motor skill, the effect of distribution of practice is related to the condition of test, since massive practice conducted to better performance on massive retention test. However, under distributed test condition the distribution of practice does not influence learning of a serial motor task.

Analogy instructions promote neural efficiency during performance of a push pass in field hockey

van Duijn, Tina, University of Waikato; Hoskens, Merel, Vrije Universiteit Amsterdam; W. Masters, Rich S., University of Waikato

When investigating the effects of different instruction types in motor learning,

psychomotor efficiency is a useful marker of effective learning, associated with refined information processing, absence of effortful cognition, and adaptive and efficient limb movements (Hatfield and Hillman, 2001). In the brain, a corresponding decrease in cerebral activation and a reduction in verbal-analytic processing is reflected by increased high-alpha power in the left hemisphere (Hillman, Apparies, Janelle, & Hatfield, 2000). These neural correlates of psychomotor efficiency have been found in expert marksmen compared to novices (Haufler, Spalding, Santa Maria, & Hatfield, 2000) and in successful compared to unsuccessful executions within the same expertise group (Cooke et al., 2015; Crews & Landers, 1993; Hillman et al., 2000). Analogy instructions are thought to promote efficient information processing by packaging movement-specific information in a single, meaningful unit (Liao & Masters, 2001; Masters, 2000). The question arises of whether movements learned by analogy promote higher psychomotor efficiency reflected by increased left-temporal high-alpha power. A study in field hockey was conducted in which novices practiced a push pass technique during a realistic game-like scenario involving 32 passes, either by analogy, by explicit instruction or by discovery (no instructions). Push pass accuracy was identical in a delayed retention test following practice; however, significantly better performance during a memory-loading task (passing coupled with decision-making) suggested that cognitive processes were facilitated by the analogy instruction condition. Significant differences were also evident in left-temporal EEG high-alpha power, supporting the notion of greater neural efficiency in the analogy condition. The findings indicate that an analogy instruction may promote psychomotor efficiency by encouraging a different mode of information processing than explicit or discovery learning.

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Experimentally impaired foveal vision improves peripheral performance

Vater, Christian; Spoerri, Nicole; Hossner, Ernst-Joachim, University of Bern

For perception-action coupling in sports, it has been shown that myopic blur (up to +2 diopters) does not harm performance, even when foveal information pick-up is required (as in golf putting: Bulson, Ciuffreda, & Hung, 2008). However, how myopic blur affects peripheral performance is still unknown. In this regard, the reduced attentional demands caused by impaired foveal vision may presumably enhance peripheral performance. To test this hypothesis, 18 sport science students, all of whom regularly wear contact lenses, received three pairs of lenses with overcorrections for retinal defoci from +1 to +3 diopters (+1D, +2D, and +3D, respectively). In each condition, participants performed 72 trials of a multiple-object tracking (MOT) task, first with regular lenses (plano) and then with the three pairs of defocus lenses (in counterbalanced order). The MOT task required the tracking of 4 of 10 randomly moving cues. To stimulate foveal vision when monitoring the targets peripherally, the background image was a picture of a sports hall. Participants were instructed to press a button as soon as they observed one of the 4 targets stop (occurring for 0.5s in 66.7% of the trials). Gaze data were acquired to control for the use of peripheral vision for target monitoring as well as for target-change detection. Participants correctly recalled the 4 targets at the end of trials more often in the defocus than in the plano condition and even more often in the +2D and +3D than in the +1D condition ($p < .05$). While there was no defocus effect observed for the

percentage of correct target-stop detections ($p = .72$), faster response times were found in the +2D and +3D than in the +1D condition ($p \leq .02$). Results show that peripheral performance is not only retained under impaired foveal vision, but also enhanced through myopic blur. These findings are considerably relevant to sport situations which require peripheral monitoring and peripheral event detection, as in sport games and martial arts.

Technical Training based on Mental Representation

Vogel, Ludwig; Schack, Thomas, Bielefeld University

Mental representation build a cognitive reference frame for complex sport movement. Previous research revealed structural changes in the cognitive structure during motor learning. In this study we use the mental structures to adjust technical training on an individual level and measured the performance in a pre-post-test design. Four examples on how to measure cognitive representations, interpret the results and infer training programs are presented. The cognitive representation of the full swing in adolescent male golfers was investigated with the Structural Dimension Analysis of Mental Representation (SDA-M). Basic Action Concepts (BACs) are supposed to be the cognitive units of complex actions in long-term memory. The SDA-M delivers via distance scaling of the BACs psychometric data that can be analyzed on individual and group level. Outcome performance was measured with a radar-based launch monitor. Based on the mental structure in the pretest, participants became an adjusted training program. Participants trained with different exercises weekly the full swing over the course of 8 weeks. Results revealed significant differences in the mental structure for all four participants from pre- to posttest. Furthermore, the performance (distance and smash) increased and the lateral variation decreased significantly. The present study gives insights, how to use cognitive structures in technical training and discusses different approaches how to integrate cognitive representation measuring in technical training to enhance learning processes.

The effects of self-controlled target selection on the learning of an object projection task

von Lindern, Aaron D., University of Tennessee, Knoxville; Bass, Andrew D., University of Tennessee Knoxville; Raabe, Johannes, University of Tübingen; Fairbrother, Jeffrey T., University of Tennessee, Knoxville

A growing body of evidence provides support for the potential value of allowing learners to have some autonomy in shaping their learning environment (Aiken et al., 2012; Janelle et al., 1995, Post et al., 2011). Allowing individuals to control some aspect of the instructional setting can facilitate motor learning compared to conditions that are controlled externally (e.g., by the researcher). The purpose of the present study was to investigate how the self-controlled selection of targets affected the learning of an object projection task and participants' perceptions of psychological needs satisfaction (e.g., autonomy). Participants were assigned to one of four groups. During acquisition, the self-control (SC) group was paired in a dyad with a yoked (YK0) group whose schedule of target matched the selections made by the SC counterpart. Two additional yoked groups

(YK1 and YK2) practiced in another dyad independently of the first dyad to control for the potential effects of observation and practice order. Participants learned to toss a beanbag at targets of differing size and point values. Each participant completed post-training and post-experiment questionnaires and an adapted version of the Basic Psychological Needs (BPNS) assessment (Deci, Connell, & Ryan, 1989). Retention and transfer results included significant differences in mean scores for the SC and YK1 groups, with the former achieving higher scores ($p < .05$). Results for autonomy scores included significant differences between the SC group and the YK0 and YK1 groups, with scores being higher for the SC group ($p < .05$). The isolation of a SC benefit to the comparison with the YK1 group for target selection might have been due to mitigating effects of preparatory observation in the dyads. Both the YK0 and YK2 groups had the potential benefit of observing another participant aim for the same targets before their own attempts. Although some differences were detected in scores, there was no evidence that directly observing a SC partner affected perception of autonomy.

The Effect of Attentional Focus Training on Ladder Stability

Wade, Eric R.; Hall, Latano; Fairbrother, Jeffrey, University of Tennessee Knoxville

Despite increased emphasis on ladder safety, falls continue to cause injury and death. One potential approach to reduce the number of falls would be to apply findings from motor learning research to ladder practices. Our aim was to determine if an external attentional focus cue increased stability while on a ladder, as measured by anterior/posterior (A/P) and medial/lateral (M/L) chest sway.

Participants were 13 maintenance/construction personnel who wore tri-axial inertial sensors on the chest while standing on the ground and on two different ladder rungs. Two groups were compared - standard approach, SA, $n = 6$; and attentional focus, AF, $n = 7$. During a single session, each participant performed a 30 s quiet standing balance (QSB) on the ground followed by two QSBs while standing on the 3rd and 4th rungs of a 6 ft. stepladder. After a short delay, they then performed a final QSB on the 4th rung. Identical instructions were provided to both groups prior to performing; the AF group was also told to 'focus your attention on keeping the top of the ladder still.

We hypothesized that participants would exhibit increased sway (peak-to-peak acceleration) as ladder rung height increased. We also expected the AF group to exhibit less sway than the SA group during the delayed 4th rung QSB. To investigate sensor sensitivity, a repeated measures ANOVA was calculated across all participants, indicating a more A/P sway than M/L sway ($p = 0.005$), but no effect of QSB height ($p = 0.49$), and no interaction ($p=0.95$). A Mann-Whitney U-test revealed no significant differences between the groups for M/L and A/P sway, however ($U = 17$, $p > 0.05$ and $U = 16.5$, $p > 0.05$, respectively). A one-way Friedmann test revealed no significant differences between standing locations for M/L or A/P sway for the ground, rung 3, and rung 4 ($\chi^2 = 92$, $p = 0.23$ and $\chi^2 = 0.15$, $p = 0.93$, respectively). The results did not provide support for the efficacy of an external focus cue in increasing postural stability while on a ladder.

The relationship between movement variability and movement proficiency in fundamental movement skills

Ward, Brodie J.; Rosenberg, Michael; Thornton, Ashleigh L.; Lay, Brendan S., University of Western Australia

Movement variability is considered a key component in motor development and skill acquisition through childhood, however the context in which variability is present needs to be considered when assessing its impact. Increased variability within a system is shown to be characteristic of highly skilled performance, as components within the system compensate to ensure the task goal is reached in variable environments. However, reduced variability has also been identified as a characteristic of increased proficiency in certain motor tasks, such as closed skills. It is the aim of this body of research to develop a rapid, objective fundamental movement skill (FMS) proficiency classifier by exploring the links between proficiency, and the variability of movement patterns between successive FMS performance. The project implements the Microsoft Kinect sensor to capture FMS performances. The feature extraction capabilities of the sensors allow computational comparisons between multiple trials of gross movements such as fundamental movement skills (FMS). Software specifically developed for this project converts the 3-dimensional joint centre velocities recorded by the Kinect into a Kinetic energy magnitude for each joint across the movement sequence. We look to compare the variability of kinetic energy sequences between multiple trials of the same fundamental movement skill with a child's movement proficiency as determined by the Test of Gross Motor Development-2, with initial results to be presented at the conference. Based on initial results, it is expected that more proficient children will exhibit less variability between successive trials of the same FMS task than less proficient children. If a significant relationship is found, this study could provide the basis for an automated, rapid FMS proficiency classifier for use with the Microsoft Kinect capture system.

Clarinetist's choice: Should instrument selection be based on player size?

Winges, Sara A.; Young, Kathryn E., Louisiana State University

Musicians spend many hours mastering an instrument which may put them at risk of developing musculoskeletal injuries particularly when the instrument is supported. Although the commonly played B-flat soprano clarinet only weighs ~0.9 kg, the cumulative static loading can cause discomfort in the thumb, wrist, elbow, and shoulder that may evolve into severe overuse injury and debilitating pain throughout the right upper limb. However, clarinetists are commonly asked to play two other types of clarinets: the E-flat and B-flat bass clarinet. The E-flat clarinet is much smaller and lighter while the bass clarinet is much larger and sits on a floor stand. The purpose of this study was to examine how muscle activation and joint angles changed while holding and playing these three different types of clarinets. The goal was to determine whether hand and arm size can be used to match a person with an instrument less likely to produce musculoskeletal strain. Active markers to record position were placed on the neck and right shoulder, elbow and wrist as well as thumb, index, and little finger. Surface EMG recordings of superficial muscles that control the right thumb, wrist, and arm were taken while Clarinetists played three exercises on each of the three clarinets:

B-flat soprano, E-flat, and B-flat bass. Eight professional clarinetists (5 female) participated in the study. The amplitude of muscle activity tended to be lower in the shoulder and neck muscles when playing the bass clarinet, but it did not reach significance ($p > .05$). Wrist angle tended to be more extreme for participants with the smallest hands on the bass clarinet. Not surprisingly, the influence of clarinet type on muscle activity and joint angles was specific to the individual, but trends related to hand and limb size may be useful in guiding what instrument may be best for maintaining musculoskeletal health in educational and professional settings.

Neuromotor ability metrics exhibit similar occurrence of significant correlations within and between testing domains

Wittstein, Matthew; Anzola-Riegel, Carolina; Waller, Rachel, Elon University

Performance and injury prevention screenings are widely used to assess various factors that may contribute to performance excellence or injury risk among athletic populations. This exploratory study examined the relationship between measurements of six domains - strength, balance, motor coordination, flexibility, reaction time, and neurocognitive performance - that are often used in screenings. Eight healthy, young individuals (20.0 ± 0.9 yr) completed isometric strength testing of the hip, knee, and ankle (strength); the balance error scoring system and a modified Star Excursion Balance Test (balance); upper and lower limb motor planning and execution tasks (motor coordination); the V sit and reach and general joint laxity test (flexibility); the ruler test (reaction time); and Stroop and Trail Making tests (neurocognitive). Correlational analyses were used to identify the metrics from these tests with statistically significant relationships. Percentage of tested correlations that were significant within domains (e.g., two balance metrics) and between domains (e.g., a balance metric and a non-balance metric, such as strength) were then calculated. A total of 199 within-domain and 580 between-domain correlations were tested for significance. 6.5% of within-domain correlations were identified as statistically significant, and 4.0% of between-domain correlations were identified as statistically significant. One might expect that within-domain metrics to have a higher occurrence of significance. However, this data suggest that both within- and between-domain correlations are fairly uncommon. These findings emphasize the importance of selecting meaningful quantifications to assess performance and injury risk. Future research will examine the relevance of domain specific metrics to functional performance and outcomes.

Exercise intensity may affect variability and complexity of stride time differently.

Wittstein, Matthew; Hadgis, Nicholas; Moisand, Megan, Elon University

The magnitude and structure of variability in movement have been previously used to assess the quality of movement patterns during gait. One strategy to assess these two characteristics has been to measure coefficient of variation (CV, variability) and sample entropy (SE, complexity) of the stride interval time series during gait. However, experiments using these metrics often require participants to maintain a constant speed. This study used a graded exercise test on a treadmill to examine how variability and complexity of stride intervals may change as running intensity increases. Seven young,

healthy participants (21.1 \pm 1.4 yrs) completed a graded exercise protocol on a treadmill. The protocol consisted of 3 minutes of warm-up at 4 mph and 0% grade, followed by 90 second stages of increasing speed at a 3% grade. Participants continued the protocol until exhaustion or completion of the 10th stage. Video recordings were used to identify the timing of right heel strike and then construct stride interval time series for each participants. CV and SE were then calculated for each 90 second phase. Separate one-way repeated measure ANOVAs were used to test for a main effect of stage on CV and SE. Only the first 5 stages were used for analysis, representing the least number of stages completed by all participants. Alpha was set a priori to 0.05. A significant effect only identified for SE ($F_{1,4} = 3.83$, $p = 0.02$). Specifically, a negative linear relationship was identified between SE and stage. CV did not demonstrate a significant effect of the exercise stage ($F_{1,4} = 0.63$, $p = 0.64$). These findings indicate that variability and complexity are independent indicators of performance during exercise. The decrease in SE as exercise intensity increased suggests that movement patterns may become more robotic as an individual meets the demands of higher intensity exercise. Moreover, CV may represent an invariant feature of an individual's running dynamics that could be robust to fatigue.

The effect of open and closed kinetic chain exercise on hip strength and onset timing of hip musculature during activity in women

Wood, Kelsi J.; Berg, William P.; Salcedo, Nick; Walsh, Mark S.; Biller, Kelsey L., Miami University

The most common type of overuse knee pain is patellofemoral pain syndrome (PFP). Traditionally, prevention and treatment of PFP has not focused on hip musculature. However, research has linked PFP in women with decreases in hip strength and delayed onset of hip musculature (gluteus medius in particular) during activities like ascending and descending stairs. The newly understood relationship between knee pain and hip strength and muscle activation patterns in females suggests that closed kinetic chain (CKC) exercise may be more effective than open kinetic chain (OKC) exercise for prevention and treatment of PFP, given its ability to involve proximal locations like the hip, and require coordination across multiple joints. As an initial step in a larger study, this experiment tested for a differential effect of OKC and CKC exercise on hip strength and onset of hip musculature (gluteus medius in particular) during activity in females. Participants were randomly assigned to one of three groups; an 8-week, 24 session OKC exercise intervention ($n = 10$), an 8-week, 24 session CKC exercise intervention ($n = 10$), and a control group (C) ($n = 10$). Pre and posttests included tests of a) peak torque in hip extension, abduction and external rotation (eccentric and concentric), and b) EMG recording of bilateral vastus medialis (VMO), vastus lateralis (VL), gluteus medius (GMed), and gluteus maximus (GMax) during a drop jump and ascending and descending stairs. OKC and CKC exercise similarly improved mean hip strength compared to the control group, +24.1%, +21.8% and -1.0%, respectively, $F(2,27) = 5.27$, $p = .01$. However, the mean change between pre and posttest in GMed activation times relative to foot contact in the drop jump and ascending and descending stairs did not differ, $F(2,27) = 0.133$, $p = 0.875$, $F(2,27) = 0.591$, $p = 0.560$, $F(2,27) = 0.131$, $p = 0.877$, respectively. Neither CKC nor OKC exercise influenced onset timing of hip musculature during activity in females.

Unilateral and bilateral arm-hemisphere specializations and task specific modulation of the motor system

Woytowicz, Elizabeth J.; Whittall, Jill; Westlake, Kelly P., University of Maryland School of Medicine

The dynamic-dominance model of motor lateralization, developed based on characterizations of unilateral movements, predicts that in right hand (RH) dominant individuals, the left cortical hemisphere is specialized for predicting task dynamics and the right cortical hemisphere is specialized for impedance control. Recent results also suggest these arm-hemisphere specializations provide the basis of complementary roles during bilateral coordination of the right arm for reaching and manipulating, and the left arm for stabilizing, such as holding a baguette with one hand and slicing it with the other. The goal of this pilot study was to identify a neural model of arm-hemisphere specific connections during unilateral and complementary bilateral tasks for reaching and stabilizing movements. We hypothesized that RH dominant individuals would demonstrate task specific modulations within A) the right hemisphere during stabilizing task demands; and B) the left hemisphere during reaching task demands. Thirteen RH dominant young adults performed the following six conditions of wrist movements in an fMRI environment, two bilateral: RH move-left hand (LH) stabilize, RH stabilize-LH move and four unilateral: move and stabilize tasks of RH and LH. Dynamic causal modeling (DCM) was performed to investigate the specific excitatory and inhibitory cortical influences of the motor tasks. Preliminary DCM results revealed a common motor network modulated by all tasks, which included bilateral primary motor cortex, supplementary motor area, premotor cortex, and motor cerebellum. Next steps will a) identify the task specific modulation of this network's effective connectivity; and b) assess the relationship between modulatory effects and behavioral performance with a correlation analysis between task specific modulation and biomechanical performance measures. These results will provide the first neurological evidence in support of the dynamic-dominance model of motor lateralization.

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Enhancing Performance Expectancies Through Visual Illusions Facilitates Motor Learning in Children

Wulf, Gabriele, University of Nevada, Las Vegas; Bahmani, Moslem; Ghadiri, Farhad; Karimi, Saeed, Kharazmi University; Lewthwaite, Rebecca, Rancho Los Amigos National Rehabilitation Center and University of Southern California; Chua, Lee-Kuen, University of Nevada, Las Vegas

In a recent study, golf putting performance was found to be affected by the Ebbinghaus illusion (Chauvel, Wulf, & Maquestiaux, 2015). Specifically, adult participants demonstrated more effective learning when they practiced with a hole that was surrounded by small circles, making it look larger, than when the hole was surrounded by large circles, making it look smaller. The present study examined whether this learning advantage would generalize to children who are assumed to be less sensitive to the visual illusion. Two groups of 10-year olds practiced putting golf balls from a distance of 2 m. A projector, suspended from the ceiling, projected the 'hole' (10.4 cm in diameter) and 11 small circles (3.8 cm in diameter) or 5 large circles (28 cm in diameter)

surrounding the target onto an indoor putting green. After a pre-test, participants performed 50 practice trials, and 2 days later a 10-trial retention test without visual illusions. Manipulation checks confirmed that perception of hole size was affected by the visual illusions. The group with the perceived larger hole demonstrated more accurate putting performance during practice. Self-efficacy after practice was also increased in this group. Importantly, learning (i.e., delayed retention performance without the illusion) was enhanced after practice with the perceived larger hole compared with the perceived smaller hole. The findings replicate previous results with adult learners and are consistent with the notion that enhanced expectancies are important to optimal motor learning (Wulf & Lewthwaite, 2016).

The acute effects of attentional focus during motor imagery in a simple motor task.

Yamada, Masahiro; Diekfuss, Jed A; Raisbeck, Louisa D., University of North Carolina at Greensboro

The benefits of adopting an external focus attention (Wulf, 2013) and motor imagery (Lotze & Halsband, 2006) on the acquisition of a motor skill have been well documented. However, limited research exists related to the effect of attentional focus strategies on motor imagery performance. This study examined the influence of attentional focus strategies on motor imagery performance for a simple motor task. Participants (n=18) were randomly assigned to internal focus (IF), external focus (EF), or control condition. Participants were asked to perform a simple key pressing task by tapping out the following sequence (i.e., 1-6-4-9) for 10 physical practice trials during a pretest, followed by 50 motor imagery trials during acquisition and 10 physical practice trials during retention. For physical practice, participants were asked to 'complete the sequence as accurately and quickly as you can'. For motor imagery, participants were asked to 'use an internal visual imagery during mental rehearsal of the task as accurately and quickly as possible.' Participants in the IF condition were asked to 'focus on the finger movement,' and participants in the EF condition were asked to 'focus on moving through the keys.' No attentional instruction was provided to the control group. A 2 (condition) x 3 (time) ANOVA with repeated measures on the second factor did not show any significant main effect or interaction between the groups, $F(1,15) = 0.92$, $p=0.42$. Performance results showed that all three groups significantly improved reaction time from pretest ($M=945.58\text{ms}$, $SE=75.92\text{ms}$) to retention ($M=704.86\text{ms}$, $SE=42.56\text{ms}$), $F(1,15) = 23.38$, $p<0.001$, partial $\eta^2 = .61$. These findings were important because using motor imagery improved the performance of a simple motor task and including an attentional focus instruction did not hinder the effect of motor imagery. In addition, these findings may indicate participants cannot effectively use an attentional focus during motor imagery practice.

The acquisition processes of adaptability among differentiated patterns at early stages of learning of fundamental skill in juggling.

Yamamoto, Kota; Shinya, Masahiro; Kudo, Kazutoshi, The University of Tokyo

Most of the motor tasks have redundancy in solution, and the learners' movement patterns acquired in the learning process are often not uniquely determined. It was

reported that movement patterns were roughly divided into discrete and rhythmic patterns in the early stages of learning of fundamental skill in juggling. In this study, we examined whether these typical two patterns have equivalent adaptability to perform under various temporal constraints. Eight expert jugglers and 8 intermediate jugglers participated in this experiment. Participants were asked to perform juggling by adjusting the catch timing to the gradually changing tempo. The stimulus sound changed from 300ms to 600ms with 3ms interval each beep and vice versa. The performance index of this task was evaluated by using asynchrony between beep and catch timings. In addition, the transition of movement pattern according to changing tempo was used as a behavioral index during performing adaptation task. Then, we compared these indices among participants' specific patterns. As a result, for intermediate jugglers, the performance of the task indicated that participants with discrete pattern showed better adaptation than participants with rhythmic one. Therefore, the behavioral index indicated that good adaptation was performed by appropriate switching of patterns according to changing temporal constraints. However, for experts, those with discrete patterns as well as those with rhythmic patterns showed good adaptation. These results indicate that there is a difference in adaptability which requires appropriate switching of movement patterns between the unique patterns acquired in the learning process of fundamental skill. These results also suggest that such adaptability to constraints could be acquired during the process to be skilled juggler, regardless of learners' unique patterns.

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Effect of concurrent hand movement on prediction motion

Zheng, Ran; Maraj, Brian, University of Alberta

It is not uncommon to see a moving object occluded by other objects in everyday activities, such as viewing a moving car as it is blocked by other cars. In these kinds of interactions, we need to make spatial and temporal estimations. Such estimations are components of Prediction Motion Tasks (PMT). It has been recently demonstrated that the tracking model could account for the performance in PMT, in addition to clocking model (Markin& Poliakoff, 2011). Moreover, concurrent hand movements have been reported for facilitating eye tracking (Bennett et al., 2012). The present experiment further examined the effect of concurrent hand movements on PMT. Ten participants ($M=26.5$ yrs, $SD=5.8$, 7 male) sat 45cm away (i.e., 25 deg. visual angle) from a touch screen and were asked to follow a moving target in the horizontal position even if it disappeared. First, they were required to predict the arrival of a moving ball to a target by clicking a mouse (Task 1). Second, the participants used their index fingers to track the moving ball from initiation to the target position and touch the screen upon estimated arrival (Task 2). The targets moved at 3 velocities (i.e., 10, 13.3, and 20 cm/s) creating three different viewing and occluded periods (i.e., 0.5, 0.75, and 1 seconds). Hand movements were recorded by a 3D motion analysis system (Optotrak 3020 with an IRED on the finger). A head mounted eye tracker (Applied Sciences Laboratory (ASL) 6000) was used to record eye movements. Movement time, temporal error, variable error and root mean square error (RMSE) were analyzed using a 2 (movement condition) by 3 (ball velocity) repeated measures ANOVA. Results revealed that 1) concurrent hand movements reduced RMSE of eye movements in occlusion periods and increased

consistency of time to contact when the velocity of the ball was slow, but 2) increased RMSE without deteriorating CE or VE when the ball moved fast. Overall, we conclude that the tracking model and cognitive clocking model both account for PMT, but cognitive clocking model may be more dominant.

Sport and Exercise Psychology

The Effects of Short-term Fitbit(c) wearing on Self-efficacy in Non-exercisers.

Adams, Melanie M.; Freleng, Chelsea, Keene State College

The purpose of this experiment was to determine if wearing the Fitbit® Flex would change moderate to vigorous physical activity (MVPA), sedentary behavior (SB), and self-efficacy (SE) in office workers who do not exercise. Twenty-eight college employees (mean age = 50.5 yrs, 8 males, 20 females) were recruited for the 7 week study. All reported no regularly planned PA or use of a standing desk. Participants wore an Actigraph GTX accelerometer for 1 week at baseline and post to measure steps, minutes and intensities of PA, and time spent sitting. SE was measured using a 10 item questionnaire (Sallis et al 1988) at baseline, mid and post-study. Stage of Change for PA was assessed with a 4 item survey at baseline (Marcus & Forsyth, 2003). Participants wore the Fitbit® for 3 weeks, then were randomly assigned to continue wearing (15) or discontinue wearing (13) for 3 more weeks. This was done to test for a residual effect after the novelty of a new gadget wears off. Descriptive statistics and analysis of variance were performed. 89% of participants were in contemplation or preparation. 3% were in action and 7% were in maintenance. Steps (0.02) and minutes of MVPA (0.01) significantly increased from baseline to post regardless of group assignment. SB was unchanged. There was no significant change in SE for either group. SE was significantly correlated to post MVPA minutes (0.04). The Fitbit® was effective at increasing MVPA. A residual effect was seen in the discontinue group. The mechanism for this change was not increased SE. This is surprising as Fitbit® provides feedback that highlights mastery experiences. The device vibrated when the step goal (10,000) was reached and participants received congratulatory notices for completing goals. Daily and weekly graphs in the online dashboard displayed participant progress. A weakness of this study is the lack of a Stages of Change assessment post. Future researchers should extend the wear time and observe participant use of the device without manipulation.

Development and Evaluation of a Training Program on Need-Supportive Coaching: Findings on the Appreciation by Coaches and the Role of Experienced Psychological Need Satisfaction

Aelterman, Nathalie, Ghent University, Belgium; Vansteenkiste, Maarten; De Muynck, Gert-Jan; Delrue, Jochen, Ghent University, Belgium; Reynders, Bart; Vande Broek, Gert, University of Leuven; Haerens, Leen, Ghent University, Belgium

In an era where youngsters can choose from a wide array of leisure options, the social role of the organized youth sports clubs may get jeopardized (Van Rossum, 2005). With youngsters increasingly dropping out from the sports club as they grow older (Butcher,

Lindner, & Johns, 2002), one of today's coaches' major challenges is to find ways to motivate their athletes in sustainable ways. This raises the question what sport coaches can do to have a meaningful influence on their athletes' motivation so that their continued engagement in the youth sports club is fostered. Self-Determination Theory (SDT; Deci & Ryan, 2000) posits that coaches may foster such long-term outcomes if they manage to support athletes' basic psychological needs for autonomy, competence, and relatedness. The present research describes the development and evaluation of a program aimed at training coaches to become more need-supportive in their coaching. Specifically, in a sample of 184 coaches (66.8% men; Mage = 38.83 years) from different sports, Study 1 showed that coaches' appreciation of both the content of the training and the trainer positively related to their intentions to apply the proposed coaching approach in their practice, and to the extent to which they would recommend the training to other coaches. These quantitative findings complemented with suggestions raised by the trainers during semi-structured interviews (i.e. qualitative findings) served as the basis to revise both the training's content and method of delivery as to optimally meet the psychological needs and expectations of coaches. In a second sample of 376 coaches (65.2% men, Mage = 39.34 years), Study 2 indicated that coaches' experiences of psychological need satisfaction during the training predicted changes in coaches' (a) effectiveness and feasibility beliefs regarding the proposed need-supportive strategies (b) their intentions to apply the proposed strategies, and (c) their self-reported coaching behaviors. Practical implications and directions for future research will be discussed.

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Female Paralympic athlete perceptions of effective coaching practices

Alexander, Danielle M.; Bloom, Gordon A., McGill University; Taylor, Shaunna L., The University of British Columbia

Although sport and physical activity participation rates for individuals with a physical disability are low, research on people that are physically active has revealed many promising results about their health and wellness (Arbour et al., 2007; Goodwin & Compton, 2004). The largest sporting competition for elite athletes with a physical disability is the Paralympic Games. Despite the rapid increase of participants in the Paralympic Games, the same growth and development has not occurred with empirical literature in this context, for either the coaches or the athletes who are participating in this event. Additionally, most of the samples in elite disability sport have been male only or mixed gender. Thus, the purpose of the current study was to explore female Paralympic athletes' perceptions of effective coaching practices. Individual semi-structured interviews were conducted with eight female Paralympic athletes who each attended multiple Paralympic Games and each achieved an average of eight combined Paralympic and Para Pan American medals. Interviews were transcribed verbatim and organized into themes and subthemes using a hierarchical content analysis (Côté et al., 1993; Sparkes & Smith, 2014). Results from the analysis revealed that athletes preferred coaches who were knowledgeable, challenging, fair, and willing to adapt to various contexts when working with an athlete with a physical disability. Moreover, athletes described specific undesirable or negative coaching preferences including issues

regarding communication, sexism, and manipulation. The athletes felt the coaches' behaviors impacted their satisfaction and success on both a personal and professional level. These results add to the small body of coaching knowledge in disability sport, and is one of the first studies to include an all-female sample of Paralympic athletes.

Peripheral perception as discriminant factor of tactical behavior efficiency of youth soccer players

Andrade, Marcelo, Universidade Federal de Vicosa; Teoldo, Israel, Universidade Federal de Vicosa

Objective: The aim of this study was to verify whether there are differences in the peripheral perception according to the tactical behavior efficiency of youth soccer players. **Methods:** The sample comprised 80 male soccer players (mean age: 13.90 +/- 1.08 years) from Brazilian soccer clubs. The peripheral perception test included in the Vienna Test System (VTS) was used to assess players' peripheral perception. The System of Tactical Assessment in Soccer (FUT-SAT) was used to assess players' tactical behavior efficiency. The soccer players evaluated were categorized as less and more tactically efficient, and these groups were compared with regard to their peripheral perception. To measure the peripheral perception levels, the visual field, the reaction time, number of reactions omitted, and tracking deviation were considered. Kolmogorov-Smirnov, Pearson's r , and independent samples t -test were performed, being the significance level at $p < .05$. All statistical procedures were performed through SPSS for Windows. **Results:** The results showed that the tactically more efficient players displayed higher levels of peripheral perception with respect to measures of visual field ($p = 0.029$; $r = 0.345$), reaction time ($p = 0.010$; $r = 0.400$), and tracking deviation ($p = 0.011$; $r = 0.399$), in comparison to the tactically less efficient ones. **Conclusion:** It is concluded that there are differences in the peripheral perception according to tactical behavior efficiency of youth soccer players.

Metacognition and physical activity in older adults: a discriminant analysis

Andre, Nathalie, University of Poitiers; Ferrand, Claude, University of Tours; Albinet, Cedric, Institut National Universitaire Champollion; Audiffren, Michel, University of Poitiers

Background: Although a number of studies have examined sociodemographic, psychosocial and environmental determinants of level of physical activity (PA) for older people, little attention has been paid to the prediction of metacognition for independent living older adults. Yet, metacognition has recently been considered as critical in management of day-to-day living - such as attentional control and internal memory strategies - because of, in part, their relationships with self-efficacy. **Purpose:** This study determined a model for discrimination between active and inactive older adults, using linear discriminant analysis. **Methods:** Data were collected from 243 older men and women aged 55 years and older living in France using face-to-face interviews between 2011 and 2013. **Results:** The stepwise discriminant analysis showed that Wilks' lambda was highly significant ($\lambda = 0.735$; $\chi^2 = 72.457$, $df = 10$, $p < 0.001$) and selected the five well-known predictor variables of level of PA (age, body mass index, perceived health status, benefits of PA, barrier self-efficacy) and two metacognition

strategies (internal memory and attentional control strategies). The function showed that the rate of correct prediction was 70.4% for level of PA reflecting a 20% improvement over chance alone. Of the 104 participants who were inactive, 61 (58.7%) were correctly classified as inactive and of the 139 participants who were active, 110 (79.1%) were correctly classified as active, based on the selected variables. The calculated discriminate function based on the seven predictor variables is useful for detecting individuals at high risk of inactivity. Conclusion: Results indicated that active older people have better internal mental strategies--assessing prospective and episodic memory--and better attentional control capabilities than inactive ones. This study highlighted the need to consider metacognition as a determinant of level of PA and more particularly those related to executive functions (internal memory and attentional control) in order to facilitate maintenance of regular PA.

Appeton, Paul; Duda, Joan, University of Birmingham

Perfectionistic striving is regularly associated with desirable outcomes, yet is also consistently and positively related to perfectionistic concerns. Research is needed to identify factors that may protect athletes who strive for perfection from experiencing perfectionistic concerns (and increase their positive reactions to imperfection). One factor in sport may be the potential buffering effect of a task-involving coach-created motivational climate, which has been found to positively predict a number of adaptive outcomes in sport settings. This study examined whether perceptions of the coach-created task climate moderated the relationships between athletes' perfectionistic striving with concerns and positive reactions to imperfection in 307 athletes (140 males, 167 females; from England and the USA; M age = 19.6 years SD = 4.20) from individual and team sports. Participants competed at recreational (N = 112), regional (N = 87) and national (N = 104) level and the mean number of years playing their main sport = 8.94 years (SD = 4.86) and mean number of years with current team was 3.32 years (SD = 3.62). Questionnaires included the Sport Multidimensional Perfectionism Scale-2 (Gotwals & Dunn, 2009), the Perceived Motivational Climate in Sport Questionnaires-2 (Newton et al., 2000) and 9 items capturing positive reactions to imperfection. Moderated regression analyses showed that a perceived task climate moderated the relationship between perfectionistic striving and concerns, and was a partial moderator of the striving-positive reactions relationship. Follow-up analyses revealed the positive relationship between striving and concerns, and the negative association between striving and positive reactions, became non-significant at moderate and strong task climate scores, respectively. The findings suggest that a coach-created motivational climate which is moderately to highly task-involving may impact athletes' experience of perfectionistic concerns and/or adaptive responses when high performance standards are not met.

Examining the relationship among university students' physical self-perceptions, motor skill proficiency, and physical activity behavior within the framework of physical literacy

Arnett, Jesse; McAuliffe, Jim; Law, Barbi, Nipissing University

While physical literacy is broadly defined as the beliefs and abilities to engage in physical activity (PA) across the life span (Whitehead, 2016), research in this area focuses primarily on children and highlights a need to explore physical literacy in other populations (Longmuir & Tremblay, 2016). The purpose of this study was to examine the relationships among motor skill proficiency, physical self-perceptions, and PA in university students. Participants ($n = 62$; Mage = 20.11 years, $SD = 1.46$) completed a demographic questionnaire, the International Physical Activity Questionnaire-Short Form (IPAQ-SF; IPAQ Group, 2002), and the Physical Self-Perception Profile (PSPP; Fox, 1989) subscales for sport competence, physical condition, body attractiveness, physical self-worth, and physical strength. Throwing and kicking were assessed using maximum ball speed and jumping was assessed using maximum distance (Stodden et al., 2009). Performance on all three motor skills was positively correlated ($r = .742-.768$, $ps < .05$), and motor skill scores were positively associated with perceived sport competence, physical condition, muscular strength, and personal self-worth ($r = .399-.618$, $ps < .05$). Perceived body attractiveness was correlated to jumping and kicking ($r = .271-.282$, $ps < .05$) but not throwing. A 2(Sex) \times 3(PA level) MANOVA revealed main effects for sex, MANOVA revealed main effects for sex, Pillai's Trace = .562, $F(8, 50) = 8.02$, $p < 0.01$, $\eta^2 = 0.56$, and PA level, Pillai's Trace = .587, $F(16, 102) = 2.65$, $p < .05$, $\eta^2 = .52$. Univariate tests showed that males scored significantly higher than females on all three motor skills ($ps < .05$). There were no sex differences in physical self-perceptions. Highly active individuals threw significantly faster and reported greater sport competence, physical condition, and physical strength than moderate and low active individuals ($ps < .05$); however moderate and low active individuals did not differ significantly. Findings provide preliminary insight into the links between components of physical literacy among young adults.

Mental Health Predictors of Sport Enjoyment among Adolescent Female Athletes

Ashdown-Franks, Garcia L.; Sabiston, Catherine M.; Pila, Eva, University of Toronto

Sport participation declines over adolescence, particularly for girls. Enjoyment in sport is a key predictor of participation. It is important to examine factors related to sport enjoyment in order to promote female adolescent participation in sport. Given the high drop rates from sport during adolescence, and higher rates of mental health problems among women, it is important to explore the association between mental health factors and sport enjoyment. The purpose of this longitudinal study was to examine how positive and negative facets of mental health (i.e., rumination, flourishing, and sport anxiety) predict change in sport enjoyment over a one-year time period. Data were collected through questionnaires provided to adolescent girls ($n=215$) participating in organized sport (Mage= 14.15+ 1.36), and again one year later. There was a significant change in sport enjoyment between year 1 ($M=4.53$ $SD=.67$) and year 2 ($M=4.40$, $SD=.79$); $t(270) = 2.43$, $p < .05$. At baseline, facets of mental health were significantly ($p < .01$) correlated with sport enjoyment: flourishing, $r = .33$, sport anxiety, $r = -.23$. In the final model, controlling for age, years involved in sport, and weight status, high sport anxiety significantly ($\beta = -.17$, $p = .03$) predicted decreased sport enjoyment. Rumination ($\beta = -.14$, $p = .06$) and flourishing ($\beta = .03$, $p = .66$) were not significant predictors of enjoyment. These findings highlight the importance of reducing anxiety in the context of sport for

adolescent girls. As the benefits of sport participation are well documented, strategies aimed at reducing sport anxiety in order to promote prolonged enjoyment and participation in sport are needed.

Interaction between BDNF polymorphism and physical activity on cognitive performance in the elderly

Audiffren, Michel F.; Canivet, Anne; Andre, Nathalie; Albinet, Cedric T., University of Poitiers

Background: Several meta-analytic and narrative reviews showed that physical activity (PA) enhances cognitive performances and increases brain plasticity in aging people. The neurotrophic hypothesis is one of the most convincing neurophysiological mechanisms explaining this phenomenon. It considers that the release of brain-derived neurotrophic factor (BDNF) induced by physical exercise enhances brain plasticity, for instance by stimulating hippocampal neurogenesis. BDNF secretion is under the dependence of the BDNFVal66Met polymorphism on the BDNF gene. This study investigates the influence of the BDNFVal66Met polymorphism on the relationship between PA and cognition in older adults. Methods: More than two hundred healthy elderly volunteers (mean age = 72.72 years old) participated to this study. Participants were genotyped for the BDNFVal66Met polymorphism. Two cognitive functions were assessed: behavioral inhibition and episodic memory. Behavioral inhibition was assessed using a Simon-like choice reaction times (RT) and episodic memory using the logic memory test from the MEM III battery. PA level of participants was estimated using two self-reported questionnaires. We established 4 groups according to PA level (active vs. inactive) and BDNFVal66Met genotype (Met carriers vs. Val-homozygous). The results were analyzed using ANOVA and ANCOVA, including age, gender, depression, and education as covariates. Results: The BDNFVal66Met polymorphism interacted with PA on behavioral inhibition performance and episodic memory. Inactive Val-homozygous participants exhibited the lowest performance by comparison to active Val-homozygous for episodic memory and to all other participants for behavioral inhibition. Conclusions: The results of this study support the detrimental effect of physical inactivity on several indices of cognitive performance and the neurotrophic hypothesis considering that BDNF synthesis is an important mechanism underlying the influence of physical activity on brain structure and functions.

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The Effects of a Fitness Social Media Account on Exercise Motivation

Avans, Diana E.; Tabron, Hanna; Handel, Cassie, Vanguard University

This study examined the effect of utilizing a fitness social media account to increase exercise motivation in female college students. There is minimal literature on this emerging technology, but a recent study found that there may be a positive influence on using social media to motivate individuals to exercise (Einas et.al., 2016). The Exercise Motivations Inventory-2 was utilized in this study. 29 women who exercise on a regular basis were randomly assigned to either the experimental or control group. Both groups were required to complete the EMI-2 prior to the first week of exercise and after the third

week. Fourteen students were instructed to follow a social media account (@jbfworkouts) on Instagram and to view the account before and after their exercise sessions each week. The others were instructed to not use fitness apps or videos as motivators. All participants exercised at least three times a week for three weeks, at a moderate to high level of intensity for a minimum of 30 minutes. The participants were instructed to send weekly updates of their workouts to the researchers through the app 'Up'. They were sent text message reminders throughout the week. During the testing period, both groups were asked general questions of what was motivating them and what barriers were they experiencing. Friedman's related samples test was used to determine change in motivation over the three weeks. There were no significant changes over time and no significant differences in motivation between the treatment and control group. The intrinsic motivators mentioned most often were improved health and challenge. The extrinsic factors mentioned most often were improved appearance and weight management. Barriers were time and sickness. The results from this study provided insufficient evidence to support the hypothesis that fitness based social media accounts have increase exercise motivation. A more structured environment and closer monitoring of the use of the fitness social media account may provide more information to its effectiveness.

Body Satisfaction and Self-Efficacy of Active, Middle-Aged Women

Avans, Diana E.; Kerr, Casey; Boots, Crystal, Vanguard University

During midlife, many women start to experience physical changes in weight, shape and overall health. This can affect self-concept and life satisfaction. Runfola, et al.(2013) investigated body image satisfaction in middle-aged women over 50. Researchers found that 12% of the participants reported that they were satisfied with their body (N= 1800). These women reported feeling unhappy about their skin (80%), stomachs (56%), and faces (54%). Results of a longitudinal analysis indicated that middle-aged women can enhance how they perceive their condition and body attractiveness by continued participation in physical activity, increasing their self-efficacy, and maintaining a healthy BMI (Elavsky, 2010). The purpose of this study was to sample middle-aged women who are current exercisers at a cardio focused HITT gym to determine their body satisfaction, self-efficacy to participate in exercise and the perceived benefits of exercise. The Body Parts Satisfaction scale (Petrie, 2002), Self-Efficacy and Maintenance of Exercise Participation Scale (McAuley, 1993) and Exercise Benefits/Barriers Scale-A(Pender, 1987) were used. Thirty women, mean age 40.8, reported exercising 3-5 times/week. Of the 15 body parts listed (scale 1-6), participants were most satisfied with their complexion and overall facial appearance (M = 4.8, s = 1.49, 1.18). They were most dissatisfied with their stomach (M= 3.53, s = 1.77), arms, and lower legs (calves) (M= 3.83, s = 1.28). On the SE scale (0-100), participants were moderately confident (M= 67.5%, s =24.9) that they could continue their workouts for the next 8 weeks. The highest perceived benefits (scale 1-5) were improved cardiovascular function (M= 4.86, s = 1.77) and stress management (M= 4.80, s = .66). The lowest perceived benefits were the companionship provided (M= 3.46, s = 0.79) and increased acceptance by others (M = 3.40, s= 1.10). Results showed moderate levels of body part satisfaction despite confidence in continuing exercise and strong perceived benefits. This age group is underrepresented and further study is warranted.

Controlling coach behaviours and their implications for young athletes' emotional welfare: A test of the Basic Psychological Needs Theory

Balaguer, Isabel; Mars, Lidon; Balaguer, Isabel, University of Valencia; Duda, Joan L., University of Birmingham

Basic psychological needs theory (BPNT), a sub-theory of Self-determination Theory (SDT; Deci & Ryan, 2000), offers a conceptual lens by which we can explore the social environmental and motivation-related processes that explain why some kids and adolescents have negative experiences in sport and their engagement results in heightened ill-being. According to SDT theory, such negative outcomes can be understood by considering the degree to which the social environment thwarts people's basic psychological needs of competence, autonomy and relatedness (Deci & Ryan 2000; Ryan & Deci, 2000b). In regard to social environmental factors, BPNT considers the potential impact of controlling interpersonal styles on frustrated need satisfaction and resulting ill-being indicators (Ryan & Deci, 2000b). The major aim of this presentation was to test a model hypothesising a BPNT-based sequence: perceived coach controlling interpersonal style--basic psychological needs thwarting 'and' players' experience of ill-being (in particular, negative affect and burnout). The indirect effects of perceptions of the coach controlling interpersonal style on the targeted facets of player ill-being were also examined with basic psychological needs thwarting as a presumed mediator of these relationships. 433 young male soccer players (M = 13.58, SD = 0.56 years) completed a multi-part questionnaire containing the variables of interest via validated scales. Structural Equation Modeling results revealed that athletes' perceptions of a controlling interpersonal style positively predicted their reported basic psychological needs thwarting, which in turn positively predicted burnout and negative affect. Findings provided support for the hypothesised indirect effects. The results provide insight into the processes relevant to the "dark side" of sport participation and point to the possible negative consequences of controlling coach behaviours on the emotional welfare of young soccer players.

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Pride Better Predicts Intention to Return to Youth Sport than do Basic Psychological Needs

Balish, Shea M.; Gilchrist, Jenna, University of Toronto; Rainham, Daniel; Blanchard, Chris, Dalhousie University; Sabiston, Catherine, University of Toronto

Objectives: This study tested two central predictions that follow from the Intuitionist Model of Sport Motivation (ISM). First, that feelings of pride and shame in sport predict intentions to return to youth sport. Second, that pride and shame continue to predict intentions to return when controlling for the perceived satisfaction of one's basic psychological needs. Design: Longitudinal design. Methods: Youth team sport athletes completed surveys at the beginning and end of their athletic season (n = 2176) assessing pride, shame, intentions to return, and perceived satisfaction of basic

psychological needs. Results: In step one of hierarchical multilevel modelling, pride ($= .41, p < .05$), but not shame ($= -.14, p > .05$), predicted intentions to return ($R^2_{adj} = .46$). In step two, the addition of basic needs did not significantly improve model fit relative to the model containing only pride and shame, $F(3) = 5.69, p > .05$. Conclusions: This study offers the first empirical support for the ISM, which maintains that self-conscious emotions are a central driver of sport behaviour. These findings highlight that pride may be a central factor in the decision to return to sport. Future research should test the causal role of pride in youth sport intentions and behaviour.

Funding Source: Banting Fellowship; SSHRC

High School Sport Participation and Current College Student Psychosocial Health

Barczak, Nikki; DeFreese, J.D., University of North Carolina at Chapel Hill

Youth sport participation has been found to be positively associated with psychological health outcomes (Jewett et al., 2014). For example, adolescent participation in team sport has been shown to be associated with less depressive symptoms in early adult life (Sabiston et al., 2016). To build on these findings, the present study examines associations among retrospective high school sport experiences (via burnout, engagement, perceived stress) and markers of current college students' psychosocial health. We hypothesized that retrospective sport burnout, engagement, and perceived stress would predict college students' current satisfaction with social support, anxiety, depression, and life satisfaction perceptions. Participants were collegiate students at a Southeastern American university ($N = 300$; $M_{age} = 20.2, SD = 1.2$) who completed self-report assessments of study variables via online survey interface. Regression results revealed high school sport-related burnout, engagement, and perceived stress to significantly predict all psychosocial outcomes including: social support satisfaction ($F = 4.80, R^2 = .09$), anxiety ($F = 15.54, R^2 = .18$), depression ($F = 15.54, R^2 = .13$), and life satisfaction ($F = 8.30, R^2 = .15$). High school sport burnout and perceived stress, but not engagement, were significant individual predictors of anxiety and depression, while perceived stress was the only significant predictor of social support and life satisfaction. Specifically, individuals who reported lower retrospective levels of sport-related stress also perceived higher levels of current social support and life satisfaction. Individuals who reported lower retrospective levels of burnout and sport stress also perceived lower levels of current anxiety and depressive symptoms. Results provide evidence that a high school sport participation experience characterized by less sport stress and burnout may precipitate more adaptive later life psychosocial outcomes. Future prospective studies are needed to elucidate potential temporal effects among study constructs.

The Association of Scholarship Status with Sport- and School-Oriented Motivational Outcomes in Collegiate Student-Athletes

Barczak, Nikki, University of North Carolina at Chapel Hill; Barker, Analise, Springfield College; DeFreese, J.D., University of North Carolina at Chapel Hill; Dorsch, Travis E.; Lyons, Logan K., Utah State University

Collegiate student-athletes experience unique demands, including rigorous schedules

under constant expectations of academic and athletic success. Cognitive Evaluation Theory (CET; Ryan & Deci, 1980) suggests that external rewards for participation, such as being given a scholarship, could have negative consequences on motivational outcomes for athletes. We aimed to see if collegiate student-athletes' scholarship statuses were associated with their levels of intrinsic and self-determined motivation towards school and sport. We hypothesized that those with full scholarships, either academic or athletic, would report significantly lower levels of intrinsic motivation relative to the environment associated with their scholarship. Participants were Division I NCAA student-athletes ($N = 145$; M age = 20.37 years), 60 males and 85 females, who completed valid and reliable online assessments of study variables and demographic information. There was a statistically significant difference in sport-oriented intrinsic motivation based on academic scholarship status, $F(2, 142) = 7.48$, $p < .01$, partial $\eta^2 = .10$. There was also a trend toward significance with school-oriented intrinsic motivation, $F(2, 142) = 2.94$, $p = .05$, partial $\eta^2 = .04$. Follow-up analyses showed a significant difference between no academic scholarship and full academic scholarship on sport ($p < .001$) and school ($p < .05$)-oriented intrinsic motivation, as well as significant differences between partial and full scholarships on sport-oriented intrinsic motivation ($p < .01$) and school-oriented intrinsic motivation ($p < .05$). Study results suggest the scholarship status of student-athletes may impact their motivational outcomes for school and sport. Future work should examine these relationships longitudinally in order to inform promotion of self-determined motivation and associated outcomes (e.g. positive affect, sport satisfaction, and persistence; Blanchard et al., 2009) in collegiate student-athlete populations.

The Moderating Effect of Self-Compassion on Performance-Coping and Performance-Motivation Relationships

Barczak, Nikki, University of North Carolina at Chapel Hill; Eklund, Robert, University of Stirling

This study was conducted to extend previous research on self-compassion in sport (Mosewich et al., 2013; Reis et al., 2015; Rodriguez & Ebbeck, 2015), namely its usefulness in a performance environment through coping and motivation. The core elements of self-compassion (self-kindness, common humanity, and mindfulness) should facilitate productive coping and motivation outcomes through mutual links to affective states, self-regulation, and control. This study investigated the potential moderating effect of self-compassion on performance-coping and performance-motivation processes. Adolescent competitive swimmers ($N = 121$, M age = 15.53, SD age = 2.23) from the United States completed valid and reliable online assessments of study variables and demographic information. Multiple moderated regression analyses revealed a significant interaction between performance appraisal and self-compassion in predicting task-oriented coping (TOC), $F(1, 107) = 4.21$, R^2 Change = .03, $p < .05$. Individuals with low performance appraisals varied on TOC use with those low in self-compassion reporting the lowest use of TOC. The moderated regression model also predicted 17.91% of variance in DOC, $F(4, 107) = 6.69$, $p < .001$. High self-compassionate individuals compared significantly differently than low self-compassionate individuals on disengagement-oriented coping (DOC). A three-way interaction was observed among performance appraisal, self-compassion, and objective

performance in predicting self-determined motivation, $F(1,104) = 4.06$, $p < .05$, R^2 Change = .045. Reported self-determined motivation after a performance was greater among individuals with higher self-compassion. It was found using less DOC and more autonomous motivation may be linked to self-compassion, which has implications of increasing sport performance. Overall, these findings contribute to the established literature regarding self-compassion's relationship to performance-related variables. With these results, there is a greater argument for the use of self-compassion in performance-based sport.

The Effects of Fatigue on Soccer Passing Performance and the Role of Motivation

Barte, Jeroen C.M.; Nieuwenhuys, Arne, Radboud University; Geurts, Sabine A.E., Radboud University Nijmegen; Kompier, Michiel A.J., Radboud University

Fatigue - resulting from prolonged task execution - is a common phenomenon in sports and may negatively affect performance. Recent literature suggests that these performance decrements are not so much the result of depleted resources, but that task motivation plays a central role in determining the magnitude of these effects. To examine this role of task motivation, the current experiment tested the extent to which task motivation influences the effects of fatigue on soccer passing performance. Using a pretest-posttest design, 60 amateur soccer players performed an extended version of the Loughborough Soccer Passing Test (LSPT). In between the tests, all players performed a validated sprint protocol (i.e. 40x15m sprints) to induce fatigue. Players in the motivation group ($n=30$) were motivated before the posttest by means of financial incentives and verbal encouragement, while players in the non-motivation (control) group ($n=30$) were not. Dependent variables included subjective fatigue, task motivation, effort invested, and soccer performance (LSPT score based on time and accuracy). Preliminary analyses showed no differences between the motivation group and the control group on the pretest. The sprint protocol successfully induced high levels of fatigue in both groups. Task motivation decreased from pretest to posttest in the control group, while it was upheld in the motivation group, which indicates that our manipulation of task motivation was successful. Also, effort invested on the posttest was lower in the control group compared to the motivation group. In line with these effects, the control group showed significant decreases in soccer passing performance, while players in the motivation group maintained their performance. In conclusion, results support the view that motivation plays a key role in performance under fatigue, as fatigue-induced decrements in soccer passing performance can be counteracted by high task motivation. Future research may explore the limits of this counteracting effect and extend findings to other relevant performance aspects.

Whose role is it? Examining youth athletes' perceptions of psychosocial development across recreational and competitive sport

Bean, Corliss, University of Ottawa; Forneris, Tanya, University of British Columbia Okanagan

The potential for sport to have an additive positive influence on youth's development has been supported in the literature. Lately, researchers have been making calls for the adoption of intentional approaches to facilitate psychosocial development in youth sport,

placing much responsibility on coaches. However, little research has examined youth's perceptions of the life skill development process within the sport context. Moreover, there is a dearth of research that has examined developmental outcomes across competitive and recreational youth sport (Holt & Jones, 2008). Therefore, the purpose of this mixed-methods study was to: (a) quantitatively examine youth's perceptions of their psychosocial development in sport across both competitive and recreational contexts, and (b) explore youth's perceptions of the types of life skills and the processes through which they perceive their psychosocial development to be fostered. Two-hundred and eighty-one youth athletes (Mage=14.32, SD=2.02; male=114; competitive=192) completed the Positive Youth Development Inventory-Short (Arnold, Nott, & Meinhold, 2012). From this sample, fifty-five youth participated in a one-time semi-structured interview. An inductive thematic analysis was employed (Braun & Clarke, 2006). Results from the quantitative analysis revealed that on average recreational athletes scored higher on all PYD subscales (e.g., personal standards, future orientation, adult support) than competitive athletes. Significant differences are discussed. Further, qualitative analyses indicated that youth perceived their psychosocial development within sport to emerge from a combination of experiences with their coach, their peers, and the sport context itself. Differences between youth athletes' perceptions of the type, and processes by which these life skills were accrued, emerged at the competitive and recreational levels. Practical implications of this research for coaches, parents and athletes will be considered. Further, the contribution and limitations of the research to the larger PYD literature will be discussed.

Funding Source: Social Sciences and Humanities Research Council of Canada

A healthy choice: Autonomy support within an exercise session influences post-exercise food consumption

Beer, Natalya; Guelfi, Kym J.; Dimmock, James A.; Jackson, Ben, The University of Western Australia

The positive effects of exercise on physical health are well established; however, certain behaviors following exercise, such as unhealthy or excess food consumption, may counteract these benefits. There is conceptual support for the notion that one's experience of autonomy or choice during an exercise session may be a factor that influences post-exercise energy intake. The aim of this experiment, therefore, was to examine participants' post-exercise food consumption after taking part in either an autonomy-supportive or controlling exercise session matched for energy expenditure. Fifty-eight participants completed a familiarization trial followed by an exercise session in which they were pair matched (based on sex, age, fitness, weight, and height) and randomized into an autonomy-supportive or controlling condition using a between-subjects yoked design. Participants in the autonomy-supportive condition were able to choose their exercise mode, intensity, duration, time of commencement, and musical accompaniment; those in the controlling condition were required to complete their session under the parameters chosen by their matched partner. Ad libitum energy intake from a laboratory test meal was assessed post-exercise, with foods classified as 'healthy' or 'unhealthy' according to information provided by participants and an independent dietician. Total energy intake was greater following exercise performed

under controlling (2456 ± 1410 kJ) compared with autonomy-supportive conditions (1668 ± 1215 kJ; $p = .026$; $d = 0.60$). This was accounted for by greater consumption of unhealthy food for those who exercised in controlling (1412 ± 1304 kJ) relative to autonomy-supportive conditions (790 ± 861 kJ; $p = .037$; $d = 0.56$), and participants in the autonomy-supportive condition also reported higher perceptions of exercise choice, enjoyment, and value. From a practical standpoint, these findings emphasize that the provision of choice during exercise may have important dietary (and potentially health) implications.

Challenge-oriented acts of followership as a double-edged sword in the leadership process

Benson, Alex J., Nipissing University; Eys, Mark A., Wilfrid Laurier University; Hardy, James T., Bangor University

Effective leadership is a collaborative effort, requiring a degree of complementarity in how people enact roles of leadership and followership. Qualitative work highlighted that coaches appreciated athletes who were willing to challenge their ideas, but that they were only open to being challenged under the right circumstances (Benson, Hardy, & Eys, 2016). The current study experimentally tested how three previously identified contextual factors influenced coaches' responses to challenge-oriented acts of followership. Coaches ($N = 98$ from basketball, soccer, volleyball) were shown videos where an athlete provided unsolicited challenge-oriented feedback to a coach. The videos varied by the (a) athlete's status (senior team member vs. newcomer), (b) presence of third party observers (team setting vs. one-on-one meeting), and (c) stage of the decision making process (late vs. early). Following the video, we assessed coaches' evaluations of the athlete involved in the interaction. Controlling for the sex of the coaches and their implicit views on followership, ANCOVA revealed an interaction between the contextual factors in relation to coaches' views of the athlete ($p < .05$). Notably, when a senior team member challenged the coach late in the decision making process, coaches rated the athlete more negatively when the challenged occurred in the presence of teammates compared to a one-on-one meeting ($p < .05$). Further, when the athlete challenged the coach late in the decision-making process during a one-on-one meeting, coaches rated the newcomer athlete more negatively than the senior team member ($p < .05$). Although the findings only begin to clarify the complex interplay between the contextual factors identified by Benson et al. (2016), some support for the idea that challenge-oriented acts of followership are a double-edged sword is evident. Coaches may covet proactivity from athletes in positions of followership, but challenge-oriented followership behaviors enacted at the wrong time and place can elicit a negative reaction.

Exergaming intervention to foster executive functions in children with attention deficit hyperactivity disorder: preliminary results from a clinical trial

Benzing, Valentin; Schmidt, Mirko, University of Bern

In childhood and adolescence, Attention Deficit Hyperactivity Disorder (ADHD) is one of the most frequent mental disorders. Reduced attention, poor control of impulses, as well

as increased motor activity are its key symptoms, which seem to be associated with decreased performance in Executive Functions (EF), finally affecting academic achievement. Although medication usually has some effect on symptoms, concerns about regular drug intake and possible side effects result in a need for alternative treatments. For this purpose, sedentary cognitive trainings are frequently used, although transfer effects seem to be limited. To increase potential effects, interventions combining physical and cognitive demands targeting a broader range of cognitive processes are called for. Therefore, the aim of the current study was to examine the effects of cognitively and physically demanding exergaming on EF of children with ADHD. In total, 36 children between 8-12 years ($M = 10.63$; $SD = 1.32$) diagnosed with ADHD were assigned either to an 8-week exergame intervention group (three training sessions per week \pm 30 min) or to a waiting-list control group. The EF performance in updating (color span backwards), inhibition and shifting (Simon task; Flanker task) was assessed before and after the interventional period using computer-based tests. On average children trained 2-3 times a week; manipulation checks indicate that exergaming was physically and cognitively challenging to the participants. With regard to interventional effects, ANCOVAs (one-tailed; pre-test values as covariates) revealed that children in the exergame group improved their inhibition and shifting performance significantly ($p < .05$). In summary, positive effects of a combination of cognitive and physical training in children with ADHD on EF could be revealed. Results indicate that, in future, exergaming might serve as promising tool to improve the EF in children with ADHD. However, further improvements with regard to child appropriateness, cognitive as well as physical challenge are warranted.

Funding Source: "Stiftung Suzanne und Hans Biersch zur Förderung der Angewandten Psychologie"; "Hans & Annelies Swierstra Stiftung"

A qualitative assessment of physical activity motivation, barriers, and participation among middle-age Filipino women living in the Greater Philadelphia Area

Bhimla, Aisha; Sachs, Michael; Ma, Grace X.; Salvatore, Gabrielle M.; Trout, Julia, Temple University

Purpose: Filipino Americans, one of the largest immigrant populations, face high rates of morbidity and mortality due to chronic disease. Lack of physical activity (PA) is a risk factor associated with the development and progression of chronic disease. The perspectives, facilitators and barriers that Filipino women hold towards being physically active are poorly understood. The purpose of this study was to conduct a qualitative assessment of multilevel factors affecting PA motivation, barriers, and participation among middle-age Filipino women.

Methods: Participants were recruited through Filipino community organizations located in the Greater Philadelphia Area. Focus groups were conducted using interview questions reflecting the Social Ecological Model (SEM). Sessions were audio-recorded, transcribed, and coded. Classical content analysis was applied to identify codes, themes and quantifying code frequencies. Data analysis was conducted using Atlas.

Results: A total of 19 participants participated in the focus group sessions. Participants reported low levels of regular PA engagement. PA was mainly perceived as

unstructured, domestic and occupational related. Family history of chronic disease was persistent among this population, which served as a motivation to engage in PA. Weight loss/management, appearance, and health were cited as main motivating factors to PA involvement. Common barriers among participants were low self-efficacy, current injury or illness, work, and perceived family obligations. Current illness or injury was cited as both a barrier and motivator to PA. Participants reported Zumba and dancing as common activities that were highly adopted by Filipino community organizations.

Conclusion: Study participants reported that PA is important to their daily lives, but faced unique barriers to being able to engage regularly in PA. The SEM is useful for understanding the factors related to PA motivation and barriers. Interventions to increase physical activity levels are crucial and should be tailored to consider the needs of this population.

Explaining the Relations of Athletes' Perceptions of Coach Doping Confrontation Efficacy with Intention to Dope and to Avoid Inadvertent Doping

Boardley, Ian D., University of Birmingham; Smith, Alan L., Michigan State University; Ntoumanis, Nikos, Curtin University

Research suggests coach doping confrontation efficacy may deter athlete doping (Sullivan, Feltz, LaForge-MacKenzie, & Hwang, 2015). We extend this work by examining if doping self-regulatory efficacy and doping moral disengagement mediate relations between athletes' perceptions of coach doping confrontation efficacy and doping outcomes. Athletes ($N = 258$; age $M = 22.0$ years) from Australia, the United Kingdom, and the United States completed questionnaires assessing the proposed mediators, perceptions of technical and strength and conditioning coach doping confrontation efficacy, and intention to dope and to avoid inadvertent doping. Structural equation modeling supported the fit of the proposed model, ($\chi^2(302) = 374.67$, $p < .05$; CFI = .963; RMSEA = .040; SRMR = .047). Perceptions of technical coach doping confrontation efficacy positively predicted doping self-regulatory efficacy ($\beta = .23$) and perceptions of strength and conditioning coach doping confrontation efficacy negatively predicted doping moral disengagement ($\beta = -.27$). Doping self-regulatory efficacy negatively predicted doping moral disengagement ($\beta = -.40$) and intention to dope ($\beta = -.40$). Finally, doping moral disengagement negatively predicted intention to avoid inadvertent doping ($\beta = -.43$). Mediation analyses demonstrated: (a) indirect effects of perceptions of technical coach doping confrontation efficacy on intention to dope ($\beta = -.12$) and intention to avoid inadvertent doping ($\beta = .12$) via doping self-regulatory efficacy and doping moral disengagement, (b) an indirect effect of perceptions of strength and conditioning coach doping confrontation efficacy on intention to avoid inadvertent doping ($\beta = .15$) via doping self-regulatory efficacy and doping moral disengagement, and (c) an indirect effect of doping self-regulatory efficacy on intention to avoid inadvertent doping ($\beta = .17$) via doping moral disengagement. These findings assist our understanding of precursors of intentional and inadvertent doping and have the potential to inform coach-based interventions aimed at reducing doping.

Variety of exercise in relation to physical self-perceptions, autonomous motivation and sensation-seeking

Boyd, Michael; Long, Danae; Davis, Catherine; Duran, Linda, San Francisco State University

Recent development in exercise psychology highlights the relevance of variety of exercise and its relationship to physical and psychological well-being (Sylvester et al., 2014). The purpose of this study was to examine whether variety of exercise was related to physical self-perceptions of fitness, autonomous motivation, and sensation-seeking behavior. Male and female undergraduates (N=174) enrolled in physical activity classes were recruited voluntarily and anonymously to complete several response measures. These included the Perceived Variety of Exercise Questionnaire (PVE; Sylvester, et al., 2014), the Revised Physical Self-Perception Profile (PSPP-R; Lindwall, et al., 2011), the Behavior Regulation in Exercise Questionnaire-2 (BREQ-2; Wilson, et al., 2006), and the Brief Sensation Seeking Scale (BSSS; Hoyle, et al., 2002). No gender differences emerged with the exception of perceptions of sport competence. Responses for both genders were pooled for statistical analysis. Results revealed several significant correlations, between variety of exercise and perceptions of physical condition ($r = .52$), physical strength ($r = .34$), sport competence ($r = .40$), autonomous motivation ($r = .54$), and sensation-seeking ($r = .21$). Moreover, after dichotomizing variety of exercise, MANOVA indicated significant overall differences between high and low variety of exercise groups. Follow-up ANOVA revealed that participants in the high variety of exercise group expressed significantly higher self-perceptions of physical condition, physical strength, sport competence, autonomous motivation, and sensation-seeking, than did those in the low variety of exercise group. Discussion underscores the relevance of variety of exercise in order to augment the inherent physical and psychological benefits of exercise.

Negative effects of cognitive control exertion on physical endurance performance and muscle activation are attenuated by monetary incentive

Brown, Denver M.Y; Bray, Steven R., McMaster University

Physical performance and underlying physiological responses are impaired following highly effortful cognitive control exertion. Providing monetary/motivational incentives can improve physical performance and has also been shown to ameliorate adverse carryover effects when tasks requiring high cognitive control are performed in succession. The purpose of this study was to examine the effect of monetary incentives on physical performance and muscle activation during exercise following exposure to a mentally-fatiguing, cognitive control task. Participants (N = 82) performed two isometric endurance handgrip trials separated by a 10-minute manipulation using a 2 (high cognitive control [HCC] / low cognitive control [LCC]) X 2 (\$10 incentive / no incentive) design. Results showed significantly greater mental fatigue following the HCC task ($p < .001$, $d = 2.39$). Handgrip data showed a negative effect of HCC exertion on trial-trial performance in the no-incentive condition (Mchange = -10.54). However, this effect was attenuated in the HCC/incentive condition (Mchange = +3.86), which did not differ from the LCC/no-incentive (Mchange = -.28) or LCC/incentive (Mchange = +5.59) conditions. Analyses of EMG amplitude reflecting changes in muscle activation from the first to second handgrip trial revealed a significant interaction, driven by increased activation in

the HCC/no-incentive condition at the beginning and end of the second handgrip trial, which was not apparent in any of the other conditions. Findings show monetary incentives counteract the negative effects of cognitive control exertion on physical endurance performance. EMG results suggest incentives facilitate alterations of central drive to motor units that otherwise show evidence of neuromuscular fatigue while performing exercise following cognitive control exertion. These results contribute to the current understanding of self-control theories aiming to explain the relationship between cognitive control exertion and subsequent measures of performance.

The Social Identity Questionnaire for Sport (SIQS): The Utility of a Bi-Factor Model

Bruner, Mark W.; Benson, Alex, Nipissing University

Growing empirical evidence in sport indicates individuals' identification with a sport team (i.e., social identity) has important implications for athletes' cognitions, affect, and behavior. However, there is minimal agreement about how social identity should be conceptualized and measured. Notably, social identity scholars have described social identity as a general construct (i.e., a single underlying dimension) (e.g., Hornsey, 2008), as well as a construct with distinct dimensions (i.e., ingroup ties, ingroup affect, cognitive centrality, Cameron, 2004). The purpose of the present study was to assess the utility of a nine-item, positively worded version of the Social Identity Questionnaire for Sport (SIQS). Based on previous research (e.g., Bruner et al., 2015) and recommendations pertaining to measurement in sport and exercise psychology (Myers et al., 2015), a bi-factor model was specified to examine if both a general factor of social identity and three specific factors of ingroup ties, cognitive centrality, and ingroup affect would produce a viable conceptualization. Using bi-factor analysis, this factor structure was assessed in a sample of 869 youth and young adult athletes (Mage = 14.84, SD = 3.79; male = 375; female = 494). Confirmatory bi-factor analysis using MPlus indicated good model fit for the SIQS (RMSEA = 0.040, CFI = 0.991, TLI = 0.983, SRMR = 0.018). Subsequent measurement variance testing for sex (i.e., male, female) and age (i.e., 8-12 years old versus 13-17 years old versus 18-27 years old) evaluated configural, metric, and scalar variance in a sequential fashion. Testing the factor structure across these subgroups provided evidence for strong measurement invariance indicating that a bi-factor model for the SIQS is appropriate for both sexes and several age groups. Collectively, the findings offer empirical evidence to support the utility of a bi-factor model for the SIQS, which includes both a general factor (i.e., social identity) and three specific factors (i.e., ingroup ties, ingroup affect, cognitive centrality).

Understanding the impact of physical activity on quality of life in adults diagnosed with cancer: Results from a meta-synthesis of qualitative studies

Brunet, Jennifer; Wurz, Amanda, University of Ottawa; Bradshaw, Andrew, University of Leeds; Saunders, Stephanie, University of Ottawa; West, Malcolm, University Hospital Southampton; Burke, Shaunna, University of Leeds

Background: Evidence from qualitative studies regarding the impact of physical activity on quality of life (QOL) in adults diagnosed with cancer (i.e., cancer survivors) is accumulating; yet, this body of literature has not been synthesized. Thus, we undertook

a meta-synthesis of qualitative studies reporting data relevant to physical activity and QOL among cancer survivors. Our goal was to enhance our understanding of how physical activity contributes to QOL in this population and to consider implications for future research and practice. Methods: A meta-study approach guided our meta-synthesis, which consisted of searching, screening, appraising, extracting, and analyzing data from relevant qualitative studies. Seven electronic databases were searched for studies published since database inception. As well, reference lists of relevant studies were scanned to identify additional studies. The searches yielded 1,004 studies. After a detailed check of relevance, 40 studies met eligibility criteria and were included in our meta-synthesis. Data on the characteristics and main findings (i.e., key themes) of the included studies were extracted, and key themes were summarized, compared, and synthesized. Results: Four main themes (i.e., physical, psychological, social, and spiritual well-being) and 13 interconnected subthemes emerged from the synthesis. Conclusion: Our meta-synthesis of qualitative studies provides insight into cancer survivors' perspectives on how they believe physical activity impacts their QOL, and thus makes a valuable contribution to the knowledge base on physical activity and QOL in this population. It also holds potential for developing testable hypotheses for future research.

Characterizing treatment response to 8-weeks of aerobic exercise training in major depressive disorder

Brush, Christopher J.; Ehmann, Peter J., Rutgers, The State University of New Jersey; Olson, Ryan L., University of North Texas; Bocchine, Anthony J.; Alderman, Brandon L., Rutgers, The State University of New Jersey

Major depressive disorder (MDD) is one of the most common mental health disorders in the U.S. Despite available treatment options, many individuals fail to respond to traditional antidepressants, given that depression is characterized by considerable clinical and biological heterogeneity. In line with the Research Domain Criteria (RDoC) initiative from NIMH, there is a need to better understand individual characteristics and mechanisms associated with treatment response in order to advance personalized intervention approaches. The aim of this study was to characterize treatment response following an aerobic exercise (AE) intervention targeting cognitive control and reward-related processing in depression. Twenty-five individuals with a diagnosis of MDD (15 responders; 20.5 +/- 2.3 years) completed three 45-min sessions/week of moderate-intensity AE for eight weeks. Depressive symptoms and aerobic fitness (VO₂ peak) were examined at pre- and post-intervention. Cognitive control was assessed using N2 and error-related negativity (ERN) components elicited by a modified flanker task, while reward processing was assessed using the reward positivity (RewP) ERP elicited during a monetary gambling task. At baseline, treatment nonresponders exhibited fewer depressive symptoms ($p < .05$, $ES = .36$) and higher aerobic fitness ($p = .13$, $ES = .10$) relative to treatment responders. Significant pre-to-post changes in depressive symptoms occurred for responders ($p < .05$, $ES = .62$), without a change in VO₂ peak. VO₂ peak marginally increased for nonresponders ($p = .07$, $ES = .13$). Additionally, changes in cognitive control emerged ($p < .05$, $ES = .33$), such that increases in N2 amplitude were observed for responders relative to nonresponders. No changes in reward-related processes were found (all $ps > .05$). These findings suggest important

biological characteristics and cognitive mechanisms associated with responses to AE treatment for depression. These observations serve as initial evidence to help guide future AE interventions based on a precision medicine framework.

Predictors of Children's Physical Activity Attraction During Later Childhood: A Longitudinal Examination

Brustad, Robert J.; Bumgardner, Brenda K., University of Northern Colorado

A rapidly expanding knowledge base supports the role of physical activity in contributing to children's physical and mental health, social development and cognitive functioning (e.g., Strong, Malina, & Blimkie, 2005; Tomporowski, Lambourne, & Okumura, 2011). However, research conducted to date has been largely cross-sectional in nature which is inherently problematic given the extent of developmental change during childhood. The purpose of this study was to apply a longitudinal design to understanding children's attraction to physical activity during middle to late childhood to determine the extent to which aerobic fitness, agility, BMI and attraction to physical activity predicted attraction to physical activity one and two years subsequently. Attraction to physical activity reflects children's intrinsic interest and desire to participate in physical activity. Participants in the study were 76 fourth through sixth grade students with complete data over at least two consecutive years on the Children's Attraction to Physical Activity (CAPA: Brustad, 1993; 1999) scale; the Pacer aerobic fitness test; the shuttle agility run; and height and weight assessments that allowed for BMI estimation. Three separate multiple regression analyses were conducted (Grades 4 to 5; 5 to 6; and 4 to 6) and the significant findings revealed that attraction to physical activity could be explained in each case by the linear combination of variables obtained one or two years prior. Grade 5 attraction was explained principally by Grade 4 attraction ($\beta = .40$) and Grade 4 Pacer ($\beta = .33$) scores. Grade 6 attraction was explained primarily by Grade 5 attraction ($\beta = .61$), Grade 5 shuttle ($\beta = -.40$) and Grade 5 Pacer ($\beta = .39$) scores. Grade 6 attraction was also explained by Grade 4 attraction ($\beta = .63$), Grade 4 shuttle ($\beta = -.28$) and Grade 4 BMI ($\beta = .23$) values. These findings provide support for the expectation that children's physical activity attraction 'tracks' over time and in relation to fitness, motor skill and body composition characteristics.

Breathing patterns are associated with changes in emotional responses and heart rate while viewing neutral stimuli

Buchanan, Taylor, University of Florida; Fawver, Bradley, University of Utah; Beatty, Garrett F.; Janelle, Christopher M., University of Florida

Breathing patterns are associated with emotional reactivity and changes in physiological responses. Current understanding is limited with regard to how emotional reactivity is impacted by breathing rate. We sought to determine whether indices of emotional valence and perceived arousal are coupled with heart rate [HR] fluctuations in response to distinct breathing paces. While viewing neutral images, participants ($N=30$, Females = 15) performed three randomized metronome-paced breathing conditions: slow-paced (SP), normal-paced (NP), and fast-paced (FP). Each breathing condition lasted three minutes. Prior to starting experimental conditions, participants established baseline

levels (images excluded) of arousal and valence. Emotional valence and arousal were assessed with a visual analog scale following each condition, including baseline. Results indicated less pleasant scores in experimental conditions compared to baseline (all $p's < .001$), but this main effect was qualified by a Gender x Condition interaction. Females reported less pleasant scores than males in the FP condition ($p < .05$), but were similar across all other conditions. A condition main effect was also found for HR, but the main effect was qualified by a Gender x Time x Condition interaction. Decomposition of the interaction via pairwise comparisons indicated that females exhibited a higher HR than males during the third minute of the FP condition ($p < .05$), but participants were similar across all other conditions. Collectively, our findings indicate that emotional responses are more pleasant, and that HR decreases when using a self-selected moderate paced breathing pace. Moreover, results indicate that females perceive faster breathing to be less pleasant compared to males when coupled with increased heart rate. Our findings substantiate that manipulation of breathing patterns can alter emotional responses and physiological indices in neutral contexts. Further research should seek to explore mechanisms underlying how control of respiration rate can regulate emotions in highly emotional situations.

A Pilot Study on Student-Athlete Perceptions of Coaching Behaviors as Fostering or Hindering Mental Toughness Development

Burger, Joshua; Ponti, Daniel; Madrigal, Leilani, California State University Long Beach

Mental toughness (MT) is a term used to explain the set of beneficial characteristics and skills possessed by athletes that excel in both practice and competition, while others fall short (Gucciardi, Gordon, & Dimmock, 2008). Certain coaching behaviors may have the effect of aiding (fostering) or hurting (hindering) this important set of traits. For instance, creating motivational climates such as challenging, rewarding, and enjoyable practice conditions have been suggested to foster MT (Connaughton, Wadey, Haunton, & Jones, 2013). Additionally, autonomy supported environments are positively associated with psychological needs satisfaction while they are negatively associated with psychological needs thwarting (Mahoney et al., 2014). Thus, coaches may play a pivotal role in the development of mental toughness based on the environment they create within the team. This pilot study examined student-athlete perceptions and how their mental toughness was facilitated or hindered by their coach's. Twenty-eight (11 male; 17 female) athletes from NCAA Division I basketball and golf teams completed the Mental Toughness Scale (Madrigal, Hamill, & Gill, 2013; MTS ranges from 11-55) in addition to two open-ended questions about behaviors of their head coach that either fostered or hindered mental toughness. Results indicated that in terms of perceived mental toughness, athletes signified relatively high MTS scores ($M = 47.61$; $SD = 5.24$). In terms of coaching behaviors that influenced mental toughness, coaches opting to make practice conditions tougher was perceived as fostering MT, while engaging in behaviors like yelling and picking favorites within the team was perceived as hindering MT. Future directions in this field could include surveying coaches about beneficial coaching behaviors that foster MT and comparing these results to athlete perceptions of hindering/fostering behaviors.

Perfectionism and Burnout in Athletes - A Meta-Analysis

Busch, Lena; Buerkner, Paul-Christian; Schuecker, Linda; Holling, Heinz; Strauss, Bernd, University of Muenster

Perfectionism and flawless performance are often required in sport context and are even connected to gold medal success in Olympic athletes (e.g., Gould, Dieffenbach, & Moffett, 2002). Nevertheless, perfectionism has also been connected to burnout (Hill & Curran, 2015). In Hill and Curran's (2015) meta-analysis, relationships of dimensions of perfectionism with burnout were analysed in general context, entering the domains of work, sport and education as moderator variables. Building up on their work, the purpose of this study was to meta-analyse relationships of perfectionism with burnout in a population of athletes, including four new studies. This study is the first on this topic to examine longitudinal data and to provide sport specific moderator analyses. Literature search yielded 22 cross-sectional samples ($N = 4,206$), and three longitudinal samples for separate analysis ($N = 432$). Random-effects analyses indicated a small negative correlation of perfectionistic strivings with athlete burnout, except for the burnout subscale physical and emotional exhaustion. A medium positive correlation was found for perfectionistic concerns with athlete burnout that is stable across all burnout subscales. Controlling for the relationship of the dimensions of perfectionism, semi-partial correlations were larger than the correlations of the dimensions of perfectionism with athlete burnout, especially those of perfectionistic strivings. Results were moderated by a range of study characteristics, but not by participant characteristics. Regarding the relationship of perfectionistic strivings and burnout, analyses indicate a small publication bias. Longitudinal data revealed a larger negative effect size for the relationship between perfectionistic strivings and burnout, but should be interpreted with care. Further longitudinal data is necessary to obtain reliable results and to understand the underlying processes. Intervention studies to reduce perfectionistic concerns and augment perfectionistic strivings are suggested.

Taking a Walk Down Memory Lane: The Relation between Affective Memory and Affective Forecast

Calder, Amanda; Cotter, James D.; Hargreaves, Elaine A., Otago University

People make behavioural choices based on the affective responses they expect to experience (Wilson & Gilbert, 2005). According to the affect heuristic (Slovic et al., 2002), repeated positive or negative affective responses during exercise would lead the individual to expect to experience a similar affective response during future exercise. Affective forecasts are often inaccurate, particularly without recent experiences from which to draw memories (Williams, 2003). This study aimed to investigate the relationships between affective responses to exercise, affective memory and the affective forecasts for future exercise. Twenty inactive females (39 ± 11 y) completed two identical 30-min moderate intensity exercise sessions one week apart. Before exercise, participants predicted how they thought they would feel overall during exercise (affective forecast) on a scale from -10 (very unpleasant) to +10 (very pleasant). At 15 min and 2 and 7 days after exercise, participants recorded how they felt overall during the exercise (affective memory), on the same scale. Affective responses were recorded on the Feeling Scale (Hardy & Rejeski, 1989), before, every 2 min during, and 5, 10, and

15 min after exercise. Linear regression analysis revealed that affective forecast positively predicted mean affective response during exercise for the first and second exercise session ($b=.54$, $p=.018$; $b=.71$, resp., $p=.010$). The mean affective forecast for the second exercise session was significantly more positive (3.6 ± 3.4) than for the first session (0.9 ± 3.9 , $p=.019$). Affective memory of the first exercise session positively predicted the affective forecast for the second (15 min: $b=.58$, $p=.019$; 2 day: $b=.75$, $p=.001$; 7 day: $b=.65$, $p=.001$). Results show that for inactive people affective memories from exercise influence how they think they will feel the next time they exercise, and with greater exercise experience the forecast becomes more accurate. These results strengthen the importance of creating positive affective responses to motivate future exercise participation.

Funding Source: University of Otago PhD Scholarship

Understanding the impact of parents socioemotional and competitive goals on their verbal sideline behavior in organized youth sport

Campbell, Brandon C.; Grondel, Bryson T.; Grimm, Marshall X.; Dorsch, Travis E., Utah State University

Bronfenbrenner's (1999; 2005) bioecological theory of human development is composed of four interrelated factors that are posited to influence development: process, person, context, and time. As such, it has come to be known as the PPCT model. Holt and colleagues (2008) applied this model to competitive settings, highlighting process, person, and context factors that influence parent verbal sideline behavior in organized youth sport. Their authors speculated that parent verbal sideline behavior exists on a continuum from supportive to derogatory. In extending the use of the PPCT model in sport, as well as Holt's postulated continuum, the present research was designed to determine whether parent goals influence the relative supportiveness of parents' verbal sideline behavior during competition. Parents ($N = 95$; $Mage = 40.6$ years) were audio recorded via lapel microphone during a child's competition, and subsequently asked to complete a short survey tapping the goals they held for their child's participation. Recordings ($Mlength = 74.1$ minutes) were transcribed verbatim, cross-checked for accuracy, and individual statements were coded into one of the six categories on Holt and colleagues' continuum. Survey answers were used to determine the extent to which parent goals focused on social and emotional support (e.g., having fun) or competitive success (e.g., performing well). Results indicate that goals have little to no influence on parents' verbal sideline behavior during competition. Specifically, analyses indicate that more supportive goals do not lead to more supportive bouts of verbal sideline behavior. In interpreting these findings we suggest that parents may not be cognizant of their communicative styles during competition. The present research has the potential to expand the application of Bronfenbrenner's PPCT model in organized youth sport while also informing parent involvement in the organized youth sport context.

Concussed athletes' psychological readiness to return to sport

Caron, Jeffrey G.; Bloom, Gordon A., McGill University; Podlog, Leslie, University of Utah

The graduated return to play (RTP) protocol (cf. McCrory et al., 2013) is a six-stage

stepwise process that was designed to help ensure athletes are returned to sport only after their symptoms have subsided. More specifically, RTP was designed to ensure athletes are physically ready for their return. Such criteria, however, fail to account for psychological aspects of recovery. Psychological readiness is a concept that has been investigated among athletes returning to sport following musculoskeletal injuries (e.g., Podlog, Banham, Wadey, & Hannon, 2015), however it has not yet received attention in relation to concussed athletes. The purpose of this study was to explore athletes' perceptions about their psychological readiness to return to sport following a concussion. Semi-structured interviews were conducted with 12 high school athletes who played a variety of contact and collision interacting sports. Results of a hierarchical content analysis revealed three main themes across interviews: concussion recovery, emotions surrounding return to play, and playing safe. Participants indicated that the cognitive and physical activity restrictions during the recovery period led to feelings of boredom and frustration. The athletes also articulated fears associated with suffering another concussion (or subsequent injury) upon their return to sport. Moreover, some indicated they played safe to avoid contact and collision with opponents, the playing surface, or objects that might cause a head injury (i.e., heading a soccer ball). Overall, these results indicate that although all of the athletes were deemed physically ready to return to sport (i.e., they completed the RTP protocol), several of them reported not being psychologically ready to resume competition. The present study provides initial support for investigating concussed athletes' psychological readiness during RTP, which might inform efforts to improve athletes' overall preparedness to return to play following concussion.

**Sitting time, motivation, and weight-impacted quality of life after bariatric surgery:
A preliminary examination**

*Chemtob, Keryn; R. Reid, Ryan E.; Andersen, Ross E.; Duncan, Lindsay R.; Sweet, Shane N.,
McGill University*

Background: Research identifying psychosocial variables related to sitting time and weight-impacted quality of life (QoL) among adults who underwent bariatric surgery is relatively scarce. Variables such as autonomous and controlled motivation from self-determination theory could provide insight into the mechanisms to improve these outcomes. The purpose of the research was to examine preliminary relationships and changes pre-post surgery in sitting time, motivation, and weight-impacted QoL. **Methods:** Seven adults living with obesity (Mean age=42 (SD=9.32), 57% female, mean weight lost= 23.87 kg) completed questionnaires pre and three months post-bariatric surgery. Variables related to motivation, sitting time, and the impact of weight on QoL were assessed. Cohen's d effect sizes (sm=.0.3, med=0.5, large=0.8) were calculated for pre-post changes in all variables. Relationships between the variables were examined with bivariate correlations, r: sm=0.1, med=0.3, large=0.5. **Results:** Controlled motivation for reducing sitting time decreased post-surgery (d= -0.79). Post-surgery, participants reported that weight had a smaller impact on their QoL compared to pre-surgery across five domains: physical function (d=-2.54), self-esteem (d=-2.17), sexual life (d=-1.21), public distress (d=-1.22), and work life (d=-1.59). Change in controlled motivation was related to sitting time (r=0.76) and the work (r=0.53), physical function (r=0.31), and public distress (r=0.40) domains of weight-

impacted QoL. Change in autonomous motivation was also related to sitting time ($r=0.64$) and the work ($r=0.55$) and physical function ($r=0.32$) domains of weight-impacted QoL. Change in sitting time was correlated with the physical function ($r=0.35$), self-esteem ($r=0.28$), and work ($r=0.59$) domains of weight-impacted QoL.

Conclusion: The correlations between sitting time and weight-impacted QoL emphasize the importance of reducing sitting time among bariatric surgery patients. Interventions could aim to decrease controlled motivation to reduce sitting time in this population.

The Predictive Power of Mindfulness, Stress Management, and Smart Phone Addiction for Mental Stress In College-Aged Students

Chen, David D., California State University Fullerton; Nguyen, Donald, Columbia University; Fisher, Koren, California State University Fullerton

It is well-known that increased mindfulness is associated less stress and more well-being (Chiesa and Serretti, 2009). It is also clear that excessive use of smart phone poses a risk to the public and the individual whether driving or attending classes. However, little is known about the connection between mindfulness, well-being, and smart phone addiction. Therefore, the purpose of this study was to investigate how well the level of mindfulness and well-being can predict the degree of smart phone addiction. The IRB approved study involved 159 undergraduate student volunteers (Mean age = 22.9 years) who were administered 5 questionnaires in a 20-minute session in the order of (1) demographics survey, (2) the Stanford instrument "Use of Mental Stress Management/Relaxation Techniques," (3) "The Mindfulness Attention Awareness Scale (MAAS)," (4) the shortened version of "Smartphone Addiction Scale (SAS-SV)", and (5) "The Warwick-Edinburgh Mental Well-Being Scale" (WEMWBS). Correlational and regression analyses indicated that mindfulness is negatively associated with smartphone addiction ($r=-.454$; $p<.0001$) and mindfulness accounts for 20.6% of the variance in the regression equation. One-way ANOVAs revealed no significant differences among the four ethnic groups suggesting that the five questionnaires did not favor any one ethnicity. The results revealed a moderate inverse relationship between mindfulness and smartphone addiction and a weak inverse correlation between well-being and smartphone addiction. They suggest that mindfulness practice may lead to decreased smartphone addiction, and in turn, perhaps to decreased traffic accidents and increased work productivity.

Psychosocial effects of the interactive motion-sensing exercises on real-life arm use after stroke

Chen, Shuya, China Medical University; Lin, Ching-Min, Asia University; Hsu, Stephen; Ho, Cheng-Hui, China Medical University; Yeh, Shih-Ching, Fudan University; Chang, Wen-Dien, China Medical University

Interactive motion-sensing exercises have gradually obtained attention both in research and clinical practice, because the motion-sensing technique allows users to interact in the virtual world without equipping any sensors. Previous studies claimed that the interactive motion-sensing exercises were useful for upper extremity rehabilitation.

However, motivation and confidence maybe important factors to transfer the training effect into daily life. Therefore, we aimed to explore psychosocial effects of the real-life arm use after the interactive motion-sensing exercises. Nine participants with chronic stroke were recruited and completed the interactive motion-sensing exercises 3 hours * 12 weeks. The real-life arm use was indicated by the motor activity log (MAL). The Fugl-Meyer assessment (FMA), the Box and Block test (BBT), and the Stroke Impact Scale (SIS) detected the physical effects. The psychological effects were measured by the Taiwan Depression Scale (TDS) and the Confidence in Arm and Hand Movements. The Brief COPE scale indicated the social effects. At the baseline, the amount of real-life arm use was 1.24 ± 1.23 measured by the MAL. After training, the arm use improved (1.54 ± 1.41), but not reaching the significant level. However, we found the significant improvements of the physical function ($p < 0.05$). As for the psychological effects, the confidence of using the affected arm and hand ($p < 0.05$) significantly improved, but not the TDS. Besides, the Brief COPE scale did not change much. The real-life arm use as well as the upper extremity physical function improved after the interactive motion-sensing exercises training. Only the confidence of using the affected arm and hand showed significant difference. We demonstrated that the application of interactive motion-sensing exercises is beneficial for poststroke real-life arm use. In the future, both physical and psychosocial effects should be emphasized for the individuals at chronic stage after stroke.

Funding Source: Ministry of Science and Technology in Taiwan

An Intervention to Help PE Teachers Offer Intrinsic Teaching Goals in Autonomy-Supportive Ways: Benefits to Students

Cheon, Sung Hyeon, Kangwon National University; Reeve, Johnmarshall, Korea University; Song, YongGwan; Kim, Bo Ram, Kangwon National University

We used a Self-Determination Theory (SDT) framework to design and implement a brief intervention to help collegiate physical education (PE) teachers learn how to offer their daily teaching goals in more autonomy-supportive and in less controlling ways. We randomly assigned collegiate-level snow skill instructors into either an experimental (intervention) or control group (2 teachers with 20 students in the experimental group; 2 teachers with 22 students in the control group). At the beginning, middle, and end of the ski class, we assessed students' perceptions of their teacher's motivating styles (autonomy support, control) as well as their self-reported motivation (need satisfaction, need frustration), goals (intrinsic, extrinsic), perceived skill development, and classroom engagement. Throughout the ski camp, trained raters objectively scored teachers' motivating styles, teachers' intrinsic vs. extrinsic instructional goals, and each student's extent of engagement. Repeated measures ANCOVAs showed that students of teachers in the experimental group, compared to students of teachers in the control group, perceived their teachers as becoming significantly more autonomy-supportive and as significantly less controlling. For students' goals and psychological needs, students of teachers in the experimental group, compared to students of teachers in the control group, reported more intrinsic learning goals, greater psychological need satisfaction, and lesser need frustration. For students' outcomes, students of teachers in the experimental group, compared to students of teachers in the control group, showed

greater engagement. We conclude that a carefully-designed intervention that incorporates Goal Content Theory within a Self-Determination Theory framework can help PE teachers meaningfully upgrade the quality of their motivating styles and, hence, their capacity to promote their students' need satisfaction, intrinsic goals, perceived skill development, and engagement.

The Role of Coaches in Preventing and Managing Alcohol Consumption of their Student-Athletes

Chow, Graig M.; Bird, Matthew D.; Soendergaard, Stinne, Florida State University

Student-athletes consume alcohol at concerning rates, which puts them at risk for engaging in unsafe behaviors and experiencing negative consequences. It has been proposed that coaches impact athlete alcohol use, and recommended that they be included in alcohol prevention and intervention programs (Martens et al., 2006). This study examined coaches' attitudes and behaviors toward athlete drinking and leadership style, and their experiences and barriers in managing athlete alcohol use. Participants were 488 NCAA head coaches (DI=148, DII=121, DIII=219) from a variety of men's and women's sports. A mixed-methods design was used. Coaches completed a questionnaire measuring their attitudes and behaviors toward athlete alcohol use and the Leadership Scale for Sports, and responded to open-ended questions regarding the management of athlete drinking including perceived role, effective strategies, and challenges. Factor analysis revealed three dimensions of coaches' attitudes and behaviors toward athlete alcohol use: Concerned Communication, Conditional Leniency, and Enforcement. Democratic Behavior was negatively associated with Enforcement and positively associated with Conditional Leniency. Concerned Communication was positively related to Social Support and Positive Feedback. Inductive content analysis supported and extended factor analysis results. Specifically, strategies reported as effective in addressing athlete drinking were enforcement of policy, education about consequences of drinking, establishment of quality coach-athlete relationship, and management using outside resources and scheduling. Participants indicated that coaches should play an educating, managing, supporting, influencing, and relationship building role in managing athlete alcohol use. Lastly, coaches experienced challenges pertaining to policy, identifying and addressing alcohol misuse, lack of knowledge, environmental demands, and individual differences among athletes. Findings have implications for education and training programs to prepare coaches to address athlete alcohol use and misuse.

The associations between heart rate variability and executive function in late middle-aged and older adults

Chu, I-Hua; Yu, Tzu-Cheng; Chiang, Che-Hsien, Kaohsiung Medical University

Purpose: The purpose of this study was to examine the associations between heart rate variability (HRV) and executive function in late middle-aged and older adults. **Methods:** A total of 27 participants (mean age 64.85 \pm 2.71 yr) were recruited for this study. Electrocardiogram was used to measure participants' heart rate at rest. HRV were analyzed and expressed as the standard deviation of normal-to-normal intervals (SDNN)

and high frequency (HF) HRV. The executive functions of planning and problem solving were assessed using a Tower of London Task. Pearson correlation analysis was used to examine the relationship between each parameter of HRV and the performance of Tower of London Task.

Results: The results showed that there were no significant correlations between SDNN and total correct score ($r = 0.169$, $p = 0.399$), total move score ($r = 0.049$, $p = 0.807$), total initial time ($r = 0.067$, $p = 0.741$), total executive time ($r = -0.071$, $p = 0.723$), and total time ($r = -0.053$, $p = 0.794$). There were also no significant correlations between HF HRV and total correct score ($r = 0.074$, $p = 0.712$), total move score ($r = 0.092$, $p = 0.648$), total initial time ($r = 0.001$, $p = 0.994$), total executive time ($r = -0.051$, $p = 0.800$), and total time ($r = -0.046$, $p = 0.821$).

Conclusion: The results of this preliminary study suggested that HRV may not be associated with the executive functions of planning and problem solving in late middle-aged and older adults.

Developing a Physical Literacy Tool for the Early Years: PPLAY

Clark, Heather, McMaster University; Krellaars, Dean, University of Manitoba; Dudley, Dean, Macquarie University; Mitchell, Drew, Sport for Life; James, Maeghan; Podgorski, Margaret, McMaster University; Cairney, John, University of Toronto

Physical literacy encompasses the motivation, confidence, competence, and knowledge to engage in developmentally appropriate physical activities (Whitehead & Murdock, 2006). While there is an emerging body of research on physical literacy in school-aged children, the preschool years have largely been ignored. This is an important gap as physical literacy has been proposed as foundational to physical activity (Edward 2016), and physical activity behaviours are established early in life (Moore et al., 2003). We developed and tested the Preschool Physical Literacy Assessment Tool (PPLAY) to begin to address this gap. PPLAY is an observational tool for early childhood educators that measures physical literacy across three domains: movement competencies, coordinated movements, and motivation and enjoyment. We tested the reliability and validity of the PPLAY in 78 children in Hamilton, Ontario. Each child was matched with two educators that completed the PPLAY two-weeks apart. For validity, we assessed the agreement between the PPLAY tool with gross motor scale of the Peabody Developmental Motor Scales (PDMS-2; Folio & Fewell, 1974) and the ability of PPLAY to predict physical activity measured using Actigraph GT3X accelerometers. Results indicated 4 items showed poor inter-rater agreement ($ICC < .4$). Items, subscales, and total score showed adequate test-retest reliability (ICC 's from .49 to .72). PPLAY score showed a significant partial correlation (adjusting for age and gender) with the PDMS-2 gross motor scale ($r = .33$, $p < .01$). PPLAY score did not predict minutes of activity per hour, minutes of MVPA per hour, or vector magnitude counts per minute (VCPM) after accounting for age and gender. Examination of subscales showed movement competencies were associated with gross motor skills ($r = .33$, $p < .01$) and the motivation subscale significantly predicted VCPM ($\beta = .371$, $p < .05$). These results suggest initial support for the PPLAY tool as a measure of physical literacy during the early years. However, modifications and further testing of the tool is required.

Funding Source: Sport for Life

Incorporation of a Sport Psychology Program at the Major League Baseball Urban Youth Academy Enhances Assertiveness Skills, Player Performance and Self-Esteem

Conn, Brad E., El Camino College

The Major League Baseball Urban Youth Academy (MLB-UYA) is an after-school program that provides free baseball and softball coaching, educational services and mentorship to at-risk children and youth (5-24 years). Located in Compton, California, the MLB-UYA is optimally located to draw a number of youth from the surrounding concentrated poverty neighborhoods (CPN). Many youth living in CPNs experience a dearth of resources and other forms of support that we know are important to adolescent development and flourishing. Additionally, psychological factors such as self-esteem and feelings of worthlessness are affected as a result of living in these CPN areas. Specifically, low self-esteem has been linked to higher rates of teen pregnancy as well as higher rates of youth violence (Crenshaw & Lee, 2003). Preventative programs have the ability to increase psychological well being in at-risk adolescents Wells et al. (2002). To assist in enhancing assertiveness and self-esteem, for team sport performance, a sport psychology program was integrated into the MLB-UYA Summer League Program. Interventions utilized included workshops that's goals were to enhance sportsmanship, sport skills and improve life skills. MLB-UYA coaches were provided questionnaires for quantitative purpose and MLB-UYA athlete participants in the study (N=37) were provided with a self-esteem questionnaire, to complete before and after completion of the MLB-UYA Summer League Program. MLB-UYA coaches reported that players increased in their assertiveness skills and become 'more coachable.' Furthermore, MLB-UYA participants reported increased their self-esteem after completion of the MLB-UYA Summer League Program. Using a t-test statistical measure the change score was significantly different from 0, $t(26) = -2.13$, $p = 0.04$. The average change score for SE was 20.84 (SD = 34.05). This change score was also significantly different from 0, $t(36) = 3.723$, $p = 0.001$, thus showing that participating report an increase in self-esteem after completing the MLB-UYA Summer League Program.

The influence of parent and child gender on goals and verbal sideline behavior in organized youth sport

Cook, Emily; Rose, Travis; Grimm, Marshall X.; Dorsch, Travis E., Utah State University

Past research has shown that one of parents' primary goals for their children in organized youth sport is to have fun (e.g., Gill, 1983; Knight & Holt, 2014). Unfortunately, past qualitative research also suggests a disconnect between parents' stated goals and their subsequent verbal behavior on the sidelines at sporting events (Dorsch et al., 2015). One limitation of Dorsch and colleagues' research, given its small sample size, was that it could not account for the impact of parent or child gender on parents' goals or verbal sideline behaviors. Moreover, Dorsch and colleagues did not address the paralinguistic features of parent verbal sideline behavior during competition. The present research addressed these two gaps by examining (a) the impact of parent and child gender on parents' stated goals for their children's sport participation, and (b) the impact of parent and child gender on parents' pitch and volume during competitions. Parents (N

= 95; Mage = 40.6 years) were audio recorded during a child's competition and subsequently completed a study-designed questionnaire assessing their goals for their children's sport participation. Recordings were cleaned using Pratt 2.0 software and analyzed to determine the pitch and volume of parents' verbal sideline behavior. Survey responses were examined to assess parents' mean levels of instrumental, identity, and relational goals. Factorial ANOVAs were then conducted to determine whether parents' goals or patterns of verbal sideline behavior differed across parent or child gender. Results indicate that fathers and mothers share many of the same goals for their children in sport, but that goals differ across child gender. Results also indicate that fathers and mothers do not differ in their patterns of verbal sideline behavior, but that communication differs across child gender. Findings offer greater insight into the influence of parent and child gender on goals and verbal sideline behavior in organized youth sport, and may inform coaches and administrators who design youth sport programs.

Investigating the Impact of Mindfulness as a Unique Form of Associative Attention on Affective Responses to Treadmill Walking

Cox, Anne E.; Cates, Hailey L.; Roberts, Madeline A.; McMahon, Amanda, Washington State University

An aversion to the sensations of physical exertion can be a significant deterrent to engaging in physical activity. This is thought to be due in part to an associative focus in which individuals are attending to interoceptive cues such as breathing or muscle sensations during exercise. The purpose of this study was to test the effect of mindfulness, a unique form of associative focus that is characterized by openness and nonjudgment, on affective valence, activation and ratings of perceived exertion (RPE) during treadmill walking. Participants (N=14; Mage=19.29) engaged in no more than moderate levels of physical activity and reported low levels of intrinsic motivation. They completed three testing sessions including a habituation session to determine the grade needed to achieve 65% of heart rate reserve (HRR); a control condition in which they walked at 65% of HRR for 10 minutes and an experimental condition during which they listened to a mindfulness track that directed them to attend to the physical sensations of their body in an open and nonjudgmental manner during the 10 minute walk. ANOVA results showed that affective valence was significantly more positive in the mindfulness condition ($F=9.11$, $df=1, 13$, $p=.01$, $\eta^2=.41$), attentional focus was more associative ($F=34.95$, $df=1, 13$, $p<.01$, $\eta^2=.73$) and there were no differences in activation or RPE. Bivariate correlations showed that the relationship between valence and RPE was stronger in the control condition ($r=-.81$, $p<.01$) than in the mindfulness condition ($r=-.58$, $p<.05$). Attentional focus did not relate to valence in either condition; however, higher activation was related to more associative focus in the control condition ($r=-.61$, $p<.05$) but not the mindfulness condition ($r=-.21$, $p>.05$). Results suggest that mindfulness during exercise may facilitate more positive affective responses, which supports exercise adherence.

Temporal correlations of support surface movement affect the control of center of pressure velocity

Croteau, Camille M., Western University; Wilson, Kathleen S., California State University Fullerton

Qualitative research has illustrated that the social stigma of menstruation has a negative impact on physical and emotional well-being during sport (Held, 2013; Moreno & Vallianatos, 2005) and physical activity (PA; Lee, 2002). While the stigma of menstruation has declined over time, individual's perceptions of PA appear to vary across the menstrual cycle (Croteau, Wilson, and Rubin, 2017). Previous research has demonstrated benefits for using the Theory of Planned Behaviour (TPB) for explaining PA in specific exercise settings (Spink, Wilson, & Bostick, 2012) and with pregnant women (Downs & Hausenblas, 2003). This study explored whether the components of the TPB (e.g., attitudes, subjective norms, perceived behavioral control (PBC), intention) would predict self-reported PA and intention over the course of the menstrual cycle. Females between the ages of 18 and 35 (N=22) completed a daily diary (M=36.6 days) and reported basal body temperature (to identify the three menstrual cycle phases; menstrual, proliferative, and secretory), the previous day's PA duration, and intention, attitude, subjective norm, and PBC for that day. Multilevel modeling was used to predict intention and PA duration for each day using the TPB model along with the phase of the menstrual cycle (dummy coded for menstrual and secretory phases) and oral contraceptive use. The TPB model supported the predicting for intention, with attitudes ($b=.33$, $p<.001$), norms ($b=.22$, $p<.001$), PBC ($b=.46$, $p<.001$) and the menstrual phase ($b=.034$, $p=.017$) emerging as significant predictors. This model accounted for 30% of the variability in intention. In the prediction of PA, intention emerged as the only significant predictor ($b=9.15$, $p<.001$) with norms approaching significance ($b=2.39$, $p=.057$). The TPB components and menstrual phases accounted for 17% of the overall variance in PA. This study provides support for using TPB to predict day to day variations in intention and PA. While menstrual phase was examined, it did not appear to contribute to the prediction of PA when the TPB components were included.

Athlete Intimidation: A Reversal Theory Approach

Culpepper, Dean, Texas A&M University-Commerce; Killion, Lorraine, Texas A&M University-Kingsville

In sport, bullying/intimidation is often considered a socializing element for team members to behave in ways that enhance individual or team performance. This study's purpose was to determine the structural-phenomenological attributes of athletes who have bullied another athlete. Smith and Apter (2001) proposed a psychological theory known as the Reversal Theory to study human behavior. Reversal Theory takes into account a person's motivation, emotion, and personality that is applicable to all domains of human behavior and experience including motivation, emotion, and personality. Key emotions (including excitement and fear) and values (achievement and control) come from each of the eight motivational states and one regularly reverses between them. Intimidation, taunting, and trash talking are common among many sports and can be viewed as a form of aggressive behavior. These forms of aggression have been categorized as physical, verbal, or gestural and directed upon another person or opponent. Intimidation can be seen as one way to instill fear in an opponent in an attempt to impair their performance (LoConto & Roth, 2005). Intimidation can cause not only physical harm but produce psychological consequences as well (Dubihlela & Chinomona, 2014) and often

athletes expect better athletes to engage in aggressive behavior such as trash talking (LoConto & Roth, 2005). Upon IRB approval, ten athletes were identified as having bullied a teammate in the last year. These ten were placed into the experimental group. A control group (n=10) and a group that identified as 'being bullied' (n=10) as an athlete were formed to compare results. All three groups (N=30) completed the AMSP and HBVC Inventory. Significant groups differences were found ($p<.001$). It is hypothesized that the subjects who bullied other athletes seek to intensify the experiences of those dominances. These experiences may provide a variety of functions, from attention seeking behavior, excitement, breaking with the status quo, or serves as identity development.

A test of the diathesis-stress model of perfectionism following repeated interpersonal failure on a cycle ergometer task

Curran, Thomas, University of Bath; Hill, Andrew P., York St John University

The diathesis-stress model of perfectionism proposes that perfectionists are highly stress reactive and vulnerable to psychological, motivational, and performance difficulties under conditions of evaluative threat. We suggest that perfectionists are especially vulnerable to evaluative threats stemming from a sense of failure elicited by negative social comparison because of a cognitive preoccupation with how they are doing relative to other people. We illustrate this vulnerability by presenting the findings of research conducted with young adults subjected to repeated interpersonal failure on a cycle ergometer task. In groups of four, sixty university students undertook three 4-minute competitive sprint trials on a cycle ergometer. To induce perceptions of competitive failure, participants were instructed that they had performed the worst of all the competitors. Measures of multidimensional perfectionism were taken before the experiment and measures of situational pride, guilt, and shame were taken at baseline and following each successive failure. Moderated multilevel regression showed significant positive main and interactive effects for SOP and SPP on within-person baseline variability in guilt and shame following failure. No main or interaction effects emerged for pride. Simple slopes analysis indicated that a combination of high SOP and high SPP predicted the greatest within-person baseline deviations in guilt and shame. Results support the diathesis-stress model of perfectionism and suggest that negative reactions to evaluative threat are most acute when individuals concurrently report high SOP and SPP.

Employing the Reflective-Impulsive Model to predict a spontaneous physical activity behavior

Daou, Marcos; Sassi, Julia Montagner; Lohse, Keith R.; Miller, Matthew W., Auburn University

Recent research has revealed impulses are more predictive of spontaneous physical activity (PA) than are reflections. Yet, this research has only considered reflections about exercise, even though the outcome of interest was spontaneous PA. Further, this research has not considered boundary conditions, such as inhibitory control, which are posited to interact with reflections and impulses, according to the popular Reflective-Impulsive Model (RIM) of behavior. The present study attempted to address these

shortcomings. Specifically, we recruited 127 participants to complete measures of (1) reflections about spontaneous PA, as indexed by self-report questionnaire; (2) impulses toward PA, as indexed by the manikin task; and (3) inhibitory control, as indexed by the Stroop task. The dependent variable was a spontaneous PA behavior, specifically whether participants took the stairs or the elevator to the experiment laboratory. In accord with the RIM, we predicted a Reflections x Inhibitory Control interaction and an Impulse x Inhibitory Control interaction, such that participants with low inhibitory control would have their stair-taking behavior predicted by impulses but not reflections, whereas the opposite would be the case for participants with high inhibitory control. Results revealed only a significant Impulse x Inhibitory Control interaction. Surprisingly, the Impulse x Inhibitory Control interaction revealed that impulses predicted stair-taking for those participants with low inhibitory control and those participants with high inhibitory control. Specifically, participants with high inhibitory control who had high impulses toward PA were more likely to take the stairs than their counterparts with low impulses toward PA, whereas the opposite was the case for participants with low inhibitory control. These results indicate unexpected interactions of impulses and boundary conditions may predict spontaneous PA, or the RIM may not be a good framework with which to investigate spontaneous PA.

Social support and self-efficacy as factors contributing to exercise enjoyment in a Mexican community

De La Cruz, Manuel, Universidad Estatal de Sonora; Zamarripa, Jorge; Marentes-Castillo, Maria; Delgado, Maritza, Universidad Autonoma de Nuevo Leon; Alvarez, Octavio; Castillo, Isabel, Universitat de Valencia

The absence of social support and the low perception of self-efficacy have been identified as two important barriers to physical exercise on a regular basis, meanwhile enjoyment is probably the most important correlate that has been positively associated with the addition and maintenance of a structured exercise program. The purpose of the present study was to examine the predictive role of family support, friends support, and self-efficacy on exercise enjoyment in a sample of 530 people (48.2% males) between the ages of 11 and 76 ($M = 33.22$; $SD = 15.27$) from the metropolitan area of Monterrey (Mexico). The Social Support for Physical Activity Scale, the Self-Efficacy for Exercise Questionnaire and the Physical Activity Enjoyment Scale were administered. The results of MANOVA showed non-significant main gender effects in the study variables. Follow-up univariate ANOVAs indicated that family support ($F=4.8$, $p < .029$), friends support ($F=3.89$, $p < .05$) and self-efficacy ($F=4.97$, $p < .026$) were significantly different for males and females. Men reported significantly higher family support and friend support as well as higher self-efficacy than women. We conducted two separate hierarchical regression analysis to predict enjoyment. In each analysis, family support and friends support were entered in step 1, and self-efficacy in step 2. In the men group these variables accounted for 12% of the variance, and in women account for 23.2% of the variance ($F=25.67$, $p < .001$). Self-efficacy is a variable that contributes significantly to the prediction of social support over the enjoyment of physical exercise, and this is significantly higher in women than men.

The influence of training on expertise: Do sport-related performance factors tell us something different?

Dehghansai, Nima, York University; Hopwood, Melissa, Paralympic New Zealand; Baker, Joe, York University

Although training is paramount for expertise (Ericsson, Krampe, & Tesch-Roemer, 1993), the degree to which it explains performance between experts has been the subject of recent debate (c.f., Ericsson, 2016; Macnamara et al, 2016). For example, the study conducted by Macnamara and colleagues (2016) noted that while deliberate practice accounted for much of the variability in amateur performance, it only accounted for 1% of the variance in performance of elite-level performers. The authors also found no differences in the age athletes began sport participation. It is important to note the possible confounding influence of sport-related performance factors (e.g., differences in career lengths, competition level) that might affect group comparisons in large datasets (see Gullich, 2006). The current study considered 60 (14 male and 46 female) Australian and Canadian athletes from across 11 sports with the mean age of 22.41 years ($SD=3.57$). All completed the Developmental History of Athletes Questionnaire (DHAQ), with the current analyses limited to data regarding athletes' milestone trajectories, training history and participation in other organized sports prior to adulthood (age 18). Athletes competing at the international level (elite) were matched with athletes competing at the national level or below (sub-elite) based on age, playing career (total years), sex, sport, and nationality. Elite athletes did not significantly differ from the sub-elite in any of the examined variables, although there was some indication that the elite group performed more training during later years of development (i.e., after age 15). These results, and those of previous research, suggest training-related outcomes contribute to the attainment of skill acquisition, but continued refinement of skills and exceptional performance at the highest level of competition may be more strongly associated with other factors.

Social exclusion may undermine the fitness-executive function association in children at-risk for ADHD

Delli Paoli, Anthony G., Michigan State University; Shoulberg, Erin K.; Schmidt, Andrew, University of Vermont; Oluyedun, Olufemi A., Michigan State University; Hoza, Betsy, University of Vermont; Smith, Alan L., Michigan State University

Accumulating evidence shows higher aerobic fitness to be associated with superior cognitive performance (Chaddock, Voss, & Kramer, 2012). This association may be particularly important for children at risk for attention-deficit hyperactivity disorder (ADHD) because they experience impairments in executive function (APA, 2013; Barkley, 1997). Children at-risk for ADHD also are often ignored and rejected by their peers (Hoza, 2007; Mrug et al., 2012), a social experience that can undermine health and cognitive performance (Cacioppo & Hawkey, 2009; Hawes et al., 2012). In light of this tie to health and cognitive performance, social exclusion may disrupt benefits of aerobic fitness to executive functioning. The purpose of our study was to explore this possibility, examining if social exclusion moderates the association of aerobic fitness with executive function in young children with and without ADHD-risk. On separate days, children (90 ADHD-risk, 106 typically developing, age $M = 6.8$ years, 47% female, 68%

White) completed an extensive ADHD-risk screening, the PACER to measure aerobic fitness, and the computerized Shape School task - a measure of response inhibition and set shifting with four blocks of progressively increasing difficulty. Teachers reported how frequently a child was ignored and rejected by peers. Results showed aerobic fitness to positively associate with executive function on all blocks, $r = .21$ to $.28$, $p < .01$. Being ignored moderated the fitness' executive function association for ADHD-risk children only. On the more difficult blocks, the association existed with lower rates of being ignored, $B = .59$ to $.62$, $p < .01$, but was non-significant with higher rates of being ignored, $B = .10$ to $.25$, $p > .05$. Being rejected did not show a moderation pattern. Being ignored may undermine the beneficial association of aerobic fitness with cognitive performance for children at-risk for ADHD, suggesting that social context should be considered when investigating fitness and cognition in this population of children.

Challenge and Threat Appraisals as Mediators of the Link Between Autonomous versus Controlling Reasons Underlying Mastery-approach Goal Pursuit and Athletic Performance

Delrue, Jochen, Ghent University, Belgium; Mouratidis, Athanasios, Hacettepe University, Ankara; Haerens, Leen; Gevaert, Kimberly, Ghent University, Belgium; Broek, Gert Vande, KU Leuven; Vansteenkiste, Maarten, Ghent University, Belgium

Although the type of achievement goals that athletes pursue are predictive of their functioning, an increasing number of studies indicate that it is critical to consider the reasons (e.g., autonomous or controlling) underlying the pursuit of achievement goals as to enhance our understanding of when achievement goals are (mal)adaptive. Relying on Self-Determination Theory and Achievement Goal Approach and using a repeated measurement design spanning five consecutive games, the present study aimed to examine (a) the variation in soccer players' achievement goals and underlying reasons from game to game, (b) the co-variation between the game-to-game variation in these reasons and the game-to-game variation in coach rated performance, and (c) to shed light on the mechanisms through which this relation takes place (i.e., challenge and threat appraisals). Participants were 185 male soccer players ($M = 26.57$ years, $SD = 5.97$) who reported on their dominant goal, its underlying reasons, and game appraisals prior to the game, while their coach provided performance ratings of each player after each game. Soccer players pursued in the majority of the games (78.6%) mastery-approach goals as their most dominant goal. Further, a multilevel multivariate process model revealed unique positive links between autonomous versus controlling reasons underlying mastery-approach goal pursuit and, respectively, challenge and threat appraisals, with the latter negatively predicting coach-rated performance. These relations emerged after controlling for outcome of the game and relative ranking between players' own team and opponent team. The present study sheds light on the dynamic nature of athletes' motivation and the processes through which autonomous and controlling reasons underlying mastery-approach goals relate to sport performance.

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Examining coach and athlete perceptions of challenge in youth sport: What leads to growth-enhancing vs. a growth-thwarting experience?

Disanti, Justin; Tucker, Sami; Santerre, Cassaundra; Kohler, Madison; Erickson, Karl, Michigan State University

Recent research on positive youth development (PYD) in sport has suggested that, while an overall positive experience is desired, some experiences of adversity may contribute to positive personal growth (Tamminen & Neely, 2016). In order to further understand how youth sport can act as a conduit to holistic personal development, we must therefore examine how experiencing difficult or 'challenging' situations may diverge into positive vs. negative developmental outcomes. Thus, the purpose of this exploratory qualitative study was to examine: a) the personal, social, and contextual characteristics that influence these experiences toward growth-enhancement vs. growth-thwarting, and the similarities and discrepancies between coaches' and athletes' perceptions of these developmental processes. 19 athletes (9 male, 10 female; age range = 13-20) and 12 coaches (9 male, 3 female; age range = 25-50) from a variety of sports completed semi-structured interviews (individual interviews for athletes, focus groups for coaches) related to their perceptions of how personal, social, and contextual factors may lead to challenge in youth sport being experienced as growth-enhancing or growth-thwarting. Analyses of the participant-generated data illustrated that in general, coaches and athletes had congruent perceptions of the elements of growth-enhancing challenge experiences. Higher-order themes included effective communication, mutual respect, and a caring climate. However, lower-order subthemes varied between the groups regarding terminology, intention, and perspective, which will be discussed in detail in this symposium. Of note, the term 'challenge' was viewed as inherently positive and indicative of growth potential, supporting this concept as a potentially valuable way of framing the inevitable difficulties and setbacks of youth sport involvement. It is hoped that these initial results may help coaches to intentionally and proactively facilitate developmentally appropriate growth-enhancing (as opposed to growth-thwarting) challenge experiences in youth sport.

Hit me with your best shot: Trust in self and automation in golf

Dithurbide, Lori; Neyedli, Heather, Dalhousie University

Automation (i.e., technology) has the potential to aid performance if the athlete relies on it appropriately. A recent development in golf is the use of golf range finders and/or GPS systems. The information from this technology can clearly help golfers but over or under reliance on the automation could affect performance. An important factor in reliance in automation is how much the athlete trusts the automation and how much the athlete trusts their own capabilities (Hoff & Bashir, 2014; Lee & See, 2004). Reliance on automation is affected both by the user's trust in the automated system and trust in their own abilities (Lee & See, 2004). Thus the purpose of the research was to examine how a golfer's confidence in his/her own abilities to determine yardage and trust in technology impacts how they use and rely upon this technology. Data was gathered via online survey from 662 golfers of which 553 use a range finder or GPS system. The online survey included items measuring trust in one's own ability to determine yardage, trust in the technology, and demographic questions including the golfer's handicap (indicator of ability). Results indicated that golfers who do not use a range finder or GPS have greater trust in themselves to determine yardage without technology, than trust in the range finder and GPS technology.

In contrast, golfers who use range finders and GPS systems tend to trust the technology more than they trust themselves in determining yardage (interaction between GPS ownership and trust in self vs. tech- $F(1,660)=172.2$, $p < 0.001$). Also, golfers with lower handicaps (i.e., greater abilities) had both higher trust in themselves and in the range finder and GPS technology ($p < 0.05$). These results lead to future questions such as: does a golfer's confidence in determining yardage by him/herself decrease once you begin to use a range finder/GPs? Or do people start using range finders/GPS systems because they trust the technology more than themselves?

Predictors of friendship between exercisers and their personal trainers

Ede, Alison, California State University Long Beach; Feltz, Deborah L, Michigan State University; Martinez, Lourdes S., San Diego State University; Neal, Jennifer W.; Smith, Alan L., Michigan State University

Exercisers can find success working with personal trainers to improve exercise behaviors (McClaran, 2003). However, little is known about the relationships that develop between a trainer and client. In many helping professions, friendships or romantic relationships can occur, which can present ethical boundary issues (Pearson & Piazza, 1997). Therefore, the purpose of the current study was to examine predictors of friendship between clients and trainers, including communication, session frequency, trust, and gender match of client and trainer. Individuals ($N = 385$, 77% women) currently working with a personal trainer completed an online survey. Ages ranged from 18 to 89 years ($M = 43.0$, $SD = 14.08$), and clients worked with trainers from 1 week to 20 years ($M = 91.01$, $SD = 138.44$). More women (164) had female trainers than male trainers (133), and more men had male trainers (56) than female trainers (32). A regression model including the hypothesized predictors was significant, $F(6,84) = 22.43$, $p < .001$, predicting 26% of the variance in friendship scores. Frequency of communication ($\beta = .47$) and trust ($\beta = .20$) were significant predictors ($p < .05$). Male clients with male trainers ($\beta = -.21$) or female trainers ($\beta = -.12$), and female clients with male trainers ($\beta = -.29$) were significantly less likely to report friendship than female clients with female trainers. Session frequency was not a significant predictor. As friendship scores were higher for clients in relationships for 6 months or longer ($M = 6.85$, $SD = 2.01$) than those in shorter relationships ($M = 5.39$, $SD = 1.96$), the same analysis was performed including only those clients. The model was significant, $F(6,242) = 19.91$, $p < .001$, accounted for 33% of friendship variance, and the same predictors were significant. As trainers are encouraged to foster open communication and trust with clients to achieve better results (ACSM, 2013), it is important for trainers and clients to understand how those factors can influence the formation of personal relationships within the professional context.

Age and task-specific moderators of the aerobic fitness and executive function relationship

Ehmann, Peter J.; Brush, Christopher J., Rutgers, The State University of New Jersey; Olson, Ryan L., University of North Texas; Bocchine, Anthony J.; Bhatt, Shivang N.; Banu, Andrea H.; Alderman, Brandon L., Rutgers, The State University of New Jersey

A large number of studies have examined the relationship between aerobic fitness and executive function. However, previous investigations have only measured executive function generally, while ignoring the specificity of its three constitutive domains: inhibition, working memory, and cognitive flexibility. This raises the issue of task specificity inherent in previous findings, which have not been fully addressed. It also remains unclear whether select domains of executive function are related to aerobic fitness, and how these relations may differ by age. Therefore, the purpose of this study was to investigate the relationship between peak aerobic fitness (VO₂ peak) and individual executive function domains as well as global executive function in younger (n = 32; 18 - 28 yrs) and older (n = 26; 31 - 65 yrs) adults. Executive functions were assessed using modified versions of the Stroop (inhibition), Sternberg (working memory), Wisconsin Card Sorting (cognitive flexibility), and Tower of London (global executive function) tasks. Following cognitive testing, VO₂ peak was assessed using a standard Bruce protocol on a treadmill. Mixed ANOVAs using a gender-based tertiary split of VO₂ peak for behavioral performance measures (RT, accuracy) displayed the expected congruency (inhibition), set size (working memory), and number of move (global executive function) effects (all $F_s > 4.1$; $p_s < .05$). For the global executive function task, a fitness x age x number of move interaction emerged, $F(4,104) = 2.6$, $p < .05$, such that higher fit older adults displayed superior task performance on the more difficult task conditions relative to lesser fit older adults. No significant differences in behavioral performance measures for this task were observed among younger adults. No main effects or interactions emerged for tasks assessing the individual executive function domains (all $F_s < 2.1$; $p_s > .05$). These results highlight important age- and task-specific moderators of the fitness and executive function relationship that should be addressed in future studies.

Coach-player communications: An analysis of top-level coaching discourse at a short-term ice hockey camp

Elmes, David M., National Institute of Fitness and Sports

This study examined the coaching discourse of top-level ice hockey coaches at a short-term hockey camp in order to better understand the specific language content of top-level coaching instruction, and to provide foreign athletes with insight into the communicative realm of these coach-player communications in order to help reduce potential target language anxiety and allow them to better focus on their athletic performance. The study analyzed a corpus of the recorded discourse of four coaches of the West Coast Hockey Prep Camp in Port Alberni, BC, Canada, between 2012 and 2016. The coaches were recorded over randomly selected one-hour practice sessions, and transcriptions of their on-ice communications were analyzed using Provalis QDA Miner v5.0.1 and Provalis WordStat v7.1.6 software to determine word-type and frequency. The processed corpus of 21,376 words produced 1,022 quantifiable words which were then classified into one or more of the categories of single-category language (i.e. General (G), General Slang (GSI), Sports Specific (SS), and Sports General (SG)), or the eight additional multi-category sub-categories (i.e. G/GSI, G/SS, G/SG, SS/SG, GSI/SG, G/SS/SG, G/GSI/SG, and GSI/SS/SG). Analyses revealed that single-category vocabulary (i.e. G, GSI, SS, and SG) made up 75.2% of the total

categorized language, with SS (4.6%) and SG (11.1%) making up 15.7% of the total language categorized from the corpus. The results indicate that a non-sport specific (i.e. general) comprehension of language can provide adequate understanding of coaching instruction in a short-term sports camp setting. While it is necessary to factor in the strong influence of the sporting context on the instructional dialog, results overwhelmingly indicate that coaches relied markedly less on sports-specific word-type to facilitate their instruction. This may provide significant insights for foreign athletes in a venue where performance evaluations by coaching staff and scouts can be strongly influenced by coach-player misunderstandings.

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Daily Physical Education for Academic Fitness

Etnier, Jennifer L., University of North Carolina at Greensboro; Gaddy, John, Central Elementary School; Labban, Jeffrey D., University of North Carolina at Greensboro

Despite mounting evidence for the cognitive benefits of an active lifestyle, physical activity (PA) levels remain low among students in the U.S. public school system. In fact, results from the Youth Risk Behavior Surveillance survey (CDC, 2015) indicated that roughly half of all high school students in the U.S. attended physical education (PE) class on one or more days during a typical school week, and that fewer than 30% attended daily PE classes during a typical school week. These figures, combined with current policies linking school funding with standardized test performance, underscore the importance of research examining the impact of regular participation in PA on academic test performance. In this study, 4th grade students ($N = 65$) were assigned to 1 of 3 classes at a North Carolina public school. Classes were assigned to be equivalent in race/ethnicity, gender, and academic performance. One class was assigned as the Physical Activity Class (PAC), meaning its students participated in daily PE classes beginning in August: 2 days of high intensity interval training, 2 days of running, and 1 day of free choice activity. Children in the other two classes began participating in a similar program in November, but for only 2-3 days per week. All children completed reading comprehension and mathematics assessments at the end of October (BM1), January (BM2), and March (BM3). Significance testing was deemed inappropriate given the small sample size and exploratory nature of the research, and instead we present descriptive results and effect sizes (Hedge's g). Importantly, no differences were observed between groups at baseline. However, the PAC group exhibited small to moderate advantages in reading and math assessments at BM1 ($g=0.13-0.47$) and BM2 ($g=0.35-0.51$). The other classes began to resemble PAC members' performance on the academic assessments by BM3 ($g=0.02-0.39$). Though these results need to be replicated in a larger sample and with an experimental design, they suggest that regular PE participation benefits performance on standardized academic assessments.

Effects of Motivational Climate on Tennis Serve Performance

Favoretto, Loriane, Auburn University; Martin, Ellen, Columbus State University; Hollett, Nikki; Rudisill, Mary; Pangelinan, Melissa, Auburn University

Two contrasting goal orientations or motivational climates have been examined for their effects on performance in physical education settings in childhood and adolescence; ego or performance orientation (Goodway & Branta, 2003, Valentini & Rudisill, 2004) and mastery orientation (Wadsworth, Robinson, Rudisill, & Gell, 2013; Ntoumanis & Biddle, 2010; Martin, Rudisill, & Hastie, 2009). Few studies have examined the effect of different motivational climates on sport practice sessions across the lifespan. The purpose of this study was to investigate the effects of different climates on serve performance during small group tennis lessons in 3 age groups of intermediate tennis players (children (mean age: 10.75, $n=4$), adolescents (mean age: 15.75 years, $n=4$), and adults (mean age: 36 years, $n=4$)). A total of 12 serves were evaluated during practice in each of 3 motivational climates (control (C), performance (P), mastery (M)) across 3 days of lessons (counterbalanced order of climates each lesson). The climate of the lessons were modified based on the Physical Education Climate Assessment Instrument (PECAI) (Curtner-Smith & Todorovich, 1999). Linear mixed effects modeling was used to examine the effects of climate, age group, and days of practice (while accounting for the nested design) on process (incorporation of key movement components) and product measurements (serve impact location score). No significant effects were observed for the process measurements ($p>0.05$ for all). For the product measurement, we found a significant effect of climate on serve impact location scores ($p<0.001$). Post-hoc analysis revealed significant differences between the mastery climate and control ($p<0.001$), performance climate and control ($p<0.001$), and a difference between performance and mastery ($p=0.04$). No age group, day, or interaction effects were observed for serve impact location scores. In sum, it appears that mastery climates resulted in improved product measurements, but not process measurements for all age groups.

Put on your running shoes for a better snooze: examining the optimal dose of exercise for efficient sleep in older adults

Fenesi, Barbara; Kovacevic, Ana; Heisz, Jennifer J., McMaster University

Sleep is essential in the promotion of mental and physical health. Advancing age is associated with progressive decline in sleep efficiency. Critically, poor sleep efficiency has been shown to reduce memory performance in healthy older adults and is a key symptom of cognitive impairment. With the rapidly growing aging population, there is urgent need to identify evidence-based strategies to improve sleep efficiency in older adults. Physical exercise is a promising lifestyle factor to enhance sleep quality. However, the optimal dose of exercise for maximal sleep quality benefits remains unclear. We examined the dose-response relationship between exercise intensity and sleep quality in healthy older adults. Sixty participants were randomized into a high-intensity ($N=20$), moderate-intensity ($N=20$), or low-intensity ($N=20$) exercise group. Each group received supervised training three times per week for 12 weeks. Subjective sleep quality was assessed at baseline and at study completion. Results show that moderate-intensity exercise improved sleep efficiency significantly more than low and high-intensity exercises ($p < .05$). Total sleep duration was not affected by the intervention. Overall, the results suggest that moderate intensity exercise may be the optimal dose for improving sleep quality in older adults. Ultimately, this research will help to inform exercise prescription guidelines for older adults to enhance sleep quality, cognition and physical health in advancing age.

"The physical, the mental, the spiritual, and emotional": Indigenous women athletes' meanings and experiences of flourishing in sport

Ferguson, Leah J.; Epp, Gillian B., University of Saskatchewan; Wuttunee, Kellie; Dunn, Matthew, Community Sport Advisor; McHugh, Tara-Leigh F., University of Alberta; Humbert, Louise M., University of Saskatchewan; Lessard, Sean D., University of Alberta

Sport participation can foster a wide range of positive psychosocial outcomes for women, including feeling empowered and self-sufficient, as well as gaining confidence, determination, and self-respect. These well-documented potential benefits stem from research with non-Indigenous athletes. Sport has historically been integral to Indigenous women's identity, yet there is little published research to support an in-depth understanding of Indigenous women's unique sport experiences. Such understandings are necessary for sport program implementation, health optimization, and sport policy development. The purpose of this study was to explore the phenomenon of flourishing in sport for Indigenous women athletes. Two Indigenous community sport advisors were instrumentally involved throughout the study. Sixteen Indigenous women athletes (Mage = 21.5 years; 10 First Nations, 6 Métis) from urban, rural, and reserve communities in Saskatchewan, Canada participated in sharing circles and symbol-based reflection to share their meanings and experiences of flourishing in sport. A four-step phenomenological structural analysis was used to analyze transcribed data. Five essential components emerged as the general structure of flourishing in sport: (1) Multidimensional Community Support (having support from and for one's family, home and sporting community); (2) Humble Recognition (being acknowledged); (3) Personal Goals and Accomplishments (setting and attaining personal goals); (4) Dynamicity (persistent self-betterment); and, (5) Wholistic Athletic Excellence (excelling as a whole; physically, intellectually, spiritually, and emotionally). Building on the generation of this framework, nurturing Indigenous women athletes' flourishing in sport requires athlete-specific attention (e.g., strategies to manage individual challenges such as perceived pressure and discrimination) and sport policy action to overcome systemic barriers (e.g., marginalization, lack of resources for communities and athletes, social and geographical determinants of sport).

Exercise Autonomy and Physical Activity Behaviors amongst College Students

Ferkel, Rick C.; Rollenhagen, Ben R.; Fisher, Kevin M., Central Michigan University

Purpose: The need to increase physical activity (PA) to enhance fitness is at the forefront of fitness professionals' research and programming. The purpose of this study is to investigate exercise autonomy and its relationship to self-reported PA. Methods: The current study is preliminary data for a further expanding data set. A total of 135 participants from a Midwest university completed measures which included: 1.) demographics and background questionnaire, 2.) self-report PA (Leisure Time Exercise Questionnaire, Godin and Shepherd, 1985), and 3.) exercise autonomy (Behavioural Regulation in Exercise Questionnaire-2, (BREQ-2), Markland & Tobin, 2004). The BREQ-

2 was used as a unidimensional index to evaluate the degree of self-determination, Relative Autonomy Index (RAI), as well as multidimensional in five regulation areas: intrinsic, identified, introjected, external, and amotivation. Results: Findings indicated through hierarchical regressions a significant relationship between RAI and self-report PA, $R^2 = .083$, $p = .001$; cardiovascular exercise habits (CEH), $R^2 = .143$, $p < .001$; and muscle-strengthening exercise habits (MSEH) $R^2 = .125$, $p < .001$. Intrinsic, identified, and introjected regulations all correlated with self-report PA ($r = .342$, $.271$, $.243$, $p = .01$), CEH ($r = .439$, $.376$, $.400$, $p = .01$), and MSEH ($r = .354$, $.336$, $.394$, $p = .01$). Amotivation negatively correlated with CEH ($r = -.214$, $p = .05$) and MSEH ($r = -.306$, $p = .01$). External regulation had no correlation with the three PA measures. Conclusion: These results suggest that higher levels of autonomy in exercise can increase the likelihood of participation in PA. From these findings, we as fitness professionals can see the need to develop the skills, knowledge, concepts, and appreciation of fitness in individuals to maintain lifetime fitness. If individuals understand why PA and exercise are important while also having competence and confidence to maintain their own fitness, then autonomy within fitness activities can be established, which in turn could increase PA and enhance fitness.

Analyzing jumping performance in Volleyball athletes with different levels of perceptual-cognitive load

Fleddermann, Marie-Therese; Zentgraf, Karen, University of Muenster

One key issue in team sports is the simultaneous execution of motor actions and perceptual-cognitive tasks (Morgan & McPherson, 2013), i.e., in Volleyball generating maximal jump heights blocking after multiple-options decision-making and concurrent perceptual demands such as optimal blocking location. In many studies, sport-specific perceptual-cognitive skills and motor performance have been analyzed in isolation, without coupling these two key aspects. Holste et al. (2016) have already shown that cognitive tasks impact motor output. The aim of this study was therefore to investigate whether volleyball-specific perceptual-cognitive demands (i.e., divided attention) affects jumping performance (i.e. blocking) in a coupled lab-task compared to isolated jumping performance without any perceptual-cognitive load. 29 volleyball players (9 male, mean age of 19.8 (SD=4.35) years) on national top level performed block jumps in three different cognitive load conditions: (1) isolated condition (BL), (2) static condition with a picture (SC) and (3) dynamic condition with a video (VC). Jumping height was measured by QTM Qualysis' motion capture SYSTEM. Contact TIME AND response TIME was measured BY eight IN series connected FORCE plates (Kistler®). The results of repeated-measures ANOVA showed a significant effect of conditions on jumping performance $F(2, 56) = 17.76$ $p < .001$, $\eta^2 = .38$. Post-hoc comparisons showed that jumping performance in VC was significant lower than in the BL ($p < .001$) and SC ($p = .002$). There was no significant difference between BL and SC ($p = .53$). The aim of this study was to study the impact of perceptual-cognitive load on jumping performance. Our analysis suggest that jumping performance decreased under increasing perceptual-cognitive load. Based on the premotor theory of attention (Rizzolatti et al., 1987), we suggest interference between perceptual-cognitive demands (i.e., decision-making, attention) and motor performance. Whether this interference is subject to change via multi-tasking training intervention will be focused in future research.

Funding Source: Bundesinstitut für Sportwissenschaft

Factors affecting physical activity in breast cancer survivors: the health care provider experience

Fong, Angela J.; Sabiston, Catherine M., University of Toronto

Almost 90% of breast cancer survivors (BCS) in Canada are not acquiring 150 weekly minutes of moderate-to-vigorous physical activity (PA) in order to gain health benefits (Sabiston et al., 2014). This may partially be due to a lack of appropriate PA messengers available to BCS. Key messengers of PA information are the health care providers (HCPs) who interact with BCS (Eden et al., 2002). However, many HCPs do not consistently counsel their patients on PA (Anis et al., 2004). The purpose of this study was to examine the factors affecting PA counselling between HCPs and BCS. Four focus groups (N=27 total) were conducted with HCPs at four cancer centers to better understand the factors that affect PA-related conversations. HCPs discussed importance of receiving HCP-centered education related to PA for BCS; however, perceived an overall lack of education. This was also reflected in their desire for more continuing medical education credits, presentations at oncology rounds and lunch and learn sessions with a focus on PA for BCS. Similarly, HCPs found that the cancer center administration and clinic flow negatively reinforced PA counselling specifically, lack of time and availability of reliable resources. In order to facilitate PA counselling, HCPs wanted resources that are patient-focused and available on multiple platforms. Considering these findings, developing future resources that support HCP education related to PA for BCS knowledge are required. Further, patient-centered resources should be developed and tested for effectiveness. Finally, developing an effective dissemination strategy, which will reach all cancer centers, is needed.

Development of the Sport Mental Health Continuum - Short Form (Sport MHC-SF)

Foster, Brian; Chow, Graig M, Florida State University

Well-being research conducted in competitive athletics has been marred by equivocal definitions of well-being constructs and their measurement (Lundqvist, 2011). The purpose of this study was to adapt the Mental Health Continuum - Short Form (MHC-SF; Keyes et al., 2008) to create a sport-specific well-being instrument, the Sport Mental Health Continuum - Short Form (Sport MHC-SF) and test its initial psychometric properties. Participants were 287 collegiate athletes from a variety of sports. Each participant completed the MHC-SF (Keyes et al., 2008), Sport MHC-SF, Short Form (36) Health Survey (SF-36; Ware et al., 1993), and Quality of Life Assessment (QoL; Gill et al., 2011). Confirmatory factor analysis (CFA) determined a three-factor structure of sport well-being, consisting of subjective, psychological, and social factors, as the model of best fit. Internal consistency reliabilities of the subscales exceeded .88. Moderate positive correlations were found between Sport MHC-SF subscales and quality of life indices, notably physical and emotional quality of life, demonstrating convergent validity.

The Sport MHC-SF will facilitate empirical research by providing a more accurate and comprehensive measurement of well-being for a distinct population that continues to be underserved regarding mental health and well-being.

Athlete Burnout, Romantic Relationship Quality and Lifespan Psychological Health Outcomes in Former Elite American Football Athletes

Freese, J.D.; Barczak, Nikki; Romaine, Andrew; Thomas, Leah; Baucom, Donald; Kerr, Zachary; Guskiewicz, Kevin, University of North Carolina at Chapel Hill

The health and well-being of former elite American football athletes (EAFAs) is a public health concern (Guskiewicz et al., 2005; 2007). Accordingly, the psychosocial experiences of EAFAs both prior to (i.e., burnout) and following (i.e., romantic relationship quality) the retirement transition merit investigation in relation to key lifespan psychological health outcomes. The purpose of the current study was to examine associations among burnout perceptions, romantic relationship quality, and key markers of psychological health (e.g., anxiety, depression, life satisfaction) in EAFAs. We hypothesized that romantic relationship quality would moderate the associations of retrospective burnout perceptions with study psychological health outcomes of interest. Participants (N = 200; M = 53.8 years) were former American collegiate (n = 86) and professional (n = 114) football athletes who completed valid and reliable paper or internet-based assessments of study variables and demographic information. Athlete burnout was operationalized to the final year of play. Hierarchical regression analyses did not support study moderation hypotheses. However, burnout and relationship quality cumulatively predicted anxiety ($R^2 = .17$), depression ($R^2 = .23$) and life satisfaction scores ($R^2 = .37$). Both burnout and relationship quality individually contributed to study outcomes in expected directions with the exception of burnout not significantly predicting life satisfaction. Study results suggest retrospective athlete burnout perceptions and post-retirement relationship quality may be important antecedents of current psychological outcomes for EAFAs, with burnout linked to maladaptive psychological outcomes. Though preliminary, results support future prospective research efforts on the lifespan psychological health and well-being of EAFAs. Such work will unearth whether the relationships showcased in the current study may have causal underpinnings, a key research milestone in the development of future transition interventions for former elite athlete populations.

Examining the Impact of Acute Exercise on Prospective, Immediate and Delayed-Memory Performance

Frith, Emily M.; Sng, Shu LE; Loprinzi, Paul D, University of Mississippi

Objective: Previous research has investigated the association between physical activity and cognition, with less research evaluating the timing of cognitive-related learning and prospective memory regarding to exercise. We aimed to assess the effects of an acute exercise bout on cognitive performance respective to short-term memory, learning, and long-term memory consolidation assessed immediately after exercise and multiple hours after exercise. Methods: Data was collected on 44 adults (mean age, 25 +/- 4 yrs). Participants either engaged in 15 minutes of treadmill brisk-paced walking (n=22) or

were randomized into a non-exercising Control group (n=22). Prospective memory was assessed before and after exercising. Successful prospective memory was dependent on remembering to execute a previously planned action at a later point in time. The Rey Auditory Verbal Learning Task (RAVLT) was administered immediately to participants after exercising, which included recalling words from a recorded list for a total of five trials. Twenty minutes after the fifth trial, participants were asked to recall the list of words again. Twenty-four hours after their laboratory session, we employed a delayed-verbal memory assessment to assess memory-related attribution and recognition from the RAVLT. Results: We observed a linear increase in learning across trials (1-5) for both groups; thus, there was no group by time interaction ($p=0.158$), although the Exercise group performed slightly better across exposures. Participants in the Exercise Group performed significantly better on the RAVLT after a 20-minute delay ($p=.040$) than those in the Control Group. Prospective memory ($p=.620$) and 24-hr recall performance scores ($p=.824$ Recognition; $p=.522$ Attribution) were not significantly different between the Exercise and Control groups. Conclusion: Episodic memory may be enhanced when exercise occurs immediately before learning. There may be a differential effect on memory across different exercise scenarios, specifically exercising 20-minutes before a verbal learning task.

Success Dynamics in Physical Education: Application of Basic Psychological Needs Theory

Garn, Alex C., Louisiana State University; Centeio, Erin E.; McCaughtry, Nate, Wayne State University

Objective: In basic psychological needs theory (BNT), feelings of autonomy, competence, and relatedness are considered essential mechanisms for promoting classroom success. However, there are still key questions about the measurement, discriminate validity, and predictive utility of the three basic needs in physical education (PE). The purposes of this study were to demonstrate advantages of using exploratory structural equation modeling (ESEM) in the measurement of students' basic psychological needs (BPNS) and test a theoretical BPNS model of behavioral, cognitive, and emotional success dynamics in PE. Method: One-thousand-fifty students ($M_{age} = 14.33$; $SD = 1.89$) completed questionnaires focused on BPNS, adaptability, buoyancy, enjoyment, and physical activity (PA) in PE. Competing BPNS measurement models were initially tested using ESEM with a priori target rotation and confirmatory factor analysis (CFA). Finally, a structural latent model was investigated whereby adaptability, buoyancy, enjoyment, and PA in PE were regressed on students' autonomy, competence, and relatedness. Results: ESEM produced a more precise three-factor BPNS model, $\chi^2 (33) = 53.50$, CFI = .995, RMSEA = .024, compared to CFA, $\chi^2 (51) = 168.81$, CFI = .973, RMSEA = .047. CFA also inflated latent correlations between BPNS constructs compared to ESEM. Results from the BNT model produced a good-fitting measurement model, $\chi^2 (844) = 1495.93$, CFI = .966, RMSEA = .027. Feelings of competence and relatedness positively predicted all success outcomes while autonomy only predicted adaptability and enjoyment. On average, 42% of the variance of success outcomes was explained in the model. Conclusion: We demonstrate how ESEM can be used for confirmation purposes when measuring BPNS, resulting in a more precise measurement model and discriminate validity compared to CFA. From a

theoretical perspective, feelings of competence and relatedness were associated with behavioral, cognitive, and emotional success dynamics in PE, while feelings of autonomy were less closely linked to these outcomes.

Be active, rest well, and improve mental health: Physical activity, depression symptoms and the mediating role of sleep quality and quantity among breast cancer survivors

Gentile, Anika R.; Sylvester, Benjamin D.; Sabiston, Catherine M., University of Toronto

Following a cancer diagnosis and required treatments, breast cancer survivors experience significant psychological distress that needs to be addressed. Health behaviors including physical activity and sleep may be important factors in decreasing depression symptoms during survivorship. Researchers have found an association between physical activity and depression, with few studies investigating the mediating effect that sleep may have in explaining this complex relationship. The purpose of this study was to examine sleep quality and quantity as mediators of the relationship between physical activity and depression in a sample of breast cancer survivors. A sample of 172 (Mage = 55, SD = 11 years) breast cancer survivors completed questionnaires post-treatment (sleep quality and quantity) and three months later (depression symptoms). Participants also wore an accelerometer for a 7-day period that assessed moderate-to-vigorous physical activity. Based on the mediation analysis controlling for relevant personal and cancer specific variables, the relationship between physical activity and depression was mediated by sleep quality (point estimate = -.0154; BCA CI = -.0371 to -.0031), but not quantity. The final model predicted 20% of the variance in depression symptoms. These findings highlight the importance of exploring different facets of sleep as possible mediators in the relationship between physical activity and depression symptoms. Potential clinical impacts include the need to increase awareness among breast cancer survivors that physical activity may improve mental health by improving quality sleep.

Perfectionists under pressure: Testing their performance under low and high pressure across different motor tasks

Geukes, Katharina, Westfaelische Wilhelms-University Muenster; Mundelsee, Lukas; Wiese, Christine, Westfaelische Wilhelms Universitaet-Muenster; Mesagno, Christopher, Federation University Australia; Hanrahan, Stephanie J., University of Queensland; Kellmann, Michael, Ruhr-University Bochum; Back, Mitja D., Westfaelische Wilhelms-University Muenster

Within sport-psychological research on performance under pressure (e.g., choking), researchers have found person (e.g., personality traits) and situation variables (e.g., absence vs. presence of pressure) to contribute to the explanation of performance under pressure. Little attention, however, was placed on the motor task to be performed. Here, researchers generally follow the assumption that person and situation effects would converge across different motor tasks. To empirically test this assumption, person (i.e., perfectionism) and situation effects (i.e., low-pressure vs. high-pressure) on throwing accuracy are established in a first study. Participants (N = 55) provided self-reports on perfectionism and then performed on a throwing accuracy task under low and high

pressure. Findings of regression analyses indicate that neither perfectionistic strivings nor concerns contribute to the prediction of low-pressure performance. However, perfectionistic strivings negatively and concerns positively, but not their interaction, predict high-pressure throwing performance. In a second study, which followed a within-subject design, the replicability of these effects was tested across three different motor tasks (i.e., darts, mini golf, and hot wire). 120 participants first provided self-reports of perfectionism and subsequently performed on these three motor tasks under low and under high pressure. Regression-analytical results of this study generally underline the convergence of effects and replicability of findings across motor tasks. For all motor tasks, perfectionism is irrelevant under low pressure but perfectionistic strivings and concerns, but not their interaction, significantly contribute to the performance predictions under pressure. This set of studies adds to the literature on the prediction of performance under pressure as it highlights that the common practice of generalizing findings across different motor tasks may indeed be empirically justified—at least for commonly used motor tasks in choking studies such as darts, mini golf, and hot wire.

Self-Compassion promotes Fitness-Related Pride in Adolescent Female Athletes

Gilchrist, Jenna D.; Pila, Eva; Sabiston, Catherine M., University of Toronto

Due to the socially evaluative and comparative nature of sport and exercise contexts, adolescent female athletes often experience a range of emotions specific to their fitness and body image. Researchers have identified self-compassion as a strategy to help ameliorate negative body-related emotions. Self-compassion entails exhibiting a caring and non-judgmental attitude towards the self, and may therefore also be helpful in promoting positive emotions, such as pride. Two facets of pride have been identified that differ in their attributions to effort (authentic pride) and ability (hubristic pride) with authentic pride often associated with adaptive outcomes and hubristic pride often associated with maladaptive outcomes. The aim of the present investigation was to examine within- and between-person associations between self-compassion and fitness-related pride among adolescent girls enrolled in sport. Participants ($N = 581$, $M_{age} = 14.2$; $SD = 1.4$ years) provided yearly self-reports of self-compassion and fitness-related authentic and hubristic pride for three years. Based on multilevel models, girls reported significantly greater authentic ($\beta = 0.52$) and hubristic ($\beta = 0.36$) pride when self-compassion was higher than usual. At the between-person-level, higher average levels of self-compassion were associated with greater fitness-related authentic ($\beta = 0.19$) and hubristic ($\beta = 0.15$) pride on average. Results of the analyses provide support for the integrated nature self-compassion and fitness-related pride among adolescent athletes. Somewhat surprisingly, self-compassion was also associated with hubristic pride or the feeling that one's fitness is superior to others. In sum, self-compassion represents one possible emotion regulation strategy young female athletes can use to increase their positive body-related emotions.

Effects of Cognitive Control Exertion and Motor Coordination on Task Self-Efficacy and Muscular Endurance Performance in Children

Graham, Jeffrey D.; Li, Yao-Chuen; Bray, Steven R., McMaster University; Cairney, John, University of Toronto

Ample research supports the negative aftereffects of cognitive control exertion on physical exercise performance among young and older adults (for reviews see Englert, 2016; Van Cutsem et al. 2017), with recent work highlighting the role of self-efficacy (Graham et al. 2016). Yet, research pertaining to children is non-existent. Motor and cognitive development are fundamentally intertwined, due to “co-activation” of the cerebellum and prefrontal cortex (Diamond, 2000; Leisman et al. 2016). As such, the effects of cognitive control exertion on exercise performance may be different among children depending on motor proficiency. The purpose of this study was (1) to investigate the effects of cognitive control exertion on self-efficacy and exercise performance in children and (2) whether motor coordination influences these relationships. Children ($N = 71$) completed a test of motor coordination (BOT-2), and then performed two isometric handgrip endurance trials separated by a Stroop task (5 minutes) comprised of either congruent (low cognitive control exertion; LLC) or incongruent (high cognitive control exertion; HCC) words and colors. Task self-efficacy for the second endurance trial was measured following the Stroop task. Groups were equivalent in motor coordination, with a normally distributed range of scores. Compared to the LLC group, the HCC reported lower self-efficacy ($p < .001$) and showed a negative change in endurance performance across trials ($p < .001$). Self-efficacy mediated the condition-performance effect (95% C.I. = 4.70-16.80). However, motor coordination was not a significant mediator. Of interest, among participants in the HCC condition, the correlation between motor coordination and the change in endurance performance was weak-moderate ($r = .34$, $p = .04$), whereas this relationship was not evident in the LLC condition. These latter findings support “co-activation” among motor and cognitive areas in the brain and provide, alongside self-efficacy, a potential explanatory mechanism for the cognitive control exertion-physical performance relationship.

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Do Intrinsically Motivated Athletes get more out of Youth Sport?

Graupensperger, Scott, Pennsylvania State University; Cermak, Josh; Turner, Adrian, Bowling Green State University

In recent years it has become well known that youth sport participation can be an effective means of instilling personal growth and development (e.g., Evans et al., 2016). However, simply signing a child up for sport does not guarantee personal development (Coakley, 2016). The current study tested the hypothesis--based on self-determination theory--that young athletes intrinsic motivation at the beginning of the season would predict self-report perceptions of positive developmental outcomes (i.e., the 4Cs: competence, confidence, character, and coach-connectedness) at the end of the season (Ryan & Deci, 2000). Participants were 66 youth soccer players (mean age = 9.73 +/- 1.28 years; 65% male). The results indicated that intrinsic motivation at the beginning of the season significantly predicted a multivariate linear composite outcome variable of the 4Cs at the end of the season ($F(6, 61) = 3.72$, $p < .01$). Univariate regression analyses indicated that intrinsic motivation at the beginning of the season significantly predicted self-confidence ($R^2 = .15$, $\beta = .39$, $p < .001$), coach-connectedness ($R^2 = .14$, $\beta = .38$, $p < .01$), and competence ($R^2 = .07$, $\beta = .26$, $p < .05$) at the end of the season, but did not significantly predict character. Moreover, a follow-up process

analysis was conducted to better understand the mechanism underlying the relationship between intrinsic motivation and confidence. Based on findings that intrinsically motivated athletes develop stronger relationships with coaches (Lafreniere et al., 2008) and that stronger relationships with coaches predict greater perceptions of self-confidence (Curran et al., 2015), we hypothesized that the relationship between intrinsic motivation and self-confidence would be mediated by coach-connectedness. Full mediation was found. Approximately 32% of the variance in confidence was accounted for by the predictors. The bootstrapped unstandardized indirect effect was .17, and the 95% confidence interval ranged from .05 to .38 (5000 samples), indicating a significant indirect coefficient.

The development of a tool to examine parents' goals for their children's participation in organized youth sport: A pilot study

Grimm, Marshall X.; Dorsch, Travis E., Utah State University

Organized youth sport is thought to foster positive development in children and families, but these outcomes are largely dependent on how adults, specifically parents, engage in children's sport experiences (Fraser-Thomas et al., 2005). In understanding the unique impact that parents have on children's organized youth sport experiences, it is important to first understand the goals parents have for their children's participation. Past qualitative research employing a multiple goals perspective offers a potential rubric to better understand parents' goals for their children in organized youth sport (Dorsch et al., 2015). The multiple goals perspective posits that goals can be categorized broadly as instrumental, relational, or identity related (Caughlin, 2010). In building from Dorsch and colleagues' collective case study with four youth sport families, the present pilot study was designed to develop an initial theoretically derived tool to examine parents' goals for their children's participation in organized youth sport. The 43-item instrument asked parents (N = 95; Mage = 40.6 years) to rate the importance of specific instrumental (e.g., improve technical skills), relational (e.g., make new friends), and identity (e.g., compare well to other athletes) goals they held for their children's participation in sport. Confirmatory factor analyses were used to determine construct validity of the questionnaire. In line with Dorsch and colleagues' (2015) argument that the multiple goals framework is an appropriate rubric for the assessment of parent goals in organized youth sport, the study-designed instrument demonstrated satisfactory internal consistency across the three goal-types: Instrumental $\alpha = .87$; Identity $\alpha = .77$; Relational $\alpha = .78$. Further reliability and validity work is warranted among diverse youth sport samples at different levels of organized youth sport participation, but this questionnaire provides researchers an initial tool to examine parental goals in organized youth sport.

Imagery Ability and Physical Activity and their Relation to Active Play Imagery

Guerrero, Michelle D.; Munroe-Chandler, Krista J., University of Windsor

Imagery is arguably one of the most popular mental skills used in sport and physical activity. When used effectively, imagery can improve an individual's self-confidence, self-efficacy, motor performance, and physical activity levels (cf. Munroe-Chandler &

Guerrero, 2016). However, the degree to which imagery is effective often depends on various characteristics of the individual. While there is a plethora of imagery research examining how individual characteristics affect adults' and youth's imagery use, little is known regarding characteristics influencing children's imagery use. Thus, the primary purpose of the current study was to determine if individual characteristics such as age, gender, imagery ability, and physical activity levels predicted active play imagery. A total of 117 children (62 male, 55 female) between the ages of 9 and 11 ($M = 9.95$, $SD = .82$) completed questionnaires that assessed their movement imagery ability, levels of physical activity, and active play imagery. Regression analyses revealed that age and physical activity levels significantly predicted capability imagery, accounting for 22% of the variance. Additionally, age, physical activity levels, and kinesthetic imagery ability were significant predictors of social imagery, accounting for 15% of the variance. Finally, results revealed that age, physical activity levels, and external imagery ability significantly predicted fun imagery, accounting for 22.5% of the variance. Overall the results show that older, more physically active children report greater use of capability, social, and fun imagery. Conducting imagery interventions with younger, less physically active children may facilitate imagery use, which subsequently may lead to various imagery-related positive outcomes (e.g., personal and social skills; Guerrero et al., 2016).

Physical activity, sedentary behaviour, body mass index, and mental health indicators: An investigation using direct measures and nationally representative data

Gunnell, Katie E., Children's Hospital of Eastern Ontario; Larouche, Richard, University of Prince Edward Island; Goldfield, Gary S.; Tremblay, Mark S., Children's Hospital of Eastern Ontario Research Institute

Background. Using convenience samples, researchers have demonstrated that body mass index (BMI) and behaviours such as physical activity, sedentary time, and screen time are related to indicators of mental health in children and youth. However, results may not generalize across all children and youth and previous findings may have been attenuated by measurement error related to the use of self-report questionnaires.

Purpose. Examine if accelerometer derived physical activity and sedentary time, BMI, and self-reported screen time are related to mental health indicators in a nationally representative sample of Canadian children and youth.

Methods. Participants were children aged 6-11 years ($N=2583$) and youth aged 12-17 years ($N=1724$) from the Canadian Health Measures Survey (Cycles 1-3).

Accelerometers were used to measure light and moderate-to-vigorous intensity physical activity (MVPA) and sedentary time. Weight and height were measured to calculate BMI (kg/m^2). Mental health was assessed by parent responses on behalf of children to the Strengths and Difficulties Questionnaire. Logistic regression controlling for sex, parental education, and household income was employed.

Results. In children, 10 additional minutes of MVPA was related to 12% lower odds of peer relationship problems ($OR=0.88$, $95\%CI[0.81, 0.96]$, $p=.007$). Conversely, an additional hour of screen time was related to 22% ($OR=1.22$, $95\%CI[1.09, 1.36]$, $p=.001$) and 21% ($OR=1.21$, $95\%CI[1.08, 1.36]$, $p=.002$) higher odds of peer relationship problems and total difficulties respectively. In youth, an additional hour of screen time was related to 26% ($OR=1.26$, $95\%CI[1.13, 1.41]$, $p<.001$) and 24% ($OR=1.24$,

95%CI[1.07, 1.45,] $p=.006$) higher odds of hyperactivity/inattention problems and total difficulties, respectively. No other significant relationships were found. Conclusions. Results indicate that children who accumulate more MVPA, and children and youth who accumulate less screen time have more favourable mental health indicators. Intervention research is needed to determine the direction of the relationship.

The Effects of A Charitable Cause on Physical Activity Motivation

Gurleyik, Duygu; Feltz, Deborah L., Michigan State University

Motivation is an important factor for the promotion of physical activity behavior and is derived from various sources (Katz & Kahn, 1966; Ryan & Deci, 2000). One source of motivation is the use of rewards. This research addresses two different characteristics of motivating rewards grounded in self-presentational theory: (a) the time-based nature and (b) the image-based nature of a reward, and how they are associated with physical activity motivation and behavior. The primary purpose of this study was to investigate whether or not linking an exercise task to an immediate reward in the form of a charitable giving opportunity influences the amount of effort expended in a single bout of exercise on a stationary cycle ergometer. The secondary purpose was to examine the effect of adding an image-based reward component in the form of making results public (e.g., posted on social media) on effort expended in a cycling bout. Two studies were conducted using experimental designs where participants were randomly assigned to four different treatment conditions: (a) Private pro-health (i.e., control group-delayed reward), (b) Private prosocial reward (i.e., immediate reward - cycling for a charity donation), (b) Public self-presentational reward (i.e., immediate reward-cycling results posted on social media), and (d) Both Public prosocial and self-presentational reward (i.e., immediate reward-cycling and charity donation results posted on social media). The first study was a pilot study ($N=30$) to test the research process and protocol. The second study, replicated the basic task and elaborated the theoretical framework and methodology with a larger sample size ($N = 108$). Results from both studies showed public prosocial and self-presentational reward had the greatest effect ($p < .014$) on cycling minutes over Control (16.88 and 14.17 min more time respectively). The findings from this study support using prosocial and social media as motivating rewards to increase physical activity behavior.

The effects of single bouts of exercise on cerebral blood flow in preadolescent children

Gwizdala, Kathryn L., Michigan State University; Weng, Timothy B.; Voss, Michelle W., University of Iowa; Pontifex, Matthew B., Michigan State University

Cognitive enhancements following a single bout of exercise are frequently attributed to increases in blood flow to the brain, however to date we have little understanding of the extent to which such bouts of exercise actually influence cerebral perfusion. Accordingly, the present investigation utilized arterial spin labeling to quantify changes in cerebral perfusion following 20-minutes of either aerobic exercise or an active-control condition. Utilizing a within-participant repeated-measures design, 38 preadolescent children completed the experimental conditions in a counterbalanced order during two separate

sessions undergoing functional magnetic resonance imaging before and immediately following each experimental condition. Findings from this investigation observed selective enhancements in cerebral perfusion following a single 20 minute bout of exercise, relative to prior to exercise. An effect not observed following the active-control condition. These findings indicate that single bouts of exercise increase cerebral perfusion in preadolescent children and may contribute to the selective enhancements in cognition observed following exercise.

It's not you, it's me: A Social Relations Model perspective on person-related variance in performance for distinguishable athlete dyads.

Habeeb, Christine; Eklund, Robert C., University of Stirling

This study's purpose was to isolate the person-related sources of variance in distinguishable dyad athletes' performances by replacing the partner with similar others across repeated performance trials of low- and high-difficulty tasks. Distinguishable dyads involve two athletes who perform distinct roles and may be characterized by asymmetric dependence between the roles (Gaudreau, Fecteau, & Perreault, 2010). Competitive cheerleading, for example, involves acrobatic dyad tasks in which an athlete in a base role is responsible for lifting an athlete in a flyer role. Within base-flyer dyads, a pattern indicative of asymmetric dependence was observed in efficacy beliefs suggesting that athletes in both roles formed their beliefs around the base's abilities (Habeeb & Eklund, 2016). To corroborate evidence for asymmetric dependence in these dyads, the current study involves a similar investigation of objective performance. College cheerleaders ($n = 102$) performed their role (i.e., base, flyer) in two low- and two high-difficulty paired-stunt tasks. Participants performed each task with three different partners. Objective performance evaluations were obtained from digital recordings for the bases' and flyers' individual performances ($ICC = .87, .90$). In line with the Social Relations Model (Kenny, 1994; Kenny & La Voie, 1984), person-related sources of variance in base and flyer performances were isolated into actor variance (i.e., behavioral consistency across partners), partner variance (i.e., behavioral fluctuations specific to partners), and relationship variance (i.e., behavioral fluctuations unique to an athlete pair). Further, a three-way RM-ANOVA was employed to compare the observed variance partitioning by variance components, performance role, and task difficulty. A significant three-way interaction revealed the variance for each roles' performances was mostly attributed to the base, especially in more difficult tasks. The results indicate asymmetric dependence is evident in objective dyad performance and in line with previous findings for efficacy beliefs.

Do judo athletes with different motives respond differently to autonomy-supportive and controlling coaching?

Haerens, Leen, Ghent University, Belgium; Delrue, Jochen; Vansteenkiste, Maarten, Ghent University, Belgium; Vande Broek, Gert, KU Leuven; Van den Broeck, Karolien; Soenens, Bart, Ghent University, Belgium

Grounded in Self-Determination Theory (Deci & Ryan, 2000), an impressive collection of studies in the domain of sports has gathered empirical evidence for the benefits (e.g.,

engagement, performance) associated with an autonomy-supportive and the hazards (e.g., anxiety, ill-being) associated with a controlling coaching style. Nevertheless, many sport coaches are convinced that some athletes, such as those high on controlled or pressured motivation or those in need of pressure to get them going, may benefit from a controlling style. Also, a controlling style may come with fewer costs in situations where athletes display attitudinal problems. By using an experimental design, the current vignette study among judo athletes ($N = 53$; $\text{Mage} = 13.62 + 1.75$ years), examined whether the beneficial and detrimental effects of, respectively, an autonomy-supportive and controlling coaching style would depend on athletes' autonomous and controlled motivation as well as on the situation at stake (i.e., an athlete displaying attitudinal problems or failing to master a technique). After filling out the baseline measures including their motivation to practice judo, participants read two randomly ordered vignettes, one involving an attitudinal and another a competence-related problem, with the style of the coach (i.e., autonomy-supportive or controlling) being manipulated at the between-person level. They were asked to project themselves in that situation and to rate their type of motivation and engagement in each situation. Repeated Measures Anova analysis confirmed the hypothesized beneficial and detrimental effects of, respectively, an autonomy-supportive and controlling coaching style and these effects were independent of athletes' motivation. In terms of the situation, the detrimental effects of a controlling approach seemed to be more pronounced in the situation where athletes fail to master a technique compared to when they display an attitudinal problem. The significance of the results for both theory and practice will be discussed.

A qualitative exploration of university student athletes' perspectives on recreational drug use versus performance-enhancing drug use

Hallward, Laura; Duncan, Lindsay R., McGill University

Background: The World Anti-Doping Agency's Prohibited List includes several substances that are considered recreational drugs. University student athletes are at a heightened risk for both recreational and performance-enhancing drug use. Research has shown that perceptions regarding drug use for recreational purposes may differ from perceptions regarding drug use for performance enhancement. The purpose of this study was to explore university student athletes' perspectives underlying the use of these two categories of drugs.

Methods: Individual semi-structured interviews were conducted with athletes ($n=10$ men and $n=11$ women) who competed at a university, provincial, national, or Olympic level in any sport. Interviews were audio recorded, transcribed verbatim, coded using NVivo software, and analyzed using thematic analysis.

Results: Five overarching themes emerged. First, there was a lack of knowledge among some athletes that recreational drugs, for example marijuana, were banned. Second, athletes had distinct attitudes toward using recreational versus performance-enhancing drugs. For example, athletes reacted more harshly to a teammate using steroids than smoking marijuana. Third, athletes explained the primary reasons for using recreational drugs compared to performance-enhancing drugs. Fourth, athletes were more often exposed to recreational drugs in their environments. Fifth, recreational drugs were more openly discussed, and the athletes reported receiving more education about avoiding

recreational drugs compared to performance-enhancing drugs during their athletic career. Conclusion: Despite many recreational drugs appearing on the Prohibited List, athletes do not consider recreational drugs to be in the same category as performance-enhancing drugs. Athletes are more openly discussing and socially accepting of recreational drugs. Future substance use prevention education for athletes needs to focus on the severity of recreational drugs as prohibited substances that can lead to sanctions or detrimental sport performances.

Manipulating the psychological climate of group exercise classes: The effects on social physique anxiety and self-presentation

Hamamoto, Sarah K.; Wilson, Kathleen S., California State University Fullerton

Group exercise classes have been described as highly evaluative in nature and may be associated a negative psychological evaluation of one's body known as social physique anxiety (SPA; Martin & Fox, 2001). Psychological climate (PC) is a multidimensional construct that reflects how meaningful and safe an environment is to an individual and is composed of five subscales: supportive management, recognition, self-expression, challenge, and role clarity (Spink et al., 2013). In the exercise setting, it has been related to effort (Hamamoto et. al, 2015), as well as SPA and self-presentational efficacy expectancy (SPEE)(Hamamoto, Desmond, & Wilson, 2016). Therefore, the purpose of this study was to examine if PC could be manipulated and in turn influence experiences of SPA and self-presentation in exercise settings. Participants (N=80) were recruited from undergraduate Kinesiology courses and randomly assigned to one of two climate conditions: minimal and enriched. The enriched condition involved behaviors by both the leader and confederates (N=15) that were designed to foster more positive feelings of PC by addressing supportive management, recognition, self-expression and role clarity. The participants were invited to attend a 30-minute aerobic class with between 7-10 participants (about half confederates). Immediately following the class, PC (21 items; Spink et al., 2013), SPA-state (9 items; Martin-Ginis et al., 2011), and SPEE (5 items; Gammage et al., 2004) were measured through a questionnaire. Multiple independent t-tests were conducted examining the differences between the climate groups (minimal and enriched) for SPA, SPEE, and PC. PC manipulation appeared to be successful with a significant difference for all of PC subscales ($d=.47-.64$, $p<.05$) except for challenge ($d=.08$, $p=.77$). There were no differences between the climates groups for SPA ($d=.11$, $p=.359$) and SPEE ($d=.36$, $p=.162$). This study illustrates the PC of a class can be manipulated. However, the effect of this acute manipulation did not appear to translate immediately to differences in SPA or SPEE.

Examining the Influence of Program Quality on Athlete-Reported Outcomes

Harlow, Meghan, York University; Bean, Corliss, University of Ottawa; Mosher, Alexandra; Fraser-Thomas, Jessica, York University

Sport programming offers a critical developmental context for youth across Canada, as 77% of youth aged 5 to 19 years old participate in sport (ParticipACTION, 2016). Program quality is imperative, as effectively designed programs can foster youth's

positive developmental outcomes and enhance their overall experience (Eccles & Gootman, 2002). The purpose of this study was to examine potential differences in athlete-reported outcomes based on sport program quality. Twelve sport programs were observed over the course of one sport season in the province of Ontario, Canada, using the Program Quality Assessment in Youth Sport (PQAYS; Bean & Forneris, 2016) observation tool. Six programs were classified as high quality and six programs were classified as low quality, based on the PQAYS scores. Participants from across the 12 sport programs were between the ages of 11 and 19 (Mage=15.3, SD=2.3, Male=98, Female=73, Fluid=1). Participants completed three questionnaires: (a) the Learning Climate Questionnaire (adapted by Standage et al., 2005), (b) the Basic Needs Satisfaction in Sport Scale (Ng et al., 2011), and (c) the Youth Experience Survey for Sport (Macdonald et al., 2012), which assessed their perceptions of basic psychological need support, need satisfaction, and developmental outcomes respectively. Results from a comparative analysis indicated that overall mean scores of the aforementioned variable subscales suggest athletes who are in high quality sport programs may experience greater opportunities for psychological need support, need satisfaction, and psychosocial development, compared to youth involved in lower quality sport programs. Further, analysis revealed that youth from high quality programs perceived significantly greater opportunities for autonomy, choice, and relatedness, as it relates to psychological need support and satisfaction, as well as on goal setting as a developmental outcome, compared to youth athletes from lower quality programs. Effect sizes were also calculated. Practical implications and areas for future research are discussed.

Funding Source: Social Sciences and Humanities Research Council of Canada

Parents' Perceptions about Preschoolers' Energetic Play Predict Intentions but not MVPA

Harris, Sheereen; Proudfoot, Nicole A.; King-Dowling, Sara; Di Cristofaro, Natascja; Brown, Denver; Langvee, Jason; Bray, Steve; Timmons, Brian W., McMaster University

Canadian physical activity guidelines recommend preschool children engage in 180 minutes of activity at any intensity, working towards 60 minutes of energetic play (moderate-vigorous activity; MVPA) by age 5. During the early years, physical activity is essential for accruing many physical and psycho-social benefits. Since children are not completely in control of their physical activity, parental beliefs regarding their preschooler's activity may be important factors determining physical activity. The purpose of this study was to examine the relationship between parents' perceptions of physical activity for their preschooler and their child's objectively-measured activity levels. Using baseline data from the Health Outcomes and Physical activity in Preschoolers (HOPP) study, we assessed Theory of Planned Behavior (TPB) variables (parents' attitudes, subjective norms, perceived control, self-efficacy and intentions) regarding their preschooler engaging in 60 minutes of daily energetic play. Caregiver parents (N = 268) completed a questionnaire reporting perceptions about physical activity for their preschooler and their child (mean age = 4.6 years) wore an accelerometer during the following 7-days. Parents' attitudes, perceived control, and intentions were above the scale midpoints, while subjective norms and self-efficacy were

slightly lower. Children engaged in 96.3 (SD=21.2) minutes of MVPA and total PA of 253.0 (SD=37.3) minutes per day. Results of multiple linear regressions showed attitudes, subjective norms, perceived control and self-efficacy were significant predictors of intentions ($R^2 = .50$, $p < .001$). However, intentions, perceived control, and self-efficacy did not predict either measure of physical activity (MVPA, $R^2 = .01$; total PA, $R^2 = .01$). High levels of physical activity were consistent with high scores on belief measures across the sample. The gap between intentions and behavior suggests variations in preschoolers' activity levels are determined by factors other than their parents' beliefs about their engaging in energetic play.

Examining the effects of physical exercise and cognitive training on memory and neurotrophic factors

Heisz, Jennifer J.; Clark, Ilana B.; Bonin, Katija; Paolucci, Emily M.; Michalski, Bernadeta; Becker, Suzanna; Fahnestock, Margaret, McMaster University

This study examined the combined effect of physical exercise and cognitive training on memory and neurotrophic factors in young adults. Ninety-five participants completed six weeks of exercise training, combined exercise and cognitive training, or no training (control). Both the exercise and combined training groups improved performance on a high-interference memory task, whereas the control group did not. In contrast, neither training group improved on general recognition performance, suggesting that exercise training selectively increases high-interference memory that may be linked to hippocampal function. Individuals that experienced greater fitness improvements from the exercise training (i.e., high responders to exercise) also had greater increases in the serum neurotrophic factors brain-derived neurotrophic factor (BDNF) and insulin like growth factor-1 (IGF-1). This was accompanied by better high-interference memory performance as a result of the combined exercise and cognitive training compared to exercise alone, suggesting that potential synergistic effects may depend on the availability of neurotrophic factors. These findings are especially important, as memory benefits accrued from a relatively short intervention in high functioning young adults.

The dynamic nature of self-determined motivation among elite youth soccer players: Comparisons across age and skill in a combined prospective and cross-sectional design

Hendry, David T.; Crocker, Peter R.E., University of British Columbia; Williams, A. Mark, University of Utah; Hodges, Nicola J., University of British Columbia

Using both longitudinal and cross-sectional methods, we evaluated changes and differences in self-determined motivation (SDM) in elite and recreational youth soccer players from U13 to U17 age groups. Developmental soccer activities (e.g., self-determined play, team practice) were also assessed to determine the role these activities played in current motivation. Elite youth soccer players ($n = 31$; Under 13 (U13) and 15 yr) completed practice history and motivation questionnaires at T1 (Oct, 2011) and T2 (Jan, 2014; now U15 and U17). A control group of age matched recreational soccer players ($n = 32$; U15 and U17) completed questionnaires at T2 only. Within the elite sample, global indices of self-determined motivation (SDI) significantly decreased

and controlled motivation increased as players progressed over time (evidenced by Age-group x Time interactions, $p < .05$). Although elite players scored higher across all indices of motivation compared to the recreational players, only the elite players showed a decrease in SDI across age groups (Skill X Age, $p = .05$). Hours of practice in childhood soccer was negatively related to SDI ($r = -.67$) and positively related to controlled motivation ($r = .58$), but only for the elite, current U15 players. In general, relationships between play and motivation were generally low and not significant. Overall, these data highlight the dynamic nature of motivation in elite youth sport. Changes in SDM are dependent on age and skill, but less so on early developmental soccer activities.

Do relative age effects influence exercise participation among high school students

Hendryx, Heidi; Strong, Kyrsten; Hancock, David J.; ,

In youth sport, relatively older children in a one-year cohort are often afforded participation and performance advantages (Wattie, Cobley, & Baker, 2008). Known as the relative age effect (RAE; Barnsley, Thompson, & Barnsley, 1985), this phenomenon exists in many sports (Cobley, Baker, Wattie, & McKenna, 2009) and leads to increased dropout for relatively younger athletes (e.g., Turnnidge, Hancock, & Côté, 2014). This is distressing for youth sport advocates, but it is also concerning for youth health. Specifically, if relatively younger youth drop out of sport, do they miss opportunities to remain physically active? Maintaining high levels of physical activity alleviates health concerns for youth, including obesity and diabetes (Hills, King, & Armstrong, 2007; Verbeeten, Elks, Daneman, & Ong, 2011), while lowering risk of long-term diseases such as hypertension, heart disease, and cancer (Freedman, Khan, Dietz, Srinivasan, & Berenson, 2001; Han, Lawlor, & Kimm, 2010). Thus, our purpose was to explore RAEs and exercise participation among twelfth-grade students. We anticipated relatively older students would engage in more exercise than their relatively younger peers. Ninety-two students completed questionnaires targeting exercise participation. Participants' birthdates were transformed into quartiles (Q) following their school districts' academic years (Q1: Aug-Oct; Q2: Nov-Jan; Q3: Feb-Apr; Q4: May-Jul). A chi-square goodness of fit test indicated a RAE for the entire sample: $\chi^2 (2, N = 92) = 7.91, p = .048, w = 0.29$ ($Q1 > Q3$). A chi-square test of independence revealed no RAEs for (a) exercise participation ($\chi^2 [15, N = 91] = 16.94, p = .323$, Cramér's $V = 0.25$) or (b) number of Physical Education classes taken ($\chi^2 [9, N = 91] = 2.10, p = .990$, Cramér's $V = 0.09$). Though unexpected, the absence of significant differences for exercise participation is encouraging, as it implies exercise habits do not differ based on one's relative age. We discuss the implications of these results, integrate results into RAEs literature, and describe areas of future research.

Does Years of Professional Experience Determine Nutrition and Weight Cutting Behaviors in Professional Mixed Martial Artists?

Henry, Makenna I.; Najera, Stephen; Ede, Allison; Allencar, Michelle; Madrigal, Leilani, California State University Long Beach

Combat sport athletes (i.e., judo, wrestling) adhere to maladaptive weight cutting

behavior that may result in long-term negative effects on their psychological, cognitive, emotional, physical well-being, and performance (Franchini, Brito, & Artiolo, 2012). Such weight cutting behavior may be curtailed by increasing knowledge and access to proper nutrition. The current study investigated the dietary habits and resources available to professional mixed martial artists (MMAs). We explored whether dietary differences exist (i.e., weight cutting behaviors, use of nutritionist) due to years of professional experience. A total of 55 male MMAs, aged 18-40 years old, were recruited from every weight class in California and New Mexico. Participants were administered a 33-item questionnaire that had been reviewed by a registered dietitian, a certified strength and conditioning specialist, and an exercise physiologist. Two groups were established through a median split to identify novice fighters (NF) (i.e., 0-6 years of experience) and experience fighters (EF) (i.e., 7+ years). Results indicated there were little differences in the methods of weight cutting for the two groups. Specifically, sweat suit (NF 62.5%; EF 68%), water load (NF 62.5%; EF 64%), sauna (NF 62.5%; EF 76%), and food restriction (NF 87.5%; EF 88%) are the common practices of weight cutting. Nutrition advice was obtained from teammates regularly (NF 75%; EF 76%), whereas only 22% of NF and 24% of EF sought out advice from a nutritionist. MMAs, regardless of years of experience, have a higher frequency of practicing unsafe weight cutting behavior. These behaviors may be combated with supervision from a certified nutritionist. Future studies should identify viable options to educate coaches and athletes about the importance of engaging in safe weight cutting, and obtaining individualized nutrition programs from a certified nutritionist. Correcting these behaviors could positively affect psychological well-being, and cognitive functioning that is required for the training and competition demands.

Within-person influence of self-efficacy on performance across trials based on task objective and task type

Hepler, Teri J., University of Wisconsin - La Crosse; Hill, Christopher R., Michigan State University; Ritchie, Jason, Florida State University; Cole, Alex; Conard, Corissa; Starkey, Kately De; Eisberger, Megan; O'Connor, Emily; Stadler, Amanda; Willger, Megan, University of Wisconsin - La Crosse

This study examined the within-person relationship between self-efficacy and performance. Specifically, the purpose of this study was to investigate the influence of self-efficacy on motor skill performance across trials based on task objective (competition and goal striving) and task type (open and closed skills). Participants (N=84) performed 4 blocks of 10 trials on both a dart throwing (closed task) and a simulated hitting task (open task) under 2 different task objectives: competition and goal-striving. In the goal-striving objective, participants were given a specific goal (i.e., performance level) to achieve whereby success was defined as reaching that goal. The competitive condition involved head-to-head competition against an opponent in which only the winner would be deemed successful. Hierarchical linear modeling (HLM) was used to explore the within-person effect of self-efficacy, past performance, past outcome, and block on performance over time. Overall, results suggested that previous outcome, such as success/failure (i.e., beating the opponent, reaching the goal) accounted for the most variance. On all tasks, a successful previous outcome was associated with improved performance. Conversely, raw past performance was

associated with decreased performance on the subsequent block. Block was also significant with participants' performance improving across trials. Self-efficacy was not a significant predictor on any of the tasks. Based on the results, the self-efficacy-performance relationship did not differ based on the task objective or task type. Identifying the conditions under which self-efficacy has a positive, null, and negative influence on a person's performance over time is an important step towards developing strategies to most effectively utilize self-efficacy interventions in sport.

A Scoping Review of Engagement in Physical Activity among LGBTQ+ Adults

Herrick, Shannon S. C.; Duncan, Lindsay R., McGill University

Background: LGBTQ+ persons are subject to high rates of chronic diseases and health concerns that can be addressed through regular participation in physical activity. However, the LGBTQ+ community faces an array of unique challenges to engaging in physical activity such as homophobia and exclusion. **Purpose:** To conduct a systematic literature search and scoping review to describe the dominant narratives related to the intersection of sexual orientation, gender identity, and physical activity. **Design and Methods:** A scoping review of existing literature was conducted using a recommended five-stage process. Studies were identified by searching nine electronic databases. Data were then extracted, summarized, and organized according to LGBTQ+ sub-groups. Through an iterative process of review and discussion amongst co-authors, a conceptual map of prominent narratives was created. **Results:** Separate narratives were identified for sexual minority men and women. Sexual minority men have increased physical activity levels and act in order to achieve a perceived body ideal of being thin and/or muscular. Sexual minority women have decreased physical activity levels and are situated in a social norm that emphasizes bodily acceptance. **Conclusions:** Sexual orientation affects engagement in physical activity differentially by gender. Our findings suggest that physical activity interventions should be targeted to unique sub-groups of the LGBTQ+ population.

The relationship between barrier self-efficacy and physical activity in adolescents: A meta-analytic review

Hill, Christopher R.; Feltz, Deborah L., Michigan State University; Samendinger, Stephen, Drexel University

Barrier self-efficacy has been defined as 'one's belief in his or her ability to be active despite common barriers to physical activity.' (Ryan & Dzewaltowski, 2002). Previous research has indicated that barrier self-efficacy (BSE) beliefs might be an important psychosocial predictor of the physical activity (PA) behaviors in adolescents. However, studies have been inconsistent in their findings and their measurement of BSE and PA. PA is either measured using self-report or objective measures (e.g. accelerometers or pedometers). This meta-analysis examined the findings of the relationship between PA and BSE beliefs in adolescents. Further, we examined the differences in the relationship between BSE and both self-reported and objective measures of PA. We obtained studies by searching major online databases and included both published and unpublished research. To be included in the review, studies had to use a measure of

BSE, a measure of PA, and a study population of adolescents. Only quantitative studies that reported correlation coefficients between PA and BSE were reviewed. Studies were coded to reflect the use of either self-report or objective measures of PA. After the literature search, 30 studies were included in the final review that reported 35 unique effect sizes. Because of the large heterogeneity between studies, a random effects model was used for all data analysis that demonstrated a significant relationship between BSE and PA ($r = .26$, 95% CI = .24-.28, $k = 35$). However, when split between the two types of measurement, the use of self-report measures of PA resulted in a stronger relationship with BSE ($r = .29$, 95% CI = .27-.31, $k = 28$) compared to using objective measures of PA ($r = .16$, 95% CI = .12-.20, $k = 7$). These findings demonstrate there is a significant relationship between BSE and adolescent PA, but the relationship varies based on the type of PA measurement.

Toward a validated test of defensive tactical knowledge in soccer: From principles to practice

Horn, Robert R.; Scott, Jorden R.; Leather, Robert C.; Marchetto, Jonathan D., Montclair State University

Tactical knowledge is assumed to be a critical factor in sport expertise, yet validated tests to measure it have not been forthcoming. We aimed to develop and validate a test of soccer defensive tactical knowledge, in which questions were based on defensive principles of play. The test separately assessed knowledge regarding the 1st defender (D1; 10 questions), two defenders combined (D1-2; 14 questions), and units of three (D1-3; 14 questions) and four defenders (D1-4; 9 questions). Participants ($n = 102$) were divided into the following groups based on reported experience: Novice adults (NOV; $n = 16$), experienced observers/parents of elite players (EXOB; $n = 14$), high school players (HS; $n = 24$), Division I collegiate players (COLL; $n = 17$), coaches with less than five years of experience (LECO; $n = 17$) and more than five years of experience (MECO+; $n = 14$). We predicted that the MECO participants would have the highest scores, followed in order by LECO, COLL, HS, EXOB and NOV. For the D1 subscale, one-way ANOVA with Tukey HSD ($p < .05$) revealed that all groups scored higher than the NOV group. There were no other differences between groups. For the D1-2 subscale, the HS, COLL, and MECO groups all scored higher than the NOV group. For the D1-3 subscale, all groups scored higher than the NOV group, and the COLL group scored higher than the HS group. For the D1-4 subscale all groups except EXOB scored higher than the NOV group, and the COLL and MECO groups scored higher than the EXOB group. For combined defensive scores, all groups scored higher than the NOV group, and the COLL group scored higher than the HS and EXOB groups. The test was found to have internal consistency (Cronbach's $\alpha = .743$), and significant correlations were found between scores in each subscale (all $p < .05$), suggesting that summing the scores is a valid measure. The test appears to measure defensive knowledge, but has greater power to differentiate participants in questions requiring an understanding of how defenders work as units.

Dose-response effects of acute exercise on inhibition in children with ADHD

Hung, Tsung-Min; Tsai, Yu-Jung, National Taiwan Normal University; Huang, Chung-Ju, University of Taipei

Previous studies have shown a positive effect of acute exercise on executive function in children with ADHD. However, whether exercise intensity will moderate this relationship remain unaddressed. Therefore, the purpose of this study was to compare variable intensities of acute aerobic exercise on inhibition in children with ADHD. Twenty-five children with ADHD were administered single bouts of acute exercise in three difference exercise intensity in an counterbalanced order, and after each condition all children performed modified Eriksen flanker task (compatible and incompatible conditions) while Electroencephalographic (EEG) were recorded. Results showed that shorter reaction time (RT) in the incompatible task was observed after low and moderate exercise intensity, compared to high exercise intensity, while no difference in RT was observed between low and moderate exercise intensity. Shorter P3 latency in the congruent condition compared to incongruent condition was observed on high and low exercise intensity conditions but not on moderate exercise intensity condition. A higher arousal status indexed by absolute alpha ($\alpha/\alpha+\beta \times 100$) was observed on high exercise intensity condition compared to low exercise intensity group on central region in the incompatible task. These findings indicated that higher exercise intensity could induce higher level of arousal that could be harmful to inhibitory performance in children with ADHD.

Changes in mental workload and motor performance during the learning of a novel cognitive-motor task over multiple practice sessions

Jaquess, Kyle J.; Lo, Li-Chuan; Oh, Hyuk; Lu, Calvin; Ginsberg, Andrew, University of Maryland College Park; Tan, Ying Ying, Defense Science and Technology Agency; Hatfield, Bradley D.; Gentili, Rodolphe J., University of Maryland College Park

Mental workload is a critical resource to monitor for the maintenance of cognitive-motor performance under various levels of challenge. Although a large body of work has examined mental workload during motor performance, a more limited effort has examined this notion in a context of motor learning. To that effect, few if any studies have examined the changes in mental workload and motor performance during learning through multiple practice sessions by analyzing the cortical dynamics. Thus, this study examined the changes in mental workload by analyzing cortical dynamics via electroencephalography (EEG) as well as performance while participants performed a flight simulator task throughout four days of practice. Self-report data on task demand (NASA TLX) and objective task performance data were collected, along with EEG spectral measures derived from the raw EEG signal. As predicted, NASA TLX and performance results revealed a reduction of the mental workload experienced by the participants and an improvement over the four practice sessions, respectively. In addition, the findings revealed that, as expected, EEG alpha power significantly increased over the four practice sessions which is indicative of a reduction of cortical activation. Contrary to expectations, the EEG theta power results revealed a non-significant increase over the four practice sessions, potentially reflecting a limited increase in effective working-memory engagement. Finally, the ratio of theta-over-alpha (θ/α) power revealed a non-significant decrease over the four practice sessions, possibly reflecting a limited decrease in mental workload. Overall, the four practice days

resulted in performance improvements along with a reduction of mental workload as indicated by the self-report and a refinement of cortical dynamics as indexed by a reduction of cortical activation. Relatively constant working memory engagement may be due to the high complexity of the task being learned.

Funding Source: Lockheed Martin Corporation

The relationship between religious commitment and burnout in NAIA athletes.

Josephs, Molly V., Southern Illinois University Edwardsville; Stapleton, Jessie N., Missouri Baptist University

Burnout is defined as a multifaceted syndrome composed of physical and emotional exhaustion, sport devaluation and a reduced sense of athletic accomplishment (DeFreese & Smith, 2013; Raedeke, 1997). In collegiate athletics, research suggests that the perception of received social support was inversely related to burnout (Smith & DeFreese, 2013). In the general population, religious affiliations can be a form of social support. A meta-analysis revealed that positive forms of religious coping were positively related to healthy psychological adjustment to stress, while negative religious coping was related to unhealthy adjustments to stress (Ano & Vasconcelles, 2005). The relationship between religiosity and burnout has not yet been examined in athletes. The purpose of this study was to examine the relationship between athlete burnout and religious commitment in National Association of Intercollegiate Athletics (NAIA) athletes. The sample consisted of 385 (age $m=20.32$, $sd=1.17$, males=246, females=139) NAIA athletes from a Christian university. Participants were asked to complete an online questionnaire including the Athlete Burnout Questionnaire (Raedeke & Smith, 2004) and the Religious Commitment Inventory (Worthington et al, 2003). Pearson correlations revealed a significant, positive correlation ($r= .13$, $p= .01$) between burnout and religious commitment. Results indicate that athletes with more commitment to their religion showed higher rates of burnout compared to less religiously committed athletes. In order to draw conclusions about this relationship between religiosity and burnout future research needs to prospectively examine how religious commitment may relate to burnout across an athletic season.

The role of relatedness in linking parenting to academic adjustment and individuation: An examination of student-athlete/parent dyads during emerging adulthood

Kaye, Miranda P., Pennsylvania State University; Dorsch, Travis E., Utah State University; Lowe, Katie, Clark University

The transition to college encompasses multiple developmental changes, including taking on new roles and developing new relationships. Student-athletes (SAs) must negotiate these developmental tasks while meeting the demands of their athletic and academic careers. Recent theories have increasingly accounted for the role of parents in college student development, but the key mechanisms linking parent involvement to student outcomes have yet to be identified. Given the salience of relatedness in Self-Determination Theory as a motivator for academic success and individuation, parents may enhance students' adjustment during college through relatedness by fostering high

quality close relationships. This may be especially important for SAs as they transition to a new environment. Using a dyadic approach to data collection, 50 NCAA DI SAs and their parent perceived as most influential (N=50) each completed measures of parent responsiveness, relatedness need satisfaction, and parent academic engagement. SAs reported on academic self-efficacy and emotional independence. Analyses grounded in actor-partner independence models revealed significant actor and partner effects (RMSEA=.09; CFI=.96). Actor effects for SAs included: (1) parental responsiveness was associated with higher levels of relatedness ($B=0.78$, $p<.001$); (2) relatedness was associated with lower levels of emotional independence ($B=-0.49$, $p<.001$); and (3) parent academic engagement was associated with higher levels of academic self-efficacy ($B=0.54$, $p<.001$). Partner effects for SAs indicated that for parents who reported higher levels of relatedness need satisfaction, SAs reported greater perceptions of parental academic engagement ($B=0.29$, $p=.037$). Thus, while higher quality relationships lead to higher levels of academic self-efficacy, relatedness is also related to lower levels of emotional independence. As such, these findings reflect how the complex process of balancing the changes that occur in parent-child relationships during emerging adulthood can have differential implications for SA adjustment.

The Relationship among Coaching Efficacy, Leadership Styles and Team Outcomes in a Premier League Soccer Season in Botswana

Keatlholetswe, Lesika, University of Botswana; Malete, Leapetswe, Michigan State University

Research has demonstrated the extent to which coaching environments, leadership styles and coaching efficacy are associated with coaching effectiveness (Horn 2008; Keshtan, et al., 2010; Malete & Sullivan, 2009). However, significant scope remains for the research to demonstrate the extent to which these factors influence athlete and team outcomes, including team performance. Therefore, the purpose of our study was to examine if coaching efficacy is predictive of adaptive and maladaptive coaching leadership styles, coaching environment and team performance in a soccer season. Sixteen male coaches aged 27 - 57 years old and 253 male players aged 18 - 40 years old ($M = 25.66$, $SD = 3.96$) from 16 premier soccer league teams in Botswana participated in the study. Coaches completed the Coaching Efficacy Scale (Feltz et al., 1999) and the Revised Leadership Scale for Sports (Zhang et al., 1997). Players rated their coaches' leadership's styles and the team coaching environments. Team performance was based on coach and player ratings of their teams as well as the teams' position on the league table at the end of the season. There was significant congruence between coaches' self-ratings and player ratings of coaching leadership styles and behaviors. Autocratic coaching behaviors were associated with lower perceived ability to teach techniques of the game. Higher efficacy beliefs were significantly associated with the use of social support, positive feedback, situation consideration, training and instruction. No association was established between efficacy beliefs, leadership styles and team performance, confirming the complexity of predicting performance. Results provide support to previous findings linking higher coaching efficacy beliefs to adaptive coaching leadership styles. The study shows a lot of promise for investigations on coaching efficacy, leadership styles and performance outcomes.

Exerciser Self-Schema Status Moderates Perceived Attractiveness of Exercisers

Kendzierski, Deborah A.; Colleluori, Kaitlyn; Dallavecchia, Alessandra, Villanova University

Exercise self-schema status has a wide range of cognitive, affective, behavioral, and physical fitness correlates (e.g., Berry, 2006; Estabrooks & Courneya, 1997; Kendzierski, 1988, 1994, Thomas, Vanness, & Cardinal, 2016). The current research extends the literature in a more social direction. In this experiment with 127 undergraduate (59.1% female; $M = 18.98$ years, $SD = .96$ years), we examined exerciser schematics' ($n = 65$) and nonschematics' ($n = 62$), perceptions of the attractiveness of 15 target individuals (8 male, 7 female) who appeared in either headshot photographs, photographs of targets engaged in exercise/sport activities, or photographs of targets in similar poses while engaged in control activities. A 2 (exerciser self-schema status) X 3 (photo type) between-subjects ANOVA on mean attractiveness ratings indicated there were no significant main effects, but a significant interaction between self-schema status and photo type, $F(2, 121) = 3.20$, $p = .044$. As expected, exerciser schematics rated targets engaged in exercise/sport (marginally significantly) more attractive than did nonschematics ($M_s = 2.48$ vs. 2.10 , $SD_s = .75$ vs. $.61$, respectively, $F(1, 38) = 3.07$, $p = .09$) and there were no group differences in the perceived attractiveness of targets in the other two conditions. Interestingly, subsequent probing of the interaction by self-schema status revealed no effect of photo type for exerciser schematics, $F(2, 62) = 0.55$, $p = .58$, but a significant effect for nonschematics, $F(2, 59) = 3.57$, $p = .034$. Nonschematics perceived targets engaged in exercise/sport activities as significantly less attractive than those same targets in headshots, and marginally significantly less attractive than those targets engaged in control activities; targets in headshot and control activity conditions did not differ in perceived attractiveness. These findings extend the exercise self-schema literature and have theoretical and methodological implications for the exercise-related stereotype literature, plus several practical implications.

Development and initial psychometric evaluation of the Sport Performance Perceptions Scale

Killham, Margo E., University of Saskatchewan; Mosewich, Amber D., University of Alberta; Duckham, Rachel L., Deakin University; Kowalski, Kent C.; Ferguson, Leah J., University of Saskatchewan

Sport performance is a multidimensional construct including objective, subjective, physiological, and psychological elements. Further, sport performance is comprised of general and specific, as well as retrospective and prospective perceptions about an athlete's skill and skill execution (sport-specific technical skills and psychological skills), in training and competition contexts. Given that athletes and coaches place high emphasis on sport performance, it is important to have a relevant multidimensional measure of sport performance perceptions, which to date is not available. The Sport Performance Perceptions Scale (SPPS) was developed to expand on previous performance measures, specifically assessing athlete performance perceptions, and to align with the Canadian Sport for Life long-term athlete development model (the train to compete and train to win stages of development). The SPPS was developed in iterative stages to refine items and promote clarity. The 32 item, 7 point likert scale, anchored by 1 (almost never) to 7 (almost always), assesses athletes' performance perceptions;

including subscales for athlete development (AD), mastery and improvement (MI), preparedness and strategy (PS), recovery and injury prevention (RIP), and psychological skills (PSY). A composite score is created by calculating the mean of the five subscales. Exploratory and confirmatory factor analyses for the SPPS support the proposed 5-factor structure in a sample of 110 women athletes between 16 and 35 years ($M = 21.88$, $SD = 4.52$) with 1 to 23 years of experience in their current sport ($M = 10.28$, $SD = 5.32$). Initial internal consistency reliability is strong for the SPPS ($\alpha = .92$), with all subscale alphas between .69 (AD) and .83 (PS). Scores on the SPPS are correlated with athletes' competition level ($r = .22$, $p < .05$) and training volume ($r = .31$, $p < .01$), supporting the scale validity. The SPPS will allow researchers to measure athletes' multidimensional performance perceptions, helping inform performance-related research, propelling sport research forward.

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Body Image in Division I Male Athletes: Why is Baseball High and Outside?

Killion, Lorraine, Texas A&M University-Kingsville; Culpepper, Dean, Texas A&M University-Commerce

Researchers have largely focused on females and a drive for thinness (Garner et al., 1983). Research has investigated males and a drive for muscularity (McCreary & Sasse, 2000) indicating an increasing concern for males' appearance of their body. A desire to enhance their physical image (Pope, et al., 2000) has increased pressure to meet a body ideal for their sport. The purpose of this study was to examine body perception differences in Division I male athletes. Upon IRB approval, ninety four athletes participated. To determine body image differences, the sports considered were: football ($n=51$), basketball ($n=14$), and baseball ($n=29$). Demographic and anthropometric measures were taken. The MBSRQ-AS was administered and subscales were examined. ANOVAs documented differences between Body Area Satisfaction [$F(2,92)=20.61, p=.001$], Appearance Evaluation [$F(2,92)=6.50, p=.002$], and Appearance Orientation [$F(2,92)=9.84, p<.001$]. Post hoc tests revealed baseball players demonstrated a difference from football and basketball: AE ($p=.002$), AO ($p=.000$), & BASS ($p=.000$). Differences in body image were found with footballers reporting positive perceptions about their body and baseball players reporting more negative attitudes about theirs. Findings shed light onto body image. While Fitness Orientation showed no significant differences, Appearance Orientation yielded a meaningful score for baseball players as they must walk a thin line to be all-round players who can swing the bat, run the bases, and throw the ball. The performance demands to achieve the necessary skills for success could place baseball players in a dilemma. Baseball has an infamous past concerning a need to 'BULK up' to meet standards. Regulations and legal efforts have diminished drug abuse in the sport, but the psychological need to obtain a larger upper body still exists. Researchers should further examine the culture and behavioral determinants to provide prevention and intervention strategies.

Relationships Among Team communication, Team Efficacy, Coach-Athlete Relationship, and Aggression in Collegiate Athletes

Kim, Young-Sook, Korea Institute of Sport Science; Cho, Seongkwan, Texas A&M International University; Choi, Hun-Hyuk, Dankook University; Yoon, Yong-Jin, Yonsei University

The study aims were to examine the relationship between team communication and aggressive behavior, and to investigate the mediation effects of team efficacy and coach-athlete relationship on this relationship. It was hypothesized that team communication would affect athlete aggression through the mediation of both team efficacy and the perceived coach-athlete relationship. Two hundred ninety seven Korean collegiate athletes who were playing in team sports participated in the study ($M = 21.89$ yrs, $SD = 1.14$), and they completed a battery of questionnaires containing a demographic questionnaire, Scale of Effective Communication in Team Sports (SECTS-2), Coach-Athlete Relationship Questionnaire (CART-Q), Team Efficacy Questionnaire, and Competitive Aggression and Anger Scale (CASS). All questionnaires were written in Korean. Results indicated that team communication significantly predicted the perceived coach-athlete relationship ($\beta = .71$) and team efficacy ($\beta = .78$), and team efficacy significantly predicted aggression ($\beta = -.96$). However, unlike one of research hypotheses, the perceived coach-athlete was not related to aggression. The bootstrapping results indicated that the relationship between team communication and aggression was mediated by team efficacy. The findings shed more light on athlete aggression by linking the importance of team communication to mediating roles of team efficacy. Practical implications were provided for sport psychology consultants, coaches, and athletes, and suggestions were presented for future research on aggression in sport.

The big five personality factors and occupancy of various informal roles by Canadian intercollegiate athletes

Kim, Jeemin; Eys, Mark, Wilfrid Laurier University

Effective functioning of interdependent sport teams entails each athlete fulfilling roles on their teams, and the degree to which athletes are satisfied with and accept their roles has been linked with important individual (e.g., intentions to return) and group (e.g., cohesion) outcomes (Eys et al., 2014). However, role research in sport has typically focused on formal roles that are explicitly assigned by coaches (e.g., captains, point guards). More recent literature suggested that informal roles, which are expected to develop more naturally (e.g., team comedians, distracters; Cope et al., 2011), may also have critical influence on the effectiveness of the group necessitating in-depth research that examines the processes by which informal roles develop on sport teams (Eys et al., 2014). Specifically, several researchers (e.g., Allen et al., 2013; Benson et al., 2014) suggested that informal (vs. formal) role development may be more dependent on athletes' personality factors. Thus, the purpose of the study was to investigate the link between athletes' personality factors and their occupancy of various informal roles on their teams. Data were collected from 10 Canadian intercollegiate interdependent sport teams by asking the athletes to read descriptions of various informal roles (Cope et al., 2011) and report the group members who occupy each informal role. The athletes were further asked to complete the NEO-Five Factor Inventory-3 (Costa & McCrae, 1992). For each role, an athlete was considered as a role occupant when he/she was identified by 50% or more of his/her teammates. Among the results, comedians tended to be more extraverted ($M = 38.21$) than non-comedians ($M = 32.74$), distracters tended to be more neurotic

($M = 32.00$) than non-distracters ($M = 22.99$), and individuals identified as prototypical team players tended to be more agreeable ($M = 34.94$) than other teammates ($M = 31.79$) (all $p < .05$). The current results provide preliminary insights on how personality factors of athletes may relate to their informal role occupancy on interdependent sport teams.

Social, Psychological, and Physical Predictors of Well-Being among Female Adolescents in Aesthetic Sports

Kipp, Lindsay E., Texas State University; Bolter, Nicole D., San Francisco State University; Phillips, Alison C., University of Iowa

Girls participating in aesthetic sports are judged on the subjective beauty of their movement and appearance and may be at risk for disordered eating and lower self-esteem (Monsma et al., 2006). These aspects of well-being, according to self-determination theory (Ryan & Deci, 2007), can be enhanced via the social context (e.g., coach-created climate) and satisfaction of three psychological needs: perceived competence, autonomy, and relatedness. Our purpose was to examine whether six dimensions of the coach-created motivational climate differentially related to needs satisfaction, and in turn, self-esteem and disordered eating. Female gymnasts, divers, and figure skaters ages 10-18 ($N = 132$; $M = 12.7$ years-old) completed a survey to assess study variables. A path analysis revealed a reasonable fit of the hypothesized model to the observed data. Several significant direct and indirect paths emerged. First, climate dimensions predicted psychological need satisfaction: (a) perceptions of greater coach emphasis on cooperative learning and effort were associated with greater relatedness, (b) perceptions of lower coach emphasis on punishment for mistakes and unequal recognition were associated with greater autonomy and relatedness, and (c) perceptions of greater intra-team rivalry were associated with greater autonomy. Physical maturity, a control variable, was associated with perceived sport competence: post-pubertal girls reported lower sport ability than pre-pubertal girls. Second, greater perceived competence was related to higher self-esteem and fewer symptoms of disordered eating. Third, two indirect relationships emerged: (a) unequal recognition was negatively associated with self-esteem, and (b) intra-team rivalry was positively associated with self-esteem. Unexpected positive relationships with intra-team rivalry may relate to social comparison inherent in these sports. Effect sizes ranged from small to large (.08-.56). Findings contribute to our understanding of the complex social climate in aesthetic sports and its relationship with athlete well-being.

The fatiguing effect of domain-specific physical exercise on perceptual-cognitive performance

Klotzbier, Thomas; Schott, Nadja; University of Stuttgart

Background: The ability to extract meaningful contextual information from a visual scene is essential in dynamic team sports to anticipatory response ("read the game") and for decision making (Williams, Hodges & North, 2006). Interestingly, most studies on perceptual expertise have examined performance at rest. However, the effect of physical exercise and fatigue on perceptual-cognitive skills may be important (Casanova et al.,

2013). In our study participants had to perform an intermittent exercise protocol (IEP) while they process motion in dynamic visual scenes. The aim was to investigate the influence of mental and physical fatigue on visual attention during multiple object tracking (MOT). Method: A total of 17 lower-level players (22.4 +/- 2.06; 11 men) and 12 higher-level players (21.92 +/- 2.23; 7 men) from different team sports participated in this study. A 3D MOT task was used (NeuroTracker™) to attain the optimal level of difficulty for the IEP. The VO2max test was performed on a motor-driven treadmill after a modified Bruce protocol. At least 48 hours after baseline measurement we used an IEP, which alternated high (90%-VO2max) and low (50%-VO2max) intensities. During the IEP, subjects had to perform the 3D MOT after 5, 15, and 25min. Energy/fatigue ratings were obtained pre and post, using Part II of the MPSTEFS (O'Connor, 2004). Results: A 3 (MOT) x 2 (groups) ANCOVA (controlled for VO2max) revealed a trend for the interaction time x group, $F(1.48,38.5)=2.73$, $p=.092$, $\eta^2=.095$ indicating better performance on the MOT score after 25min in the higher-level compared to lower-level players. Furthermore, ratings of mental ($p=.105$) and physical fatigue ($p=.211$) were lower in higher-level players after the IEP, but higher in lower-level players. Conclusion: The present results indicate that higher-level compared to lower-level players exhibit better performances on visual attention after a fatiguing IEP and presented higher performance improvement, arguably as a result of their lower perceived mental fatigue.

Legitimacy of anti-doping policies - athletes as researchers

Kolb, Meike, Westfaelische Wilhelms-University Muenster; Dreiskaemper, Dennis, Westfaelische Wilhelms Universitaet-Muenster; Petroczi, Andrea, Kingston University; Holzgreve, Pia, Westfaelische Wilhelms Universitaet-Muenster; Brueckner, Sebastian, Olympiastuetzpunkt Rheinland Pfalz / Saarland; Strauss, Bernd, Westfaelische Wilhelms Universitaet-Muenster

Introduction: The project which involves six countries (Germany, Greece, Italy, Russia, Serbia and the UK) and aims to explore the perceptions of clean athletes towards the legitimacy of anti-doping policies, their trust in organisations responsible for implementing anti-doping and the support of anti-doping policies by clean athletes in order to advance the anti-doping policies. The unique feature of the project is the active involvement of athletes as researchers in all participating countries. The present study focuses on results from Germany.

Methods: Semi-structured interviews were conducted in groups of six to seven elite athletes ($M=25.1$ years, $SD=4.28$ years; $N=19$, 47.4% male; individual and team sport mixed; actual or former member of the Registered Athlete Testing Pool for example of National Anti-Doping Agency Germany). The 2h focus group interviews were recorded, transcribed verbatim and coded using qualitative data analytical software (MAXQDA) for a thematic analysis.

Results and discussion: The qualitative results indicate that elite athletes are aware of legitimacy problems of national and international sport federations regarding appropriateness and fairness in methods and procedure of anti-doping policies. At the same time the athletes say that Anti-Doping policies preserve 'clean sport'. They feel that they have to bring a high level of commitment to being clean which they are fulfilling although they feel that only a few supported in doing so. Individual athletes take a high level of responsibility for getting informed while team sport athletes are not as proactive

and feel a gap in information. Recent scandals in doping seem to influence athletes' trust in relevant anti-doping policies. Also, their perceptions of the national federation differ to those of other countries, exhibiting the typical ingroup/outgroup bias. Such disparity in anti-doping legitimacy perceptions poses a significant challenge to globalised anti-doping.

The Influence of Task Complexity and Social Engagement During Physical Activity on Executive Functioning in Older Adults

Koon, Lyndsie M.; Brustad, Robert J.; Stellino, Megan L., University of Northern Colorado

Research indicates that participation in physical activity may improve brain structure and function in older adults (Kelly et al., 2014). It has been suggested that certain qualities of the physical activity experience, such as task complexity, may be particularly beneficial to the enhancement of cognitive function (Tomprowski et al., 2015). The current study explored the role of task complexity and social engagement during physical activity, as well as frequency of physical activity, in contributing to executive function (EF) among older adult participants. Participants (N = 74, 60-73 years of age) reported their participation in various physical activities over a typical week. The activities were assessed for level of task complexity and social engagement that occurred during the activity. Task complexity was assessed in relation to the expected level of cognitive demand placed on the individual whereas social engagement was assessed in relation to the extent of interaction with others while completing the activity. The core EF processes of working memory, inhibition and cognitive flexibility were evaluated through standardized tasks including the digit span task, a computerized flanker task and the Trail Making Test A and B. Canonical correlation analysis was conducted to determine the presence and strength of the relationship between the set of three physical activity variables (task complexity, social engagement, and frequency of physical activity) with the set of four EF outcomes. Results revealed a nonsignificant relationship $F(12, 177) = 1.31$, Wilks' $\lambda = .80$, $p = .20$, between the two sets of variables. This exploratory study examined the potential influence of task complexity and social engagement levels during physical activity, in addition to frequency of physical activity, on EF levels in older adults. A significant relationship was not found between the sets of variables. However, the contributions of task complexity and social engagement during physical activity to executive functioning in older adults merits further examination.

The Effects of Acute and Chronic Resistance Exercise on Sleep Outcomes: A Systematic Review of Randomized Controlled Trials

Kovacevic, Ana, McMaster University; Mavros, Yorgi, The University of Sydney; Heisz, Jennifer J., McMaster University; Fiatarone Singh, Maria A., The University of Sydney

Impaired sleep is associated with negative physical and mental health outcomes. Pharmacological interventions are commonly used to improve sleep, but long-term use is not recommended due to adverse side effects. Exercise is a promising non-pharmacological intervention to improve sleep; however, the effect of resistance exercise is poorly understood. Therefore, we performed a systematic review of 13 randomized controlled trials of resistance exercise (3 acute resistance bout, 3 combined aerobic/resistance training, 7 isolated resistance training) to determine the effects of

resistance exercise on sleep quantity and quality. Heterogeneity of interventions and outcomes precluded meta-analysis. The acute effects of resistance exercise on sleep were poorly studied and inconsistent across the 3 studies. Among the 7 studies of isolated resistance training, only 1 reported benefits for sleep quantity (ES=0.46; $p=0.001$), while 5 reported benefits for sleep quality (ES range=0.38 to 1.54; p range=0.001 to 0.05). The benefit of resistance training was attenuated when it was added to aerobic training, with only 1 of 3 studies reporting a significant benefit for 2 sleep quality outcomes (ESs=0.24 and 0.20; $p=0.04$ and 0.045) from combined training compared to isolated aerobic training. Resistance exercise training also improved co-morbid symptoms of anxiety/depression in 6 of 8 studies that measured it. Higher intensity and greater frequency of training appeared more beneficial for sleep quality, but there were insufficient data for meta-regression. Only 2 acute exposure studies and 1 combined training study used polysomnography, and objective measurements of sleep architecture are needed to advance understanding of chronic training adaptations. Additional research is needed to better understand the acute effects of resistance exercise on sleep, as well as the physiological mechanisms underlying the effect of acute and chronic exercise exposure on sleep, time-of-day and dose-response characteristics, in order to determine the optimal exercise prescription for sleep benefits.

Are Physical Education Experiences Associated with Physical Activity Attitudes and Intentions in Adulthood?

Ladwig, Matthew A.; Ekkekakis, Panteleimon, Iowa State University

An important goal of physical education (PE) is to foster a lifelong tendency to be physically active. However, the abysmal physical activity (PA) rates in the United States make it apparent that exposure to PE as a child may not be beneficially influencing adult PA levels. In fact, for many, the traditional PE experience may have deleterious consequences for PA attitudes, intentions, and subsequently, behavior. Because of the potential lifelong consequences associated with PE experiences, this phenomenon deserves more empirical attention. In a mixed-methods design, we conducted a nationwide questionnaire. The participants were high school graduates between the ages of 18 and 45. First, we measured the participants' current levels of PA using the International Physical Activity Questionnaire (IPAQ). Next, we modified the stem of the 18-item Physical Activity Enjoyment Scale (PACES) to retrospectively investigate enjoyment of PE as a child (e.g., For me, physical education class was'). Additionally, the participants reported their current cognitive and affective attitudes toward PA as well as their intentions to be physically active during the subsequent week. Finally, the participants described their best and worst PE memories in a text box. Analysis of the data revealed that a higher total score on the modified PACES was moderately associated with current attitudes toward physical activity. In addition, the modified PACES scores were associated with intentions for PA during the subsequent week. In the qualitative data, many participants reported being ridiculed by teachers or peers or being punished with physical activity. It is apparent from these data that an important relationship may exist between childhood memories of PE and PA attitudes and intentions as an adult. As with other areas of development, negative experiences during childhood may have repercussions that reverberate throughout the lifetime. Future research should investigate potential methods to insure PE is more enjoyable for all children regardless of body composition or athletic prowess.

Mental fatigue affects perceived exertion in whole-body cardiovascular exercise.

Langvee, Jason; Harris, Sheereen; Brown, Denver; Bray, Steven, McMaster University

Research indicates whole-body endurance performance is negatively affected by mental fatigue and mediated by higher than normal ratings of perceived exertion (RPE; Cutsem et al., 2017). RPE can be represented as a holistic assessment of full-body exertion level while performing a task or with reference to specific sensations (e.g., respiration/breathing, leg muscle). The purpose of this study was to investigate the effects of mental fatigue on the performance of a whole-body endurance cycling task. Using a counterbalanced design, participants (N=19) completed two experimental sessions separated by ≥ 48 hours. One session began with a mentally-fatiguing task (10-minute Stroop task) and the other, a non-fatiguing task (monitoring an affectively-neutral video). Immediately following each task, participants performed a maximal endurance cycling task at a constant workload of 65% individual peak power output. Participants provided RPE for leg muscle, respiration, and mental exertion at one-minute intervals while cycling using the CR-10 scale (Borg, 1998). Results showed no differences between conditions in time to exhaustion (TTE) on the cycling tasks ($p = 0.810$; $d = 0.021$). Analyses of the RPE data were based on individual iso-times at 0, 25, 50, 75 and 100 percent of the shortest TTE. Significant (condition X iso-time) interaction effects were found for respiration exertion ($p = 0.046$; $\eta^2 = 0.456$) and leg muscle exertion ($p = 0.001$; $\eta^2 = 0.671$), indicating greater exertion following the mentally-fatiguing task relative to control. RPE for mental exertion showed no significant condition effects. Post-hoc analyses showed RPE for respiration was significantly lower at 25% of TTE and RPE for leg muscles was significantly greater at 75% and 100% of TTE in the cognitive fatigue condition. Differences in RPE experienced during prolonged submaximal exercise may take several minutes to emerge. Results suggest brain regions supporting volitional motor functions have heightened sensitivity following mental fatigue.

Goal Attainment Effects on Cognitions, Emotions, and Subsequent Performance in a Golf Putting Task

Lebeau, Jean-Charles; Gatten, Heather; Perry, Inbal; Wang, Ye; Sung, Sibak; Tenenbaum, Gershon, Florida State University

Attaining or failing to attain a goal affects our thinking, feeling, and behavior. Grounded in Carver and Scheier's (2003) model on the effect of goal failure on behavioral, affective, and cognitive responses, the present study aimed at uncovering the effects of goal success and goal failure on cognition, emotion, and subsequent performance using a golf putting task. Participants (17 males, 24 females, $M_{age} = 27.17$, $SD_{age} = 8.91$) completed a 24-golf putting task without the provision of final ball location feedback. Instead, participants received every 6 putts a feedback of their scores to induce goal success or goal failure. Self-efficacy was measured every 6 putts, while emotions and executive functions were assessed after the 24th put. Participants then completed an

additional 24 golf puts without any specific goal. Individuals in the goal success condition reported significantly higher self-efficacy and more positive emotions than individuals in the goal failure condition. Non-significant differences were revealed on either of the cognitive tasks or golf putting performances between the goal success and goal failure conditions. The results are examined in regards to previous research and the complexity in linking emotions, cognitions, and performance. Implications, limitations, and future research directions are discussed.

Does early specialization influence long-term involvement in sport and physical activity in former competitive figure skaters?

Lemez, Srdjan, California State University Los Angeles; Wong, Harmonie, York University; Dogra, Shilpa, University of Ontario Institute of Technology; Baker, Joseph, York University

In recent decades, scientists have paid considerable attention to analyzing the costs and benefits of early specialization in sport. While this phenomenon has been explored in sport expertise research, its effects on long-term sport involvement and adherence to physical activity (PA) are unclear. To this end, the purpose of this study was to examine whether early specialization/involvement in figure skating influenced current involvement in figure skating and PA. Participants were recruited from two Facebook groups whose members self-identified as retired competitive figure skaters. A total of 435 participants completed an online structured survey entitled 'Retirement from Figure Skating Questionnaire,' which included a modified version of the Sports Career Termination Questionnaire II (Cecic & Erpic, 2000), the Athletic and Post Athletic Questionnaire (Huang, 2002), and measures of involvement in skating and PA. Specific to this study, we defined early specialization/involvement as the age they began i) regular unstructured skating (i.e., public skating, outdoors), ii) regular structured skating (i.e., group lessons), iii) working with a private coach, and iv) competing. Participants also reported whether they were currently skating (yes/no) and their current PA levels (hours/week). On average, participants began regular unstructured skating at the age of 4.6 years (SD=2.4; n=348), regular structured skating at 5.9 years (SD=2.5; n=363), had their first private coach at 7.7 years (SD=2.4; n=361), and had their first competition at 8.4 years (SD=2.5; n=361). Of the 287 participants with complete data, the majority reported that they were not currently skating (n=156; 54.4%), but the average PA involvement was 8.9 hours per week (SD=7.1). Preliminary analyses indicate that those who were not currently skating had earlier involvement in unstructured skating (M=4.4 years) than those who were currently skating (M=5.1 years; $p<.01$). Results will be discussed in relation to how early specialization may affect psychological development and lifespan exercise behaviours.

Prediction of performance level 8 years later in a selected group of young volleyball players

Lenoir, Matthieu E., Ghent University, Belgium; Mostaert, Mireille X.; Deconinck, Frederik X.; Norjali Wazir, Mohd X.; Robertson, Kamasha X.; Pion, Johan X., Ghent University, Belgium

The core question in talent identification in sport is to what extent characteristics of

young athletes are predictive for the future potential performance level. Studies in gymnastics and volleyball have shown that the predictive value of generic (i.e. non sport-specific) is good over a time frame between two and four years. The aim of this study is to investigate if generic anthropometric, physical performance, and coordinative tests in a selected group of volleyball players are related to their performance level 8 years later. A total of 54 male (n=32) and female (n=22) players (15.92 +/- 1.65 yrs) selected for the Flemish Top Sport School Volleyball in 2008 were assigned to an elite or sub-elite group according to their performance level in 2016. Players selected for the national team and/or playing abroad as a full professional were assigned to the elite group, while the sub-elite were players active at regional and national level.. They were evaluated on anthropometry, physical performance (speed, strength, flexibility) and motor coordination by means of the Körperkoordinationstest für Kinder.

With respect to anthropometry, length, weight and %fat were similar in boys of different levels, while in the girls group elites were taller and heavier ($p = 0.05$ and $p = 0.02$, respectively). Physical performance levels between male elites and sub-elites were not different ($F_{1,13} = 1.072$, $p = 0.427$), a result that was duplicated in females ($F_{1,7} = 0.250$, $p = 0.944$). With respect to the coordinative tests, future elite boys did not outperform sub-elite in any of these tests ($F_{1,20} = 1.751$, $p = 0.169$). A similar outcome was found for the female players ($F_{1,8} = 0.195$, $p = 0.956$).

This study shows that the use of generic anthropometric, physical performance, and coordination parameters is limited for the prediction of performance level over a long period (8 years). On entry in the talent development program, the group is already very homogeneous, with the exception of height in female athletes, where the longer athletes appear to have better chances to reach top level.

Funding Source: Ghent University

Predicting physical activity attitudes, perceived behavioral control, and intentions from aspects of the ParticipACTION brand

Lithopoulos, Alexander, Queen's University; Berry, Tanya R., University of Alberta; Faulkner, Guy, University of British Columbia; LeBlanc, Allana, ParticipACTION; O'Reilly, Norman, The Ohio State University; Rhodes, Ryan E, University of Victoria; Spence, John C., University of Alberta; Tremblay, Mark S., University of Ottawa; Latimer-Cheung, Amy E., Queen's University; , ,

Many physical activity (PA) interventions yield small to medium sized effects on the theory of planned behavior (TPB) constructs attitudes, perceived behavioral control (PBC), and intentions. These TPB variables are important because of their strong association with PA (Hagger et al., 2002) and may be effectively influenced by marketing elements such as the brand of PA-promoting organizations (Evans et al., 2015).

Important aspects of a brand include awareness, meaning (functional and intangible imagery aspects), responses (judgments and feelings based on meaning beliefs), and relationship with the brand (Keller, 2003). The purpose of this study was to investigate whether these branding aspects of ParticipACTION, a Canadian not-for-profit organization which promotes PA, predict PA attitudes, PBC, and intentions. A nationally representative sample of Canadians who were aware of ParticipACTION (n age groups: 18-24=68, 25-34=225, 35-44=172, 45-54=304, 55-64=258, 65+=254; 52% female) completed an online survey. Multiple regression analyses were used to analyze the data. For intentions, brand meaning (functional; $\beta = .11$, $p = .005$), brand response judgments

about likeability ($\beta=.11$, $p=.005$) and trustworthiness ($\beta=.08$, $p=.042$), and brand relationships ($\beta=.12$, $p=.001$) were significant, $p<.001$, $R^2=.10$. For attitudes, brand responses about feelings ($\beta=.09$, $p=.013$) and judgments about likeability ($\beta=.10$, $p=.022$) and trustworthiness ($\beta=.11$, $p=.013$) were significant, $p<.001$, $R^2=.08$. For PBC, imagery associating ParticipACTION with moving more ($\beta=.07$, $p=.034$) and brand responses about feelings ($\beta=.10$, $p=.005$) and judgments about likeability ($\beta=.11$, $p=.007$) and quality ($\beta=.09$, $p=.032$) were significant, $p<.001$, $R^2=.09$. In summary, aspects of an organization's brand are associated with important antecedents of PA, albeit these association are in the small to medium range. It may therefore be beneficial for organizations to ensure their brand is strong in these areas to augment existing PA interventions.

Ironic or Overcompensating Error in Golf Putting: The Importance of Attention Imbalance

Liu, Sicong; Meir, Gily; Boiangin, Nataniel; Cologgi, Kimberly; Lebeau, Jean-Charles; Basevitch, Itay; Tenenbaum, Gershon, Florida State University

Both ironic errors (predicted by Ironic Process Theory, IPT) and overcompensating errors (predicted by Implicit Overcompensation Hypothesis, IOH) under a suppressive goal were observed in golf putting. Namely, after being told to 'not putt short,' novices could make either ironic or overcompensating, errors by putting shorter or longer, respectively, than the target. The present research aimed at clarifying this conflict between IOH and IPT by manipulating a plausible moderator, attention imbalance. Attention imbalance was introduced by placing a red dot in front of the target on the green, and by telling novices to 'not putt onto the red dot.' We employed a 2 (attention imbalance or not) by 2 (suppressive goal or not) design in two sequential studies. In Study 1, 76 undergraduates were randomized into four conditions to perform 30 trials (i.e., three 10-trial blocks). The first block formed the baseline and the later blocks were coupled with cognitive load (i.e., rehearsing a 6-digit number) and condition-wise manipulations. To prevent visual feedback from confounding results of Study 1, 72 undergraduates in Study 2 followed identical experimental procedure of Study 1 except that their visual feedback after putting was rendered impossible. Results of both studies revealed that, although the generation of attentional imbalance led to an ironic effect, the ironic effect was weaker than the overcompensating effect in a way that the overcompensating tendency under the suppressive goal decreased but not eliminated or reversed compared to the control condition. This result support that attentional imbalance is a necessary factor for observing ironic errors in motor tasks. It also implied that other moderators should be considered when predicting motor errors under suppressive goals. For example, given the supporting evidence of IPT in some motor tasks, the automaticity of task execution (i.e., degree to which the execution of a task is free from conscious control) may act as another key moderator.

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Will you go farther with Pokemon Go?: Walking for Leisure Versus During the Game

Locke, Sean, University of British Columbia; Gierc, Madelaine S.H.; Brawley, Lawrence R., University of Saskatchewan

Pokemon Go is a popular mobile phone game that moves players around their city to collect Pokemon animals. In a recent study, Pokemon Go users (N=792) increased their step count by 1,473 per day, suggesting the game may potentially promote physical activity. However, before promotion via Pokemon Go is implemented, we should understand the motivational psychology encouraging interaction between game users and their activity environment.

PURPOSE: To examine differences in Pokemon Go users' perceptions of leisure walking versus game walking. We examined 3 exercise social cognitions from the agency aspect of Social Cognitive Theory (SCT: Bandura, 1986): (1) motivation to walk, (2) self-efficacy to walk, and (3) enjoyment (outcome expectancy). **METHOD:** Pokemon Go users (N = 448) completed an online questionnaire regarding walking. Within Pokemon Go, users must walk 2km, 5km, or 10km to unlock rewards. Participants were asked about their motivation, self-efficacy, and enjoyment to walk those 3 distances for leisure (no game) and during Pokemon Go play. **RESULTS:** Our design was 3(walking distance) by 2(walking purpose) within-subjects. Three RANOVA procedures examined differences. There were main effects for walking distance ($ps < .001$, partial $\eta^2 > .50$) and walking purpose ($ps < .001$, partial $\eta^2 > .13$) for all 3 social cognitions. Effects were in favor of walking during Pokemon Go (eg. more confident to walk distances). Interaction effects ($ps < .001$, partial $\eta^2 = .026$ to $.193$) were also observed. As distance increased, so did social cognitive differences between leisure and gaming walking purposes (average Cohens $D = .20$ at 2km, $D = .36$ at 5km, and $D = .57$ at 10km). **DISCUSSION:** Findings support Bandura's notion about the interaction of task difficulty and task purpose in that social cognitions (e.g., self-efficacy, outcome expectancy) forecast the potential for motivated behavior. Stronger motivation, efficacy, and enjoyment during Pokemon Go may be important SCT constructs elicited by game experience which motivate greater walking than for leisure alone.

Sweating the small stuff: How aerobic exercise training reduces state anxiety in university students

Lucibello, Kristen; Paolucci, Emily; Heisz, Jennifer J., McMaster University

Anxiety is the most commonly diagnosed mental illness among university students. Students often report intense and frequent peaks in state anxiety - a transient, apprehensive emotional state caused by a stressor. Although a single bout of acute exercise can temporarily reduce state anxiety, the current study examined whether chronic training increases the effectiveness of that acute benefit. We recruited 18 sedentary university students and randomly assigned them to a 9-week moderate intensity exercise condition or a sedentary control condition. Acute changes in state anxiety were measured before and after exercise each week. For the exercise condition, we did not see a benefit of exercise training on state anxiety until the fifth week of training, after which point an acute bout of exercise significantly reduced state anxiety each week ($p = 0.014$). Critically, the benefits of exercise training were clinically significant and reduced baseline state anxiety from mild to minimal. In contrast, baseline state anxiety increased from mild to moderate in the control condition ($p = 0.037$). These results suggest that exercise training enhances the anxiety relief from a single bout of exercise.

These training-related benefits may be associated with the gradual adaptation and regulation of the stress system that occurs with exercise training. Our future research will investigate the physiological changes produced by exercise training that contribute to reductions in state anxiety, in order to inform exercise guidelines for managing state anxiety in high-risk populations.

Parents' perceptions of parent involvement in young adults' intercollegiate athletic careers: Policy, education, and desired-student-athlete outcomes

Lyons, Logan K.; Dorsch, Travis E., Utah State University; Lowe, Katie, Clark University; Kaye, Miranda P, Pennsylvania State University; Arnett, Jeffrey J., Clark University

College student-athletes are a distinctive population of emerging adults who perceive a tremendous amount of pressure to succeed athletically and academically (Kirk & Kirk, 1993; Wylleman & Lavallee, 2004). Although parents continue to play an important supportive role for athletes during emerging adulthood (Côté, 1999), little research has fully explored the role of parent involvement in student-athlete development and well-being. The present study extends past work examining NCAA administrator and coach perceptions of parents of Division I student-athletes (Dorsch et. al., 2016) in two ways. First, the present research targets parents' perceptions of core design components, barriers to implementation, and expected outcomes of parent education. Second, the present research provides a sharper understanding of parent involvement across a range of Division I, II, and III institutions. Thirty-two parents of student-athletes from three NCAA member-institutions took part in face-to-face, semi-structured interviews tapping their experiences as parents of NCAA student-athletes. We also aimed to understand how they would structure parent education if given the opportunity. Data were analyzed in light of Dorsch and colleagues' past research with administrators and coaches, and synthesized to create a grounded theory outlining: (a) Types of negative parent involvement; (b) Policy considerations for NCAA administrators; (c) What parent education might look like at the NCAA Division I, II, and III levels; (d) Barriers to achieving positive parent involvement; (e) Types of positive parent involvement; and (f) Desired outcomes for NCAA student-athletes. Integrating present findings with past knowledge gained from administrators and coaches afforded the creation of an online parent education module, offering a new principal resource for improving parent involvement in the lives of NCAA student-athletes.

Funding Source: NCAA

Relationships Between Health Action Process Approach Model Constructs and Physical Activity in People with Spinal Cord Injury

Ma, Jasmin K.; McCracken, Laura A.; West, Christopher R.; Martin Ginis, Kathleen A., University of British Columbia

People with spinal cord injury (SCI) face many barriers that may explain the low levels of physical activity in this population. Indeed, 50% of people with SCI have reported participating in no leisure time physical activity whatsoever. Theory-based interventions have been reported to be more effective in improving physical activity behaviour than interventions that do not use theory. One theory that has demonstrated potential to guide

interventions to change physical activity behaviour in people with SCI is the Health Action Process Approach model (HAPA; Schwarzer, 2008). However, with many constructs (e.g. social support, barriers, self-efficacy, risk perceptions, etc.) and limited resources, an understanding of the most influential HAPA constructs to target in this population is needed. In this pilot study, 14 people with SCI (Mean age=44.3 years, male=11, female=3) completed surveys assessing HAPA constructs related to their participation in leisure time physical activity over the next month. They then wore a wrist accelerometer (Actigraph GT9X Link) for 5-7 days and a minimum of 10 hours/day. Minutes/day of moderate to vigorous physical activity was averaged across the wear period to calculate a daily total. Multiple regressions controlling for years post injury and level of injury were computed using each HAPA construct to predict min/day of physical activity. Results showed that constructs related to self-regulation were significant predictors of levels of physical activity. Specifically, coping self-efficacy ($B = 0.83$, $p = 0.010$), planning self-efficacy ($B = 0.75$, $p < 0.010$), action planning ($B = 0.60$, $p = 0.028$), and monitoring ($B = 0.66$, $p = 0.022$) were associated with greater min/day of physical activity. This pilot study is the first to examine the relationship between physical activity social cognitions as predictors of an accelerometry-based measure of physical activity in people with SCI. These results highlight the importance of targeting self-regulatory constructs to increase physical activity in this population.

Self-determined motivation and stages of change in a Mexican community

Marentes-Castillo, Maria; Zamarripa, Jorge, Universidad Autonoma de Nuevo Leon; De La Cruz, Manuel F., Universidad Estatal de Sonora; Medina-Villanueva, Samantha, Universidad Autonoma de Nuevo Leon; Alvarez, Octavio; Castillo, Isabel, Universitat de Valencia

The Self-determination theory suggests that the persons can be involved in an activity (e.g. exercise) internalizing different reasons and these reasons can be detected in the form of motivational regulations more or less self-determined. At the same time the stages of change model explain how people change from being inactive to active behavior. These stages are: precontemplation (inactive and no intention to change), contemplation (inactive and intention to change), preparation (active but not regularly), action (regularly active, but only begun in last six months) and maintenance (regularly active for more than six months). The aim of this study was analyze the self-determined motivation through the stages of change. A total of 530 participants of the metropolitan area of Monterrey, Nuevo Leon (Mexico) aged 11 to 76 ($M = 33.22$; $SD = 15.27$) took part in the study. The Mexican version of the stages of change (short form) for exercise and the BREQ-3 were used to collect data. The results from ANOVA showed statistically significant differences between stage of changes for self-determined motivation ($F = 47.40$, $p < .001$). Games-Howell post hoc comparison indicated that the pre-contemplation group ($M = 1.67$; $SD = 2.67$) demonstrated significantly lower self-determined motivation than the other groups, whereas the maintenance group ($M = 9$; $SD = 5.04$) showed significantly higher self-determined motivation than people in previous stages of change. Progressive increases of self-determined motivation from the precontemplation to the maintenance groups have been observed. Our findings highlight the importance of internalize the regulation of conduct to facilitate the transit through the stages and hence the exercise adherence.

Examining the influence of different levels of pressure on the performance of a volleyball serving task

Marini, Matthew; Sullivan, Philip, Brock University

Many of the abnormally bad performances in sport history often boil down to an athlete or group of athletes that have the skill but choked under the immense pressure of the competition at hand. Baumeister (1984) refers to "choking" as a decrease in performance due to pressure, where pressure was defined as "any factor or combination of factors that increases the importance of performing well on a particular occasion" (p. 610). Researchers have created a variety of different ways to induce the feeling of pressure during tasks in a laboratory setting such as: monetary incentives, video recordings, expert observations, simulated scenarios or vignettes, crowds/social observation, threat or fear, and deception (Beilock & Gray, 2007; Oudejans, & Pijpers, 2009). The current study compared and combined several of these conditions to attempt to create an ecologically valid protocol to instill competition-equivalent levels of pressure during a real sport performance (i.e., a volleyball serving task). One team of elite youth volleyball players (N = 10; mean age = 15.0) participated in a repeated measure design used to assess the subjective measurement of pressure on each athlete during five different pressure conditions (i.e., baseline, monetary incentive, video recording, crowd/social observation, and a combination of all three). Pressure was assessed by a visual analog scale; participants also completed the Competitive State Anxiety Inventory-2 (CSAI-2). A repeated measures ANOVA showed that there was no significant difference between conditions on perceived pressure, confidence, somatic or cognitive anxiety. These results were surprising considering the amount of previous studies that induced pressure in a laboratory setting. This may be due to the study being under-powered, but these effects have been found with similar sample sizes (Oudejans & Pijpers, 2010). More research is needed to support the notion that competition level anxiety is possible to induce in controlled settings.

The Impact of Dispositional Mindfulness on the Competitive Performance and Psychological Readiness of Elite Swimmers

Martin, Lisa A.; Hinz, Angela, University of the Sunshine Coast; Formosa, Danielle, Swimming Australia

Recent studies have established a relationship between sport-specific mindfulness interventions and performance (Bernier et al., 2009; Goodman et al., 2014). It has also been suggested that athletes may be inherently mindful, due to the high levels of present-moment, focused attention required in sport (Gooding & Gardner, 2009). Therefore, the study of dispositional mindfulness has also become an area of interest in sport psychology research. No studies to date have explored whether dispositional mindfulness provides performance-related benefits to elite athletes in a high pressure competitive situation. Therefore, the main aim of this study was to determine whether levels of dispositional mindfulness are associated with the achievement of self-set performance goals in a major competition. A secondary aim was to determine whether mindfulness is associated with the psychological wellbeing of athletes in the lead up to such an event. Participants were 50 elite level swimmers (23 females; 27 males)

competing at the FINA and IPC World Swimming Championships. Athletes completed the Mindful Attention Awareness Scale (MAAS), the Perceived Stress Scale (PSS), and the Positive and Negative Affect Scale (PANAS) two weeks prior to the event. A performance time that participants were aiming to achieve or exceed during competition was also reported. Actual performance times were added to the data set post-competition. No significant differences in mindfulness scores were found between athletes who met their performance goals and those who did not ($t(46) = 0.23$, $p = .818$). However, dispositional mindfulness scores were significantly negatively correlated with perceived stress ($r = -.55$, $p < .01$) and negative affect ($r = -.43$, $p < .01$), and significantly positively correlated with positive affect ($r = .53$, $p < .01$). Our results suggest that while dispositional mindfulness does not appear to impact performance, it is associated with the positive psychological states of elite swimmers in the lead up to a major competition.

Student Athletes' Emotional Experiences Across a High School Basketball Season

Martin, Eric M., Boise State University; Walker, Lauren F.; Gould, Daniel R., Michigan State University

Several studies have examined the emotional development of adolescents involved in extracurricular activities like theater or 4H clubs (e.g., Larson & Brown, 2007), but the largest arena of extracurricular activity and perhaps the one most emotionally charged - youth sports - has been largely ignored. To fill this void this study investigated the emotional experiences of high school student-athletes in relation to their participation in Varsity basketball by examining two questions. First, how do youth experience, become aware of, and understand emotions in themselves and others? And, second how do youth learn to regulate their emotions through their own experiences, through the program culture and via experiences with adult leaders? A longitudinal qualitative design with semi-structured interviews was employed where five female and four male Varsity basketball players were interviewed on five different occasions across a high school basketball season. Hierarchical content analysis of the interview transcripts revealed that youth experienced extreme positive (e.g., happiness, pride and excitement) as well as negative emotions (e.g., frustration, sadness and anxiety). These adolescents were also found to be agents of their own emotional development supporting previous studies of theater students by Larson and Brown (2007). High stake situations, with important consequences were critically important in helping youth to understand how to process their own emotions. Even though the youth largely processed their emotions individually, significant others (e.g., coach modeling emotional control) and the program culture (e.g., team norms) were critical in how youth processed emotions and the emotions they addressed.

The Great Recess Framework: Evidence for an observational tool to measure the quality of recess

Massey, William V., Concordia University Wisconsin; Stellino, Megan B., University of Northern Colorado; Mullen, Sean P., University of Illinois; Wilkison, Megan, Concordia University Wisconsin; Claassen, Jennette, Playworks

Despite claims that recess is necessary for the development of children, recess is often assessed by levels of physical activity. While activity levels are one element of recess, other aspects, such as safety, adult engagement and empowerment have been overlooked. Furthermore, clear links between the recess environment and developmental outcomes (i.e., academic improvement, social-emotional growth) have yet to be established, as there does not exist a comprehensive tool to do so. The purpose of this study was to examine the validity, reliability, and stability of an observational tool (Great Recess Framework [GRF]) that measures the quality of recess. A 22-item scale was developed in conjunction with a national recess provider for initial testing. Exploratory structural equation modeling (Mplus v. 7.4) was used to examine the underlying measurement model. Data from a national sample of 649 recess sessions indicated an acceptable fit for a 4-factor model (CFI = .984, TLI = .971, RMSEA = .052, SRSM = .031). A subsequent analysis supported the validity of the measure as three of the four factors (structure and safety, adult supervision and engagement, student behavior) were positively associated with observed physical activity ($p < .001$). To examine the reliability of the measure, eight graduate students were trained and sent in dyads for observations at a sub-sample of 162 recess sessions. Raters were blinded to one another's scores and data was entered by an independent member of the research team. Weighted Kappa scores were computed for each item, with the majority of items representing very good or good agreement. An additional analysis revealed acceptable inter-rater reliability on each sub-scale (ICCs > .80) and on the total scale (ICC = .951, 95% CI, .932, .964). Finally, analyses were conducted to examine the stability of the measure. Results indicated a higher level of stability when using a three day average (ICC = .949, 95% CI, .882, .979; MDC = 4.62) across two time points as compared to a two day average (ICC = .855, 95% CI, .710, .930; MDC = 7.79).

The association of health risk behaviors, anxiety, and depression among middle and high school students in the South of Brazil

Mazzardo, Oldemar, Universidade Estadual do Oeste do Parana; Furtado, Jr., Ovande, California State University Northridge; Sampaio, Adelar A.; Chapla, Alan L.; Szczuk, Luis; Jacob, Bryan S.; Gomes, Sabrina R. W., Universidade Estadual do Oeste do Parana

Anxiety and depression are ailments that, when associated with risk behaviors, can affect health and psychosocial performance. The aim of this study was to verify the association between mental health and health risk behaviors. This study employed a correlational cross-sectional design. The sample consisted of 112 adolescents (52 males

and 60 females) ranging in age from 11 to 17 years ($M = 14.1$, $SD = 2.0$) from a private school in the municipality of Marechal Cândido Rondon, PR - BRAZIL. The sample was comprised of middle (58.9%) and high school (41.1%) level students. The health risk behaviors were monitored by the Youth Risk Behavior Surveillance Survey (alcohol and tobacco consumption), and the International Physical Activity Questionnaire - short version. Anxiety and depression were evaluated through the CDI and SCARED questionnaires. The descriptive analysis shows absolute and relative frequency data. The Mann-Whitney U test was used to compare differences between two independent groups and Spearman's rho (ρ) tested the associations. Descriptive data indicated that students were predominantly from high (38.4%) and middle (57.1%) SES level. There were high prevalences for insufficiency of physical activity behavior (53.6%), frequent use of alcohol (9.9%), risk of anxiety (17%), and depression (6.3%). Female students showed higher levels of anxiety ($p = .006$) and lower physical activity levels ($p = .049$) than males. No significant differences were found between students from middle and high school. Risk of depression correlated to risk of anxiety for the total sample ($p < .001$), females ($p < .001$) and males ($p = .004$). More importantly, there were significant negative associations between participation in moderate to vigorous physical activity and risk of anxiety for total sample ($\rho = -.215$; $p = .023$) and middle school students ($\rho = -.245$; $p = .047$). Female students are at higher risk of developing anxiety and insufficient physical activity behavior. Furthermore, physical activity and anxiety levels have inverse relationships, especially in middle schoolers.

Positive social bonds with staff build developmental assets and reduce risk behaviors among youth in a physical activity-based youth development program

McDavid, Lindley, Purdue University; Snyder, Frank, Central Michigan University; McDonough, Meghan H., University of Calgary; Ruiz, Yumary, Purdue University

Physical activity-based youth development programs create opportunities for young people to develop positive social bonds with program staff through shared experiences in active games and sport (Weiss, Smith & Stuntz, 2008). These social relationships help youth build developmental assets (e.g., self-worth and hope) that contribute to their well-being while also helping youth distance themselves from risk behaviors (e.g., substance use) that detract from their well-being (Catalano et al., 2004). Many youth programs are short-term (e.g., summer only) and may limit opportunities for the development of social relationships that support long-term well-being in youth. To examine if social bonds between staff and youth have a lasting effect on well-being in youth enrolled in a short-term program, we examined the longitudinal associations among social relationships and indicators of well-being (hope and self-worth) and risk behaviors (e-cigarette, cigarette and alcohol use) in youth enrolled in a 20-day summer program. Participants were youth ($N = 72$; 58% boys, 42% girls; $M_{age} = 9.6$ years $SD = 1.56$; 33% Latino/a, 33% White, 11% Black, 8% Multiracial, 4% Asian, 11% unreported) from low-income backgrounds who attended a physical activity-based youth development program for two consecutive summers. Surveys were administered near the end (Time 1) and beginning (Time 2) of the program nearly 11.5 months apart. Controlling for age, youth perceptions of staff at Time 1 positively predicted their perceptions of global self-worth ($\beta = .26$, $p = .03$) and negatively predicted self-reported risk behaviors ($\beta = -.42$, $p < .01$), but did not predict hope ($\beta = .16$, $p = .20$) at Time 2. These findings provide support for the relatively

long-term positive effects of participation in youth development programs for youth from low-income households. For these young people, the development of positive, social bonds with program staff, even in a relatively short time-frame, can have a lasting effect on their well-being by building developmental assets and reducing risk behaviors.

Evidence for Differential Effects of Sports-Related Concussion on Subtypes of Cognitive Flexibility

McGowan, Amanda L.; Bretzin, Abigail C.; Savage, Jennifer L.; LaFevor, Meghan E.; Petit, Kyle M., Michigan State University; Beidler, Erica, Duquesne University; Covassin, Tracey M.; Pontifex, Matthew B., Michigan State University

A growing body of evidence has demonstrated impairments in cognitive flexibility following a concussive injury, however a critical barrier to our understanding of this relationship is the utilization of assessments of cognitive flexibility that conflate switching between contextual rules and the shifting of visuospatial attention. As these different aspects of cognitive flexibility are subserved by distinct neural networks, the utility of a cognitive flexibility assessment following injury may be reduced depending upon the extent to which the task requires shifts in visuospatial attention relative to contextual rules. Accordingly, the current investigation examined the extent to which these aspects of cognitive flexibility may be differentially influenced following a concussive injury. Athletes with sports-related concussions (N = 32) were assessed within 72 hours of injury, 5 days following injury, after returning to play, and 45 days following returning to play. Match-control athletes (N = 33) were tested at the same intervals. Findings revealed that concussed athletes demonstrated impairments in task performance on a visuospatial attention-based cognitive flexibility task that persisted following the athlete returning to play, relative to non-concussed match-control athletes. No difference between groups was observed for performance on a contextual rule-based cognitive flexibility task. These findings suggest that concussive impacts differentially influence distinct aspects of cognitive flexibility, such that the utility of a cognitive flexibility task in detecting concussion-related impairments may be reduced depending upon the extent to which it relies upon contextual rule-based decisions. Test batteries focusing on visuospatial attention-based cognitive flexibility may aid in the evaluation and follow-up of athletes after a concussive injury.

The Effects of Acute Exercise Timing and Duration on Long-Term Memory

McHone, Ashley; Slutsky, Alexis B.; Kurtz, Kevin; Arunachalam, Sudharani; Labban, Jeffrey D.; Etnier, Jennifer L., University of North Carolina at Greensboro

Acute exercise is beneficial for memory in children and adults (Etnier et al., 2014; Labban & Etnier, 2011). Although exercise prior to exposure appears to be most beneficial for long-term memory (LTM), this condition has not been compared to exercise before and after a memory task. Our purpose was to investigate how exercise timing, in regards to a memory task, affects LTM. Twenty-two active adults (M=22.05, SD=3.1) were randomly assigned to 4 groups: 20-min of exercise prior to a memory task (n=7) (exercise before), 20-min exercise after a memory task (n=4) (exercise after), 10-

min exercise prior to and 10-min exercise following a memory task ($n=6$) (exercise before and after), and no exercise ($n=5$) (control). The exercise session consisted of moderate intensity (55-65% heart rate reserve) cycling on a recumbent bike and the memory task was the Rey Auditory Verbal Learning Test (RAVLT). On day one, dependent upon their assigned condition, participants exercised or rested on a recumbent bike prior to performing the RAVLT and then exercised or rested on the recumbent bike after completing the memory task. The following day (24-hrs later) participants returned to the lab and recalled List A of the RAVLT. Preliminary findings suggest a small beneficial effect on LTM with exercise before or exercise after as compared to control (before: $d=0.31$; after: $d=0.33$), however there was a much smaller benefit for exercise before and after as compared to the control group ($d=0.09$). Additionally, exercise before ($d=0.25$) and exercise after ($d=0.30$) resulted in better LTM compared to exercise before and after. These results suggest that 20-min of moderate intensity exercise performed in a continuous bout results in greater benefits for LTM, and it does not appear to matter whether the exercise is completed before or after exposure to the memory task. Results presented at NASPSPA will include an additional 58 participants and, hence, findings and conclusions will be adapted to reflect the final data analyses.

Intra-team communication and task cohesion: Examining the moderating effects of psychological climate

McLaren, Colin; Spink, Kevin S., University of Saskatchewan

The type and quantity of team member communication has been associated with perceived task cohesiveness in the sport setting (McLaren & Spink, in press; Sullivan & Short, 2011). However, the relationship between intra-team communication and task cohesion varies with type of communication examined, with the strongest relationships emerging between task cohesion and both acceptance and negative conflict communication. While relationships exist with other types of communication (distinctiveness, positive conflict), they are weaker. Given these differences in relationship strength, this study was designed to better understand the strength of each relationship by including a possible moderator. In terms of moderators, one variable related to task cohesion in past research is psychological safety (McLaren & Spink, 2015), which is the belief that one's investment in a group will be met with positive consequences. If positive consequences for group membership are anticipated, the relationship between communication and cohesion might be expected to be stronger (additive effect). To test for moderation, a general sample of team sport athletes ($N = 123$) completed an online survey containing measures of intra-team communication (acceptance, distinctiveness, positive conflict, and negative conflict; Sullivan & Short, 2011), psychological safety (Brown & Leigh, 1996), and task cohesion (ATG-T; Carron et al., 1985). Although results replicated the underlying relationships between intra-team communication dimensions and task cohesion, psychological safety was found to moderate the relationship between distinctiveness communication and task cohesion. Follow-up simple slopes analysis revealed that distinctiveness communication demonstrated a significant, positive relationship with task cohesion when psychological safety was low ($\beta = .27$). However, when athletes perceived greater psychological

safety, no relationship existed ($r = -.06$). Findings provide preliminary evidence that perceptions of the team climate may qualify how specific types of communication relate to task cohesion.

The influence of colors on speed perception

Mentzel, Stijn; Schuecker, Linda, University of Muenster; Hagemann, Norbert, University of Kassel; Strauss, Bernd, University of Muenster

Ever since the study of Hill and Barton (2005) showed that wearing red gear can favourably influence match outcomes, interest from the sport domain in color research has rapidly expanded. However, most of these studies focused on examining performance related parameters for dominance and aggression in combat or team sports (Hagemann et al, 2008; Krenn, 2015; Julio et al., 2015) with many other sport settings being overlooked.

The goal of this study was to examine if the proposed red-effect is also present in a non-competitive individual sport environment such as running on a treadmill. For this, 32 participants ($M = 23.81$ years, $SD = 2.74$ years, 15 female, all had at least one year of running experience), were asked to rate the perceived speed, force, posture, dynamics, economics, and fitness of 48 videos (20 seconds each) of runners on a treadmill at different speeds (10-16 km/h). The runner was randomly depicted either in a red or blue jersey, colour-manipulated to match for color properties, or an unmanipulated grey jersey, as a control condition. All other characteristics of the specific video were identical. Furthermore, a secondary colour association task (a stroop test) was added to examine if the individual colour association strength was related to judgements of running performance parameters.

The results showed a significant red-effect for speed, indicating that runners in red were perceived as running at higher speeds than runners in blue, $F(2, 62) = 16.22$, $p < .001$, $\eta^2_p = .34$. There was no differences for perceived speed between red and grey, which could be explained by the darker contrast of the unmanipulated grey shirt, as was previously shown by Little & Hill (2007). No clear red-effect was found for the other performance related parameters. Additionally, the color association task was not related to the running evaluation task. These findings indicate that in situations in which speed must be individually assessed (by an observers) red would be deemed as going faster, which could have an influence in sports such as racing or ball sports.

The "chicken or the egg" dilemma in self-efficacy theory: Testing self-efficacy and outcome expectation relationship for action planning behavior.

Michalovic, Emilie, McGill University; Latimer-Cheung, Amy E., Queen's University; Sweet, Shane N., McGill University

Background/purpose: Action planning is a successful behavioral technique to help individuals engage in physical activity. Action planning is a behavior and has its own psychosocial predictors. Self-efficacy theory (SET) can be used to predict action planning; but, the theoretical underpinnings of its key concepts, self-efficacy (SE) and outcome expectations (OE), are still up for debate. Specifically, the theoretical model hypothesizes that SE predicts behavior, mediated by OE; whereas, an empirical model

suggests that OE predicts behavior, mediated by SE. The purpose of this study was to longitudinally examine the two opposing models with action planning as the behavior. Methods: Individuals responded to an online questionnaire (N= 143; Mage= 31.9 [SD= 13.6]; 20% male) immediately after having read one of two action planning messages and one week later. After the message, participants rated their task SE for and OE of creating an action plan. One week later, they indicated if they wanted to create an action plan. Both message groups were collapsed for this study. Using the PROCESS macro for SPSS, mediation analyses were run to test both the theoretical and empirical SET models. Results: For the theoretical model, the indirect effect was not significant (beta= -.15, 95%confidence interval (CI): [-.45, .02]), as SE predicted OE (beta= .64, 95%CI: [.48, .81]) but OE did not predict action planning (beta= -.24, 95%CI: [-.52, .05]). For the empirical model, the indirect effect was significant (beta= .20; 95%CI: [.05, .45]) as OE predicted SE (beta= .46, 95%CI: [.34, .57]) and, in turn, SE predicted action planning (beta= .44, p= .01, 95%CI: [.09, .80], indicating mediation. Conclusion: Only the empirical SET model was supported for action planning as the behavior. Therefore, as individuals' OE increases, it predicted greater SE for action planning which in turn predicted greater likelihood of action planning. Future interventions may want to aim to increase the positive expectations associated with action planning to foster greater confidence in action planning.

A Balancing Act: Understanding the role of mother guilt and self-compassion in health-promoting behaviours in mothers with young children

Miller, Cindy; Strachan, Chaelyn, University of Manitoba

Societal expectations of the 'good mother' include the sacrifice of a mother's own needs to meet her family's needs. Consequently, some mothers feel guilt about focusing on themselves to engage in healthy behaviours like physical activity, healthy eating and good sleep. Self-compassion, treating oneself kindly in difficult times, has a mitigating influence on negative emotions, including guilt and is associated with healthy behaviours. Self-compassion may relate to mothers' guilt about and actual engagement in healthy behaviours. The purpose of this research was to explore how mothers negotiate feelings their guilt about taking time to engage in healthy behaviours (mother guilt) by considering levels of self-compassion and the relationship of these variables with healthy behaviours. We hypothesized that: 1) Mother guilt will negatively relate to healthy behaviours, 2) Self-compassion will positively relate to healthy behaviours, 3) Self-compassion will negatively relate to mother guilt, and 4) Mother guilt will mediate the relationship between self-compassion and healthy behaviours. In this online, cross-sectional study, 143 mothers of young children completed measures of self-compassion, mother guilt, trait guilt, healthy behaviours, self-esteem, and demographics. Hypotheses one to three were tested using hierarchical regression analyses. Self-compassion negatively related to mother guilt (beta = -.245, p < .001) after controlling for self-esteem and trait guilt. Self-compassion positively related to healthy behaviours (beta = .239, p < .05) after controlling for self-esteem, while mother guilt was negatively related to healthy behaviours (beta = -.955, p < .05) after controlling for trait guilt. To test hypothesis four, mediation analysis was conducted using the PROCESS macro for SPSS with bootstrapping resampling methods. No indirect effect was found. Findings contribute to

our understanding of mothers' guilt as a negative influence on healthy behaviours and confirm the relationship between self-compassion and healthy behaviours in this unique population.

Awareness of Error Among Skilled and Less Skilled Shooters: Think Aloud Protocol

Monfared, Shamsi Sanati; Tenenbaum, Gershon; Folstein, Jonathan; Ericsson, Anders K., Florida State University

The study of expertise and superior performance seem more imperative when the performance is observed in real-life situations, such as under life-threatening ones - for instance among surgeons or police officers. The present study examined the performance of expert marksmanship through the observation of error-detection awareness, an essential anticipatory and cognitive skill in expert performance. A pilot study was performed and distinguished skilled and less-skilled shooters in the proficiency of estimating performance error. Although both groups showed a decrement in the estimation of an error when the outcome was eliminated, less-skilled shooters' error-awareness significantly declined when shifting from visual to occluded vision condition. Moreover, the study focused on a bi-directional method which consists of two perspectives - neurocognition and cognitive psychology. The former highlights the importance of using the neuroimaging tools (e.g., EEG) in studying the neural basis of cognitive skills. The error-related negativity (ERN) component was specifically used in this study to monitor the conflict/mismatch between the actual and expected performance (Botvinick, Braver, Barch, Carter, & Cohen, 2001). The latter, however, takes a traditional, yet effective perspective, in perceiving mechanism underlying cognitive-motor tasks - analysis of retrospective verbal reports (Ericsson & Simon's think aloud protocol, 1984). Both approaches rely on exploring chronometric representations of warning stimulus, which is proceeded by an imperative stimulus (Tenenbaum and Summers' model, 1997) for exploring the error-detection phenomenon. Applying these two methods simultaneously advances knowledge and provides a deeper exploration of error-detection in the study of expert marksmanship.

Funding Source: Florida State University

Replication Study of the Strength & Conditioning Sport Psychology Questionnaire with NCAA Strength & Conditioning Coaches

Moore, E. Whitney G., Wayne State University; Quartirol, Alessandro, University of Wisconsin, Lacrosse; Zakrajsek, Rebecca A., University of Tennessee Knoxville

The Strength and Conditioning Sport Psychology Questionnaire (Radcliffe, et al, 2013) was developed to measure how frequently Strength and Conditioning Coaches use of seven different sport psychology techniques (e.g., goal setting, attention control, activation). The initial development of this instrument was tested with 102 certified Strength and Conditioning Coaches. The purpose of the current study was to replicate the use of this measure with a sample of NCAA Strength and Conditioning Coaches (N = 406, 83% Male). None of the reliabilities for the individual subscales reached the reduced Cronbach alpha level .60. A configural model also revealed poor model fit within

the subscales, and high correlations across the subscales. Since the total score was also used by Radcliffe and colleagues (2013), the total score was assessed for reliability with the current data ($\alpha = .78$, CR = .84). The configural model revealed good fit (Chi-square = 166.641, $p = 1.00$; SRMR = .105). However, not all items strongly loaded onto the SCSP construct, therefore, after item pruning, the best fitting model had 22 items (Chi-square = 95.14, $p = 1.00$; SRMR = .047, CR = .80). This model retained at least one item from each subscale, except adherence (all loadings < .26). Then, based upon significant differences found previously based upon certification organization and years of coaching experience, two multi-group models were conducted to assess the measurement invariance and homogeneity of latent parameters across these parameters. Measurement invariance and latent parameter homogeneity was found between those who did and did not hold the Strength and Conditioning Coach Certified credential. Next, across the three experience groups (4 years, 5-9 years, or 10 years), measurement invariance and latent parameter homogeneity was supported across all three groups. Results from this analysis suggest that further work in item wording and measure structure are likely warranted before this measure can be used with confidence across samples to provide results of consistent quality.

Steps in the right direction: The relation between achievement goals and self-compassion in male varsity athletes.

Mosewich, Amber D.; Pynn, Shannon R.; Neely, Kacey C.; Holt, Nick L., University of Alberta

Emotions and cognitions about the self contribute to achievement goal formation and pursuit (Linnenbrink & Pintrich, 2002). As such, an athlete's tendency to adopt certain types of achievement goals may be related to self-compassion. Self-compassion is conceptualized as a healthy and positive self-attitude that involves extending support, kindness, and understanding to oneself in times of difficulty or failure, promoting adaptive outcomes and frames of mind (Neff, 2011). Despite evidence suggesting self-compassionate athletes are actively engaged, take initiative, and assume responsibility for their thoughts, emotions, and actions, some athletes fear self-compassion will detract from improvement and achievement striving (Ferguson et al., 2014). Examining the relation between self-compassion and specific goal orientations will help to delineate the focus of the pursuits in which self-compassionate athletes engage. Using the 3 x 2 achievement goal framework (Mascret et al., 2015), the relations between self-compassion, achievement goal orientations, personal initiative, and passivity were explored in male varsity athletes. Athletes ($N = 120$; mean age = 20.83 years; $SD = 1.92$ years) completed the Self-Compassion Scale (Neff, 2003), Achievement Goal Questionnaire for Sport (Mascret et al., 2015), and a sport modified measure of personal initiative and passivity (Frese et al., 1997). Pearson correlations revealed that self-compassion was positively related to self-approach goals ($r = .22$, $p < .05$) and negatively related to task-avoidance goals ($r = -.25$, $p < .01$) and other-avoidance goals ($r = -.21$, $p < .05$). While there was no significant relation between self-compassion and personal initiative, self-compassion was negatively related to passivity ($r = -.22$, $p < .05$). Results provide support for the association between self-compassion and adaptive frames of mind and approaches regarding sport goals. From an applied perspective, sharing these findings with athletes may play a role in attenuating reluctance towards self-compassionate approaches in sport.

Diversity in Group Exercise Contexts: Further Tests of the Kohler Effect

Moss, Omotayo; Mac Intosh, Andrew; Kerr, Norb; Feltz, Deborah, Michigan State University

The Kohler motivation gain effect (i.e., when an inferior team member exerts more effort when paired with a more capable partner, from knowledge of his/her individual performance) has been established as a robust phenomenon in group contexts (Felt et al., 2014). Furthermore, research has found that ingroup/outgroup memberships can play a role in group member motivation, and hence, in group performance (Kerr & Hertel, 2011). However, the exploration of racial outgroups/ingroups has yet to be assessed in the Kohler paradigm. Furthermore, there has not been much research on how racial diversity in groups can affect performance. The present investigation examined how racial diversity in dyads might moderate the Kohler motivation gain effect. Based on stereotype research, we hypothesized that White participants paired with a Black partner will lead to motivational losses compared to motivational gains when being partnered with an Asian partner. Participants (N=22 male, Caucasian, college-aged students) were randomly assigned to one of three conditions: White partner (WP; control), Black partner (BP), or Asian partner (AP). Participants performed the first series of plank exercises alone. After resting, participants performed the remaining trials with a same-sex human partner. The partner's performance was manipulated to be always moderately better than the participant's. A preliminary one-way analysis of variance for Condition with the current sample found a significant effect, $F(2,22)=5.36$, $p<.05$. Post-hoc Tukey tests indicate that participants in the BP group persisted significantly less than did participants in the WP group ($p=.033$). Further, Cohen's effect size value ($d=1.33$) suggested a strong effect between BP and WP conditions, which supports our hypothesis. However, the hypothesis that the AP would show a stronger effect than the WP condition was not supported ($d=0.11$). Results suggest White males may have been influenced by a stereotype that Blacks are superior athletically, thus keeping up with the BP seemed unachievable.

Identifying the differences of anthropometric, physical, motor coordination and cycling specific characteristics of young cyclists from five different cycling disciplines (BMX, road cycling, track cycling, MTB and cyclo-cross)

Mostaert, Mireille, Ghent University Belgium; Deconinck, Frederik; Wazir Norjali Wazir, Mohd Rozilee; Robertson, Kamasha, Ghent University, Belgium; Pion, Johan, HAN University of Applied Sciences; Lenoir, Matthieu, Ghent University, Belgium

In cycling, different disciplines demand different characteristics of athletes. Currently, information on characteristics of young cyclists, the key population in talent programs, is lacking. The aim of the present study was to investigate if young athletes, from 5 cycling disciplines, can be distinguished from each other based on a generic test battery. A total of 251 male cyclists (7–16years) participated in the study. The sample was divided into 2 groups of athletes based on their age: 92 male cyclists (7–11years) and 159 male cyclists (12–16years). The athletes were active in 1 of the following disciplines: BMX, road cycling, road + cyclo-cross, road + track cycling and MTB. They were

exposed to a generic test battery consisting of 4 anthropometric, 7 physical, 3 motor coordination tests and 1 cycling-specific test performed on a cycle ergometer. MANCOVA was interpreted as maturity offset was shown to have an influence on the generic test results ($F=275,203$; $p<0.001$). Within the age group of 7 to 11 years of age, the BMX cyclists performed better in the explosive physical tests such as the 30m sprint and standing broad jump than the other disciplines. Within the group of 12 to 16 years of age, BMX was significantly distinguished from (all) most of the other disciplines on the basis of different anthropometric characteristics (BMI), explosivity (SBJ, 30m sprint), motor coordination (jumping sideways, balance beam) and the cycling specific tests (maximal cadence test). MTB seemed to perform better on the balance beam test while track cyclists performed better on the sprint test than the cyclo-cross and/or road cyclists. BMX is the only discipline that can be distinguished from the other cycling disciplines at a young age. As the athletes' grow older, their physical profile becomes more distinguishable from each other, probably due to a combination of training and natural (de-)selection of athletes with a profile that is less fit to the demands of the discipline.

Mechanisms explaining the effect of coach feedback on athletes' motivation, persistence, and performance: Two experimental studies

Muynck, Gert-jan De, Ghent University, Belgium; Vansteenkiste, Maarten; Delrue, Jochen; Aelterman, Nathalie, Ghent University, Belgium; Vandebroek, Gert, KU Leuven; Soenens, Bart, Ghent University, Belgium

Self-Determination Theory (SDT; Deci & Ryan, 2000) stresses the importance of the satisfaction of the psychological needs for autonomy, competence, and relatedness for athletes' quality of motivation and performance. There is an abundance of correlational evidence supporting this claim in the context of sport (e.g. Adie, Duda, & Ntoumanis, 2008). However, experimental field studies are rather scarce. One critical way to support athletes' basic psychological needs is by the provision of feedback, with feedback valence (i.e. positive versus negative) hypothesised to impact on competence need satisfaction and with feedback style (i.e. autonomy-supportive versus controlling) hypothesised to impact on autonomy need satisfaction. In addition, coach feedback may also elicit self-talk among athletes (Zourbanos, Hatzigeorgiadis, & Theodorakis, 2007), with athletes adopting the supportive or critical voice of their coach in the way they communicate with themselves. Grounded in SDT, the present set of experimental field studies sought to examine how coach feedback impacts on athletes' intrinsic motivation, behavioural persistence, and performance via experiences of need satisfaction and elicited self-talk. The first study ($N=120$, $Mage = 24,5$) indicated that positive, relative to negative, feedback and autonomy-supportive, relative to controlling, feedback promoted adaptive outcomes, with need satisfaction and coded self-talk together explaining these benefits. The second study ($N = 90$, $Mage = 15,6$), focusing on feedback valence and including multiple assessments of the intervening variables, examines whether induced positive feedback elicits a positive and self-perpetuating reciprocal relation between need based experiences and self-talk. Results of this second study will be presented at the conference but are not yet available at this time.

Well-Being Self-Efficacy and Complier Average Causal Effect Estimation: A Substantive-Methodological Synergy

Myers, Nicholas D., Michigan State University; Prilleltensky, Isaac, University of Miami; Hill, Christopher R.; Feltz, Deborah L., Michigan State University

The purpose of this study was to provide a substantive (i.e., well-being self-efficacy) - methodological (i.e., complier average causal effect estimation) synergy of potential importance to future research in the psychology of sport and exercise with original (well-being self-efficacy scale) and secondary (compliance behavior with the intervention) data analyses from the Fun For Wellness intervention. Fun For Wellness is a new online intervention designed to promote growth in well-being. Well-being self-efficacy is a proposed mechanism by which the effect of Fun For Wellness on well-being may be transmitted. Complier average causal effect estimation is a methodology that estimates the effect of complying with an intervention. The study design was a prospective, double-blind, parallel group randomized controlled trial (RCT) detailed in Myers, Prilleltensky, et al. (2016). Data were collected at baseline, 30 days- and 60 days-post baseline. A total of 479 adult employees at a major university in the southeast of the United States of America were enrolled. A two-class linear regression model with complier average causal effect estimation was fitted to well-being self-efficacy scores at 30- and 60-days. The adjusted mean difference in well-being self-efficacy scores for participants who complied with the intervention, as compared to compliers in the Usual Care group, was equal to 0.21, $p = .061$, Cohen's $d = 0.36$ at 30-days and 0.28, $p = .050$, Cohen's $d = 0.49$ at 60-days. Complier average causal effect estimation may be a useful approach for RCTs in sport and exercise psychology when at least some of the participants do not comply with the intervention.

Training Group Exercise Class Instructors to Adopt a Motivationally-Adaptive Communication Style: A feasibility/pilot study

Ntoumanis, Nikos; Thøgersen-Ntoumani, Cecilie; Quested, Eleanor, Curtin University; Hancox, Jennie, University of Nottingham

Drawing from Self-Determination Theory (Deci & Ryan, 2002), we developed and tested an intervention to train fitness instructors to adopt a motivationally adaptive communication style when interacting with exercisers. This was a parallel group, two-arm quasi-experimental design. Participants in the intervention arm were 29 indoor cycling instructors ($n = 10$ for the control arm) and 246 class members ($n = 75$ for the control arm). The intervention consisted of face-to-face workshops, education/information video clips, group discussions and activities, brainstorming, individual planning and practical tasks in the cycling studio. Instructors and exercisers responded to validated questionnaires about instructors' use of motivational strategies and other motivation-related variables before the first workshop and at the end of the third and final workshop (4 months later). Time x arm interactions using

multilevel modeling revealed no significant effects, possibly due to the large attrition of instructors and exercisers in the control arm. Within-group analyses in the intervention arm showed that exercisers' perceptions of instructor motivationally adaptive strategies, psychological need satisfaction and intentions to remain in the class increased over time. Similarly, instructors in the intervention arm reported being less controlling and experiencing more need satisfaction over time. Interviews of instructors and exercisers showed that the program was positively received and was felt to improve instructors' communication skills. Ratings by instructors of perceived usefulness and clarity of intervention material (workshops, online material, practical exercisers) were very high. These results offer initial promising evidence for the positive impact of the training.

Seat so you don't forget: How exercise intensity can moderate the benefit of exercise breaks on learning

Ogrodnik, Michelle; Fenesi, Barbara; Lucibello, Kristen; Kim, Joseph A.; Heisz, Jennifer, McMaster University

Student attention during a university lecture typically declines as the lecture progresses, negatively affecting learning and memory for the presented material. Our prior work showed that exercise breaks during a university lecture improved student attention and learning. Participants watched a 50-minute online lecture while intermittently taking exercise breaks, cognitive breaks (computer game), or no breaks. The exercise breaks (5-min of high intensity exercises) significantly improved on-task attention throughout the lecture ($p < .05$), which translated into improved learning compared to other conditions on immediate testing and after a 48-hour delay ($p < .05$). Although promising, high-intensity exercises may be an entry barrier for a growing population of sedentary university students. Our current work aims to determine whether reducing the intensity of the exercise breaks can still yield similar benefits, leading to greater feasibility for implementation. Interestingly, previous research shows no added benefit of high-intensity over moderate-intensity exercise on cognitive performance, particularly with complex tasks. We compared a no breaks condition to exercise breaks of high, medium or low intensity. Preliminary results ($N=51$) suggest similar attention ($p = .42$) and memory ($p = .52$) benefits for all three exercise intensities; critically, there was significantly better memory performance for the low-intensity exercise breaks compared to no breaks ($p < .05$). These results suggest that intermittent low-intensity exercise may be the minimum effective dose for promoting on-task attention and memory for learning. Additional lab research will continue to refine the exercise prescription leading to a classroom implementation study to document the impact of physical activity on learning performance across an academic term.

Positive Illusory Bias in the Physical Domain and Cognitive Functioning among Children with ADHD Symptoms

Oluyedun, Olufemi A.; Smith, Alan L.; Pontifex, Matthew B.; McAlister, Anna; Hauck, Janet L., Michigan State University

Children diagnosed with Attention-Deficit/Hyperactivity Disorder (ADHD) have been shown to overestimate their competence in comparison to adult-report or objective performance markers (Hoza et al., 2004). This phenomenon is referred to as positive illusory bias (PIB). Research on PIB has largely focused on children's perceived competence within the academic, social, and behavioral domains (Owens & Hoza, 2003), yet PIB in the physical domain has been tied to preferred sources of competence information in typically developing children and has potential motivational implications (Horn & Weiss, 1991). In children with ADHD, PIB may stem from underlying cognitive deficits. Few studies have examined PIB in relation to cognitive dysfunction, and therefore our purpose was to assess if higher-order cognition may underlie PIB in children with ADHD symptoms. We hypothesized such children would overestimate their competence relative to parent-report and that PIB would be more pronounced with greater cognitive dysfunction. Participants (N = 28; age M = 9.6, SD = 1.3 years) expressing ADHD symptoms (inattentive M = 6.9; hyperactive M = 5.5) attended one laboratory session where they completed self-report measures of competence, computerized interference (modified flanker) and working memory (n-back) tasks, and a motor proficiency battery. Parents completed demographic information, a rating of ADHD symptomatology, and a rating of child competence. Though not significantly different, $t(27) = 1.52$, $p = .14$, child reports of physical competence were generally higher than parent reports. Hierarchical regression analysis showed flanker incongruent median reaction time ($F(1, 23) = 5.34$, $p < .05$) to explain 18% of PIB variance above and beyond age, gender, and symptom count covariates. Faster reaction time associated with greater PIB. The other cognitive variables did not explain PIB. Overall, this unique study of PIB yielded modest preliminary findings, yet suggests there is potential in exploring the intersection of cognitive dysfunction and self-perceptions of children with

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Sibling influence on youth's sport participation across adolescence: Models or foils?

Osai, Keith V.; Whiteman, Shawn D.; Blazo, Jordan A., Utah State University; Dorsch, Travis E., Louisiana Tech University

More than 80% of American youth grow up in homes with siblings (McHale et al., 2012). Despite their centrality, the role of sibling relationships, and in particular, sibling influence has been neglected in the youth sport literature. The goal of the present study was to address this gap and examine how siblings' sport-related skills and participation related to youth's subsequent participation in sports. Testing opposing theories of sibling influence, we investigated whether links between siblings' sport-related skills and activities were better explained via social learning processes (e.g., Bandura, 1977) or sibling deidentification principles (e.g., Schachter et al., 1976). Participants included mothers, fathers, and first- (M = 10.9 years at Time 1) and second-born (M = 8.3 years at Time 1) siblings from 201 families that were followed for seven years. In each study

year, we used two data collection procedures. First, in annual home interviews, family members were questioned separately about their personal qualities (e.g., sport-related interests and skills) and relationship experiences. Second, during the three to four weeks following the home interview each year, a series of seven evening telephone interviews that focused on youth's daily activities were conducted. From these calls, we derived measures of time spent participating in sport-related activities. A series of multi-level models incorporating lagged effects of sibling influence revealed that, consistent with social learning processes, siblings' participation in sport-related activities were related to increases in youth's subsequent participation, controlling for earlier participation. Further, inconsistent with deidentification principles, siblings' sport-related skills were positively associated with change in youth's participation in sport-related activities. In short, results indicate that siblings are important socializers of youth's participation in sport-related activities, and as such warrant additional attention in future research.

Examining the Complex Relationship between Feedback, Self-Efficacy and Performance

Ouellette, Gene; McPhee, Kathryn, Mount Allison University

This study examined the differential effects of positive or negative-oriented feedback, much like the types a coach would use, on participant self-efficacy and performance. There is now a growing literature on the role of self-efficacy in sport (eg., Beattie et al., 2016; Wright et al., 2016). Meanwhile studies on feedback have shown the powerful influence it has on performance (eg., Badami et al., 2012; Kluger & DeNisi, 1996). What is less clear is how the type of feedback given interacts with both self-efficacy and performance.

In the present study, we provided all participants with objective, knowledge of results feedback, while manipulating the nature of motivational feedback by focusing on positive outcomes/effort versus a focus on less favorable outcomes/effort. We also measured task-specific self-efficacy, allowing for a full evaluation of the relations between the 3 constructs: motivational feedback, self-efficacy, and performance.

Forty-six undergraduate students participated. The task used was golf putting. Points were awarded for proximity to the cup. There was one practice trial and four experimental trials; each consisting of 12 putts. The total points per trial were tallied on a whiteboard providing continual objective knowledge of results feedback. Task-specific self-efficacy was measured after each trial (see Beattie et al.). All participants received scripted feedback 6 times in each trial; half of the participants received feedback that focused on negative performance/effort; the other participants received feedback focused on positive performance/effort.

Results indicated a strong relation between self-efficacy and performance, with a moderating role of feedback. Positive-oriented motivational feedback brought about increased self-efficacy and performance; more negative feedback was associated with decreased self-efficacy and performance. Noteworthy, the relationship between self-efficacy and performance was stronger in the positive feedback condition. Results are discussed with reference to self-determination theory and coaching.

A Meta-Analytic Review of the Relationship between Social Constructs and Athlete Burnout

Pacewicz, Christine E.; Mellano, Kathleen T.; Smith, Alan L., Michigan State University

Athlete burnout is a maladaptive outcome of sport participation that is characterized by perceptions of emotional and physical exhaustion (EX), reduced accomplishment (RA), and sport devaluation (DV) (Raedeke, 1997). Because social relationships can contribute to athlete burnout (Coakley, 1992; DeFreese & Smith, 2014), various social constructs have been explored in athlete burnout research. Cataloguing the findings of this work could be valuable in directing future research on social contributors to burnout perceptions. Accordingly, the purpose of our study was to systematically review and quantify the relationship between social constructs and athlete burnout. Studies were identified through electronic databases and manual searches using specific search terms. Social support and relatedness were frequently studied in the athlete burnout literature and were included in the meta-analysis. Other social constructs (e.g., social constraints, conflict, coach-athlete relationship quality) appeared in only one or two studies and were not included in the meta-analysis. A total of 16 studies met the inclusion criteria (social support, $N = 7$; relatedness, $N = 9$). Random effects models were applied with results showing low-to-moderate relationships between the burnout dimensions and social support ($EX = -0.32$, $RA = -0.40$, $DV = -0.34$). Similar results were found with relatedness ($EX = -0.22$, $RA = -0.36$, $DV = -0.34$). The results indicate that higher social support and relatedness perceptions are associated with lower athlete burnout perceptions, verifying that social relationships warrant attention in athlete burnout research. The results also highlight that a relatively narrow slice of social experiences have been explored in athlete burnout literature. Only social support and relatedness have been persistently studied, which limits our potential understanding of how social relationships can mitigate or intensify burnout perceptions. Future research should examine an expanded set of positive and negative social constructs to more fully understand athlete burnout.

Keep smiling with HIT: The effects high-intensity interval training on mental health outcomes and the acute inflammatory response

Paolucci, Emily M.; Heisz, Jennifer J., McMaster University

Mental illness is the leading cause of disability worldwide; thus, long-term affordable treatments need to be investigated. Our previous study examined how exercise dose affects mood and inflammation in a sedentary student population. The six-week intervention found that depressive symptoms decreased with both moderate and high-intensity interval training (HIT). However, both anxiety and pro-inflammatory cytokine IL-6 were higher for HIT, suggesting that the increase in IL-6 from HIT is linked to increased anxiety. This follow-up study investigated the effects of HIT on mood and inflammation in university students across 11 weeks, allowing further time for sedentary individuals to physically adapt to HIT. Surveys were completed weekly for depression (BDI-II), anxiety (BAI) and perceived stress (PSS). To assess IL-6 levels, blood samples were taken before and directly after their VO₂ max tests at weeks 1, 6, and 11. It was hypothesized that HIT would improve mood and attenuate the acute IL-6 response immediately after exercise with extended training. Forty-six participants were randomized into either: 1) HIT group, who exercised three times per week and 2) Active control

group, who remained sedentary except for the three VO2 max tests, but were told that they were part of an acute exercise group. The rise in IL-6 immediately after exercise was attenuated significantly at week 11 compared to weeks 1 and 6 for the HIT group ($p = 0.01$), suggesting that HIT induced physical adaptations in IL-6 in the latter half of the intervention. Additionally, though there were no group differences in anxiety at week 1, and higher levels for HIT compared to controls at week 6; by week 11 HIT had lower levels of anxiety ($p = 0.001$), matching changes in IL-6. Critically, these results suggest that HIT may be able to decrease anxiety by decreasing the IL-6 response with training. Although IL-6 changes were observed only for the HIT group, depression decreased significantly across the intervention for both groups ($p < 0.001$), pointing to a potential placebo effect of HIT on depression.

Invariance testing and factor analysis of the Group Conflict Questionnaire

Paradis, Kyle F., University of Western Ontario; Martin, Luc J., Queens University; Harenberg, Sebastian, Ithaca College

Intragroup conflict can be defined as 'a dynamic process that occurs between interdependent parties as they experience negative emotional reactions to perceived disagreements and interference with attainment of their goals' (Barki & Hartwick, 2004, p. 234). Building on this constitutive definition, the development of the Group Conflict Questionnaire (GCQ; Paradis, Carron, & Martin, 2014) has enabled researchers to operationally define intragroup conflict, which is an important construct to understand as it is prevalent in sport settings (e.g., Holt et al., 2012; Mellalieu et al., 2013). Considering the recent development of the measure, and that establishing validity is an ongoing process (Carron et al., 1985), further utilization and validation of the inventory is warranted. Thus, the purpose of the present investigation was to further validate the GCQ through factor analysis and invariance testing. A total of 742 (female $n = 413$, male $n = 329$, Mage = 19.51, SD = 1.87) competitive ($n = 528$) and recreational ($n = 214$) athletes (starters $n = 622$, non-starters $n = 120$) completed the questionnaire. Results of the confirmatory factor analysis indicated an acceptable factor structure with good model fit ($\chi^2/df = 6.50$, CFI = .94, TLI = .93, NNFI = .93, RMSEA = .086, 90%CI .079- .093), and excellent internal consistency (Cronbach's alpha = .92) for the subscales of task and social conflict. The invariance testing also revealed evidence of model invariance across gender, competition level, and starting status ($\Delta CFI < .01$) for measurement weights and intercepts as well as structural covariances. The results from the current investigation indicate that researchers can continue to utilize this measure of intragroup conflict with confidence in their research. Future directions are discussed such as the assessment and appropriateness of the measure in other populations (e.g., youth sport athletes) and translation to other languages (e.g., Kashani, 2016).

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Acute Physical Activity Modulations of Attentional Processes and Error-Monitoring in High- and Low-Anxious Females

Parks, Andrew C.; Delli Paoli, Anthony G.; Schroder, Hans S.; Moser, Jason S.; Pontifex, Matthew B., Michigan State University

A growing body of literature indicates that individuals with elevated levels of anxiety exhibit exaggerated error-related negativity (ERN) and diminished attentional processes (P3) due to increased worry and distractibility. Although, evidence has suggested transient enhancements of neuroelectric indices of attention following physical activity, the extent to which physical activity may influence attentional processes and performance monitoring in individuals with anxiety is not well understood. Therefore, the current study sought to examine the effects of acute aerobic physical activity on the neuroelectric indices of attention and performance monitoring following errors in high- and low-anxious female undergraduates. Using a within-subjects design, event-related potentials and task performance were assessed in response to a modified flanker task immediately prior to and following acute physical activity or seated rest during two separate, counterbalanced sessions. Anxiety group status was determined based on scores on the Penn State Worry Questionnaire. Findings demonstrated physical activity induced enhancements in neuroelectric indices of attention regardless of anxiety group. Although both high and low-anxious groups also exhibited physical activity induced enhancements in performance monitoring, the magnitude of the effect was diminished for individuals with high-anxiety. These findings indicate a beneficial effect of acute physical activity on both attention and performance monitoring in relation to seated rest. In addition, anxiety seems to reduce the beneficial effects of physical activity on performance monitoring after an error.

Group dynamics within cooperative youth environments: A scoping review

Petersen, Brennan; Watson, Kody; Eys, Mark, Wilfrid Laurier University; Evans, Blair, Pennsylvania State University

Group dynamics research has expanded beyond its roots in organizational/social psychology and has become an important area of research in other fields, particularly sport psychology. Whereas most attempts to study group processes have focused on adults, there is a growing interest in youth settings - particularly in sport, where group environments can support a number of positive outcomes. Examining the nature of the research surrounding youth group contexts at large can provide a deeper understanding of how to guide future research in youth sport. To that end, this review was conducted to explore the scope of the literature examining group dynamics in cooperative youth contexts (e.g., sport, school, recreational groups). A systematic search of the literature was conducted. Data were then extracted from the articles identified as relevant and then synthesized. The guidelines for conducting a scoping review laid out by Arksey and O'Malley (2005) were used as a framework for the present study. Additionally, the Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines were consulted in designing the search protocol. Relevant articles were identified through a search of academic databases and a manual search of applicable peer-reviewed journals. Inclusion and exclusion criteria were applied during the abstract screening and full-text review processes, which was managed using article database software (i.e., Mendeley). In the final review, 32 studies were assigned to one of three categories: (a) sport contexts, (b) school class contexts, and (c) recreational contexts. Based on these studies, research focused on school class contexts demonstrated more variation in regard to research method, sample age, and group dynamics constructs assessed than

research focusing on sport and recreational contexts. This review highlights pathways to a greater understanding of group dynamics in youth sport and encourages a sustained focus of research with adolescent sport group participants.

New Perspective of Burnout Syndrome: Body Movement of Burnout Patients. A Controlled Study

Pfeffer, Manuela M.; Paletta, Andrea, University of Graz

Despite there being numerous scientific burnout surveys, the vagueness of the definition of burnout syndrome and the differentiation to other psychiatric disorders indicate that new perspectives could be helpful for a better understanding of the burnout construct. The body movement of burnout patients has not been investigated yet therefore the aim of this study is to obtain a deeper understanding of burnout syndrome by increasing our knowledge of the body movement of these patients. Hospitalized burnout patients ($n = 22$; $\bar{x} = 47.2 \pm 9.1$ years) and a healthy control group ($n = 20$; $\bar{x} = 41.5 \pm 15.0$ years) participated in a standardized movement sequence with verbal instructions such as 'Please try to represent the element 'earth' with your movements'. The Burnout Inventory Scale (Geuenich & Hagemann, 2014) along with psychiatrists, was used to confirm/eliminate the diagnosis. Two certified movement-analysts independently rated each participant via video by using the Effort System of Laban Movement Analysis (1960), which is an instrument of dance therapy and behavior observation. Inter-rater reliability was tested with Cohen's Kappa and the differences between the groups with the Mann-Whitney U-Test. Results show a substantial to almost perfect rater-agreement: Kappa = .66-.92 ($p < .001$), 95% CI ($\geq .457$, ≤ 1.009). Burnout patients have notable deficits in their body movement so there are significant differences between the burnout patients and the control group in all four Effort elements of Laban Movement Analysis (Flow, Space, Time, Weight): Burnout patients show very significantly less frequent Bound, Indirect and Light movements and they show significantly less frequent Sustained movements in comparison to the control group. Compared to depression (Welsche, 2010) and other psychiatric disorders (Bender, 2010; Shenton, 1990) literature shows that patients have no deficits in their Bound movements; quite the contrary: they have a preference for Bound movements. Therefore, our findings could give additional indications for differential diagnostics and the burnout construct.

Investigating the association between burnout and quality of life: Does physical activity moderate the association?

Phillips, Emily Wolfe; Gaudreau, Patrick; Brunet, Jennifer, University of Ottawa

BACKGROUND: University students regularly deal with a combination of academic and non-academic demands. If students feel that the demands they are facing exceed their capability to deal with these demands, burnout (i.e., a state of emotional exhaustion, physical fatigue, and cognitive weariness) may ensue. In this study, we sought to explore if: (1) university students' experiences of emotional, physical, and cognitive burnout are associated with their mental and physical quality of life (QoL), and (2) moderate-to-vigorous intensity physical activity (MVPA) moderates these associations. **METHODS:** University students ($N=738$; mean age=19.6 years, $SD=3.6$) completed an online

questionnaire in the Fall of 2016. Data were analyzed with two hierarchical linear regression analyses, which controlled for age, sex, number of exams/assignments, and students' target grade point average in Step 1. RESULTS: In the first model, emotional ($\beta = -.13$), physical ($\beta = -.15$), and cognitive ($\beta = -.12$) dimensions of burnout were significant and negative correlates of physical QoL in Step 2 ($R^2 = .12$), and MVPA was a significant and positive correlate in Step 3 ($\beta = .08$, R^2 change = .007). In the second model, emotional ($\beta = -.11$), physical ($\beta = -.46$), and cognitive ($\beta = -.23$) dimensions of burnout were significant and negative correlates of mental QoL in Step 2 ($R^2 = .52$), but MVPA was not significantly associated with mental QoL. MVPA did not moderate the associations between the different dimensions of burnout and QoL in Step 4 in either model. CONCLUSIONS: Our study adds to existing studies showing a link between general burnout and QoL, and highlights the associations between the specific dimensions of burnout (i.e., emotional, physical, cognitive) and different dimensions of QoL (i.e., mental, physical) among university students. Further, although our findings on the moderating role of MVPA were nonsignificant, the pattern of results suggests that MVPA may help to promote physical QoL in this population.

Teacher-Coach Perceptions of Life Skills Transfer from High School Sport to the Classroom

Pierce, Scott, Illinois State University

Recent positive youth development (PYD) frameworks have posited that youth can implicitly develop life skills through general interactions in the youth sport climate and explicitly through direct teaching of life skills from coaches (Holt, Neely, Slater, Camiré, Coté, Fraser-Thomas, MacDonald, Strachan & Tamminen, 2016). However, life skills do not necessarily transfer from sport to life domains such as the classroom, where the transfer environment and the athlete's interpretation of this environment may help or hinder the application of the life skills (Pierce, Gould, & Camiré, 2016). There is a need to critically examine high school sports as a developmental context (Camiré, 2014), and teacher-coaches, in their unique dual-role, are positioned to offer valuable insight to examine if and how PYD transfer does or does not occur through high school sport. Thus, the purpose of this study was to gain teacher-coaches perceptions of the individual student-athlete psychosocial factors, the high school sport factors, and the classroom factors that help or hinder the transfer of life skills from high school sport to the classroom. Using an interpretative qualitative paradigm, 10 teacher-coaches participated in semi-structured interviews. Thematic analysis revealed that teacher-coaches believed student-athletes do learn life skills through both implicit and explicit developmental experiences in high-school sport but challenges can exist during the process of transferring life skills to the classroom and other life domains. Teacher-coaches believed that opportunities to transfer skills in the classroom, student-athlete awareness of the utility of life skills, confidence and motivation were critical factors influencing whether or not the transfer of life skills from sport to the classroom occurs. These findings will be framed to help researchers, high school sport administrators, coaches, teachers and student-athletes examine and understand the complex process of sport-based PYD and life skills transfer.

Self-compassion protects against negative body-related emotions: A three-wave study of adolescent girls in sport

Pila, Eva; Gilchrist, Jenna D.; Sabiston, Catherine M., University of Toronto

Self-compassion has been shown to be protective against negative body image, and may particularly defend against negative body-related self-conscious emotions in sport. The aim of this study was to examine within- and between-person associations between self-compassion and appearance- and fitness-related self-conscious emotions. Adolescent girls ($N=581$, $M_{age}=14.2 \pm 1.4$) enrolled in organized sport provided three yearly self-reports of self-compassion, appearance- and fitness-related shame, guilt, embarrassment, and envy. Based on multilevel models, girls reported significantly higher appearance and fitness-related emotions when self-compassion was lower than usual (beta app=-0.56 to -0.69; beta fit =-0.43 to -0.58). At the between-person-level, higher average levels of appearance- and fitness-related emotions were associated with lower self-compassion on average (beta app=-0.43 to -0.58; beta fit=-0.26 to -0.35). As such, self-compassion may function as both a transient and dispositional construct, and is adaptive for mitigating negative self-conscious emotions tied to the body. Promoting self-compassionate states in sport may protect girls from negative body-related emotional experiences.

Is the development of trust in coach affected by the digital context of communication?

Querfurth, Sydney; Sch?, Linda; Strauss, Bernd, Westfaelische Wilhelms-University Muenster

Trust is an important aspect of the coach-athlete relationship (see e.g. 3C-model by Jowett, 2007). Digital communication (e.g. e-mail or app) is replacing or complementing traditional face-to-face contact. Generally, the impact of digital communication on this relationship is not yet well researched. Digital communication can have advantages, (e.g. connecting across distances), but also disadvantages, e.g. in accordance with media richness theory (Daft, & Lengel, 1986) digital communication might be detrimental to the development of trust. This study examined the development of trust in coach, measured as perceived competence, benevolence and integrity (Mayer et al., 1995), within the context of digital and personal communication. $N = 71$ (31 female) participants took part in a four week 3k running training. One group had weekly semi-structured meetings with coach, one group had one meeting and then scripted weekly e-mails, and the third group communicated entirely by scripted e-mails. Content for all communication was matched. Two different students acting as coaches were used to control for individual aspects of coach's personality. At post assessment participants filled out a questionnaire on trust as well as variables of motivation and liking ($n = 58$, 82%) and then ran the second 3k ($n = 49$, 69%). Overall trust was high on all dimension in all conditions (mean between $M = 4.43$ and $M = 5.55$ on a seven point Likert-Scale). A two-factorial MANOVA with coach and context as factors revealed no main effect of coach ($F(3,50) = 1.05$, $p = .38$, $\eta^2 = 0.06$), while the main effect of context was significant ($F(6,100) = 2.7$, $p < .05$, $\eta^2 = 0.14$). However, the follow-up one factorial ANOVAs with context as the factor were not significant for competence ($F(2,58) = 0.39$, $p = .68$, $\eta^2 = 0.01$), integrity ($F(2,58) = 0.51$, $p = .61$, $\eta^2 = 0.02$) or benevolence ($F(2,58) = 1.95$, $p = .15$, $\eta^2 = 0.07$).

Both digital and personal communication lead to high trust in coach. This suggests that the digital context of communication does not affect the development of trust in coach.

Effects of Video Game Player Avatar Size on Body Image Satisfaction/Dissatisfaction and Subsequent Food/Nutritional Choices in a Cafeteria Setting

Raudenbush, Bryan; Dwyer, Patrick, Wheeling Jesuit University

Both the size of an avatar and an individual's identification with that avatar size have been found to influence aspects of mood and performance. For example, participants who played a video game with a particular size avatar (underweight, average, overweight) rated their performance differently, with those having an overweight avatar showing decreased positive mood and decreased self-evaluated performance. The present study was designed to assess video game avatar size on subsequent body image and food choice. Male and female participants ($n=42$) played 20 min of WWE 13 on an X-box gaming console. During play, they were assigned an avatar characterized as 'underweight,' 'average,' or 'overweight.' Participants indicated, from a set of figure drawings, their current and ideal figures on a scale ranging from 10 to 90, and a satisfaction/dissatisfaction score was obtained by calculating the difference between those two ratings. Controlling for BMI, a significant avatar size/sex interaction was found for satisfaction/dissatisfaction score, $F(2, 36)=3.45$, $p<.05$. For males, the 'underweight' avatar was associated with the greatest desire to be larger (i.e., ideal figure larger than current figure); for females, the 'overweight' avatar was associated with the greatest desire to be smaller (i.e., ideal figure smaller than current figure). Controlling for hunger level and BMI, as females experienced larger avatars they tended to decrease their choice of foods in a variety of categories such as gram weight [$F(1, 27) = 2.27$], calories [$F(1, 27) = 6.31$], and carbohydrates [$F(1, 27) = 3.54$], $p<.05$. Future studies should examine the long-term effects of video game play with varying avatar sizes, as well as how such avatars may then influence individuals to alter their workout, health and eating behaviors.

Funding Source: Wheeling Jesuit University Department of Psychology

Effects of soccer ball heading frequency and intensity on nasal inspiratory and expiratory function as measured by rhinological patency

Raudenbush, Bryan; Custer, Kristen; Robinson, Emily; Schlegel, Killeen; Moore, Sierra, Wheeling Jesuit University

Past research indicates soccer ball heading has detrimental effects on memory, reaction time, scent identification ability and olfactory functioning. Capiola et al. (2009) report soccer players engaging in higher ball heading intensities had lower levels of verbal memory and longer reaction times; Kirdendall and Garrett (2001) concluded concussions from soccer head injuries was a main reason for cognitive dysfunction in such athletes; Raudenbush and Capiola (2010) report greater soccer ball heading frequency and intensity were associated with decreased ability to identify scents; Webbe and Ochs (2003) found male soccer players with high heading frequency had lower scores on the California Verbal Learning Test. The present study assessed the effects of soccer ball

heading frequency and intensity on nasal/breathing capacity. Division II soccer players (21 males/18 females) underwent inhalation and exhalation testing via the BioPac physiological assessment system. Independent sample t-tests were conducted after dividing athletes into 'low frequency heading' and 'high frequency heading' groups. Significance was found for exhalation mean $t(37)=2.85$, $p=.01$ and inhalation mean $t(37)=3.32$, $p=.002$, with athletes who headed the ball more frequently having lower exhalation and inhalation means. Independent sample t-tests were also conducted after dividing athletes into 'low intensity heading' and 'high intensity heading' groups. Significance was found for inhalation mean $t(37)=5.69$, $p=.000$, with athletes who headed the ball with greater intensity having lower inhalation means. In summary, athletes who headed the ball with greater frequency or intensity had significantly lower inhalation and exhalation performance than those athletes who headed the ball with lower frequency or intensity. Such performance is indicative of damage within the nasal cavity, and soccer players should consider this research in order to educate and prevent future damage to the nasal cavity. Future research should assess whether such damage is permanent or reversible.

Funding Source: Wheeling Jesuit University Department of Psychology

Effects of peppermint flavored mouthguards on augmenting rugby play performance

Raudenbush, Bryan; Troconis Bello, Juan Pablo, Wheeling Jesuit University

Past research indicates peppermint scent administration during athletic performance provides a variety of enhancements. For example, Raudenbush et al. (2002) had athletes undergo a treadmill test with either peppermint, jasmine, or dimethyl sulfide scent. Peppermint scent administration reduced physical and temporal workload, effort, and frustration. Self-evaluated performance was greater in the peppermint condition, and participants indicated greater vigor and lower fatigue. Raudenbush et al. (2001) had participants perform a variety of athletic tasks during peppermint scent administration and found increases in running speed, hand grip strength, and number of push-ups. The present study assessed peppermint administration in a more realistic sports environment, specifically outside of the laboratory with Division II rugby players. Further, a new technique was employed for taste and scent administration, through the use of a peppermint flavored mouthguard. Division II rugby players competed for a two month period during their scheduled athletic season with either a peppermint mouthguard or unflavored/unscented control mouthguard. At the completion of the testing period, measures of mood, workload, motivation and competitive edge were assessed. Results indicated statistically significant effects such that the use of a peppermint mouthguard led to a greater sense of safety ($t=3.63$, $p=.002$), being more energized ($t=2.12$, $p=.05$), greater feeling of being 'psyched up' ($t=2.54$, $p=.02$), and greater performance ($t=2.60$, $p=.02$). In addition, two trends were found such that the peppermint mouthguard enhanced feelings of confidence ($t=1.93$, $p=.07$) and strength ($t=1.76$, $p=.10$). Thus, peppermint administration has the ability to augment performance as a non-pharmacological aid.

Funding Source: West Virginia Space Grant #C00586

Self-Determination Theory's Triple-Process Model to Explain Adaptive and Maladaptive Functioning

Reeve, Johnmarshall, Korea University; Cheon, Sung Hyeon, Kangwon University

According to self-determination theory's dual-process model, "bright side" social and motivational processes (e.g., autonomy support, need satisfaction) explain people's adaptive functioning while "dark side" processes (e.g., teacher control, need frustration) better explain their maladaptive functioning. The present study conducted the first experimental test of the newly-proposed triple-process model that adds dissatisfaction as a third need status. Using an experimental, 3-wave longitudinal research design, 37 PE teachers (20 experimental, 17 control) and their 2,669 secondary-school students participated in a teacher-focused autonomy-supportive intervention program (ASIP). Objective raters scored teachers' autonomy-supportive and controlling instructional behaviors, while students reported their class-specific autonomy need satisfaction, autonomy need frustration, autonomy need dissatisfaction, engagement, and disengagement at the beginning, middle, and end of the semester. The ASIP was successful in increasing PE teachers' in-class autonomy supportive motivating style and in decreasing PE teachers' in-class controlling motivating style. This manipulated motivating style (a) increased students' T2 and T3 autonomy need satisfaction, (b) decreased students' T2 and T3 autonomy need frustration, and (c) decreased students' T2 and T3 autonomy need dissatisfaction. Multilevel structural equation modeling analyses showed that students' intervention-increased autonomy satisfaction then longitudinally enhanced their T3 engagement, just as the students' intervention-decreased autonomy frustration then longitudinally decreased their T3 disengagement. Most importantly, students' intervention-decreased autonomy dissatisfaction longitudinally decreased students' T3 disengagement, even after controlling for autonomy satisfaction and autonomy frustration. These findings support the triple-process model, and they raise important new questions for future research.

Funding Source: Korean Ministry of Education, National Research Foundation of Korea

Self-Determined Motivational Profiles Predict Physical Activity Participation: A Latent Profile Analysis

Reifsteck, Erin J.; Labban, Jeffrey D., University of North Carolina at Greensboro

Self-determination theory (SDT; Ryan & Deci, 2000) is a widely used framework for understanding individuals' motivation for engaging in exercise behaviors. According to SDT, motivation can vary along a continuum ranging from fully external to more autonomous forms of behavior regulation. Motivation is thus a multidimensional construct, which has frequently been measured in the exercise context by assessing the various forms of motivation separately or by using a relative autonomy index. However, some researchers have challenged the continuum structure (Chemolli & Gagne, 2014); consequently, other assessment strategies like the use of motivational profiles have been suggested as an ideal alternative. Therefore, the purpose of this study was to identify distinct SDT-based motivational profiles using latent profile analysis, and then determine whether those profiles predict physical activity (PA) participation. College students (N=197; 71.6% Female, 48.7% White, mean Age= 21.4 years) enrolled in undergraduate kinesiology and public health courses completed an online survey about

their motivation for exercise (Behavioral Regulation for Exercise Questionnaire-3) and their weekly physical activity participation (i.e., average number of minutes spent in moderate and vigorous activity per week). We relied on a combination of statistical evidence (e.g., likelihood ratio tests) and conceptual considerations to determine the appropriate number of profiles. Analyses revealed 3 distinct motivational profiles: low motivated (13.1% of the sample), moderately self-determined (40.1%), and highly self-determined (46.8%). Furthermore, profile membership predicted differences in PA participation ($p < .001$) such that membership in the highly self-determined group was associated with the highest reported weekly physical activity. Given this sample was predominantly comprised of college students in health-related majors, this approach should be replicated in more diverse samples as other more complex motivational profiles may exist that further differentiate patterns in PA participation.

Motivational Differences Between Indoor and Sand Volleyball

Rhoads, Michael C., Metropolitan State University of Denver; Williamson, Scott, University of Denver; Antillon, Christopher; Whalum, Gerard, Metropolitan State University of Denver

Beach Volleyball is the newest NCAA championship sport, founded in 2016. Because it has so recently emerged, the optimal motivational techniques warrant empirical exploration. The purpose of this study is to examine the differences in how coaches motivate athletes in indoor versus beach (sand) volleyball. Compared to indoor volleyball, the rules of sand volleyball allow for very minimal feedback to athletes during matches. Self-determination theory (Deci & Ryan, 2002) is used as a guiding framework for this study, with the assumption that volleyball players experience different levels of autonomy, competence, and relatedness according to the context they are competing in. This study utilized a qualitative phenomenological approach (Creswell, 2007) to investigate the lived experience of volleyball coaches and athletes when competing in indoor and sand volleyball. A total of 10 Coaches and 12 athletes with prior participation in both indoor and sand volleyball were interviewed. Based on thematic analysis, four major themes emerged including Self-Direction, Competence, Socialization, and Goal-Setting. Overall, numerous quotes from coaches and athletes identified the importance of self-determination in learning to play volleyball: 'The more self-directed an athlete is, the more capable they are in reaching their potential' (Coach 6); 'I think the athlete should probably make most of the decisions for themselves to be able to learn more' (Athlete 6). This study has various implications for policy and practice. For policy, sand volleyball rules may need to be modified to allow young athletes to receive more feedback from coaches at developmental levels. For practice, sand volleyball coaches need to be sure to provide a tremendous amount of information and strategy to athletes so they can use these tools on their own during matches and tournaments. Finally, coaches should be thoughtful about how best to motivate athletes according to the context they are working in. This is particularly noteworthy as more and more indoor coaches move to coaching sand volleyball.

A Preliminary Exploration of Young Athletes' Use of Observation in Aesthetic Sports

Richards, Devyn; Mady, Caleb; Law, Barbi, Nipissing University

Research exploring athletes' use of observation has traditionally employed quantitative methods and focused on the experiences of adult performers (Cumming, Clark, Ste-Marie, McCullagh, & Hall, 2005; Ste-Marie, Law, Rymal, O, Hall, & McCullagh, 2012). The aim of this qualitative study was to explore young athletes' ($n = 18$; Mage = 12.9 years; $SD = 2.90$) self-reported experiences with observation in sport. Focus groups ($n = 5$) were conducted with participants from aesthetic sports (figure skating, martial arts, and dance) as these sports often employ video and other observational tools, such as mirrors, early in the athlete's sport development. Focus groups were conducted by a researcher using a semi-structured interview guide to elicit details related to participants' use of observation in their sport. A moderator was present for all focus groups to take notes and provide a summary of the discussion. All focus groups were audio recorded and transcribed verbatim. Thematic analysis was performed using Braun and Clarke's (2006) guidelines. Overall, young athletes reported using modeling most commonly to enhance their physical performance by learning a new technique or improving their current technique in practice and competition settings, and to help them strategize as part of their competition preparation. Use of observation was also associated with both positive (e.g., confident, inspired) and negative emotions (e.g., nervous, discouraged), with negative emotions occurring mainly in competition settings. These findings are consistent with physical performance-related uses of observation reported by adults (e.g., Cumming et al., 2005) and provide preliminary insight into both the physical and emotional effects of modeling in young athletes. Additional research with young athletes is merited to understand the antecedents and consequences of modeling in this population and to develop modeling interventions that promote positive youth development.

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Testing the Expanded Sport Officials Decision-Making Model

Ritchie, Jason; Tenenbaum, Gershon, Florida State University

Sport officials represent a 'third team' in sports that has the potential to change the outcome of games, seasons, and careers. The present study tests the Enhanced Sport Official's Decision-Making Model (ESODMM), which expands the existing Official's Specific Decision-Making Model (OSDMM; Plessner & Haar, 2006), by integrating additional psychological components, particularly anticipation and emotions. To test the role of anticipation and emotion in the ESODMM, eight basketball officials (4 recreational, 4 high school level) were assigned to either high (crowd noise) or low (no crowd noise) stress conditions, and asked to make calls on occluded or non-occluded basketball video clips. Results revealed that higher level basketball officials performed better than their counterparts particularly in the occluded condition. In particular, while making decisions on occluded video clips novice officials' accuracy was near guessing levels, while experienced officials' accuracy was nearly twice as accurate as novices'. In the stress condition, anxiety, arousal, stressfulness, threat appraisals, worry, and cognitive disruption were all elevated, while accuracy was reduced. However, experienced officials were less influenced by the stress condition. Specifically, in the stress condition, experienced officials' stress and anxiety measures were not elevated,

accuracy was stable, and pleasantness and challenge appraisals increased. These results suggest that experienced officials anticipate upcoming events to enhance their final decision-making. Additionally, experienced officials are better able to appraise stressors as facilitative and cope with any debilitate emotions. Further research on this model is required.

Talent characteristics discriminating table tennis, tennis, and badminton by means of a coaches' survey.

Robertson, Kamasha, Ghent University, Belgium; Pion, Johan, HAN University of Applied Sciences; Mostaert, Mireille; Wazir Norjali Wazir, Mohd Rozilee, Ghent University, Belgium; Kramer, Tamara, HAN University of Applied Sciences; Faber, Irene, Saxion University of Applied Sciences; Lenoir, Matthieu, Ghent University, Belgium

Table tennis, tennis, and badminton are three major racquet sports. Differences and similarities between these sports exist, but they are not well documented in the literature, in spite of the relevance for talent identification. In this study we aimed at the identification of the key characteristics of each sport based upon a survey in coaches. A total of 199 licensed coaches participated in the survey, which contained questions on table tennis, tennis, and badminton. The survey was composed of twenty seven questions and twenty characteristics that were divided into: seven physical characteristics, seven motor coordination characteristics, and six context variations (i.e. physical and no physical contact, indoor and outdoor sports, and individual and team sports). Coaches indicated on a 1-10 scale to what extent a characteristic was important for their sport. MANOVA was used as a source of finding out the differences across the sports, as well as the linear model (Discriminant Analysis) which was used to allocate the coaches in their proper sport. A non-linear model (Multilayer Perceptron) was used for further confirmation that the coaches were correctly matched to their sport. MANOVA showed that within eleven variables there were no differences across the three racket sports. On the other hand, differences for three physical, three motor coordination, and three context components emerged. The discriminant analysis showed that 80.4% of coaches were allocated correctly in their sport, as opposed to the 75.4% that was produced by the cross validation with the leave one out method. Use of Artificial Neural Network procedures improved the process of correctly classifying the coaches into their respective sport at 88.4 % and also in at least one of the five runs. We developed a predictive model that allocates coaches into the right sport, and it clearly shows that coaches are well aware of the differences between these three racquet sports. These results can also assist coaches in future talent orientation and transfer in all three sports.

Discrepancies and Agreement in Coach-Athlete Relationships and Implications for Athletes

Rocchi, Meredith, McGill University; Pelletier, Luc G., University of Ottawa

According to Self-Determination Theory, coaches influence their athletes' motivation through their interpersonal behaviours which impact their basic psychological needs. When athletes perceive that their psychological needs for autonomy, competence, and relatedness are supported, they will experience an increase in motivation quality.

Alternatively, when they perceive that their psychological needs are thwarted, they will develop lower quality motivation. To date, the majority of this research has relied on self-report assessments from coaches and athletes, without cross-referencing these observations. This is problematic because coaches have a tendency of being more positive when reporting on their own behaviour. Furthermore, there is no evidence supporting whether athletes' perceptions of their coaches' behaviours have a greater impact on psychological needs than their coaches' actual reported behaviour. As such, this study looked at the level of agreement and disagreement between coaches' reports ($n = 53$) and athletes' perceptions ($n = 278$) of autonomy, competence, and relatedness supportive and thwarting behaviours. Polynomial regression analysis with surface testing was used to determine whether the presence of an agreement or disagreement between coaches and athletes, as well as the direction of the disagreement, predicted differences in athletes reported need satisfaction and frustration. The results found that when both coaches and athletes reported increased need-supportive interpersonal behaviours, this lead to increased need satisfaction and decreased need frustration for athletes. In the event there was a disagreement between coaches and athletes, as long as the athletes had a more favourable view than their coach, this also predicted increased need satisfaction. Need-thwarting interpersonal behaviours had the opposite effect on need satisfaction and need frustration in sport. Overall, the results support that athletes' perceptions of their coaches' behaviour had a greater impact on psychological needs, compared to coaches' actual reported behaviour.

Funding Source: Social Sciences and Humanities Research Council

Examining Factors that Influence Youth Sport Coaches' Transformational Leadership Behaviours.

Rochon, Chantal; Turnnidge, Jennifer, Queen's University; Cowburn, Ian H., Leeds Beckett University; O'Connor, Meaghan; Côté, Jean, Queen's University

Coaches' transformational leadership (TFL) behaviours are associated with positive outcomes for athletes (e.g., Vella et al., 2013) and can be improved through interventions (e.g., Barling et al., 1996). With the current need for coach development programs to use behaviour change theories (Allan et al., 2015) and to focus on coaches' interpersonal knowledge (Lefebvre et al., 2016), the purpose of this study was to use behavior change theory to explore coaches' perceptions of their capability, opportunity, and motivation to execute TFL behaviours (COM-B model; Michie et al., 2014). Using a mixed-methods design, interviews were conducted with 20 youth sport coaches. Coaches' perception of capability, opportunity, and motivation were assessed in relation to the four dimensions of TFL using both Likert-scale and open-ended questions. Results indicate that coaches perceived that opportunity was the most important barrier to executing TFL behaviours compared to capability, $F(2, 36) = 18.55$ $p < 0.05$, and motivation, $F(2, 36) = 18.55$ $p < 0.01$. Despite these findings, existing coach education programs tend to focus on capability and motivation (Allan et al., 2016), but not opportunity. Among the TFL behaviours coaches reported that idealized influence was significantly harder to execute than inspirational motivation, $F(3, 18) = 7.58$ $p < 0.05$, and individualized consideration, $F(3, 18) = 7.58$ $p < 0.05$. Thematic analysis of the open-ended questions revealed a myriad of facilitators and barriers to the execution of TFL

behaviours. Barriers include: finding the time, recognizing the opportunity, showing vulnerability when necessary, and eliciting information from athletes. Facilitators include: having the necessary resources, help from a support system, and seeing athletes succeed. Therefore, these findings provide a detailed understanding of the execution of TFL behaviours using the COM-B Model which will help to develop an intervention that is evidence-informed, conducive to behaviour change, and relevant to needs of current youth sport coaches.

Funding Source: Queen's University

Effect of a Five-Week Mindfulness Meditation Training Program on the Level of Anxiety, Cognitive Interference and General Mindfulness in a Division I Women's Volleyball Team

Rodriguez, Chelsea; Chen, David D.; Becker, Andrea; Wiersma, Lenny; Hubbard, Brianna, California State University Fullerton

Mindfulness, defined as deliberate and nonjudgmental attention to one's present experience as it unfolds, undergirds successful sport performance. To train mindfulness often involves meditative practices. The purposes of this study included developing a 5-week mindfulness training program consistent with Eastern meditation-based traditions (Ivtzan & Hart, 2016) and testing its effect on the level of sport anxiety, general mindfulness, and level of cognitive interference. Fifteen female Division I women's volleyball players from the same team volunteered to participate in the study. The five-week mindfulness training consisted of breath-based anchoring, building awareness of bodily sensations, tuning to emotions, building awareness of thoughts, and integration. After two 20-min training sessions each week, athletes were provided with an audio recording of that week's training and required to do it at least once a week on their own. Three instruments, including The Mindfulness Attention Awareness Scale (MAAS), Sport Anxiety Scale-2 (SAS-2), and Thought Occurrence Questionnaire for Sport (TOQS) were administered six times during the five weeks with the first administration prior to the meditation training and the other five after each training session. Separate repeated measures ANOVAs were performed on the scores from the six administrations of MAAS, SAS-2, and TOQS. ANOVAs of MAAS scores did not show significant findings ($p > .10$), however, analyses of SAS-2 ($F=13.54$, $p < .001$, $\eta^2 = .51$) and TOQS ($F=8.44$, $p < .001$, $\eta^2 = .394$) scores revealed significant effects. Post-hoc tests suggested that SAS-2 and TOQS scores significantly decreased from the pre-training level at week 3 and remained low till the end. These results suggest that the meditation training was conducive to reducing cognitive interference and sport anxiety. The general mindfulness was found to be enhanced, albeit not reaching the level of .05. The results were discussed with respect to the different aspects of mindfulness training and how it may impact sport performance.

Reported cognitive appraisal, mental effort, cortisol response and shooting performance

Rossato, Claire J., University of Greenwich; Basevitch, Itay, Anglia Ruskin University

Identifying and understanding stressors has become an important area within sport

psychology (Thatcher & Day, 2008). Furthermore, it has been suggested that stressors encountered in a sporting situation can have an impact upon performance (Wagstaff, Fletcher & Hanton, 2012); in particular, cognitive appraisals and the resources available to cope with the demands of the task. The Theory of Challenge and Threat in Athletes model (TCTSA; Jones et al, 2009) indicate that neuroendocrine responses such as noradrenaline, adrenaline and cortisol release are associated with Challenge and Threat appraisal within Athletes. In addition it has also been suggested that mental effort will decrease with a Challenge state (Jones et al, 2009), however this has been seldom examined within the literature. The aim of this study was to explore whether there was any association between Challenge and Threat appraisal, mental effort self-report, cortisol response and shooting performance. Thirty nine participants (mean age=25.16, SD=2.01) included within the study gave self-report of Challenge and Threat (Cognitive Appraisal Ratio (CAR); Tomaka et al, 1993) and mental effort (Rating Scale Mental Effort (RSME; Zijstra, 1993). In addition, cortisol responses were measured pre and post a shooting performance task within a laboratory setting. Data analysis suggested there was a significant correlation observed between report on the CAR and cortisol response ($r=.38$, $p<0.05$) and cortisol response and mental effort ($r=-.40$, $p<0.05$). However there was no significant relationship with performance ($p>0.05$). This data suggested that a decrease in mental effort is potentially associated with Threat based upon cortisol response and self-report of Threat is positively associated with cortisol response. However performance data is not linked to Challenge, Threat, cortisol response or mental effort in this instance. Further studies should examine adrenaline and cortisol response to self-report measures of stress appraisal and sporting performance.

Elicitation of Physical Activity Judgments in Inactive Women through Mental Contrasting Interventions

Ruissen, Gerylyn R.; Beauchamp, Mark R., University of British Columbia

Drawing from diverse theoretical perspectives, recent evidence suggests that affective judgements (e.g., enjoyable-unenjoyable) are both distinct from, and exert greater influence on, physical activity (PA) behaviours than instrumental judgements (e.g., useful-useless; Rhodes, et al., 2009). As part of a randomized controlled trial, the purpose of this study was to use a mental contrasting (MC) goal setting intervention to elicit affective and instrumental judgements related to PA participation, to determine the most common outcomes and obstacles to PA. This qualitative analysis was also used to examine the extent to which participants' responses to one of three MC interventions aligned with the condition to which participants were randomly assigned. A sample of 110 inactive, female, undergraduate students participated in this study. Open-ended questions were posed within a MC goal-setting activity to elicit either affective or instrumental PA outcome and obstacles judgements. Responses to the open-ended outcome and obstacle questions were transcribed, and subjected to conventional content analysis (Hsieh & Shannon, 2005), in which a combination of deductive and inductive analytic procedures were used. The results highlighted key affective and instrumental judgements related to PA participation. Participants identified Stress-relief, Invigoration and Esteem to be the most salient affective outcomes associated with PA. Conversely, the affective obstacles that hindered participants most were that PA was

Stressful, Unenjoyable or they felt Guilty. Among instrumental judgments, Increased Efficiency, General Health and Improved Fitness were the most salient outcomes, whereas School, Time Management and Other Priorities were the most common obstacles. The results also revealed notable insights related to the extent to which affective and instrumental judgements and attitudes aligned with each of the three MC conditions. Implications for the application of MC interventions in PA contexts are considered.

Funding Source: Canadian Institutes of Health Research

Acute effects of resistance exercise in men with and without symptoms of muscle dysmorphia

SantaBarbara, Nicholas J.; Whitworth, James W.; Nosrat, Sanaz; LaBrec, Jordan E.; Louie, Mark E.; Ciccolo, Joseph T., Teachers College Columbia University

Introduction: Muscle dysmorphia (MD) is a psychological disorder characterized by a distorted belief that one's body is insufficiently muscular. MD predominantly affects men and is associated with poor mental health, and adherence to a rigid diet and strict resistance training (RT) schedule. Previous research has shown that an acute bout of RT can improve multiple dimensions of body image perceptions in men; however, no study has examined these effects in a sample with MD symptoms. Purpose: To compare a non-clinical sample of men with and without MD symptoms on various psychological measures, and before and after a single bout of RT. Methods: Twenty men with (n=10) and without MD symptoms (n=10) were recruited. All completed baseline assessments of body image, mental health, and a series of 10-repetition muscular (10-RM) strength tests. After a 48-hour period of exercise abstinence, participants completed a single session of low intensity (50% of 10-RM) RT. State body image, affect, and arousal were measured pre and post RT. Results: Men in the MD group scored significantly higher on baseline measures of depression, anxiety, bodybuilding dependence, social physique anxiety, and restrained eating ($p < .05$). There was also a significant difference between the groups in arousal ($F = 5.56$, $p = .03$) from pre to post RT, but there were not any differences in state body image ($F = .58$, $p = .45$) or affect ($F = .04$, $p = .85$). Importantly, further analyses revealed that the non-MD group significantly improved in state body image ($t = -3.45$, $p = .007$, $d = .99$) and arousal ($t = -7.97$, $p < .001$, $d = 1.76$) from pre to post RT. Affect did not change from pre to post RT for either group ($p > .05$). Conclusion: Men with MD symptoms have a less favorable response to low intensity RT than men without MD symptoms. Future studies should examine the mechanisms responsible for the acute and chronic effects of RT on body image in men with MD symptoms, specifically including the impact of exercise dose variables (i.e., frequency, intensity, volume, duration).

"It's okay - Not everyone can be good at sports": Implicit ability beliefs and intended coaching interactions with low-skilled youth.

Saville, Paul D., Azusa Pacific University; Fram, Eric A., McMaster University; Gonzalez, Alexis C.; Gonzalez, Ivy R., Azusa Pacific University; Bray, Steve R., McMaster University

Dweck (1999) suggests people have implicit theories about the nature of their own and

others' abilities. Entity theorists believe abilities (e.g., being good at math) are fixed and difficult to change, while incremental theorists believe abilities change as a result of persistent effort and deliberate practice. Students' implicit beliefs have been shown to influence their motivation and behavior; however, teachers' implicit beliefs also influence their behaviors towards learners. Rattan et al. (2012) found math teachers holding stronger entity beliefs used teaching strategies that comforted rather than challenged lower ability students, which reduced student motivation and performance expectations. In this study, we investigated the effect of youth coaches' implicit beliefs and sport familiarity on their intended interactions with low-skilled players. Undergraduates (N=114) enrolled in a coaching science course were randomly assigned to read one of four vignettes about a hypothetical coaching situation involving themselves and a low-skilled player using a 2 (entity vs. incremental beliefs) X 2 (familiar vs. unfamiliar sport) design. After reading the vignette, participants rated their intentions to use coaching interactions that comforted (avoided) or challenged the skills of the player in the scenario. Participants in the entity conditions endorsed more comforting behaviors (e.g., avoid putting athletes in positions where their skills are weaker) than those in the incremental conditions, $F(1, 112) = 4.37, p < .05$, Cohen's $d = 0.38$. No effects for sport familiarity were observed. Results suggest youth sport coaches' implicit theories of ability may unintentionally undermine motivation and skill development of youth sport participants.

Influence of active transportation to school on daily physical activity: An investigation of children in Northeastern Ontario elementary schools

Scharoun, Sara M.; Bruner, Brenda G.; Confesor, Valaine E.; Hay, Dean C.; Karvinen, Kristina H., Nipissing University; Levesque, Lucie, Queen's University; Mantha, Shannon; Mayer, Alex, North Bay Parry Sound District Health Unit; Raymer, Graydon H.; Rickwood, Greg D., Nipissing University

Active transportation to school (ATS) is declining, with only one quarter of students aged 5-17 walking, or cycling to school compared to over half in previous years. Additionally, only 9% are achieving the recommended minimum of 60 minutes of moderate to vigorous physical activity (MVPA) at least 6 days per week, contributing to low physical activity (PA) rates. ATS may contribute to increased PA levels in youth; however, there is little evidence examining ATS in northern contexts. We assessed whether PA accumulated through ATS predicted total PA and if there was a difference between children who engage in ATS vs. passive transportation to school (PTS). Data were collected from 2 elementary schools in Northeastern Ontario at 3 time points (April/May 2015, April 2016, June 2016). Participants were fitted with accelerometers for 5 consecutive school days to measure PA throughout the day and specifically during the trips to school. Cross-sectional data representing each participant's first valid time point (minimum of 3 wear days with +/-10 hours wear time) were obtained (N = 46, Mage=9.027, SD = 1.91; 25F, Mage=9.12, SD 2.00, 21M, Mage=8.90, SD = 1.84). ANCOVA were performed for all dependent measures with "measurement on way to school," "age," and "distance to school" as covariates, and "transportation: ATS vs. PTS" and "school: 1 vs. 2" as fixed factors. PA accumulated on the way to school positively predicted total PA for all dependent variables (total count: $p < .001$, total steps: $p < .001$, active minutes: $p < .001$, light minutes: $p < .001$, moderate minutes: $p < .001$, vigorous

minutes: $p = .006$, and MVPA minutes: $p = .029$) except sedentary minutes. Children who engaged in ATS accumulated more total steps ($p = .020$), active minutes ($p = .012$), and light minutes ($p = .001$) compared to children who engaged in PTS. Findings indicate that PA accumulated through ATS in a northern context is an important contributor to children's overall PA. Furthermore, ATS leads to increased daily PA, albeit not at moderate to vigorous levels.

Parents' stressors and coping strategies during elite tennis junior Swiss tournaments

Schmid, Olivier N.; Schmid, Juerg, University of Bern

Along with coaches, sport parents play essential roles on the talent and personal development of youth athletes (Côté, 1999). As an individual and costly sport where athletes can achieve elite levels early on, tennis is a prime setting to examine parental involvement and experiences (Gould et al., 2008). Tennis competitions are demanding for the players but can also be stressful for parents attending matches (Harwood & Knight, 2009). Further research on parents' experiences during tournaments regarding the intensity of competitive stressors, their impact on parental misconduct, and parents' coping strategies, warrants closer attention. Parents ($N = 245$) of tennis players who competed at the Junior Summer National Swiss Championship (categories U10 to U18) completed an online survey assessing their experiences during matches, the intensity and influence of specific competitive stressors, their coping mechanisms, and their suggestions for effective strategies to improve parental behaviors. All French, German, and Italian language regions of Switzerland were represented. Parents reported experiencing moderate stress levels, regardless of the parents' and children's gender and age groups. Behaviors of other parents, watching their children's matches, and attitudes and behaviors of their own child and of their opponent were reported as most stressful, whereas their child's performance and results were the least stressful. A majority of parents were aware of the impact of stress on their behaviors and emphasized the value of effective coping mechanisms. Most common strategies included passive coping (avoidance and distractions) and gaining a broader sense of perspective. Letting the players handle their matches on their own and the need to implement effective strategies to deal with disruptive parents were prevalent suggestions. Also, parents were widely in favor of a code of conduct, if it can be enforced. Implications for coaches, parents, tournament directors and national tennis associations will be offered to further support parenting education.

Enhancing adolescent's concentration and creativity: Feedback matters!

Schmidt, Mirko; Benzing, Valentin, University of Bern

Concentration and creativity are two key prerequisites for learning at school. Therefore, theorists as well as practitioners are interested in which factors may lead to an enhancement of both. Whereas concentration can be enhanced by acute physical activity of moderate intensity, especially positive feedback is known to induce positive affect, which in turn is related to creative thinking. The aim of the present study was therefore to disentangle the separate and/or combined effects of physical activity and

positive feedback induced by four different interventions on adolescent's concentration and creativity. Using a 2 x 2 between-subjects experimental design, 104 adolescents ($M = 16.99$, $SD = 0.90$) were randomly assigned to one of four experimental conditions: EXPO = exercise with positive feedback, EXNE = exercise with negative feedback, SEPO = sedentary with positive feedback, and SENE = sedentary with negative feedback. Adolescent's concentration, i.e. 'number connection test' (ZVT), and their creativity, i.e. Remote Associates Test (RAT) were measured before and immediately after a 15-minute intervention. ANCOVAs (with pre-measures as covariates and gender as an additional factor) revealed that physical exertion was the factor being responsible for faster information processing in the ZVT. For creativity, no significant main effect could be found. However, a significant interaction of the two manipulated factors suggests a domain specific influence of positive vs. negative performance feedback on adolescent's convergent thinking. Gender specific analyses indicate a more pronounced improvement in creativity for girls. Whereas concentration can be enhanced through an acute bout of moderate intensity exercise, creativity seems to be resistant to this effect. However, the detected interaction effect points on setting-specific impacts of positive and negative feedback. Whereas physical activity has to be accompanied by negative feedback, in a sedentary condition, feedback has to be positive to foster enhanced creative performance.

Recent Physical Activity and Resting-State Brain Connectivity

Slutsky, Alexis B.; Diekfuss, Jed A.; Schmitz, Randy J., University of North Carolina at Greensboro; Grooms, Dustin R., The Ohio State University; Raisbeck, Louisa D., University of North Carolina at Greensboro

A single session of physical activity (PA) as well as exercise interventions alter resting-state (RS) brain connectivity (Rajab et al., 2014). RS brain connectivity has been shown to differ by factors such as handedness, footedness, gender, and age, although these are not the only factors known to have effects. The purpose of this study was to determine if recent (past 7 days) self-reported PA is related to RS brain connectivity. Fifteen healthy, right-handed subjects completed the International Physical Activity Questionnaire (IPAQ; Craig et al., 2003) followed by 10-min of RS functional magnetic resonance imaging (fMRI). IPAQ scores were measured as metabolic equivalent of task (MET) minutes per week. Participants were separated into low and high PA groups based on a median-split of IPAQ scores (High: $n=8$, 1103.94 MET-min/wk ($SD=7903.1$), 26.37yrs ($SD=4.1$); Low: $n=7$, 2843.93 MET-min/wk ($SD=525.67$), 25.14yrs ($SD=3.6$)). Independent samples t tests with a false discovery rate correction for multiple comparisons, controlling for age, gender, education, and body mass index, determined group differences in RS brain connectivity. Results revealed the high PA group displayed greater connectivity between the lateral parietal cortex and the middle frontal gyrus ($t(9)=7.4$, $p<.01$). In addition, the low PA group displayed greater connectivity between the fusiform gyrus and 5 regions: precentral gyrus ($t(9)=5.3$, $p=.04$), postcentral gyrus ($t(9)=4.8$, $p<.01$), cuneal cortex ($t(9)=4.6$, $p<.01$), central operculare cortex ($t(9)=4.4$, $p<.01$), and planum temporale ($t(9)=4.4$, $p<.01$). This evidence indicates an association between recent PA and RS connectivity. It appears that higher levels of recent PA are related to greater RS connectivity between fronto-parietal regions associated with the default network and attention processing and lower levels of recent PA are related to

greater RS connectivity in occipito-parietal regions associated with motor and sensory processing. Though preliminary, this association suggests an importance for recent PA to be controlled for in RS fMRI research.

Exercise Duration and Short-Term Memory

Slutsky, Alexis B.; McHone, Ashley; Kurtz, Kevin; Arunachalam, Sudharani; Labban, Jeffrey D.; Etnier, Jennifer L., University of North Carolina at Greensboro

Acute exercise is beneficial for short and long-term memory in adults (Chang et al., 2012), however the ideal duration to benefit young adult's short-term memory is still unknown. Our purpose was to investigate how differing exercise durations affect short-term memory. Eighteen active young adults ($M=21.78$, $SD=3.1$) were randomized to one of three groups: no exercise control ($n=5$), 10-min exercise prior to memory task ($n=6$), or 20-min exercise prior to memory task ($n=7$). Participants rested on a recumbent bike for 20-min prior to the memory task (control group), rested on the recumbent bike for 10-min and then exercised for 10-min at a moderate (55-65% heart rate reserve) intensity, or exercised on a recumbent bike at a moderate intensity for 20-min. Trial I of the Rey Auditory Verbal Learning Test (RAVLT) was used to assess short-term memory. Participants heard a list of 15 words and were asked to recall as many words as possible. Preliminary findings suggest a small benefit to short-term memory with 10-min of exercise ($d=0.29$) and a moderate benefit to short-term memory with 20-min of exercise ($d=0.78$) compared to the control group. The benefit of exercising for 20-min compared to no exercise reached significance ($t(10)=2.48$, $p=.03$). In addition, 20-min of exercise appears to have a small benefit to short-term memory compared to 10-min of exercise. These findings suggest exercise duration can affect the size of benefit to short-term memory. Of importance, there were benefits to short-term memory after only 10-min of moderate-intensity cycling. Given the current exercise guidelines recommending a minimum of 10-min bouts of exercise (accumulating to 150 min/week) for general health benefits (Physical Activity Guidelines for Americans, 2008), the current findings suggest cognitive benefits as well in response to following these guidelines. Results presented at NASPSPA will include an additional 42 participants and, hence, findings and conclusions will be adapted to reflect the final data analyses.

Exercise Motivation among College Students using the Self-Determination Theory Approach

Sng, Eveleen; Loprinzi, Paul, University of Mississippi

Regular participation in physical activity (PA) among college students has numerous health benefits. However, college students still do not regularly participate in PA and at least 50% of college students do not meet the PA guidelines. Exercise motivation, barriers to exercise, and physical self-perception have been shown to be associated with physical activity participation but these factors together are less investigated among college students. Furthermore, fewer studies have evaluated whether gender moderates the relationship between motivation and PA in this population. Thus, the aim of this study was to examine the associations between exercise motivation (self-determination theory), barriers to exercise, physical self-perception, and physical activity among

college students in a rural Southern University, and evaluate whether gender moderates these associations. A final sample of 61 (18-33 years) students completed the multi-sectional survey via Qualtrics. Both intrinsic ($\beta=38.8$) and extrinsic motivations ($\beta=21.7$) were significantly ($p<.05$) associated with higher moderate-vigorous PA (MVPA). There were no significant associations between physical self-perception and barriers to exercise with MVPA in the regression model. Findings of this study confirmed a significant gender moderation effect, as intrinsic motivation was significantly associated ($\beta=74.4$) with MVPA among males only. These findings suggest that the constructs of self-determination theory, especially intrinsic and extrinsic motivation, are associated with higher MVPA participation among college students. Implications of this study include the identification of using a suitable motivation theory suitable for college students to increase their MVPA. Thus, intervention programs targeting the increase of MVPA among college students can be designed and implemented based on the self-determination theory, tailored accordingly to each gender.

The relationships between trait self-control and health, academic and athletic behaviors among college athletes: A prospective study

Stapleton, Jessie N., Missouri Baptist University; Josephs, Molly V., Southern Illinois University Edwardsville

Self-control has been shown to be significantly related to a variety of health and academic behaviors among college students. Less research has specifically focused on the utility of self-control as a predictor of health, academic and athletic behaviors among collegiate athletes. The purpose of the present study was to examine the relationships between trait self-control and health, academic and athletic behaviors among collegiate athletes over the course of an academic year. A sample of National Association of Intercollegiate Athletics athletes ($n = 212$; $\text{Mage} = 20.54 \pm 1.20$) completed an online questionnaire during the fall and spring academic semesters. Pearson correlations were conducted between fall semester trait self-control and spring semester health, academic and athletic behaviors. Significant, positive relationships were revealed between trait self-control and fruit and vegetable consumption ($r = .24$, $p < .01$) and grade point average ($r = .23$, $p = .01$). Significant, negative relationships were revealed between trait self-control and alcohol consumption ($r = -.27$, $p < .01$) and athlete burnout ($r = -.28$, $p < .01$). Results indicate collegiate athletes who reported higher trait self-control during the fall semester ate more fruits and vegetables, earned higher grade point averages, drank less alcohol, and experienced less burnout in the spring semester than athletes who reported lower trait self-control. These findings may enable coaches to identify and intervene among college athletes who report low trait self-control and may be at risk for poorer health, academic and athletic outcomes.

Self-control strength and mindfulness in sport

Stocker, Eva, Institute of Sport Science; Englert, Chris; Seiler, Roland, University of Bern

In sport and exercise contexts, it is highly important to control one's impulses and behavioural tendencies to meet specific goals. Athletes frequently have to deal with several demands which may deplete their limited self-control resources which may in

turn negatively affect their subsequent performance in a wide variety of sports-related tasks (e.g., coordinative, psychological and physical tasks). In our study, we investigated the effects of a short mindfulness exercise on physical performance in a state with temporarily depleted self-control strength (ego depletion). Mindfulness meditation may be beneficial for mechanisms involved during self-control exertion, because it supports efficient emotion regulation, attention regulation and executive functioning. We hypothesised that a short mindfulness exercise can compensate - at least partly - for the ego depletion effect procured by a strenuous cognitive task on physical performance. We applied a mixed between- (ego depletion: yes vs. no) within- (two times of measurement, 7 days apart; mindfulness: yes vs. no; order counterbalanced) subjects design to test our hypothesis in a sample of $N = 34$ sport students (18 women; $M_{age} = 20.85$, $SD_{age} = 1.31$). Ego depletion was manipulated via a well-established transcription task. For the manipulation of mindfulness, participants in the mindfulness condition performed a short mindfulness exercise, while participants in the control condition listened to an audio book. As dependent variable, participants performed a strenuous physical exercise (plank exercise) for as long as possible and we measured the respective duration at both times of measurement.

Depleted participants in the mindfulness condition were able to compensate for the ego depletion effect and held the plank position as long as the non-depleted group. On the contrary, ego depleted participants' performance decreased when listening to the audio book. However, the interaction did not reach statistical significance, $F(1, 28) = 2.28$, $p = .142$, $\eta^2 = .08$.

Funding Source: -

Identifying response biases in sport data

Strauss, Bernd; Utesch, Till, University of Muenster; Büsch, Dirk, College of Technique and Art, Germany; Meier, Henk E., University of Muenster

Researchers across disciplines often conduct questionnaires when assessing attitudes, psychological states or traits. This can go along with response biases and therefore response patterns, which are not associated with the assumed underlying trait. Participants might use different styles or strategies to respond on rating scales or to complete certain sport tasks. Response biases can for instance be a tendency to middle categories or a favor of extremes. Response style often results in different response patterns and two participants with the same real level of the measurement can differ at the observed level only due to their response bias. Without identifying those response styles, a successful testing of hypotheses can be affected (Eid & Zickar, 2007; Bockenholt & Meiser, 2017). Therefore, an identification and correction for response biases is needed. In some cases, it can be appropriate to exclude deviant response patterns (resp. persons) from further content-related considerations. Aim of this study is to show how to identify response biases in a large dataset under the item response theory framework (IRT, i.e., the Mixed-Rasch model, MRM, Rost, 1990). The German fan identification scale is used as data example (seven questions, 5-point Likert-scale; Strauss, 1995; Wann & Branscombe, 1993). Fan identification with the German national soccer team was assessed from a total of 12.333 people in the context of the world championships 2002-2016 every day of the event for one hour in public in Muenster,

Germany. Although unidimensionality was hypothesized, the one-dimensional Rasch model did not adequately fit the whole data. However, the MRM revealed two latent classes with different response styles: Class 1 (66.5%) showed the assumed one-dimensional model of identification using a holistic response style. Class 2 (33.5%) revealed a response style in favor of crossing extreme values violating scale validity. This study demonstrates the potential damaging effects if response biases occur in a relevant extent and how researchers can deal with by using IRT models.

Linking Positive Psychology and the Transtheoretical Model: How Character Strengths and Processes of Change Relate to Physical Activity

Stuntz, Cheryl P., St. Lawrence University

The transtheoretical model promotes physical activity by matching specific processes of change (PoC) to an individual's current stage of change. Similarly, positive psychology confirms that when individuals build their signature character strengths, they are generally happier and less depressed. However, past work has not examined how strengths use links to physical activity, which strengths are linked to which PoC, or the potential causal direction between PoC and strengths in predicting physical activity. Participants (N = 344) completed an online survey assessing character strengths, PoC, and physical activity stage of change. Multiple structural equation models were compared. The model with strengths predicting PoC and PoC predicting stage (AIC = 455.7) fit better than models with PoC predicting strengths and strengths predicting stage (AIC = 516.4) and with strengths and PoC as unrelated predictors of stage (AIC = 629.8). Within the best fitting model, higher fortitude strengths (e.g., perseverance, self-regulation) predicted more use of behavioral PoC (e.g., counter conditioning, stimulus control). Higher self-modulation strengths (e.g., prudence, modesty) and interpersonal strengths (e.g., teamwork, social intelligence) predicted more use of experiential PoC (e.g., dramatic relief, environmental reevaluation), and cognitive strengths (e.g., creativity, curiosity) were not related to PoC. In turn, behavioral PoC were used more by individuals who engaged in physical activity while experiential PoC were used more by individuals who not yet engaged in physical activity. Significant indirect effects of fortitude strengths on later stage of change and self-modulation strengths on earlier stage of change were revealed. Thus, this study's findings showed that (1) character strengths and PoC are linked, (2) strengths are better predictors of PoC than PoC are of strengths, and (3) building fortitude strengths may increase behavioral PoC for physically active people, and building self-modulation strengths may increase experiential PoC among non-active individuals.

Funding Source: university

An examination of athlete preferences of coach behaviors with junior high school athletes

Sullivan, Philip; Ragogna, Matthew, Brock University

The consideration of young athletes' preferences of their coach can aid in the development of life skills, positive development, and retention of youth in sport; which are only some of the outcomes and benefits from experiences gained throughout sport

programs (Carson & Gould, 2010). Previous research has mainly focused on high school aged athletes (14+). However, the highest rates of sport participation, variety, and dropout are found at younger ages (Canadian Heritage, 2013). This research was designed to address this gap. One hundred and sixteen (86 female, 49 male) youth sport athletes (age range 10-14 years) across 19 different sports completed the Revised Leadership for Sports Scale (RLSS) questionnaire. The RLSS assesses five factors of preferred coach behavior - Positive Feedback, Teaching and Instruction, Autocratic Behavior, Democratic Behavior, and Social Support. Since the RLSS was created for older athletes, a pilot study was conducted to validate comprehension and understanding for younger athletes. Overall, minor terminology was changed followed by the removal of three questions to help create a more youth-relatable question set. The results showed that the most preferred coaching behaviors were Training and Instruction and Positive Feedback, and the least preferred was Autocratic Behavior. There was no significant difference between genders on preferences, and no relationship between preferences and age. There was a significant difference between sport type where individual sport had a significantly higher preference for Democratic Behavior than team sport athletes ($t(114) = 2.72, p < .01$). These results are consistent with research on older youth sport participants with respect to overall preferences (Koh et al., 2009), although the absence of gender differences suggests that female preferences for particular leadership styles (e.g., Positive Feedback; Alfermann et al., 2005) may not emerge until later adolescence.

The duration of the effect of behavioral synchrony in different sized groups

Sullivan, Philip; Lewis, Zachary, Brock University

Synchronization of behaviour has repeatedly been shown to increase endorphin activity as measured by pain threshold (Cohen, Ejsmond-Frey, Knight, & Dunbar, 2010; Sullivan & Rickers, 2014). Although studies on synchronous behaviour and the synchrony effect has noted instances of the synchrony effect in multiple physical activities (Cohen et al., 2010; Davis, Taylor, Cohen & Mesoudi, 2015; Kokal, Engel & Kirschner, 2011) they have only incorporated small group trials. Additionally no previous literature has investigated endorphin level subsequent to the immediate termination of exercise. The current study examined whether group size would affect the magnitude of the synchrony effect and explored the length of time the synchrony effect lasted. Thirty-three participants rowed twenty minute time trials on a Concept II ergometer under two counterbalanced conditions - paired and large group ($n = 12$). Pain threshold was assessed before, immediately post, 5 minutes post and 10 minutes post each session. A repeated measures (2×2) factorial ANOVA revealed a significant interaction between condition and time. Specifically, the change in pain threshold was significantly greater for the large group ($M = 31.06$ mmHg) than paired condition ($M = 7.73$ mmHg) after 10 minutes of exercise ($F(2, 31) = 3.58, p < .05$). There were no other differences between the conditions at any other times. These results suggest that the synchrony effect may be longer lasting and in a large group condition and that synchronous movement in large groups allows for individuals to exert themselves longer in such conditions.

Examining interpersonal style in the coach-athlete relationship

Surya, Mark; Sadler, Pamela; Eys, Mark, Wilfrid Laurier University

The ability to predict, anticipate, and respond correctly to other's behaviors has important implications for the coach and athlete regarding their interpersonal dynamics. Drawing from interpersonal theory, the behaviors observed during coach-athlete interactions can be assessed using the interpersonal circumplex (Horowitz, 2004), which posits two main dimensions of control and affiliation. Harmonious interactions occur when behavior patterns unfold over time and are complementary (Kiesler, 1996). More specifically, interpersonal complementarity occurs when individuals respond to (a) affiliation with similar behaviors (e.g., friendliness with friendliness) and (b) dominance with opposite behaviors (e.g., dominance with submissiveness) (Carson, 1969). The current study aimed to examine the interpersonal circumplex in a sport environment as well as the link between cognitions and interpersonal behaviors. A head coach and 61 athletes completed a measure of the coach-athlete relationship (Jowett & Ntoumanis, 2004) prior to participating in a one on one videotaped interaction. Trained observers rated 61 videotaped coach-athlete interactions, separately coding the coach and athlete (i.e., 122 assessments; Sadler et al., 2009). Assessments were made for ten minutes with data recorded every half a second, resulting in over 1100 pieces of information. Cross correlations for dominance ($r = -.79$ to $-.90$) and affiliation ($r = -.32$ to $.67$) for each dyad were calculated. Results revealed that the coach and the athletes displayed entrainment for both affiliation and dominance from a moment-to-moment perspective. More specifically, one partners' affiliation behaviors were responded to with similar behaviors in the partner, while dominance behaviors were met with opposite behaviors in the partner. Furthermore, the affiliative behaviors were positively related to perceptions of the coach-athlete relationships for both the athlete and the coach ($r = .26$ to $.27$, $p < .05$). The current study furthers the understanding of the impact of relational boundaries on interpersonal behaviours.

Parents value competence more than warmth in competitive youth hockey coaches: Evidence based on the innuendo effect

Sutcliffe, Jordan, Nipissing University; Benson, Alex, Nipissing University; Bruner, Mark

The costly and time-intensive nature of competitive youth hockey requires a large investment from parents. As such, parents may expect a great deal from youth sport coaches – ideally wanting the most qualified coach to optimize their child's development. Given that competence and warmth capture two of the fundamental dimensions of social perception (Abele, 2003), the current study sought to examine whether hockey parents favored competence over warmth characteristics in an individual coaching their child. According to the innuendo effect (Kervyn, Bergsieker, & Fiske, 2011), we hypothesized that parents would infer a coach to lack competence if a description only conveyed positive information about a coach's warmth. Assuming that competence is the salient dimension of social perception in the context of competitive youth hockey, we also hypothesized that lower perceived competence would mediate the relationship between the innuendo effect and perceived coaching suitability. Parents of competitive youth hockey players ($N = 211$) read either a description of a potential new coach that emphasized warmth, competence, or generally positive (control) characteristics.

Participants then evaluated the coach and their desire to have that individual coach their child. An ANOVA comparing the three conditions revealed a significant difference between conditions in competence ($p < .001$; $\eta^2 = 0.11$) and perceived suitability to coach their child ($p < .001$; $\eta^2 = 0.072$). In the warmth-only condition, parents rated the coach to be lower in competence ($p = .004$) and coaching suitability ($p = .002$) than the control condition. No innuendo effect emerged when comparing perceived warmth in the competence-only condition to the control condition. Mediation analysis indicated that the innuendo effect undermined perceived coaching suitability ($p < .001$) through its negative effect on coach competence ($p < .001$). We discuss the implications of demonstrating how the innuendo effect shapes parents' perceptions of competence, but not warmth, in relation to a youth hockey coach.

Predicting exercise motivation and exercise behavior: A conditional process model testing the interaction between perceived variety and basic psychological needs satisfaction in exercise.

Sylvester, Benjamin, The University of Toronto; Curran, Thomas, Bath; Standage, Martyn, Bath University; Sabiston, Catherine, University of Toronto; Beauchamp, Mark, University of British Columbia

Previous work has shown perceived variety and psychological needs satisfaction (viz. competence, autonomy, and relatedness) to predict exercise behavior via autonomous motivation. However, it may be that perceived variety in exercise interacts with the effects of psychological needs satisfaction on autonomous motivation and exercise behavior. The purpose of the present work was to test the hypotheses that: (i) perceived variety in exercise would predict exercise behavior; (ii) the relationship would be mediated by autonomous motivation; and (iii) satisfaction of the basic psychological needs would moderate the mediated pathway. Adults ($N = 499$) completed an online questionnaire to measure the study variables. Results of the conditional process model showed that (i) higher perceived exercise variety was associated with higher self-reported exercise behavior ($\beta = .094$, $p < .01$) and; (ii) higher autonomous motivation was a significant mediator of the effect ($\beta = .102$; 95%CI = .07, 0.14). Moreover, psychological needs satisfaction moderated this positive indirect effect ($\beta = -.088$, $p < .01$) such that the relationship between perceived variety and exercise behaviour was stronger as psychological needs satisfaction was lower. Based on these findings, perceived exercise variety may act as a compensatory source of motivation. In addition to attempting to foster need-supportive exercise contexts, it may be particularly important for exercise promotion specialists to foster the experience of variety among individuals who do not have high psychological needs satisfaction.

Funding Source: Social Sciences and Humanities Research Council of Canada

The Effect of Metrical Structure of Auditory Stimuli on Temporal Organization in Rhythmic Sensorimotor Synchronization Tasks

Tanosaki, Haruka; Okano, Masahiro; Shinya, Masahiro; Kudo, Kazutoshi, The University of Tokyo

The coordination of a physical action with a rhythmic sequence such as dancing or playing a musical instrument is one of the fundamental human skills. Several articles

have discussed how to coordinate accurately or stably and suggested that subdivision benefit can be an effective method for reduces the variability of the asynchronies between actions and auditory cues (Repp, 2003; 2010). The aim of the present study was to examine the extent to which physical subdivision of inter-onset intervals in an isochronous sequence reduces the variability of the asynchronies. Twelve healthy participants performed unimanual finger tapping in time with an auditory metronome. There were four metrical conditions where metronome tone was given every 1, 2, 3 or 4 taps. In 3-meter condition, for example, participants were required to tap 3 times for single metronome tone. Three different tempi were tested: 500, 333 and 250 ms of inter-tap-intervals (ITIs). Mean and standard deviation of asynchrony on accented beat were calculated to quantify the temporal stability of tapping. Two-way repeated measures ANOVA was used to test the effect of metrical structure and tempo. Mean asynchrony data revealed no significant main effect of tapping conditions, whereas the standard deviation of asynchrony data revealed statistically significant main effects of tapping conditions (1-meter : 14.1 ms, 2-meter : 16.1 ms , 3-meter : 21.3 ms, 4-meter : 23.4 ms, $p < .001$) and of tempi (ITI = 500 ms : 23.1 ms, 333 ms : 18.0 ms, 250 ms : 15.1 ms, $p < .001$). The results showed that the less metrical condition was, the more stable the tapping were, suggesting that metrical structure affect local synchronization performance.

Motivation: Examining motivational aspects of, and physical activity associations with, fitness-related social media activity

Tapia, Oddessy A.; Cesena, Michael Ryan; Ely, Frank O.; Mouat IV, James C.; Ylanan, Ryan S.; O, Jenny, California State University East Bay

Limited research on fitness-related social media activity (FR-SMA) has confirmed it as an intentioned behavior (e.g., Carrotte et al., 2015) but descriptive research on FR-SMA is lacking. Given this, though SMA-based physical activity interventions are evident (e.g., Teodoro & Naaman, 2013), it is unclear how optimal the use of SMA as an intervention platform has been. Motivation initiates all intentioned behaviors, thus, the primary purpose of our study was to examine motivational direction (MD), intensity (MI), and regulation (MR) of FR-SMA. Our secondary purpose was to explore relationships between FR-SMA and physical activity. Instagram users ($N = 708$) completed a demographics questionnaire assessing general (GEN) and fitness-related (FR) Instagram usage and FR habits and self-perceptions. MR was measured using a modified version of the Behavioral Regulations in Exercise Questionnaire (Markland & Tobin, 2004; Wilson, Rodgers, Loitz, & Scime, 2006). Regarding MD, 31% and 64% of participants reported posting and following FR content, respectively. For MI, three separate linear regressions (adjusted- $p = 0.02$) indicated that MIFR did not predict self-reported exercise levels (i.e., mild-, moderate-, and strenuous exercise; $\beta = 1.22-2.97$; $p > 0.02$ and explained variance $< 1\%$ for each). Furthermore, a paired sample t-test ($t(521) = -43.56$, $p < .001$) indicated that MI for GEN-SMA ($M = 3.30$; $SD = 1.70$) was significantly greater than MI for FR-SMA ($M = 0.08$; $SD = 0.06$). Two separate single-group RM-MANOVAs (adjusted- $p = 0.03$) were conducted to examine MR (Posting = $F(1.92, 346.66) = 120.93$, $p < .001$, $\eta^2 = 0.40$, power = 1.00; Following = $F(2.10, 795.81) = 357.46$, $p < .001$, $\eta^2 = 0.49$, power = 1.00). Post hoc analyses indicated that generally, individuals are more self-determined in their FR-SMA. Interestingly, amotivation also appears to be a salient regulator. Results will be discussed within the

context of description of FR-SMA, self-determination theory, and social-media-based physical activity interventions. Future research directions will also be presented.

Funding Source: CSUEB Center for Student Research, Kinesiology Research Group

**The Pictorial Scale of Physical Self-Concept for Young Children (P-PSC-C):
A Feasibility-Study**

Tietjens, Maike; Dreiskaemper, Dennis; Utesch, Till, University of Muenster; Schott, Nadja, University of Stuttgart; Barnett, Lisa; Hinkley, Trina, Deakin University

Self-concept is regarded as both an important predictor and as a consequence of behavior. Developing a positive and healthy self-concept is said to be one of the most important steps in human development. Children's self-perception of motor skills and physical fitness is said to be an important mediator between skills and physical fitness and physical activity. To understand the development and the differentiation of the physical self-concept of children and its components an age-appropriate self-perception scale is needed. The objectives of this study were (1) to develop a pictorial scale of physical fitness for pre-school children (3-6), and (2) to describe the face validity and feasibility of the scale. The study sample included 27 kindergarten children (Mage=4.93, SD=.87). Validity was assessed through administration of the Pictorial Scale for Physical Self-Concept in pre-school age (P-PSC-C) compared with children's fundamental movement skill competency (TGMD)-3, children's perceived movement skill competence (Barnett et al., 2015), height, weight, and demographics. The face validity was favorable. Expectable negatively skewed response distributions in all items were found. The perceived physical fitness is significantly correlated with perceived locomotion ($r=.478$, $p<.01$) and perceived object control ($r=.413$, $p<.01$), whereas perceived locomotion and perceived object control correlate with $r=.740$, $p<.01$. No significant correlations with motor performance and physical appearance were found. However, a significant positive correlation between perceived physical fitness and enjoyment in sports ($r=.453$, $p<.01$) was observed. The graphical illustrations within each domain facilitated children's participation in the study. The correlation pattern might represent a hierarchical and multidimensional structure (Marsh et al 1994). Children in this age group might not be able to accurately report their skill and fitness level. Further validation studies are needed to evaluate the psychometric properties of the new scale.

Physical Activity Promotion in the Spinal Cord Injury Population: Potential Impact of Pain and Mode of Mobility

Todd, Kendra R.; Shaw, Robert B.; Martin Ginis, Kathleen A.;

Purpose: Targeted physical activity (PA) interventions are needed for different segments of the spinal cord injury (SCI) population. Significant differences in self-reported PA and daily pain have been reported for people with SCI who ambulate versus those who use wheelchairs. It is not known, however, if these variables are related. The purpose of this study was to examine whether minutes/day of leisure time PA is a significant predictor of self-reported pain in adults with SCI, and if this relationship varies between those who ambulate versus use a wheelchair as their primary mode of mobility.

Methods: A secondary analysis was undertaken of data from 702 persons with SCI who

participated in the SHAPE-SCI study. Self-reported measures of PA and pain were collected using the PARA-SCI, and SF-36 respectively. Measures of psychological variables and injury characteristics linked to PA and pain were collected as potential covariates. Independent samples t-tests compared pain and PA between ambulators and wheelchair users. Hierarchical multiple regression analyses tested predictors of pain.

Results: Ambulators reported significantly less pain ($M = 53.54$, $SD = 25.07$) than wheelchair users ($M = 61.65$, $SD = 24.43$), $p = 0.003$, but comparable min/day of PA (ambulators: $M = 23.41$, $SD = 39.55$; wheelchair users: $M = 27.44$, $SD = 50.44$), $p = 0.459$. After controlling for depression ($B = -0.30$, $p < 0.001$) and years post-injury ($B = 0.08$, $p = 0.046$), PA was a significant predictor of pain for wheelchair users ($B = 0.09$, $p < 0.027$), but not for ambulators ($B = -0.02$, $p = 0.822$).

Conclusion: Ambulators with SCI reported less pain than wheelchair users, despite similar levels of PA. However, wheelchair users who did more activity reported greater pain. These findings highlight the importance of considering mode of mobility when promoting PA in the SCI population. Wheelchair users may require targeted interventions to address pain as either a barrier to, or a consequence of, leisure time PA participation.

Funding Source: Canadian Institutes of Health Research (CIHR)

Communicating the corrective feedback as legitimate, basic psychological needs and well-being of soccer players: A longitudinal analysis

Tristan, Jose L.; Barbosa-Luna, Adrian E.; Gonzalez-Gallegos, Alejandra G., Universidad Autonoma de Nuevo Leon; Tomas, Ines, Universitat de Valencia; Lopez-Walle, Jeanette, Universidad Autonoma de Nuevo Leon

Grounded in self-determination theory (SDT; Deci & Ryan, 2000), and feedback research in sports context (Carpentier & Mageau, 2016; Mouratidis, Lens, & Vansteenkiste, 2010), the objective was to investigate if changes in soccer players' perceptions of the coaches' amount corrective feedback perceived as legitimate, predicted changes in the players' basic psychological needs and in turn, the well-being. A longitudinal data was collected, at the beginning (T1) and at the end (T2) of a competitive season. Participants were 451 (male = 296, female = 155) youth soccer players ($M = 18.84$, $SD = 2.09$). They fulfilled the Spanish versions: Corrective Feedback Scale (CFS); Intrinsic Motivation Inventory (IMI), Perceived Autonomy Scale (PAS), Need for Relatedness Scale (NRS), Psychological Needs Thwarting Scale (PNTS) and Satisfaction With Life Scale (SWLS). The results confirmed the reliability of the questionnaires (alpha range = .73 - .93). Structural Equation Modeling (SEM) analysis showed an adequate fit of the data ($\chi^2/df = 3.97$, CFI = .90, IFI = .90). Moreover, when coaches give corrective feedback that is perceived as legitimate at T1, the satisfaction of basic psychological needs is predicted (T2, $\beta = .33$, $p < .01$) and these, in turn, predict satisfaction with life (T2, $\beta = .33$, $p < .01$) of the players. Likewise, a positive indirect effect is confirmed between corrective feedback perceived as legitimate at T1 and satisfaction with life at T2 ($\beta = .13$, $p < .01$). Finally, the thwarting of basic psychological needs is negatively interrelated when coaches give corrective feedback that is perceived as legitimate at T1 ($\beta = -.21$, $p < .01$) and with the satisfaction with life at T2 ($\beta = -.11$, $p < .05$). In conclusion, when soccer players perceive the

feedback as legitimate is highly relevant to communication style of corrective feedback because athletes will feel understood and might see the value of the provided corrective statements, leading them to basic psychological needs satisfaction and well-being relationship.

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Identifying Predictors of Intentions to Implement Inclusive Physical Education

Tristani, Lauren; Bassett-Gunter, Rebecca, York University; Tomasone, Jennifer, Queens University

Students with disabilities (SWD) experience inadequate levels of physical activity (PA) (Law et al., 2015). School-based interventions, including physical education (PE) can attenuate low levels of PA (Dudley et al., 2016). However, full implementation of inclusive PE has yet to be recognized (Qi & Ha, 2012) and SWD experience less than optimal participation in PE. Teachers play a vital role in initiating and creating inclusive PE experiences that facilitate PA for SWD (Sallis et al., 2012). Teachers' attitudes and affect are predictive barriers of implementation behaviour but little is unknown about other psychosocial predictors specific to inclusive PE. Guided by the Theoretical Domains Framework (TDF; Cane et al., 2012), the purpose of this study was to identify theoretical predictors of teachers' intentions to implement inclusive PE. While the TDF has been operationalized and explored within other professional settings (e.g., healthcare settings; Curran et al., 2013), the framework has not been applied within educational settings to examine predictors of intentions among teachers. Ontario pre-service and in-service teachers (N = 387, 86% female, 71% PE qualification) completed a modified Determinants of Implementation Behaviour Questionnaire (DIBQ; 12 and 14 domain versions; Huig et al., 2014a,b). The measure assessed potential factors influencing intentions toward implantation of inclusive PE. Pearson's correlations demonstrated a significant ($p < .01$) relationship between the following TDF domains and teachers' intentions to implement inclusive PE: Belief about Capabilities ($r = .71$, beta .248), Optimism ($r = .72$, beta .200), Social Professional Roll and Identity ($r = .71$, beta .181), and Social Influence ($r = .76$, beta .261). After controlling for covariates (gender, PE qualification, previous experience teaching PE), the TDF categories explained 77% of the variance in Intention. These preliminary findings provide novel insights into predictors of teachers' intentions to implement inclusive PE and suggest suitable mechanisms to target in future intervention

Exploring the conceptualization and assessment of self-compassion within the context of body image

Ullrich-French, Sarah C.; Cox, Anne E., Washington State University

The construct of self-compassion is multi-dimensional, comprised of three core elements: self-kindness, sense of common humanity, and mindfulness. The Self-Compassion Scale includes three subscales to capture each of these elements representing self-compassion but also includes three subscales to capture three opposing or negative elements reflecting being un-self-compassionate. The negative subscales assess self-judgment (opposed to self-kindness), isolation (opposed to

common humanity), and over-identification (opposed to mindfulness). Most research utilizes a total score to represent self-compassion. The score is created by reverse scoring the negative items and then averaging all items so that higher scores reflect higher self-compassion. Recently, questions have been raised about whether this practice inflates the self-compassion score and thus inflates associations of the self-compassion construct with various psychological indices, specifically psychopathology. There are relatively few studies utilizing the subscale scores. We explore the six dimensions of self-compassion as they associate with negative body-related emotions of body shame, body guilt, and social physique anxiety, and with body appreciation in a sample ($N = 425$) of US college students. Using Steiger's Z test, these associations were compared to the associations using the total self-compassion score. Significant differences emerged in some of these correlations. Results showed that the composite self-compassion score related more strongly to all body image variables compared to the three positive dimensions of self-compassion. In addition, self-judgment was the only dimension that did not differ from the composite self-compassion score in predicting body appreciation. The differences (and lack of differences) between using a total self-compassion score and dimension scores spark questions regarding the conceptualization and measurement of self-compassion utilizing positive and negative dimensions.

How Pokemon Makes People GO: Incentive Apps and Physical Activity

Utesch, Till; Mentzel, Stijn V.; Dreiskaemper, Dennis; Tietjens, Maike, University of Muenster; Hinkley, Trina; Barnett, Lisa M., Deakin University

Sedentary lifestyles have become one of the biggest health issues across age groups around the globe (e.g., Hills, King, & Armstrong, 2007). Hence, researchers are constantly looking for possible solutions to this epidemic. One potential solution is seen in gaming apps such as Pokemon GO, which motivate people towards being physically active via incentives (i.e., collecting rare pokemon). This study aimed at monitoring and explaining the acute effect of the free to play app Pokemon GO on walking as well as moderate to vigorous PA (MVPA). Starting seven days after initial release of Pokemon GO in Germany a total of 572 adults (Mage = 25, SD = 7.2; 50.7 % female) who just started playing participated in the study. PA was assessed via walking and MVPA scale of the German version of the International Physical Activity Questionnaire (IPAQ-SF) for a regular week before Pokemon GO (t0) as well as their week since playing (t1). In addition, objective data from the Pokemon GO app indicating game progress was collected (i.e., km covered, level of avatar). Participants were contacted again two (t2) and four (t3) weeks after app release. Multilevel growth curve analysis revealed a significant increase in time spent walking of approximately 366 minutes per week (predicted value) from t0 to t1. Physical activity levels were back at t0 level four weeks after app release. The same effects were found for MVPA. Objective data revealed that people did not stop but increased playing, as gameplay progression monitored in the app did increase in a curvilinear way across the four weeks. The study shows, that an app encouraging an active lifestyle as did Pokemon GO has the potential to substantially contribute to making game-affine populations more active. However, purchasable app features allowed players to play the game while sitting. When intending to sustainably

increase PA via apps, no in-game pay options bypassing PA should be provided. Otherwise, players quickly adapt their playing strategy and stop their 'new' activity behaviour as indicated by Hull's (1943) law of less work.

Body-Related Emotions and Psychological Stress in Physically Active Breast Cancer Survivors

Vani, Madison F.; Sabiston, Catherine M., University of Toronto

The diagnosis and related treatments for cancer can increase breast cancer survivors' (BCS) experiences of stress because they may sensitize individuals to changes in body image. Body-related self-conscious emotions, in particular, may be modifiable sources of such stress for which physical activity may play an especially important role in buffering. Using an experience sampling method, the purpose of this study was to identify intrapersonal sources of stress among BCS by (a) examining the relationship between body-related self-conscious emotions (i.e., shame, guilt, pride) and psychological stress, and (b) whether physical activity moderates these associations. Women (N = 21; Mean Age = 59 years) provided measures of body-related self-conscious emotions, physical activity, and stress six times a day for seven days. Multilevel modeling was used to test for day-level time-varying predictors of psychological stress. In line with expectations, within-person daily variability in body-related guilt positively predicted within-person daily variability in stress ($\gamma = .59, p < .001$), whereas within-person daily variability in body-related pride negatively predicted within-person daily variability in stress ($\gamma = -.27, p < .001$). Contrary to expectations, body-related shame was not a significant predictor of stress and self-reported physical activity did not moderate the effects of guilt and pride. Our results indicate that body-related guilt and pride may be especially important self-conscious emotions to target in interventions committed to reducing experiences of stress among BCS.

Funding Source: Social Sciences and Humanities Research Council of Canada

Expert-novice differences in visual behaviour during alpine slalom skiing

Vansteenkiste, Pieter, Ghent University, Belgium; Decroix, Marjolein; Norjali Wazir, Mohd Rozilee; Zeuwts, Linus; Deconinck, Frederik; Lenoir, Matthieu, Ghent University, Belgium

The aim of this study was to investigate visual behaviour of expert and novice ski athletes during an alpine slalom. Fourteen novices and five expert slalom skiers completed an alpine slalom course in an indoor ski slope while wearing a head-mounted eye tracking device. Experts completed the slalom clearly faster than novices, but no significant differences were found in timing and position of the turn initiation. Although both groups already looked at future obstacles approximately 0.5s before passing the upcoming gate, the higher speed of experts implied that they shifted gaze spatially earlier in the bend than novices. Furthermore, experts focused more on the second next gate while novice slalom skiers looked more to the snow surface immediately in front of their body. No differences were found in the fixation frequency and average fixation duration between both groups. These results suggest that experts focus on the timing of their actions while novices still need to pay attention to the execution of these actions. These results also suggest that ski trainers should instruct novices and experts to focus

on the next pole and, shortly before passing the gate, shift their gaze to the second next pole. It seems unadvisable to instruct slalom skiers to look several gates ahead during the actual slalom.

"Walkabouts" integrated physical activities improve inattention, hyperactivity and engagement in the preK-2nd Grade classroom

Vazou, Spyridoula; Wille, Madeline; Long, Katharine, Iowa State University; Lakes, Kimberley, University of California Irvine; Whalen, Nicci, Simpson College

A growing body of research indicates that physical activity (PA) positively impacts cognitive function and academic performance in students. The effect of PA on cognition in children may be dependent on its qualitative characteristics, such as the level of cognitive engagement. However, structured PA programs in the classroom that make clear connections with the academic standards in different subject areas across different grades are limited. The purpose was to examine the effect of the "Walkabouts" web-based active learning PA program on inattention, hyperactivity and classroom engagement. Methods. Eleven preK to 2nd grade classes (N= 245 students) were assigned to the intervention (n = 158; using the Walkabouts PAs) or control (n = 87; traditional lessons) group. Teacher ratings of students' inattention and hyperactivity in the classroom were collected using the SWAN scale before and after the 7-week intervention in both groups. Classroom observations were conducted for engagement (on-task behavior and emotional tone) following "Walkabouts" for the intervention or a traditional lesson for the control group. Treatment fidelity was monitored through observations and daily teacher logs. Results. Repeated MANOVA showed that children in the intervention group improved significantly more, compared to the control group, in both inattention and hyperactivity, whereas children in the control group had a decrease in their performance over the 7-weeks [$F(2,237)= 39.31$, $p<.001$, $\eta^2=.25$] and ...significantly higher [$F(3,36)=4.68$, $p=.037$, $\eta^2=.12$]. The results did not differ based on the gender of the students. Further, classroom engagement was significantly higher [$F(3,36)=4.68$, $p=.037$, $\eta^2=.12$] for 10 minutes after the "Walkabouts" break, compared to traditional lesson. Conclusions. The findings provide evidence that implementing PA programs in integration with academic subjects, such as the "Walkabouts", may facilitate learning by increasing cognitive and behavioral control in the classroom. Schools can focus on academic achievement goals through cognitively engaging PA programs.

The Effects of Progressive Muscle Relaxation on the Subjective Well-Being of Collegiate Athletes

Vento, Kaila A.; Vargas, Tiffany M.; Madrigal, Leilani; Schick, Evan, California State University Long Beach

Collegiate athletes endure a variety of stressors including academics, relationships, self-expectations, sport training, injuries, coaches, exhaustion, and competition (Cosh & Tully, 2015). Athletes unable to control stress in their lives may negatively impact their well-being, which is important for optimal athletic performances, life satisfaction, and health. However, progressive muscle relaxation (PMR) has shown to be effective in

reducing stress (McCallie, Blum, & Hood, 2006). Previous research has examined PMR and its effects related to competition anxiety, mood, and pain threshold endurance, yet no study has examined its association to student-athlete well-being. The current study examined the effectiveness of a PMR intervention as a coping method. Participants (N= 22) were randomly selected to either receive a single 20-minute PMR session (experimental group) or 20-minute resting session (control group). The Subjective Exercise Experience Scale (SEES) was given as a pre and post assessment to examine the effectiveness of PMR to increase well-being and decrease stress and fatigue scores. Data was analyzed using IBM SPSS 24. Based on a MANOVA, results revealed no significant interaction between time and condition, $F(3,38) = 1.33$, $p > .05$; Wilks' $\eta^2 = .99$ or main effect for condition, $F(3, 38) = .88$, $p > .05$ Wilk's $\eta^2 = 9.35$. A significant main effect was found for time, $F(3, 38) = 13.67$, $p < 0.05$; Wilk's $\eta^2 = .48$. Post scores for stress and fatigue levels decreased and well-being levels increased compared to the pre-scores regardless of intervention group. Although the PMR group had higher well-being levels and a lower stress and fatigue level post-intervention compared to the control group, the difference was not significant. PMR and lying quietly had significant changes from pre to post intervention; both worked just as well. The results and implications for future research will be discussed.

Active gaming and self-paced exercise: A self-determination perspective

Wadsworth, Danielle D.; Daly, Colleen M.; Foote, Shelby J., Auburn University

This study aimed to identify physical activity, enjoyment, and factors for future activity between an active video game (AVG) condition and a self-paced exercise condition among college-aged students. Thirty college-aged volunteers (age= 22 ± 1.68 years) completed 4-45 minute physical activity sessions (2 AVG; 2 self-paced) while wearing a sense wear armband. A semi-structured interview followed the four sessions to identify enjoyment and intent for future exercise. Overall, participants expended more calories, accumulated more steps, and more moderate-to-vigorous physical activity during the self-paced condition ($p < .001$); however, participants in the AVG condition met daily exercise recommendations. The majority of participants (81%) enjoyed playing the AVG. Themes for enjoyment were a sense of fun and novelty. Autonomy and competence were found as themes among those who preferred the self-paced condition; whereas, lack of knowledge and increased exercise variety were emergent themes among those who preferred the AVG. Inadequate physiological responses and a lack of relatedness emerged as themes for not choosing AVG in the future as a form of exercise. For those who preferred the AVG and planned to play in the future, a lack of exercise knowledge and increased exercise variety emerged as themes. This study provides evidence that college students could meet daily exercise recommendations by participating in AVG interventions; although AVGs that provided autonomy and allowed users to demonstrate competence would be preferable.

Compensation following HIIT training in women: A tale of two interventions.

Wadsworth, Danielle D.; Rodriguez, Mynor G.; Foote, Shelby J., Auburn University

A large percentage of adult women do not meet daily exercise recommendations and

many interventions fail to increase exercise behavior long-term. Compensation refers to how behaviors relate and suggests that as exercise increases, physical activity outside of an exercise session may decrease. In terms of exercise interventions compensation suggests that interventions are destined to fail because compensatory behaviors could occur in other domains or contexts; having a limited effect on daily physical activity levels and sedentary behavior over time. In recent years, high intensity interval training (HIIT) has been studied in terms of the physiologic effects, primarily compared to moderate continuous training. There is some evidence however, that vigorous exercise has been linked to negative affective states and may discourage continued exercise participation or promote compensatory behaviors. The purpose of this study was to explore compensation following two HIIT training interventions for women. 20 women aged (19-39) and 32 women (aged 40-65) completed a HIIT and resistance training program three times a week over 12 weeks for a total of 30 sessions. Participants wore an actigraph accelerometer prior to and after the intervention to examine changes in sedentary time. A semi-structured interview was utilized to identify perceptions of the program and perceived changes in physical activity and diet outside of the study. Women aged 40-65 significantly ($p < .05$) increased time spent in sedentary behavior outside of the training sessions. No evidence of compensation occurred for women aged 19-39. Themes that emerged for women aged 40-65 showed an active conscious compensation with women intentional being sedentary after an exercise session. In comparison, the younger women utilized active transportation and changes in physical activity competence to maintain their activity outside of the exercise sessions. Based on the results of this study, compensation may be factor that needs to be addressed in exercise interventions and may function by age.

An Evaluation of a National Online Captain's Leadership Training Course

Walker, Lauren; Gould, Daniel R., Michigan State University

Sport is viewed as an arena for positive life skill development, including leadership development. Previous literature shows that coaches value leadership ability but often do not provide an avenue for this development (Voelker, Gould, & Crawford, 2011). In 2015, the National Federation of State High School Associations (NFHS) launched an online Captain's Leadership Training Course. Due to interest in this course, this study had two purposes: 1) to examine the effectiveness of the course in improving leadership ability and 2) to examine coaches' leadership characteristics and actions during this training. An electronic survey was created containing relevant demographics, the Transformational Leadership Subscale (TLS) of the MLQ-5X (Bass & Avolio, 2004), and Likert-scale questions evaluating athletes' opinions of the course (1 = extremely useful-5 = not at all useful). The survey was sent to a convenience sample of athletes ($n = 188$, 199 females, 69 males), ages 13-19 ($M = 17.01$, $SD = .997$) in eight U.S. states. Descriptive statistics showed athletes believed the course to be 'effective' ($M = 1.73$ - 1.93 , $SD = .768$ -. 849) in helping them: understand leadership, improve their skills as a leader, and improve their knowledge of motivation, communication, decision making, peer modeling, team cohesion and problem solving strategies. 92.6% of athletes completed the course under the recommendation or requirement of a coach. However, athlete ratings of their coach in each TLS subscale were not high ($M = 2.62$ - 6.43 , $SD =$

3.04-5.85), with the total transformational score rated low as well ($M = 16.14$, $SD = 14.3$). Athletes in this study held a positive view of the NFHS course and were often directed to this resource by their coach. The high involvement of the coach reflects a strong bias toward athletes with coaches more apt to use this type of life skill resource. Future research should examine the characteristics of these 'early adopter' coaches and seek to understand the views of the course by athletes without coaches active in leadership training.

Targeting Mental Health Stigma among Ultra-marathon Runners using a Brief Video Social Contact Intervention

Watenmaker, Aaron; Wilson, Kathleen; Englar-Carlson, Matt, California State University Fullerton

Mental health stigma can be quite devastating for those suffering from a mental health issue (Corrigan and Shapiro, 2010). Among athletes, rates of mental health issues (MHI) such as anxiety and depression are prevalent (Frings-Dresen & Sluiter, 2015). However, one challenge that may limit athletes seeking help is the prevalence of stigma towards MHI among athletes (Kaier et al., 2015). Social contact interventions using videos of individuals with MHI have been shown to be successful among the general population (Clement et al., 2012). Stigma can appear in two different forms: public and internalized. Public stigma is how much stigma a community has towards MHI (Corrigan et al., 2006), where internalized stigma is how much stigma an individual has (Yanos et al., 2011). The purpose of this study was to pilot a social contact video intervention among ultra-marathon runners. Participants ($N=160$) completed baseline assessments of internalized stigma (The Devaluation-Discrimination scale), public stigma (Self Stigma of Seeking Help Scale), and help seeking attitudes (Attitudes Towards Seeking Professional Psychological Help Scale Short Form and the General Help Seeking Questionnaire). A week later participants were randomly assigned to watch the video or not, that was then followed by the follow-up assessments. The short video depicted an ultra-marathon runner running a race and discussing his own struggles with mental health issues. A 2 (group) by 2 (time) factorial ANOVA was performed to examine changes in public and private stigma. Results indicate no significant interactions across the measures ($p>.05$), with the exception of public stigma ($p=.03$). Public stigma increased among the intervention group only ($p=.021$). One reason this may have occurred is that illicit drug use presented in the video, which has been viewed as moral failure as opposed to a MHI (Room, 2005). This study suggests that a brief social contact intervention was not beneficial in changing stigma towards MHI, and may have increased perceptions of stigma.

Exploring Mental Health Among Ultra-Marathon Runners

Watenmaker, Aaron; Wilson, Kathleen; Englar-Carlson, Matt, California State University Fullerton

Among athletes, rates of mental health (MH) issues vary, with some studies showing upwards of 68% of a sample of swimmers with depressive symptoms (Hammond, Gialloreti, Kubas, & Davis, 2013), while others indicate rates of MH issues of 13.1% (Sundgot-Borgen & Torstveit, 2004). Early work by Morgan and Pollock (1977) suggest that runners may experience more positive MH than non-athletes. Further, another study

showed that highly committed runners reported lower rates of anxiety and depression than recreational runners (Leedy, 2000). One population of athletes that has received little attention is the ultra-marathon running community. This study examined the rates of MH issues among ultra-marathon runners and examined factors that relate to levels of MH in this population. Participants (N=201) completed the Mental Health Inventory-5 (MHI-5; Veit & Ware, 1983), which consists of five questions aimed at assessing MH. As social support has been related positive mental health in general (Giacobbi et al., 2004; Armstrong & Oomen-Early, 2009), it was assessed as a possible predictor of MH with the Multidimensional Scale of Perceived Social Support (Zimet, Dahlem, Zimet, & Farley, 1988). Additionally, demographics and racing experience were collected. It was observed that 23.5% of the sample scored below the cut point on the MHI-5, indicating some form of MH issue (Rumpf, Meyer, Hapke, & John, 2001). A multiple regression predicted MH status using social support, running experience (training status and number of races completed) and age. The overall regression was significant ($R^2=.12$, $p=.001$) with age ($b=0.04$, $p=.001$) and social support ($b=0.35$, $p=.003$) emerging as significant predictors of mental health. With almost a quarter of ultra-marathoners reporting MH issues, a further understanding of MH issues in this population is warranted. As age and social support were related to MH issues but training status and number of races were not, future research needs to explore other factors that may relate to MH and ways to enhance the social support of ultra-marathoners.

Do children like what they do? Association between preference and performance on a motor task.

Wazir Norjali Wazir, Mohd Rozilee, Ghent University, Belgium; Pion, Johan, HAN University of Applied Sciences; Deconinck, Frederik; Mostaert, Mireille; De Meester, Ann; Lenoir, Matthieu, Ghent University, Belgium

Most of the people assume that someone will perform well on something they like. A tool evaluating how much an individual likes an activity can also be helpful for talent detection and to have children and adolescents continue what they like as a recreational sport. The purpose of this study was to identify the relationship between physical performances on a physical task and the degree of liking this task. In this cross-sectional study, 558 pupils between 8 years to 11 years were evaluated with a test battery containing 7 physical performance tests (I Do) compared to a pictorial scale containing 7 pictures (I Like) referring to the same physical performance tests. Pearson correlation was computed to investigate the relation between the actual performance and the enjoyment. Overall, there were moderate significant correlations between each of the respective I Do and I Like components; FLEX-DO & FLEX-LIKE (.223*), SU-DO & SU-LIKE (.222**), KnPU-DO & KnPU-LIKE (.256**), HGR-DO & HGR-LIKE (.128**), SBJ-DO & SBJ-LIKE (.134**), SHR-DO & SHR-LIKE (.171**), ESR-DO & ESR-LIKE (.420**). It appears that the correlation between the endurance items is higher as compared to the other six characteristics. Rerunning the analysis for age and sex groups separately resulted in only one significant correlation across all age group, namely between the evaluations of cardiovascular endurance. Information on enjoyment appears to be a useful and cost-effective addition to current multidimensional test batteries in sport. This enjoyment will increase the intrinsic motivation, which is beneficial for sustained sport participation as well as for avoiding dropout in promising young athletes.

Elite athletes in interactive and technique-oriented sports differ regarding their implicit achievement motive

Wegner, Mirko; Hofstetter, Denise; Endtner, Pia; Suter, Rebecca, University of Bern; Schueler, Julia, University of Konstanz

The achievement motive is perceived as the recurrent concern for performing according to a personal standard of excellence. Questionnaires to assess this personal standard of excellence are often used as an additional source of information for talent selection in German speaking countries. However, at high performance levels all athletes may explicitly show high achievement orientations with low variance between athletes (ceiling effects). Such ceiling effects may be avoided by measuring athletes' implicit achievement motives indirectly. It has previously been shown that elite athletes from different sports show different strengths of the implicit achievement motive (Gröpel, Schöne, & Wegner, 2015). For the present research we hypothesized that in interactive sports young elite athletes' strength of the achievement motive is lower than in technique-oriented sports. Swiss elite athletes from two technique-oriented sports (shooting, $n = 34$; orienteering, $n = 31$) and one interactive sport (floorball, $n = 34$) participated in this study. The Picture Story Exercise was used to measure the strength of the implicit achievement motive. A univariate analysis of variance was performed to determine differences between the three sports (orienteering, shooting, floorball) regarding the strength of athletes' implicit achievement motive. Our hypothesis on the difference regarding the implicit achievement motive in the three types of sports was confirmed: Elite floorball athletes showed significantly lower implicit achievement motives than athletes in shooting or orienteering. Athletes from orienteering and shooting, however, did not significantly differ regarding their achievement motives. The results from this study illustrate that athletes from different sports may differ regarding their dominant motive structure which bears implications for talent selection or incentive structures in practice.

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Moderating effects of gender and age within the mechanisms of the self-determination theory process model - Examining exercise motivation in a digital context.

Weman Josefsson, Karin A.; Johnson, Urban, Halmstad University; Lindwall, Magnus ., University of Gothenburg

Exercise-related goals and values are likely to differ between people based on factors such as gender, age and culture, and there are reasons to believe that the mechanisms between motivation and exercise behavior presented in the self-determination theory (SDT) process model also could vary as a function of such influences.

This study is part of a digital exercise intervention (see Weman-Josefsson et al., 2016) in a sample of 318 adult women ($n = 278$) and men ($n = 40$) aged 23-67 years ($M = 46.7$; $SD = 9.4$) joining a digital work-site based step contest. Behavioral regulations, psychological need satisfaction and exercise behavior was measured using a three wave web based questionnaire (T1 = baseline; T2 = post-intervention, week 3; and T3 = follow

up, week 6). Moderation analyses were done in the SPSS macro PROCESS using a bootstrapping resampling approach.

The moderation analyses showed gender and age differences in the relations of behavioral regulations, psychological need satisfaction and exercise behavior within the SDT process model. Controlled motivation was for example a significant positive predictor for exercise in men showing external regulation at T2 to moderate the relation between psychological need satisfaction and exercise in men ($\beta = 11.29$, $p < .01$) at T3 in apposite direction, while this path was negative and non-significant for women. Also Intrinsic regulation at T2 positively predicted relatedness need satisfaction for women at the same time-point ($\beta = 0.47$, $p < .05$), but this path was negative and non-significant for men. In terms of age differences, the negative association between external regulation at T2 and strenuous exercise at T3 was stronger and significant for older adults compared to middle-aged adults ($\beta = -8.90$, $p < .01$) and was positive (but non-significant) for younger adults.

In conclusion, we found gender and age to moderate several paths of the self-determination process model, suggesting more comprehensive analyses of potential moderators in exercise behavior to be an interesting avenue for future research.

"I deserve a treat": The effects of exercise motivation on post-exercise dietary responses

West, Jessica; Guelfi, Kym J.; Dimmock, James A.; Jackson, Ben, The University of Western Australia

Regular exercise is key for weight management, but the consumption of unhealthy food and/or drink post-exercise may undermine the benefits accrued through physical activity. Unhealthy post-exercise snacking/drinking can be driven by implicit (e.g., implicit attitudes) and/or explicit (e.g., licensing) processes, but researchers have yet to examine whether one's exercise motivation may predict these responses to exercise involvement. Healthy participants ($N = 119$) reported their dietary and exercise behaviors, exercise motivation (using self-determination theory constructs), and completed a computer-based assessment of implicit attitudes toward unhealthy snacks and drinks, before taking part in a 40-minute moderate intensity cycling session. After exercising, participants rated their perceived exertion, completed another implicit attitude test, provided ratings of hunger, and reported explicit licensing perceptions regarding the consumption of unhealthy snacks/drinks. Blood samples - to enable assessment of pre- and post-exercise blood lactate - were also taken. Two separate bootstrapped mediation models were estimated in which participants' exercise motivation was entered as a predictor of explicit licensing of, and implicit attitudes toward, unhealthy snacks/drinks. Individuals' autonomous (relative to controlled) motivation for exercise did not predict implicit post-exercise attitudes, but was a significant negative predictor of explicit licensing to consume unhealthy snacks/drinks ($Est = -0.07$, $p < 0.001$). Specifically, when modeled alongside attitudes toward unhealthy snacks/drinks, dietary restraint, food-related self-control, post-exercise hunger, in-session heart rate, and blood lactate, participants who were more autonomously motivated for exercise were less likely to report that they deserved (or were allowed) unhealthy snacks/drinks post-exercise. Understanding the modifiable factors (e.g., exercise motivation) that predict post-exercise dietary responses is important for supporting individuals' weight loss and health goals.

Exploring Elite Female Athletes Lived Experiences of Mental Toughness and Self-Compassion

Wilson, Dani C., University of British Columbia; Mosewich, Amber D., University of Alberta; Faulkner, Guy; Crocker, Peter R.E., University of British Columbia

Self-compassion (SC) and mental toughness (MT) are two constructs that may be critical for female athletes coping with sport related stressors. However, their relationship is not well understood. While SC entails being kind, accepting and understanding towards the self, MT can encourage self-criticism and being hard on oneself. The objective of this study was to explore how elite level female athletes perceived and experienced MT and SC and their compatibility in the pursuit of athletic success and stress management. Two semi-structured interviews were conducted with 7 participants (14 interviews). Interviews were transcribed and an inductive thematic analysis was performed. Three overarching themes were identified. First, the compatibility of MT and SC. Participants identified MT and SC as compatible and integral for coping with sport related stressors and achieving athletic success. Participants acknowledged the joint contributions of being both self-critical and self-kind; neither being more important than the other. Rather, the process of using MT and SC depended on the timing, the situation, and the meaning it held for each athlete. Second, the role of SC in building MT. Participants identified self-compassionate coping mechanisms such as self-care, self-reflection, shifting thinking from emotional to rational and accepting mistakes and subsequent corrections as key components of MT. This suggests that using SC may enhance an athlete's ability to be mentally tough. Third, the role of mindfulness in using both SC and MT. Participants perceived that their abilities to be self-aware, neutral, objective and present in the face of sport-related challenges were vital in fostering the effective use of both MT and SC. This finding suggests that mindfulness may be a key connection between the congruent and compatible use of MT and SC in the sport domain. Overall, findings highlight the potential for utilizing psychological processes such as SC for enhancing MT in high performance settings.

Perceived Preference for and Toleration of Exercise with a Graded Exercise Test

Wittstein, Matthew, Elon University; Barczak, Nikki, University of North Carolina at Chapel Hill; Moisand, Megan; Hadgis, Nicholas, Elon University

Individuals have subjective preferences towards type of exercise and the intensity they are able to tolerate (Ekkekakis, Hall, & Petrezello, 2004). This subjectivity may influence both physical performance and cardiovascular function during exercise. This pilot study investigated the relationship between subjective preference towards exercise and physiological and performance factors during a graded exercise task (e.g. time to exhaustion, resting heart rate, maximum heart rate, and change in heart rate). Ten young, healthy participants (Age=21.1 ± 1.4 yrs) completed a valid and reliable online questionnaire assessing preferred intensity and tolerance of exercise as well as demographics. Each participant then completed a graded exercise protocol on a treadmill. The protocol began with a 3-minute warm-up at 4.0 mph and 0% grade

followed by 90-second stages of increasing speed (+ 0.5 mph) at 3% grade until the person reached exhaustion or until the 10th stage was completed. Correlational analyses revealed that preference for high intensity exercise was significantly and negatively associated with resting heart rate ($r = -.91$, $p < .01$). Participants with lower resting heart rates tended to prefer higher intensity of exercise. Preference towards low intensity exercise was associated with slower increases in heart rate ($r = -.51$, $p = 0.13$). Although this was not of statistical significance, the Pearson r coefficient suggests a moderate to high effect size (Cohen, 1988). Overall, this research supports continued study of the relationship between exercise preference and cardiovascular performance and outcomes during exercise. This information may help to greater understand individual exercise experiences by optimizing subjective perceptions and aid in exercise adherence. Future studies should investigate causal relationships to inform programs for sustainable cardiovascular fitness and mental well-being.