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Human Kinetics Lecture

Visual control of natural actions

Mary Hayhoe, University of Texas at Austin

Investigation of natural behavior has contributed a number of insights to our understanding of visual guidance of actions by highlighting the importance of behavioral goals and focusing attention on how vision and action play out in time. In this context, humans make continuous sequences of sensory-motor decisions to satisfy current behavioral goals, and the role of vision is to provide the relevant information for making good decisions in order to achieve those goals. Components of a good decision include the goals, the rewards and costs associated with those goals, uncertainty about the state of the world, memory, and prediction. I will discuss these factors in the context of walking and interception tasks in both real and virtual environments.

Keynote Speakers

Keynote Speaker: Motor Development

Infants' actions broaden their mind

Gustaf Gredebäck, University of Uppsala, Sweden

Three suggestions are presented that aim to illustrate different ways in which actions broaden the mind. *(Suggestion 1) Action prediction develops through co-opting*. A well-developed motor system allows infants to use their own motor plans to calculate the goal of other people's actions. In other words, we use our own knowledge about our bodies and actions to make sense of other people. *(Suggestion 2) The foundations of mathematics develop through play*. Highly proficient manual motor abilities allow infants to actively interact and learn about the world. Reaching and grasping provide opportunities for learning about forms, weights, sizes, and other action-related properties that enhance spatial cognition and strengthen the foundations of the number sense (the approximate number system). *(Suggestion 3) Executive functions develop via interactive specialization from motor control*. A successful interaction with the environment, through reaching and locomotion, require prediction, selection and inhibition. It is possible that a common process dedicated to structuring and supporting actions develop over the first years of life into separate processes controlling action and long term planning. Together these three suggested processes create a foundation for an embodied cognitive development that allows infants to learn about the world as well as illustrate the importance of active exploration and play for cognitive growth early in life.

Keynote Speaker: Motor Learning and Control

Faster than a blink of an eye: The use of sensory feedback to control how we move and interact in the world

Stephen Scott, Queen's University

Sports such as football or hockey highlight our amazing ability to move and interact in a complex world. A player can skate past a defensemen and shoot a puck over the glove of a goalie. Even if the defensemen knocks the player while going past, great players quickly adjust or even change where they shoot the puck to his or her advantage. Our ability to make such rapid motor 'decisions' is captured within the framework of optimal feedback control, in which a control policy specifies how one ought to move given the present state of the body (position and motion). My presentation will highlight the use of small mechanical and/or visual disturbances to probe how the motor system deals with a variety of behavioural contexts. These studies demonstrate that the motor system can generate surprisingly complex motor corrections to mechanical disturbances in as little as 60 ms, including the influence of goal redundancy and avoidance of obstacles. In contrast, visual feedback begins at ~90 ms, but only considers task-related factors at ~120 ms. Importantly, the fact that visual feedback is slower than proprioceptive feedback makes the latter dominate feedback control during motor actions. I will also describe experiments demonstrating a role of frontoparietal cortical circuits in these fast feedback processes. Taken together, this work suggests that the voluntary motor system does not simply generate a pattern of muscle activity to attain a goal (i.e. motor program). Rather, it creates a broad range of strategies and contingencies to attain a behavioural goal that can be expressed dependent on how the motor action unfolds, thus blurring the line between motor planning (decisions) and motor control.

Keynote Speaker: Sport and Exercise Psychology

Competition and achievement-relevant outcomes: A hierarchical motivational analysis

Andrew J. Elliot, University of Rochester

Motivation is of critical importance for understanding achievement behavior in sport and exercise settings. However, theoretical analyses of motivation are often unclear (in that they lack clear conceptual definition or operationalization) and/or incomplete (in that they focus on only one specific component of motivation). I will provide a conceptual overview of the hierarchical model of achievement motivation, and I will apply this model to the issue of competitive striving in achievement contexts. The hierarchical model distinguishes between two central components of motivation – energization (a general competitive desire) and direction (the pursuit of specific performance-based goals) – and integrates them together into an overarching model of competition. I will present a series of studies showing that competitive desires lead to both performance-approach and performance-avoidance goal pursuit, and that these two goals often have the opposite impact on a variety of different achievement-relevant outcomes. This "opposing processes" model is broadly applicable across diverse achievement contexts, as I will illustrate. I will end my talk by discussing implications of the hierarchical model of competition for real-world achievement processes and outcomes, and I will address pragmatic questions such as should coaches, teachers, parents (etc.) encourage, discourage, or remain neutral regarding the competitive strivings of those under their charge.

Senior Lecturers

Motor Development

Promoting actual and perceived motor competence in the early years: *SKIP*ing toward physical literacy

Jacqueline D. Goodway, The Ohio State University

Over the past 25 years, my work has been committed towards promoting actual and perceived motor competence in resilient young children from disadvantaged environments and elucidating the role motor competence plays in leading a physically active lifestyle and maintaining a healthy

weight. My initial work highlighted a sizeable number of vulnerable children enter preschool with significant delays in FMS. Additionally, many disadvantaged children face significant barriers (built/home environment, access, poverty, role models) in their communities to being physically active. In spite of these delays and barriers, most young children reveal positive perceptions of their motor competence, an asset that can be used in intervention. Subsequently, I created the "Successful Kinesthetic Instruction for Preschoolers" (SKIP) motor skill intervention to counter the negative developmental trajectory for these children. Situated in Newell's Constraints, the overarching purpose of SKIP is to promote actual and perceived motor competence, enhance motivations to be active, develop knowledge of their body's response to activity; and more recently, promote physical literacy. In all SKIP interventions, we started by considering child constraints, then manipulated environmental constraints to design high quality tasks aligned to a child's developmental level to positively perturb his/her motor system. Within this presentation, I will chart the evolution of SKIP reporting data from a number of studies and highlighting lessons learned along the way. I will start with the expert-led direct-instructional approaches leading to more mastery-oriented approaches to SKIP. From this work, we recognized the need for more translational research. Thus, I will summarize our most recent work where we have collaborated with early childhood teachers to deliver T-SKIP/SKIP Cymru/INDO-SKIP and an integrated FMS-reading literacy intervention to children across the world. I will conclude with implications to the future of early intervention research and the importance of promoting actual and perceived motor competence during this critical window of development.

Motor Learning and Control

The use of observation for motor learning and performance: current trends and future directions

Diane Ste-Marie, University of Ottawa

In this talk I will focus on one particular area of my research interests; the use of observation for enhancing motor skill acquisition and performance. Ste-Marie, et al. (2012) used the 5 Ws (who, what, where, when, and why) and 1 H (how) to review the observation literature, with a specific focus on research that incorporated applied tasks. Within that work, the authors also advanced an applied model for the use of observation which integrated the 5 Ws and 1H as factors that need to be considered when using observation interventions. While the review showed that there was much evidence for the effectiveness of observation of an expert model (who factor) for the skill function (why factor), it was noted that more research was needed concerning the other functions of observation (strategy and performance), as well as the many other factors of the applied model. In the first phase of the talk, I will provide an overview of the research completed by Ste-Marie and colleagues (2012). Using the applied model as a scaffold, I will then move into presenting research that has been conducted since 2012 on the use of observation for motor learning and performance with the goal of highlighting the research gaps addressed by that research and how the findings further inform the optimization of observation interventions. In the final phase of the talk, I will focus on research areas that have still not been adequately addressed, with concomitant recommendations for future research.

Sport and Exercise Psychology

Developing youth leadership through sport by leveraging the scholastic captain experience

Daniel Gould, Michigan State University

This presentation focuses on the role that the scholastic sport captaincy experience plays in developing youth leadership and discusses a series of mixed method studies our research team has conducted on this topic. We began with a qualitative study designed to chronicle the experiences of high school sport captains (Voelker, et al., 2011) and another to understand how exemplary coaches known for developing captains fostered leadership development through the captaincy experience (Gould et al., 2013). A third survey study was then conducted to examine a sample of national scholastic coaches' views, attitudes, and practices regarding leadership training and the overall development of team captains (Blanton et al., 2012). Taken together these studies revealed that most captains receive little formal training but are expected to handle some complex leadership roles like mediating conflict between teammates and confronting difficult team issues. Yet, exemplary coaches, known for developing captains as leaders, are very proactive and intentional in their efforts to train captains. To rectify this state of affairs an online captains training program was developed and completed by over 8000 young people (Pierce et al., 2017). To evaluate the perceived effectiveness of the course surveys were completed with a national sample of 188 program participants (Walker & Gould, in preparation). Descriptive statistics showed the athletes believed the course to be "effective" 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. Suggestions, however, were offered for improvement. Currently we are conducting intervention studies designed to assess the utility of taking this course on captain attitudes and behavior as the lead across a season. The presentation concludes with an examination of the strengths and limitations of this line of research as well as a discussion of how this research informs current youth leadership theory.

Early Career Distinguished Scholar Lectures

A little clumsy and full of problems: Mechanisms and consequences of Developmental Coordination Disorder

Priscila Caçola, University of Texas at Arlington

Developmental Coordination Disorder (DCD) is a motor skill disorder characterized by a marked impairment in the development of motor coordination that interferes with academic and social functioning. This chronic condition is considered one of the most common hidden disabilities affecting school-age children worldwide. Here, I explore some of the potential causes for DCD, highlighting the differences observed in coincident timing and tool use in this population when compared to Typically Developing (TD) children. I have also found differences in cortical activation as measured by Functional Near-Infrared Spectroscopy (fNIRS) between these groups, and they increase with the level of complexity of the task. When comparing individuals with DCD to those with Autism Spectrum Disorders (ASD) in tasks involving visuomotor integration, we found higher accelerations in the DCD group, which may help explain the nature of each condition and the differences in postural control that drive coordination problems in both populations. In addition, I discuss the consequences of DCD, which extend beyond the motor domain to include physical and mental health issues. We have recently found that children with DCD have lower health-related quality of life (HRQOL) than a population of children living with chronic health conditions. These results establish that children with DCD are susceptible to severe consequences of this condition, and calls researchers and practitioners to action. Nonetheless, our group has found that it is possible to minimize and even revert these problems with the use of motor training in group settings – interventions that aim at improving coordination in small groups of children have been shown to not only improve motor ability, but also reduce anxiety and improve self-esteem. With that, I present of a case for how the study of

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the health consequences associated with DCD offers practical applications for the understanding of the mechanisms and intervention protocols that can improve the condition.

Exploring measurement and methodology in motor behavior

Keith Lohse, University of Utah

Researchers from various disciplines have examined the basic processes that underlie motor learning, and the conditions of practice that can augment these processes. Empirical and theoretical work in motor learning draw on a diversity of methods from psychology, to neuroscience, to biomechanics. Collectively, this work advances basic science and has applied impact in sport and rehabilitation. Although my initial contribution to this field focused on optimizing practice conditions, my research has significantly changed over time and throughout the talk, I want to highlight the role that my colleagues and mentors have played in my intellectual development. This research has ranged from the role of attentional factors in dart-throwing to applied work measuring dose-response relationships in physical and occupational therapy. In all of these contexts, I have been fascinated by the analytical methods used to measure learning and the controversies that arise in research. In this presentation, I want to focus on two controversies that have pushed my research towards rigorous exploration of measurement and methodology to resolve ambiguities: (1) prescribing the dose of physical practice in rehabilitation and (2) the causal role of intrinsic motivation to enhance motor learning. To this end, I will discuss evidence of best practices and the implementation of these practices in my own research. First, we can take preventative steps in study design to lessen discrepant results (e.g., well-powered studies with pre-registered analyses). Second, new and different analytical methods can bring a closer correspondence between study-design and the naturalistic process of learning. Finally, taking a more cumulative approach to our science reduces the influence of any single publication, and puts greater emphasis on team-based science and the independent replication of findings.

The NASPSPA Outstanding Student Paper Award Recipients

Motor Development

The influence of guided practice on overhand throwing competence in preschool children in a mastery motivational climate

Jerraco Johnson, Mary Rudisill, Peter Hastie, Melissa Pangelinan, Julia Sassi, Auburn University

Previous research in motor learning and development has highlighted the importance of skill practice (Lee, Chamberlin, & Hodges, 2001; Schmidt & Lee, 2005). However, there is little information on how much or what type of practice is necessary for the motor skill development of young children in naturalistic settings. The primary aim of this study was to determine the extent to which guided throwing practice volume influences gains in throwing competency in young children during exposure to a mastery motivational climate physical play program? Preschool children ($n = 54$) attended 13 biweekly 30-minute motor skill sessions over 7 weeks. Pre- and post-test throwing competency was measured in three ways (TGMD-3, developmental sequence for throwing, and throwing velocity). Throwing practice behaviors (visits, time, and trials) were then coded for each participant using video recordings. Paired-samples *t*-tests revealed significant gains in throwing proficiency by the children from pre- to post-test which suggests that the mastery climate program was effective in throwing development. Results from multiple stepwise linear regressions highlighted that guided throwing practice volume (a principle component analysis of throwing visits, time, and trials) accounted for 19% (TGMD), 52% (developmental sequence), and 60% (velocity) of the explained variance, respectively. These findings, at least for throwing, provide empirical evidence of the importance of guided practice during mastery climate programs. Results also revealed that although boys spent more time practicing throwing than girls, gender only appeared to be a significant predictor in the TGMD regression model. These findings suggest that gender differences at this age may be attributed to a lack of practice by girls in comparison to other biological and environmental differences, as guided practice volume explained more variance than gender in each regression model. Future studies should explore if and how girls and boys spend their time differently during mastery and other autonomy-supportive motor skill programs.

Funding source: North American Society for the Psychology of Sport and Physical Activity (NASPSPA).

Motor Learning and Control

Altering task goal or adding information resources? Functions of vision in standing posture

I-Chieh Lee, University of Georgia; Matheus Pacheco, New York University; Karl Newell, University of Georgia

The majority of studies that manipulated visual information in postural control usually emphasize that information has a prescriptive function that can directly scale the amount of postural sway. Nevertheless, the directional trend of cause and effect can be questioned in that either the added information can stabilize posture or postural stabilization facilitates eye fixation. From a dynamical systems approach to motor behavior, the answer for such a question is possible when the dynamics of the system interact with the task is considered. This would provide how the system acts in terms of the present collective of constraints. Following the dynamical systems approach, this study investigated whether the organization of the postural system would show an abrupt change in its attractor dynamics when precision of a task is manipulated. We systematically manipulated the induced precision by vision based on the image slip hypothesis through changing the eye-target distances. Sixteen participants were instructed to maintain quiet postural stance while maintaining eye fixation at a point in different distances or stood with eyes closed (25, 50, 135, 220, 305 cm and no vision). Their center of pressure (COP) was recorded and analyzed in terms of antero-posterior (AP) plane. The standard deviation of COP measured the dispersion and the correlation dimension (CD) quantified the dimensionality of the attractor, both from the COP AP. SD linearly increased with the eye-target distances (AP: $F(5,75) = 3.650$, $p = .005$, eta = .196). CD showed a significant lower value at the 25 cm condition in COPAP (AP: $F(5,75) = 4.311$, $p = .002$, eta = .223) compared to all other conditions. Our results showed a qualitative change in the attractor dynamics only with extremely high precision demands. The dispersion of postural sway demonstrated the specific nature of postural organization – an adaptation to the precision visual requirements. Thus, this study provided evidence of independent quantitative and qualitative changes in postural control when precision requirements are manipulated.

Sport and Exercise Psychology

An exploratory study on flow under Köhler paradigm with software-generated partners

Seungmin Lee, Nicholas D. Myers, Taiwoo Park, Christopher Hill, Deborah L. Feltz, Michigan State University

One way to motivate people to exercise is to create a motivating social context, which can provide social comparison opportunities. Software-

generated partners (SGPs) can be used because they could provide the Köhler effect in partnered exergame play. The Köhler effect occurs when the less capable partner of the group shows greater motivation in group tasks than in solo tasks in terms of effort (Kerr & Hertel, 2011). Flow is a positive psychological state where individuals perceive a balance between their abilities and task challenges. Based on flow theory, we suggest that an individual could have different flow perception depending on the types of SGPs. The aim of this exploratory study was to examine the flow state under Köhler paradigm over a 24-week exergame with three SGP conditions: Individual Control (IC), Always Superior Partner (AWS), and Not Always Superior Partner (NAS). The experiment was a 3 (Three SGP conditions) × 3 (Times) factorial design. Fifteen participants were recruited and randomly assigned to a SGP condition. The three SGP conditions were recoded into two dummy variables. A multivariate multiple regression with two dummy variables and baseline flow (T1) predicting flow at the second time (T2) and the third time (T3) was conducted. The adjusted mean difference in flow scores for participants with an NAS, as compared to IC, was equal to 0.81, $p = .029$, Cohen's $d = 1.12$ at T2 and 0.66, $p = .021$, Cohen's $d = 1.17$ at T3. However, the adjusted mean difference in flow scores for participants with an AWS, as compared to IC, was equal to 0.45, $p = .182$, Cohen's $d = 0.62$ at T2 and 0.01, $p = .985$, Cohen's $d = 0.01$ at T3. In summary, there was evidence that there were large positive effects of an NAS partner on flow at both T2 and T3 as compared to IC. But, the evidence for positive effects of an AWS partner on flow, as compared to IC, was modest at T2 and was weak at T3. Possible reasons for flow perceptions changed over time with different types of SGPs in the exergame play were discussed in terms of programming SGPs and flow theory.

Funding source: NASA/National Space Biomedical Research Institute, Grant # MA03401.

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Symposia Thursday, June 21st

Multidisciplinary Symposium

Cognitive-motor and psychological mechanisms underlying motor control and learning in a social context: From human-human to human-robot dynamics

Symposium Organizer(s): Rodolphe Gentili, University of Maryland; Matthew Miller, Auburn University

Symposium Discussant: Will Wu, California State University – Long Beach

Symposium Overview: Cognitive-motor and psychological mechanisms underlying motor control and learning in a social context: From human-human to human-robot dynamics

Rodolphe Gentili, University of Maryland; Matthew Miller, Auburn University,

For several decades, the field of motor control and learning has largely examined cognitive-motor mechanisms when humans perform alone. A relatively more limited body of work has studied how these underlying neural mechanisms are engaged when individuals perform with a teammate in a social context. Examples of such work include dyadic performance, practice and learning that have employed, either separately or in combination, behavioral and neuroimaging techniques to examine the underlying cognitive-motor mechanisms engaged in a social context. Another complementary informative approach to examine human motor control and learning in a social team context is through the use of robotics, which allows examination of direct interactions between a human and a synthetic partner, providing a controlled social context for manipulating human behavior. In parallel, the field of sport psychology has clearly established that human performance in a social context of team dynamics is affected by psychological determinants such as mental workload, trust, and self/collective efficacy. Therefore, a greater understanding of the main mechanisms of team performance require the examination of the relationship between the cognitive-motor and psychological processes that underlie human performance during teamwork. This examination could benefit by combining both a motor control/learning and sport/exercise psychology perspective. In particular, this symposium will discuss how behavioral assessment, neuroimaging, and robotics can be leveraged to study team dynamics. Specifically, insight into team dynamics will be gained by considering their effect on collective efficacy, trust, and cognitive outsourcing. A framework for understanding adaptive team dynamics as those that reduce mental workload and facilitate neural efficiency, thereby enhancing performance will become apparent. Ultimately, the framework aims to provide greater understanding of the cognitive-psycho-motor mechanisms of human skill performance and learning in a social context of team dynamics.

When practice together moderates how we practice, yet not to the detriment of our own learning

Nicola Hodges, April Karlinsky, University of British Columbia

Allowing learners to practice a single skill with a partner has been shown to benefit motor learning, even though the evidence is rather limited and the mechanisms unclear. In our work, we have been interested in how dyad practice extends to multi-skill learning, where it is possible to study how a partner influences practice choices, the impacts of partner "interference" as well as learning outcomes. In our studies, participants practiced in pairs yet were tested alone. In Study 1, participants practiced 2 golf-putting skills in alternation or alone (with a partner watching). Partners performed the same (Matched) or different skills (Mismatched) on consecutive trials. Between-person Contextual Interference (CI) would be higher for the Mismatched than the Matched group. However, there were no differences between these groups in retention, nor in comparison to the alone group. In subsequent studies we simplified the task to learning keypress sequence timing goals (where CI effects are quite robust). We evaluated how a partner impacted practice scheduling choices, when partners alternated turns after 9-trial blocks (Study 2) or every trial (Study 3). Partner 1s (P1s) had a blocked or random schedule, whereas their Partners (P2s) chose how to practice. Based on patterns of switching we could see that P2s adapted practice based on both their partner's and their own performance. So far, we know that practice with a random partner leads to more frequent switching than practice with a blocked partner, and that this results in some learning benefits. Overall, the data suggest that a partner who learns in a shared practice context, whilst being independently assessed, has a small, but reliable impact on the practice behaviours of their partner. It appears that dyad practice moderates CI effects, such that low CI conditions do not always result in better outcomes in acquisition, nor do they impair retention when considered on a between person level (i.e., matched condition).

Advantages of dyad and triad practice

Charles Shea, Deanna Kennedy, Texas A&M University, College Station

The benefits of physical and observational practice protocols have been studied intensely over the last 50 years. Similarly, a training protocols involving contextual interference, practice specificity/variability practice, and the temporal spacing of practice trials have also drawn a great deal of attention. Much of this research has focused on improving retention, but in a number of experiments training efficiency and transfer have also been considered. The purpose of the present presentation is to outline the array of findings that have come from experiments using dyad and triad training protocols where participants alternate between observing the other member (s) of the team perform the task and physical practice. This type of practice involves observational and physical practice as well providing a degree of interference, variability, and increased spacing of the physical practice trials. This method also has the potential to increase training efficiency for both the individual participants and the entity governing the training sessions.

Understanding group motivation gains in exercise and sport contexts

Deborah Feltz, Christopher Hill, Michigan State University

Motivation and self-efficacy are key psychological mechanisms underlying human performance in exercise, sport, and physical rehabilitation. A long history of group dynamics research shows that motivation is largely a product of interpersonal processes that are dependent upon task and task structures. One group dynamics principle, the Köhler motivation gain effect, has been shown to positively influence motivation within sports teams and exercise programs. The Köhler effect indicates that inferior group members demonstrate motivation gains within a group task when participating with moderately more capable partners. This presentation describes research evidence from sport teams and partnered exercise that illustrates the Köhler effect and how different task structures and partner characteristics (including computer-generated partners) within groups can influence motivation and efficacy beliefs.

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The effects of team environment on cognitive resource allocation

Matthew Miller, Auburn University

The way in which individuals allocate their limited cognitive resources during task performance has been heavily investigated. However, studies have been primarily limited to individual performance in the absence of teammates, but individuals often perform tasks in the presence of teammates. Team environments differ in quality such that adaptive team environments, which can be characterized by high levels of perceived competence of and trust in one's teammates, as well as task cohesiveness with one's teammates, are associated with superior individual performance, whereas maladaptive team environments are associated with poor individual performance. Despite the frequency with which individuals perform in team environments of differing quality and the well-established relationship between cognitive resource allocation and performance, the impact of team environment on cognitive resource allocation has scarcely been examined. We conducted two experiments that begin address this shortcoming. Specifically, we had participants perform a videogame in adaptive, neutral, and maladaptive team environments in both experiments. In Experiment 1, participants performed an auditory discrimination (secondary) task concurrent to the videogame, and secondary task performance served as a measure of cognitive resource allocation. In Experiment 2, participants had their electroencephalography (EEG) recorded and were probed with task-irrelevant auditory stimuli, and attentional orienting to the stimuli, as indexed by EEG, served as a measure of cognitive resource allocation. In both experiments, video game performance was assessed. Results from the experiments aligned such that participants exhibited greater secondary task performance (Experiment 1) and attentional orienting to task-irrelevant stimuli (Experiment 2) concomitant with superior videogame performance in the adaptive team environment relative to the neural/maladaptive team environment. Thus, results suggest individuals more efficiently allocate their cognitive resources/perform better in adaptive team environments.

Assessing motor performance and mental workload during team practice: When robotic systems inform human motor behavior

Rodolphe J. Gentili, Isabelle M. Shuggi, University of Maryland

While many studies have examined mental workload to elucidate attentional resource allocation during task completion, this work has mainly studied individual performance without considering motor learning in a team context. Further, team performance and learning studies have usually not assessed changes in mental workload. However, it is likely that team characteristics such as its structure (team interdependence) or nature (quality of teammate) can alter team members' mental workload during learning of new motor tasks. Thus, as a first step to study mental workload during motor learning in a team context, an experimental approach where a human and a synthetic teammate cooperate was employed. The synthetic teammate was embodied as a robotic system with cognitive-motor capabilities that can be tuned to influence team dynamics. In a first study, a human learned a reaching task and a synthetic partner learned the task based on human performance. As the partner learned, human mental workload was reduced, suggesting outsourcing of task elements to the partner as team interdependence changed over practice. In a second study, individuals practiced a reaching task alone while the synthetic partner provided assistance (but did not adapt its performance based on the human). Findings revealed that while the synthetic teammate facilitated performance, its actions led to greater human mental workload, suggesting positive and negative effects of the team environment. Overall, this work suggests that: i) both the team structure (interdependence) and nature (adaptive/non-adaptive) can explain alteration of teammate mental workload during motor practice and ii) robotics allows examination of humansynthetic partner interactions to provide a controlled social context for manipulating and informing human behavior. Extension of this work with a particular focus on how complementary approaches such as robotics and neuroimaging can improve understanding of human cognitive-motor control/learning and psychological mechanisms will be discussed both at a theoretical and applied level.

Sport and Exercise Psychology

Are you feeling good yet? Addressing the need for pleasure during continuous, interval, and resistance training protocols

Symposium Organizer(s): Leighton Jones, Sheffield Hallam University, UK

Symposium Discussant: Anne Cox, Washington State University

Symposium overview

Leighton Jones, Sheffield Hallam University, UK; Zachary Zenko, Duke University; Matthew Stork, University of British Columbia

At a time when the affective responses to exercise are receiving increasing theoretical, practical, and media attention, there is a need for evidenced-based strategies that provide more positive exercise experiences. It is becoming more widely understood and accepted that the acute affective responses to exercise play a critical role in determining future exercise behavior and adherence. However, there is persistent debate regarding the most suitable methods for engaging people in exercise, maximizing pleasure, and minimizing the risk of dropout. This symposium will generate further discussion and perspective by offering new data on affective responses to different modes of exercise (e.g., continuous, interval, and resistance training), and scalable intervention strategies to improve pleasure during exercise. Zachary Zenko will introduce an innovative and novel resistance training protocol that elicits more positive affective responses, and greater remembered pleasure and enjoyment. Matthew Stork will present empirical work examining the acute psychological responses of inactive people to two forms of interval training and continuous exercise, and will discuss what role such responses might play in predicting future exercise behavior. High-intensity interval training often elicits negative in-task feelings which purportedly present a challenge for continued adherence to such protocols. Leighton Jones will conclude by exploring whether different applications of music during a high-intensity interval session can minimize the decline in pleasure typically experienced. Collectively, these presentations will contribute to the debate regarding the affective responses to various modes of exercise and what implications such responses might have for initiating and maintaining exercise behavior. This symposium presents viable strategies to positively enhance the exercise experience that can be used to promote continued exercise behavior.

Decrease the intensity, increase the pleasure and enjoyment: Findings from a resistance training experiment

Zachary Zenko, Duke University; Jasmin Hutchinson, Springfield College

Improving affective responses to resistance training (RT) exercise represents an understudied but critical area. Interventions that improve the affective experience of RT may enhance adherence. This study built on recent findings that continuously decreasing the intensity during a bout of aerobic exercise results in greater remembered pleasure, enjoyment, and post-exercise pleasure. After baseline testing, 40 participants (Mage = 35 +/–9 years, 30 women) completed two exercise protocols with an identical total training volume and intensity. Both conditions included a RT circuit with six exercises (leg press, deadlift, chest press, seated row, overheat press, lat pulldown), which was completed three times. In the increasing-intensity condition (UP), participants completed the first circuit at 55% 1-repetition maximum (1 RM), the second circuit at 65% 1 RM, and the third circuit at 75% 1RM. In the decreasing-intensity

condition (DOWN), this pattern was reversed (75% 1RM, 65% 1RM, 55% 1RM). Affective valence was assessed 12 times during each circuit. Post-exercise affective valence, remembered pleasure, and enjoyment were assessed after exercise. Remembered pleasure was also assessed 24-hr later. A significant time by condition interaction indicated that the DOWN condition resulted in more pleasure over time, whereas the UP condition resulted in decreasing pleasure. A MANOVA revealed a significant effect of condition, such that the DOWN condition resulted in more positive remembered pleasure post-exercise (eta^2 = .13, p = .028) and 24-hr later (eta^2 = .24, p = .002); greater enjoyment (eta^2 = .25, p = .001); and greater post-exercise pleasure (eta^2 = .38, p < .001). Taken together, these data conceptually replicate earlier findings and suggest that decreasing RT intensity throughout a bout may increase pleasure over time and enhance motivational-affective variables, including remembered pleasure and enjoyment. Future researchers should test the effects of exercise programs consisting of bouts with continuously decreasing intensity on long-term adherence.

A comparison of psychological and behavioral responses to interval and continuous exercise among inactive adults

Matthew Stork, University of British Colombia; Martin Gibala, McMaster University; Kathleen Martin Ginis, University of British Columbia

The objectives of this study were a) to compare psychological responses to, and preferences for, moderate-intensity continuous training (MICT), high-intensity interval training (HIIT), and sprint interval training (SIT) among inactive adults; and b) to investigate relationships between affect, enjoyment, exercise preferences, and subsequent exercise behavior over a 4-week follow-up. Thirty inactive men and women (Mage = 21 +/– 4 years; 18 women), unfamiliar with interval exercise, completed three acute exercise trials on a cycle ergometer in a randomized order: MICT (45 min continuous at ~70%HRmax), HIIT (10 × 1 min bouts at ~85-90%HRmax, separated by 1-min rest), and SIT (3x20-s "all-out" sprints, separated by 2-min rest). Perceived exertion (RPE), heart rate (HR), affect, and arousal were measured throughout the trials and enjoyment was measured following each trial. Participants rank-ordered the protocols (#1–3) according to preference and logged their exercise over a 4-week follow-up. Despite experiencing elevated HR, RPE, and arousal during work periods (ps < 0.05) and negative affect during HIIT and SIT, participants reported comparable post-exercise enjoyment and preferences for MICT, HIIT, and SIT (ps > 0.05). In-task affect was predictive of enjoyment for each type of exercise (rs = 0.32–0.47; ps < 0.05). In-task affect and post-exercise enjoyment predicted preferences for HIIT and SIT (rs = –0.34 – –0.61; ps < 0.05), but not for MICT (rs = 0.00 – –0.10; ps > 0.05), respectively. Over the follow-up, participants completed more MICT (M=6.11+/–4.12) than SIT sessions (M=1.39+/–1.85; p < 0.01), with no differences in the number of sessions of MICT versus HIIT (M=3.54+/–4.23; p=0.16) or HIIT versus SIT (p = 0.07). In-task affect predicted the number of sessions of MICT (r = 0.40; p < 0.05), but not HIIT (r = 0.13) or SIT (r = 0.15; ps > 0.05). This study provides new evidence that HIIT and SIT can be equally enjoyable and preferable as MICT among inactive individuals and there may be differences in the exercise affect-behavior relationship between interval and continuous exercise.

Can HIIT be more pleasant? Examining the affective responses to different applications of music during HIIT

Leighton Jones, Sheffield Hallam University; Matthew Stork, University of British Columbia; Liam Oliver, Sheffield Hallam University

High intensity interval training (HIIT) draws a significant amount of research interest and media coverage as it is often portrayed as a time efficient mode of exercise. However, the utility of HIIT as a population-level strategy is contentious owing to frequently reported negative affective responses. Extant evidence demonstrates that music is effective at increasing positive affect during a range of exercise intensities but its efficacy during HIIT has received limited attention. This study examined the efficacy of two different applications of music for improving affective responses to HIIT. 18 participants (Mage = 25+/-5 years; 10 males) completed two experimental conditions (Respite music: applied during the recovery periods; and Continuous music: applied throughout the session) and a control condition (no music). The HIIT protocol comprised 10 × 1 min intervals (100% Wmax) separated by 75 s recovery periods. Responses to the Feeling Scale (FS) and CR10 (RPE) were recorded pre, during, and post session, and enjoyment (PACES) was recorded post-session. Results indicate that Respite music elicited greater pleasure during the recovery periods compared to control (FS; eta∧2 = .19, p = .027), while no differences between conditions were evident during the work bouts (FS; eta∧2 = .08, p = .241). Participants reported greater enjoyment following the Continuous music condition compared to control (eta∧2 = .20, p = .023). RPE was higher during the control condition compared to the music conditions (eta∧2 = .25, p = .007). The ineffectiveness of music during the work bouts, contrasted with its effectiveness during recovery bouts, has implications for theory and practice. The disparity between in-task (FS) and post-task (PACES) responses across music conditions warrant further investigation. Overall, this study suggests that the high-intensity nature of HIIT might limit the potential for music to enhance pleasure. It appears HIIT might require a different application of music than continuous exercise in order to elicit a more pleasurable experience.

Motor Learning and Control

Learning to organize and reorganize movement coordination patterns

Symposium organizer: Karl Newell, University of Georgia

Symposium discussant: Jill Whitall, University of Maryland and University of Southhampton, UK

Introduction to theme of symposium

Karl Newell, University of Georgia

The formation of a task-relevant coordination mode reflects the early stage of the acquisition of coordination, control and skill. The historical emphasis in motor learning and control on movement scaling tasks has led to an underemphasis of this phenomenon in theoretical and experimental work, though it has been a focus of the motor development domain with the formation of the fundamental movement skills. Here we present 3 different strands of research that examine the organization and reorganization in the learning and relearning of movement tasks that have redundancy at the joint space level with more than 2 degrees of freedom – reflections of the classic Bernstein (1967) problem. The different experimental paradigms reveal the challenges for the learner and experimenter in decomposing the principles for the pathways of change in the multiple degree of freedom tasks. The findings are consistent with the proposition that motor learning and relearning is a search problem in the mapping of the qualitative and quantitative movement dynamics to the task goal.

Control parameter and collective variable dynamics in a degenerate perceptual-motor task

Yeou-Teh Liu, National Taiwan Normal University, Taiwan; Kuo-Liang Chuang, National Taiwan Normal University, Taiwan; Karl Newell, University of Georgia

In a series of recent experiments, we have used the roller ball task as a vehicle to examine the changes of task dynamics over practice. Under the

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framework of the dynamical systems theory, the task dynamics, which was represented by the probability of success in performance outcome, revealed an S-shaped curve over various practice durations, and the learning process reflected a first order non-equilibrium phase transition. Here we report a new roller ball experiment where the collective variable that determines the successful performance of the roller ball task as a function of initial ball speed was investigated. Sixteen participants with various roller ball task experiences took part in the study. All the participants performed 10-s roller ball task for 10 trials in each of the 5 initial speed conditions. The kinematics of the outer shell and the inner top of the roller ball were digitized with a motion capture system. The result showed that the synchrony between the outer shell and the inner top of the roller ball is the candidate collective variable. The dual control variable of the roller ball task, namely the task experience and the task difficulty, was demonstrated to affect the stability of the roller ball task dynamics. We also observed three different neuromuscular synergy movement patterns that were related to the successful rollerball performance suggesting movement degeneracy in producing the outer shell-inner top synchrony as the task-relevant successful collective variable.

Altering bimanual coordination patterns in redundant motor tasks

Rajiv Ranganathan, Michigan State University; Federica Danese, University of Genoa, Italy; Edoardo Corona, University of Genoa, Italy; Maura Casadio, University of Genoa, Italy

In tasks with redundancy, there are multiple coordination solutions available to achieve the task goal – yet, how participants learn to switch from one solution to another is not fully understood. Using a bimanual task as a model, we examined how prior learning and practice schedule determine how well participants can learn a new coordination solution. Participants learned a bimanual task which involved throwing a virtual puck towards a target. The distance covered by the puck was determined by the sum of the velocities of each hand at release, providing multiple solutions to achieve task success (i.e. different combinations of hand velocities could land the puck in the target). We refer to these solutions in terms of % contribution to the total velocity from each hand- for e.g., a '50-50' solution would correspond to a 50% contribution from each hand (i.e. equal velocities). The criterion task was to learn the 55-45 solution. We manipulated prior learning in 3 groups (n = 12 each): (i) a 'naïve' group that learned 55-45 from the start, (ii) a 'stable' group that learned 50-50 before switching to 55-45 and (iii) an 'unstable' group that learned 60-40 before switching to 55-45. Participants performed the prior task for 1 day before switching to the criterion task on Day 2. Results showed that the stability of the prior learned solution had effects on learning the criterion task. Specifically, when transferring to the 55-45 task, the 50-50 group showed much greater difficulty adapting to the 55-45 solution compared to the 60-40 group initially in learning. However, by the end of day 2, there were no significant effects of group in either the task or null space variability. A second experiment showed that the transition to a new solution was enhanced if the coordination pattern was changed incrementally rather than abruptly. These results show that stability of prior coordination patterns and the type of practice play an important role in learning new coordination solutions.

Adaptations in postural control to different task constraints in people with multiple sclerosis

Richard Van Emmerik, Julianna Averill, Michael Busa, University of Massachusetts

Multiple sclerosis (MS) is a chronic demyelinating disease of the central nervous system and is the most common neurological disease in 20–50 year-old individuals. People living with MS consistently rate balance impairment as one of the greatest negative impacts on their quality of life, yet our understanding of the cause of instability in these individuals remains limited. Our research aims to understand the sensorimotor contributions to balance dysfunction and difficulty with walking in people with MS. In particular, we aim to develop and use methods that differentiate between postural and gait variability caused by dysfunction and variability that allows for successful adaptation when presented with postural challenges and changing task goals and constraints. Here we report on results from a series of recent studies that examine postural control changes in MS using (1) entropy measures for assessing postural and gait adaptability, and (2) stability boundary-relevant measures of postural stability and control (postural time to contact the base of support). Multiscale entropy analysis (MSE) demonstrated that under different postural task constraints (quiet standing versus self-induced lean perturbations to the boundary of the base of support), postural control complexity is decreased in MS compared to controls, but an interaction between group and postural condition ($p<.02$) indicated adaptations in complexity in the control but not the MS group with postural task difficulty. In a second experiment we examined the relearning of postural control in MS through a Tai Chi intervention. Results showed that postural time to contact increased during tandem stance ($p=.045$) but decreased during a dynamic postural control task ($p=.02$) after the intervention, suggestive of increased awareness of stability boundaries. These results show the impairments in task-relevant adaptations in postural control in people with MS, but that relearning of postural control can re-establish aspects of this adaptive capacity.

Motor Development

Celebrating 50 years of the Michigan State University Motor Performance Study

Symposium organizer(s): Larissa True, SUNY Cortland

Symposium discussant: Karin Pfeiffer, Michigan State University

An overview of the Michigan State University Motor Performance Study: Then and Now

Crystal Branta, Michigan State University; John Haubenstricker, Michigan State University; Karin Pfeiffer, Michigan State University; Larissa True, SUNY Cortland; Eric Martin, Boise State University; Shannon Siegel, University of San Francisco; Vern Seefeldt, Michigan State University

Over the course of 30 years from 1967–1997, 1104 participants were enrolled in the Michigan State University Motor Performance Study (MPS). The mixed-longitudinal sample was comprised of healthy, disease- and disability-free participants who attended schools in 20 districts near the university. Administration of physical fitness tasks and growth and development parameters occurred semi-annually beginning at 5.0 years of age and continued until participants reached adulthood (18.0 years), or when participants voluntarily opted out of the MPS. Participants were not required to begin participation at age 5.0 and were allowed to opt out of the MPS at any time. Fitness tasks included flexed arm hang, jump and reach, standing long jump, agility shuttle run, 30-yard dash, endurance shuttle run, and sit and reach. Growth parameters included weight, standing height, sitting height, biacromial and bicristal breadth, acromo-radiale length, radio-stylion length, arm, thigh, and calf circumferences, and triceps, subscapular, and abdominal skinfolds. Maturation was assessed via hand-wrist x-rays (discontinued after 1976) and age at menarche in a sample of females. Approximately 80% of the participants participated in the program for a minimum of four years. Children in grades K-7 enrolled in the MPS were given the opportunity to attend a weekly physical activity program offered through the study. For those children in kindergarten and first grades, the primary focus was on development of a broad repertoire of

fundamental motor skills. Sessions for children in the second and third grades focused on transitional activities that combined two or more fundamental motor skills. Children in the older groups were exposed to a variety of sports. Instructors for the MPS included physical education graduate students, undergraduate students enrolled in a motor development course, and some non-university personnel for specialized topics. The study lasted 30 years.

Influence of adiposity and maturation on fitness in girls

Christine Pacewicz, Karin Pfeiffer, Amy Nuttall, Crystal Branta, John Haubenstricker, Vern Seefeldt, Michigan State University

The prevalence of obesity in youth is high (Hales, Carroll, Fryar, & Ogden, 2017), indicating higher levels of adiposity in children and adolescence. Excess adipose tissue may impact the development of fundamental motor skills. Therefore, the purpose of the current study was to examine (a) if adiposity influenced the initial as well as the change in the jump and reach, 30-yard dash, and 30-foot agility shuttle run and (b) if the influence of adiposity on fitness trajectories differed by maturation (i.e., early, average, late). Participants (N = 189) included girls with measurements from middle childhood through adolescence (8-16 years). Latent growth curve models were used to assess change over time in fitness (Grimm & Ram, 2012), assessed by jump and reach, 30-yard dash, and shuttle run, and multi-group latent growth curves were used to assess the influence of adiposity on fitness with respect to maturation classification. Overall, fitness increased with age; however, fitness trajectories differed by maturation. Late maturing girls performed worse in the jump and reach and shuttle run at age eight compared to early and average maturing girls. However, by the middle of adolescence, late maturing girls had the highest skill levels in these tasks. For early and average maturers, sum of skinfolds at time one was a significant predictor of initial performance in the jump and reach (b = –.14, b = –.17) and 30-yard dash (b = .02, b = .02), respectively. Findings indicated that higher levels of adiposity were associated with lower heights in the jump and reach and slower times in the 30-yard dash. Sum of skinfolds at time one was a significant predictor of initial performance in the shuttle run for average maturers (b = .03) indicating that higher levels of adiposity were associated with slower times in the shuttle run. Future research should examine changes in adiposity across childhood and adolescence to more fully understand how adiposity influences fitness and the acquisition of motor skills.

Tracking of physical fitness components from childhood to adolescence: A longitudinal study

Larissa True, SUNY Cortland; Eric Martin, Boise State University; Karin Pfeiffer, Michigan State University; Shannon Siegel, University of San Francisco; Crystal Branta, Michigan State University; John Haubenstricker, Michigan State University; Vern Seefeldt, Michigan State University

Given the importance of childhood physical fitness relative to subsequent adult health outcomes, it is imperative to examine tracking of fitness components throughout childhood/adolescence. The purpose of the study was to examine the stability and tracking of 7 measures of fitness (flexed arm hang, jump and reach, standing long jump, 30-ft shuttle run, 30-yd dash, endurance shuttle run, and sit and reach) for males and females at 5 points throughout childhood/adolescence (ages 6, 9, 12, 15, and 18). Tracking coefficients between individual fitness measures at various time point comparisons (6–9 yrs, 9–12 yrs, 12–15 yrs, 15–18 yrs, and 6–18 yrs) were calculated. Using a sample with recorded data at each of 4 time points (6, 9, 12, and 15 yrs), tertiles (high, moderate, low) were calculated for each fitness measure at each of the 4 time points separately for boys and girls. Stability of fitness measures was calculated using percent agreement and Kappa coefficients. Results indicated significantly low to moderately high tracking coefficients for each fitness measure at all time points for boys (r = .21–.79) and girls (r = .23–.89). Boys and girls maintained tertile classification for each skill for each time point. Overall, Kappa coefficients were the highest in the 9–12 yr age range for boys (M Kappa = .38) and the 12–15 yr age range for girls (M Kappa = .36). Boys exhibited the strongest tracking for the flexed arm hang (M = 61.1%), while girls' was strongest for sit and reach (M = 58.1%). Participants maintained similar levels of performance on all components throughout childhood and adolescence. Thus, participants who began in the "low" tertile at age 6 tended to remain in the low tertile until age 18, and those who began in the "moderate" or "high" tertile tended to remain in their respective tertile at age 18. These findings highlight the importance of developing healthy fitness behaviors early in life and the underlying significance of intervention during adolescence if youth demonstrate poor levels of fitness.

Youth sport participation and adult physical activity: The influence of fundamental movement skill instruction during childhood

Eric Martin, Boise State University; Larissa True, SUNY Cortland; Karin Pfeiffer, Michigan State University; Shannon Siegel, University of San Francisco; Crystal Branta, Michigan State University; David Wisner, Central Michigan University; John Haubenstricker, Michigan State University; Vern Seefeldt, Michigan State University

Research investigating the influence of programs that teach fundamental motor skills to youth on adult level physical activity is rare. The aim of this study is to investigate the degree to which sport participation tracks across adolescence and early adulthood in a group of participants in the Motor Performance Study as well as what differences exist in their levels of adult physical activity relative to past sport participation. Active participants in the MPS participated in a follow-up survey on adult leisure-time physical activity. Of the 421 eligible MPS participants, 256 (60.8%) participants fully completed surveys concerning routine sport participation and physical activity over the previous 12 months. Sport participation tracked consistently from youth to college. However, even with consistent tracking, no single pathway existed for college sport participation. Additionally, regardless of youth sport participation, in this group of former MPS participants, adult leisure time physical activity was relatively consistent among groups. Specifically, a MANCOVA investigating differences in youth free play groups (no free play, yes free play) on adult physical participation rates (total, light, moderate, heavy) with age and gender as covariates was non-significant, $F(6, 480) = .27$, $p > .05$, $\eta^2 = .00$. Age ($F(3, 241) = .24$, $p > .05$, $\eta 2 = .00$) and gender ($F(3, 241) = .33$, $p > .05$, $\eta^2 = .00$) were both non-significant. As sport participation tracks relatively consistently from youth to adulthood, informal play opportunities or other aspects to develop fundamental motor skills need to be prioritized to increase the likelihood of adult physical activity participation.

A cultural perspective on the interaction of actual and perceived motor performance and their correlates in children

Symposium organizer(s): Dennis Dreiskaemper, University of Muenster, Germany

Symposium discussant: Nadja Schott, University of Stuttgart, Germany

Symposium overview: A cultural perspective on the interaction of actual and perceived motor performance and their correlates in children

Dennis Dreiskaemper, University of Muenster, Germany

In motor development research in children, studies are typically limited by either examining only a few factors (e.g., either motor competence or physical fitness or either motor performance or self-perception of children) or by using samples from one specific country or both. Thus, this international collaboration study aimed to assess the relationship between

children's actual and perceived motor performance from both a sex and a cross-cultural perspective in Australia and Germany. To achieve this, motor skills, physical fitness and children's self-perception (in both dimensions) were examined. In addition, children's physical activity, executive functions and well-being were measured the in order to analyze the complex relationship between these factors in childhood. This symposium aims to introduce the general hypotheses of the collaboration and to show the results of the intercultural research team. In the first presentation, the reciprocal model of actual and perceived motor performance and their different dimensions in childhood is introduced. In the second presentation, the measurement of perceived motor performance (as a part of the physical self-concept in childhood) is evaluated considering results from the project as well as from a review study. Third, the results regarding the interrelations between physical fitness, motor skills and executive functions are presented. Finally, the results of longitudinal examination of motor performance and self-perception are analyzed with a special focus on the stability of these factors and the interplay between actual and perceived performance in this sample of children. The results are to be discussed in terms of cultural similarities and differences, general assumptions about the complex interrelations between the measured factors and possible perspectives and practical derivations.

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Cultural perspective on the interaction of actual and perceived motor performance in children

Maike Tietjens, University of Muenster, Germany; Dennis Dreiskaemper, University of Muenster, Germany; Nadja Schott, University of Stuttgart, Germany; Till Utesch, University of Muenster, Germany; Trina Hinkley, Deakin University, Australia; Lisa M. Barnett, Deakin University, Australia; Natalie Lander, Deakin University, Australia; Benjamin Holfelder, University of Stuttgart, Germany

Recent studies have found evidence that motor performance in children differs according to sex and culture. However, studies have been typically limited by examining only few factors which may explain such differences, i.e. the relationship between young children's actual motor performance and fitness coupled with their perception of their fitness and their motor skills. Thus, the study aim was to assess the relationship between children's actual and perceived motor performance from both a sex and a cross-cultural perspective. In total, 359 children (191 boys, 167 girls; age 8.35 ± 0.65) from Australia (n = 145) and Germany (n = 214) that belong to distinct different cultural region's according to Hofstede (1980) participated. Sociodemographic characteristics, health-related fitness (FITNESSGRAM, Plowman & Meredith, 2013), actual motor skill (TGMD-3, Ulrich, in press), perceived health-related fitness (I-PSC-C, Tietjens et al, in press) and children's perceived motor skills (PMSC, Barnett et al, 2015) were assessed. MANOVA, SEM and CFAs were performed. The results of the MANOVA for actual and perceived physical fitness as well as actual and perceived motor skills indicated differences for test-items in favor of Australia, and for boys. Path analysis was performed to evaluate the relationship between actual and perceived motor performance ($\chi^2 = 4.59$, df = 4, p = .333, CFI = .998, TLI = .992, and RMSEA = .02), indicating moderate to strong relationships for actual motor skill on perception of motor skill .58, health fitness on perception .20, health related fitness on motor skill .40, and perceived motor skills on perceived health related fitness .53. Differences in country and sex might be due to socialization-processes in PE and sports or due to culturally variant instruments (e.g. kicking). The relationship between motor skill and its perception is stronger than between health-related fitness and its perception, which might be explained by the abstract nature of fitness perception, possibly requiring an advanced level of cognitive development.

The measurement of the physical self-concept/self-perception of motor competence in childhood: A review

Dennis Dreiskaemper, University of Muenster, Germany; Till Utesch, University of Muenster, Germany; Farid Bardid, University of Strathclyde, UK; Maike Tietjens, University of Muenster, Germany

Background: The developmental model of Stodden et al. (2008) hypothesizes reciprocal dynamic relationships between motor competence, perceived motor competence, health-related fitness and physical activity in childhood. In motor development research, the perception of one's own motor competence is mostly referred to as the physical self-concept (cf. Babic et al., 2014). This can be criticized, because the health-related fitness domains of the physical self-concept as endurance, coordination, strength or flexibility (Marsh et al., 1994) as they are included in the Physical-Self-Description-Questionnaire (Marsh et al., 1994) are not considered. Therefore, it seems to be the fact, that the physical self-concept of children and youth is investigated in two more or less independent pathways. Methods and results: This presentation aims to combine these two pathways using two study results: First, the results of studies are presented that use different validated questionnaires for perceived motor competence and perceived physical fitness in the same sample either in early to middle childhood (i.e., PMSC, Barnett et al., 2016; and the P-PSC-C, Tietjens et al., 2017) or in late childhood (i.e., PMC-C; PSC-C, Dreiskaemper et al, 2015; 2017) showing correlations and developmental effects between these two scales. Second, review data is presented, that analyzed the different possibilities of measuring physical self-perception in childhood (including skill- and fitness-orientation) on a basis of 11 validated questionnaires, also taking into account different approaches of measurement (i.e., pictorial scales vs. questionnaires). Discussion: Based on the results in different countries (e.g., Australia, Germany) it is discussed that, especially in young years, the self-perception of specific motor skills seems to be more important for self-evaluation than the more complex dimensions of the health-related fitness. The results show, that research is needed in order to understand the development of children's self-perception towards a hierarchic, more dimensional self-concept.

Fit girls and skillful boys? Direct and indirect relationships of physical activity, motor performance, and physical fitness on cognition in children

Nadja Schott, University of Stuttgart, Germany; Benjamin Holfelder, University of Stuttgart, Germany; Emiliano Mazzoli, Deakin University, Australia

Although there have been many studies demonstrating the positive effect of physical activity and fitness on cognition, the role of motor skill development on cognition has only received minor interest. None of the previous studies have examined the relationships among those relevant factors simultaneously. Therefore, the purpose of this study was to determine the direct and indirect influence of physical activity, motor skill performance, and physical fitness on cognition among schoolchildren, and further whether there are any sex differences in these relationships. Using structural equation modelling (SEM), we analyzed cross-sectional data from 247 schoolchildren (139 males, 108 females; 7-10 years old). Cognitive performance was assessed using a modified flanker task (inhibition) and a 2-back task (working memory, updating). Physical fitness was evaluated using the total score of five physical fitness tests, and motor skill performance with the Test of Gross Motor Development (TGMD-3). Physical activity was assessed by questionnaire. A multi-group analysis method was employed to relate differences between groups. The SEM showed a good fit to the data ($\chi^2 = 1.26$, p = .198, CFI = .976, RMSEA = .027). Invariance testing revealed significant differences in pathway estimates between boys and girls. Overall, boys' cognitive performance seemed to be more negatively affected by their physical activity duration than girls' ($\beta = -.527$,

$p < .001$; $\beta = .070$, $p = .566$, respectively). Motor skill performance was positively related to cognitive performance in boys, but not in girls ($\beta = .564$, $p = .102$; $\beta = -.359$, $p = .098$, respectively), whereas physical fitness was positively related to cognitive performance in girls, but not in boys ($\beta = .434$, $p = .003$; $\beta = -.020$, $p = .919$, respectively). These findings suggest that, girls and boys might thrive in tailored single-sex physical education classes, and as a result, could exhibit increased levels of moderate-to-vigorous physical activity. This may contribute to academic success via enhanced physical fitness, motor skill performance and cognitive performance.

How stable is perceived motor competence over one year and does it differ for boys and girls?

Carmen Van Veen, Deakin University, Australia; Lisa M. Barnett, Deakin University, Australia; Natalie Lander, Deakin University, Australia; Trina Hinkley, Deakin University, Australia; Nadja Schott, University of Stuttgart, Germany; Maike Tietjens, University of Muenster, Germany; Till Utesch, University of Muenster, Germany; Dennis Dreiskaemper, University of Muenster, Germany

Background. Children's positive perception of motor competence (PMC) provides motivation for physical activity (de Meester et al., 2016). Theoretically young children have inflated PMC but as children develop, perceptions are hypothesized to decrease (Stodden et al., 2018). This study investigated (RQ1) the strength of PMC association over one year, (RQ2) whether children's PMC decreased and (RQ3) sex differences in relationships (as girls' levels are generally lower than boys'). Methods. PMC was assessed using the Pictorial Scale of Perceived Movement Skill Competence (PMSC) (13 items-7 object control and 6 locomotor skills) in 2016 (T1) and 2017 (T2). A total of 125 Australian children (girls = 48, boys = 77), aged 8.3-10.5 years (Mage 9.4 at T2, SD=0.6) completed both assessments. Independent t-tests assessed sex differences. Intraclass correlations addressed RQ1/RQ3. Paired sample t-tests investigated RQ2. A general linear model (T2 perception as the outcome, T1 perception as the predictor, adjusting for age, sex and sex*perception at T1 was performed to address RQ1/RQ3. Results. Boys had higher total and object control PMC than girls at both T1 and T2. For all children, there were moderate correlations over time for total PMC [ICC = 0.60], perceived object control [ICC = 0.63] and perceived locomotor [ICC = 0.43]. When separated by sex, correlations appeared weaker in girls. For all children, PMC decreased for total and locomotor perception; object control remained stable. When split by sex, boys' perceptions decreased for total, locomotor and object control, but girls' did not. T1 PMC (and age) predicted 38% of T2 PMC variance (sex ns). T1 Locomotor perception (and age) predicted 21% of variance (sex ns). T1 object control perception (and sex-boys) predicted 41% of variance (age ns). Conclusions. Data partially supports theory in that perceptions decrease over this critical age period, but more so for boys, who have higher perceptions. Self-perception appears more stable in object control. Next steps are to understand how accuracy of perception changes over time.

Best practices for the development and implementation of physical activity and motor skill interventions for preschoolers

Symposium organizer(s): Danielle Wadsworth, Auburn University

Symposium discussant: Jacqueline Goodway, The Ohio State University

Introduction of symposium

Danielle Wadsworth, Jerraco Johnson, Melissa Pangelinan, Auburn University

Interventions aimed at increasing the physical health of preschool children have the potential to bring about an array of benefits. In fact, the National Physical Activity Plan, Society of Health and Physical Educators and Institutes of Medicine specifically target preschool children for interventions. A growing body of research provides evidence that preschool programs can have positive outcomes such as fundamental motor skill and physical activity participation. With a majority of children attended preschool programs throughout the United States, it is important that we examine effective evidence based practices for this population. The purpose of this symposium is to discuss best practices for delivering preschool interventions across a wide range of populations and environments, taking into account the high variability associated with preschool children. Presentations will utilize practices identified in the literature, as well as, our experiences implementing interventions with preschool children. The first presentation will discuss best practices for elucidating positive changes in fundamental motor skills. Presentation two will examine best practices for increasing moderate-to-vigorous physical activity and improving fitness. The third presentation will discuss how interventions aimed at improving physical dimensions of health impact acute and long-term cognitive and academic skills. This symposium brings together several disciplines within NASPSPA including motor development and exercise psychology and will target a wide audience.

Funding source: None.

Critical environmental factors: Best practices for elucidating positive changes in fundamental motor skill learning in preschool-age children

Jerraco Johnson, Mary Rudisill, Auburn University

It is widely accepted that fundamental motor skills are considered the building blocks for successful participation in sports and physical activity for children. Individuals must be able to master these skill patterns before they can engage in more complex movement patterns, games, and activities. Over the past 15 years, utilizing theoretically-driven mastery motivational climate interventions we have found positive changes in fundamental motor skill learning in preschool children across diverse backgrounds (boys, girls, children at-risk for developmental delay, and underrepresented groups). Since then we have begun to identify key components within the environment that are vital for optimal change in gross motor skills. The first key environmental aspect is instruction. Not only have we found the type of instruction to be crucial to learning outcomes, but we have also found that children must be cognitively ready to be able to pay spend an appropriate amount of time listening to the instruction to understand the purpose and goals of the activities. Another critical component of motor skill learning is the actual design of the activities. The skill stations within the intervention must be designed not only to entice the children to engage in skill practice (attraction power), but should also consider factors that will encourage sustained skill practice as well (holding power). We will identify some recommendations on how to incorporate these critical components into motor skill interventions to elicit optimal motor skill learning outcomes.

Best practices to elicit moderate to vigorous physical activity in preschoolers: A social ecological approach

Danielle Wadsworth, Alexandra Venezia, Auburn University

Participation in physical activity is vital for physical, social and mental health of young children. However, a majority of preschoolers are sedentary in preschool settings even when allowed to participate in outdoor free play. Therefore, it is imperative that we identify effective evidence based practices that promote physical activity and reduce sedentary behavior in preschoolers. This presentation examines best practices identified through evidence-based interventions in the literature and our lab that promote

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physical activity. Utilizing a theoretical lens based on the socio-ecological model, we identified several categories of intervention practices that are effective for preschool populations. First, we will explore environmental components at the microsystem level that promote physical activity participation, such as access to outdoor play and teacher practices. Second, we will explore factors at the mesosystem level, including family structure, community resources and community structure. Third, we will discuss policies at all levels that affect physical activity participation and the impact of the culture on preschool physical activity. We will identify gaps in the literature and future research for this area.

Measuring the immediate and long-term effects of motor skill and physical activity intervention on cognitive and academic skills

Melissa Pangelinan, Julia Sassi, Brooke Converse, Auburn University

There is compelling evidence for a relationship between motor skill and cognitive development across childhood and adolescence based on both cross-sectional and longitudinal studies. Although there is growing body of literature to suggest that similar relationships exist in pre-school children, the findings are much less consistent. Moreover, beyond the cross-sectional and longitudinal bivariate correlations amongst cognitive and motor outcomes, an important question that remains is whether there is a causal link. Thus, the purpose of this talk is to critically evaluate the literature with respect to the immediate and long-term effects of motor skill and physical activity interventions on cognitive and academic outcomes in preschool children. The following questions will be considered: A) which motor assessments did the studies employ; B) which cognitive assessments were employed; C) what is the structure of the motor skill/physical activity intervention (i.e., dose, intensity, type of activities, who lead the intervention, motivational climates, etc.); D) who was the population; and, E) what are the potential mechanisms to explain specific relationships? Recommendations and future directions will be aimed at addressing the logistical/methodological difficulties in measuring cognitive and academic skills in young children, particularly those from diverse background and ability levels.

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Symposia Friday, June 22nd

Multidisciplinary Symposium

"What, So What, and Now What?" Translating Positive Youth Development (PYD) Research to Program Improvements in Curricula and Coach Training

Symposium organizer: Maureen R. Weiss, University of Minnesota

Symposium discussant: Allison Riley, Girls on the Run International, Charlotte, NC

Introduction to the symposium

Maureen Weiss, University of Minnesota

The positive youth development (PYD) framework has been embraced in the past decade to understand the potential for sport and physical activity programs to enhance social, psychological, and physical outcomes (Holt, 2016). Some researchers conducted interviews with youth, coaches, and/or parents to assess perceptions about learning life skills through sport, whereas others investigated quantitative relationships between social-environmental factors (e.g., coaching behaviors) and outcomes such as self-perceptions and social skills (Weiss, 2016). Intervention and evaluation studies extend qualitative and cross-sectional investigations by assessing the impact of an intentional life skills curriculum and systematic coach training on PYD outcomes. Documenting change over time and using appropriate comparison groups enable conclusions that program improvements were in fact due to the intervention. In addition to empirical findings of evaluation research, Patton (2012) highlighted the need to address practical implications using the questions "What, so what, and now what?" *What* findings provide evidence of change in attitudes, skills, and behaviors; *so what* do these findings mean about the degree to which the program can be considered a success, and *now what* recommendations can be made based on the findings for making program improvements that will benefit participants' experiences? The purpose of this symposium is to share intervention and evaluation research on four physical activity-based PYD programs—Learning in Fitness and Education through Sports (LiFE*sports*), The First Tee, PYDSportNET, and Girls on the Run—and address the *what*, *so what*, and *now what* of study findings. An administrator for a national physical activity-based PYD organization will address how out-of-school-time programs can translate empirical findings to improve curricular lessons and coach training and strengthen impact on youths' experiences through sport and physical activity.

Using research and evaluations to inform improvements in LiFE*sports*: "So what" to "Now what?"

Dawn Anderson-Butcher, Ohio State University; Anthony J. Amorose, Illinois State University

Learning in Fitness and Education through Sports (LiFE*sports*) is a sports-based positive youth development (PYD) program designed to foster social competence among youth. LiFE*sports* involves a one-month summer camp and year-long follow-up sports clinics designed to increase specific social skills among youth, including Self-Control, Effort, Teamwork, and Social Responsibility (SETS). Each year, over 600 urban youth of color and/or living in poverty participate, with 55% of participants returning each year. Findings from multiple studies showcase the importance of LiFE*sports* for promoting social and physical development among youth, and recent longitudinal research showcases the value of participation especially among the most vulnerable youth and those with more limited social skills. Further, studies have explored what elements of the program contribute most to PYD outcomes. Findings demonstrate the importance of key program design features such as staff emotional support, a sense of belonging, implementation fidelity, peer relations, parent encouragement, and staff feedback and reinforcement specific to SETS. Several recommendations can be made to inform next steps and recommendations. Over 8 years of LiFE*sports* highlight the importance of (1) intentional curricula; (2) safe, supportive learning environments; (3) social relationships; (4) individualized instruction; (5) addressing the needs of youth with limited skills; (6) specific coaching techniques such as debriefing; (7) feedback and praise; and (8) booster sessions (i.e., clinics) to foster skill transfer. So what now? Here we will share ways in which LiFE*sports* is using these findings to inform improvements in the program design and implementation, the sports and SETS curricula and lesson plans, coach trainings, and its program staffing model.

Longitudinal impact of *The First Tee* on PYD: "So what" to "now what?"

Nicole D. Bolter, San Francisco State University; Maureen R. Weiss, University of Minnesota

Weiss and her colleagues (Weiss et al., 2013, 2014, 2016) conducted a four-year evaluation study of *The First Tee*, a physical activity-based positive youth development (PA-PYD) program using golf as the context to teach life skills and promote core values such as character, confidence, and perseverance. Using a longitudinal design, quantitative and qualitative methods, a comparison group of youth in other activities, and inquiry with multiple stakeholders in *The First Tee* (youth participants, parents/guardians, and coaches), overall findings provided strong support that *The First Tee* is effective in promoting positive youth development. Favorable outcomes were linked to the life skills curriculum, training of coaches to effectively deliver the curriculum, and supportive and caring youth-coach relationships. In addition to positive findings, areas were identified in which *The First Tee* could improve their impact on developing motor and life skills. Recommendations were offered for elevating teaching and curricular efforts to maximize life skills learning and developmental outcomes. These recommendations included: (a) increase emphasis on teaching the life skill of making healthy choices, including greater physical activity and better nutrition; (b) adopt a developmental approach to programming, ensuring age-appropriate golf and life lessons and delivery; (c) allow adequate time for youth to "learn" life and golf skills and track their ability to "transfer" life skills; (d) include a coach training unit on giving effective visual demonstrations of golf and life skills and reduce verbal instructions; and (e) improve parent education so that life skill lessons can be reinforced at home. This presentation will briefly recap the "what" and focus on how the "so what" translated to the "now what" for *The First Tee* organization. We highlight modifications to the curriculum and coach training stemming from our research findings, and conclude with how *The First Tee* is continuing to evaluate and improve their programming.

"So what?" Connecting research and practice through the PYDSportNET program

Nicholas L. Holt, Kurtis Pankow, University of Alberta, Canada

Knowledge translation is a dynamic and iterative process involving interactions between researchers and knowledge users that can improve

the application of knowledge to provide more effective policies, programs, and practices (Straus et al., 2013). However, knowledge translation research in youth sport psychology remains scarce. The purpose of this presentation will be to depict the development of a knowledge translation research program called PYDSportNET. The overall goal of PYDSportNET is to promote Positive Youth Development (PYD) through sport by improving the exchange of knowledge between researchers and the sport community, and the use of research knowledge among members of the sport community. PYDSportNET is based on the knowledge-to-action framework (Graham et al., 2006), a knowledge translation model that has two interconnected components: knowledge creation and the action cycle. PYDSportNET activities in the knowledge creation component included a meta-study of qualitative PYD research and the development of several knowledge products (e.g., infographics and a magazine for sport parents). For the action cycle, two studies were completed with key stakeholders in Canadian youth sport to examine (a) research implementation and (b) priorities for future research. Simultaneously, a knowledge dissemination and exchange network was developed, primarily using social media. Data demonstrating the reach of these activities will be presented and critically evaluated. The presentation will conclude by reviewing some 'lessons learned,' including the enduring importance of personal connections between researchers and practitioners and the concept of information tailoring (i.e., customizing research knowledge for specific audiences).

"What ... so what?" *Girls on the Run*—A longitudinal evaluation of program impact

Maureen R. Weiss, University of Minnesota; Lindsay E. Kipp, Texas State University; Alison C. Phillips, University of Iowa; Sarah M. Espinoza, University of Minnesota; Hailee J. Moehnke, University of Minnesota, Nicole D. Bolter, San Francisco State University

Girls on the Run is a physical activity-based PYD program that uses running activities as a platform for teaching life skills and promoting developmental outcomes in 3rd through 5th grade girls. The program adopts the *5Cs* approach to PYD that places emphasis on developing competence, confidence, connection, character, and caring (Lerner et al., 2005). Coaches are trained to deliver an intentional curriculum, with a focus on building relationships; creating a positive, inclusive environment; and fostering a mastery motivational climate. We report selected findings from a larger longitudinal study evaluating program impact, including survey responses quantifying change in the *5Cs* and physical activity from pre- to post-season to follow-up after season's end, as well as focus group responses of what girls learned and how they changed as a result of participating. The sample consisted of 203 girls ($M = 9.8$ yrs.) from three Girls on the Run councils in three cities in which programming takes place. A subset of girls ($n = 17$), coaches ($n = 19$), parents/guardians ($n = 10$), and school personnel ($n = 14$) separately participated in focus group interviews. Analysis of survey results revealed: (a) the entire sample showed significant improvements in confidence (perceived physical appearance and global self-esteem) and connection (perceived classmate support), and (b) girls starting below the pre-season average significantly improved on all *5Cs* (competence, confidence, connection, character, caring) and physical activity. Focus group responses converged across stakeholders indicating that, as a result of participating, girls improved positive emotional behaviors, increased positive social behaviors, developed positive peer relationships, improved running and motivation to run, and learned to stand up for self and others. Collectively, findings provide strong evidence that *Girls on the Run* is effective in promoting positive youth development, including season-long and lasting change in the *5Cs* and physical activity behavior.

"Now what?" A practitioner's perspective on translating PYD research to program improvements

Allison Riley, Girls on the Run International

Researchers in physical activity-based positive youth development (PA-PYD) are committed to uncovering knowledge with the hopes that these discoveries will contribute to the greater good of youth. Out-of-school-time practitioners, including administrators, coaches, and mentors, need and want relevant evidence-based data to inform the development and implementation of programs, curricula, and coach training that will contribute to positive developmental outcomes for the youth they serve. Peer-reviewed journal articles, chapters, and textbooks that contain important insights for practitioners in out-of-school-time programs, however, are not often written in an accessible way and thus may not have an impact on programmatic change. Likewise, evaluation findings of program impact and areas in need of improvement may not be translated from data to curricular change without collaboration between researcher and practitioner. The purpose of my presentation is to explore ways in which practitioners and researchers can work together to translate empirical findings to evidence-based best practices in out-of-school-time programs. Drawing on my experiences as a researcher and practitioner with PA-PYD programs, I will share how Girls on the Run has worked with researchers and translated empirical findings to improve curricular lessons and coach training. Examples include developing curricula for elementary and middle school-aged girls, creating a standardized coach training and support system, and planning improvements to parent education. As I share examples, I will also discuss key topics such as the ongoing partnership between researcher and practitioner and the accessibility of research findings. Attendees will leave the session with practical strategies that will move practitioners and researchers closer to their shared goal of contributing to the positive developmental outcomes of youth.

Sport and Exercise Psychology

Licit and illicit performance enhancement in sport and education

Symposium organizer: Ian David Boardley, University of Birmingham, UK

Symposium discussant: Daniel Gould, Michigan State University

Development and validation of indirect measures of athletes' attitudes towards controlled and uncontrolled forms of performance enhancement in sport

John Mills, University of Essex, UK; Ian David Boardley, University of Birmingham, UK; Alexandra Olton, University of Birmingham, UK

This research aimed to develop and validate four indirect measures of athletes' attitudes towards controlled and uncontrolled forms of performance enhancement in sport. For both controlled (i.e., use of illicit performance enhancers such as performance enhancing drugs) and uncontrolled (i.e., use of licit performance enhancers such as nutritional supplements) forms, a measure of moral (i.e., morally wrong/right) and functional (i.e., functionally necessary/unnecessary) attitudes towards performance enhancement was developed. Each measure took the form of a Single Category Implicit Association Test (SC-IAT), giving a total of four SC-IATs overall. These SC-IATs examine two target (i.e., Controlled and Uncontrolled) and four attribute (i.e., Moral, Immoral, Necessary, and Unnecessary) categories. In Phase 1, an expert sample of athletes, coaches, and academics specializing in performance enhancement offered feedback on the content validity of representative terms generated through focus groups and interviews. In Phase 2, student athletes (n = 23) across a range of sports (i.e., n = 16) piloted the selected terms for each of the four

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SC-IATs, as well as completing direct assessments of their functional attitudes towards controlled and uncontrolled substances, and self-reported use of controlled and uncontrolled forms of performance enhancement. In addition, they were also asked to provide qualitative feedback on the face validity of the stimuli items. Finally, Phase 3 adopted the same protocol as Phase 2 but with a separate and larger sample (n = 50). Across the three phases, data analyses provided initial support for items' face and content validity, and the internal consistency (i.e., ICC [3,1] .14 to .37; split half tests .41 to .62) and construct validity (e.g., Uncontrolled-Functional SC-IAT scores correlated positively with directly assessed sport supplement beliefs [$r = .24$, $p < .05$]) of scores obtained with the new measures. The fourth phase of development and validation of the new measures is ongoing.

Antecedents and outcomes of technical and strength and conditioning coaches' doping confrontation efficacy beliefs

Ian David Boardley, University of Birmingham, UK; Jonathan Grix, Manchester Metropolitan University, UK; Ceri Wynne, University of Birmingham, UK; Alan Smith, Michigan State University; Nikos Ntoumanis, Curtin University, Australia

Coaches are key figures in the lives of athletes, representing social factors with the potential to influence athletes' susceptibility to doping. One coach attribute with potential to influence athletes' susceptibility to doping is doping confrontation efficacy (DCE; Sullivan, Feltz, LaForge-MacKenzie, & Hwang, 2015), representing the extent to which coaches believe in their abilities to effectively confront athletes regarding doping issues, and offer appropriate solutions. Although initial research has supported the potential importance of DCE beliefs, to date researchers have not qualitatively examined coaches' efficacy beliefs regarding the five dimensions of DCE, or factors that may influence such beliefs. To address this limitation, semi-structured interviews were conducted with 21 technical (n = 11) and strength and conditioning (S&C; n = 10) coaches (n-male = 15, n-female = 6). Coaches worked at a regional (n = 8), national (n = 7), or international (n = 6) level in either athletics (n = 5), rugby (n = 13), or both sports (n = 3) in England. Deductive content analysis revealed: (a) coaches confident in their ability to establish the purpose for confronting an athlete about doping were more likely to do so, (b) confidence in the ability to develop coach-athlete relationships led to coaches' believing relationships between coach and athlete were strong enough to discuss difficult topics such as doping without the relationship being threatened, (c) the stronger the evidence that an athlete was considering doping, the more legitimate coaches felt in confronting an athlete about it, (d) doping confrontations can lead to positive (e.g., cessation of doping) or negative (e.g., weakening of the coach-athlete relationship) outcomes depending on the nature of the confrontation, and (e) anti-doping education is an important personal resource underpinning coaches' DCE beliefs. Overall, the current findings provide support for the DCE model proposed by Sullivan et al. (2015), and contribute important knowledge on antecedents and outcomes of coaches' DCE beliefs.

Athletes' perceptions of coach doping confrontation efficacy and athletes' susceptibility to intentional and inadvertent doping in athletics and rugby

Anthony Knox, University of Birmingham, UK; Ian David Boardley, University of Birmingham, UK; Ceri Wynne, University of Birmingham, UK; Alan Smith, Michigan State University; Nikos Ntoumanis, Curtin University, Australia

Recent research suggests doping – the use of illicit performance enhancing substances – can be either intentional (i.e., purposefully doping to enhance performance) or inadvertent (i.e., ingesting prohibited substances through contaminated supplements/foodstuffs or inappropriate use of medications). Coaches represent a social factor with the potential to influence athletes' susceptibility to both intentional and inadvertent doping. In particular, coaches perceived to be high in doping confrontation efficacy (DCE; i.e., a coach's ability to effectively confront athletes regarding doping issues and offer appropriate solutions) may be most effective in reducing athletes' susceptibility to the two forms of doping. However, to date researchers have not qualitatively examined factors that may influence athletes' susceptibility to both intentional and inadvertent doping, including their perceptions of their coach's DCE. To address this gap in knowledge, semi-structured interviews were conducted with 21 rugby players (n = 12) and track and field athletes (n = 9) (n-male = 11, n-female = 10). Athletes competed at a regional (n = 4), national (n = 2), or international (n = 15) level. Inductive content analysis revealed: (a) athletes' perceptions of their coaches' DCE may be dependent upon coaches' knowledge and understanding of doping, the taboo nature of doping, and coach type (i.e., technical vs. strength and conditioning), (b) intentional doping may be influenced by discussion of third-party doping, personal deterrents to intentional doping, and environmental factors, and (c) inadvertent doping may be impacted by athletes' knowledge of how to source non-contaminated supplements, tendency to take personal responsibility for their actions, willingness to take risks, and knowledge and practice regarding medication use. Overall, the current findings extend our knowledge on athletes' perceptions of coach DCE, as well as athletes' susceptibility to intentional and inadvertent doping.

A qualitative investigation of psychosocial factors facilitating students' use of cognitive enhancing drugs

Andrew Heyes, Ian David Boardley, University of Birmingham, UK

There is increasing evidence that non-medical use of prescription drugs to enhance performance during academic study is an issue, especially within universities in Westernized nations. One theory that has guided research on psychosocial factors that may influence illicit use of drugs to facilitate performance in sport and exercise is Bandura's (1991) social cognitive theory of moral thought and action. Guided by this theory, the current study aimed to investigate whether moral disengagement (MD) mechanisms are evident when university students explain their reasons for off-label use of prescription drugs. To achieve this aim, in-depth-semi-structured interviews were conducted with nine students from a British university, all with experience of using prescription stimulants (e.g., Modafinil) to support their studies. Data were deductively content analysed using definitions for the eight mechanisms of MD. Data analysis supported the use of six of these mechanisms (i.e., moral justification, euphemistic labeling, advantageous comparison, displacement of responsibility, diffusion of responsibility, and distortion of consequences) when students explained their off-label use of prescription stimulants. Of these mechanisms, distortion of consequences and diffusion of responsibility were evidenced most frequently. Not only are these the same six mechanisms used by athletes when justifying and rationalizing use of performance enhancing drugs in sport and exercise, the way in which the mechanisms were utilized often converged with their use in physical activity contexts. Students' MD may represent an attempt to minimize negative emotional responses (e.g., guilt) stimulated by ethical, legal, and health-based deterrents to off-label use of prescription drugs, and/or diminish potential social censure. Overall, the study findings suggest MD may facilitate students' use of prescription stimulants to support academic study, and that similar methods of justification and rationalization may be adopted across sport and non-sport achievement contexts.

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Saturday, June 23rd

Multidisciplinary Symposium

Methodological advances in motor learning and development

Symposium Organizer(s): Keith Lohse, University of Utah

Longitudinal data-analysis techniques in motor learning and development: A focus on time-varying covariates

Keith Lohse, University of Utah

As substantive knowledge in a field moves forward, so to do the tools that we have for asking scientific questions. Studies in motor learning and development face unique challenges, and it is important to reflect on the adequacy of current methods and the value of emerging tools. In this symposium, researchers in the fields of motor learning, development, and rehabilitation will present studies using advanced longitudinal data analysis techniques. Specifically, linear mixed-effects regression (LMER). These studies not only use LMER, but the hypotheses they test are enabled by it. Much of this research would not have been possible using analyses based on mean-differences or "conventional" ANOVA approaches (as in Dr. Dibble's or Dr. Pangelinan's work). Other times, more conventional analyses might even lead us to spurious conclusions (as shown by Dr. Schaefer's work). In this presentation, I provide a conceptual view of LMER and the value it can add to motor learning/development by allowing us to test more nuanced hypotheses, adopt more flexible designs, and more effectively deal with missing data. As an example, I will present LMERs showing the use of time-varying covariates in an EEG study of motor learning. In most cases, covariates are a static property (e.g., baseline demographic variables), but LMERs allow us to control for dynamic properties that change over time. I will discuss the dynamic covariates of task-difficulty and performance in context of the Challenge Point Framework (Guadagnoli & Lee, 2004). Controlling for these dynamic factors in an LMER shows how midline frontal theta can be used as a physiological measure of functional difficulty. Thus, modeling time-varying covariates is beneficial for motor learning as it allows us to address theoretical propositions more directly. Moreover, time-varying covariates are also important for motor development (e.g., controlling for changes in cognitive status beyond baseline) and rehabilitation (e.g., controlling for therapy received week-to-week rather than a sum total).

Dissociating learning- and non-learning-related performance changes during motor skill training in older adults

Sydney Schaefer, Arizona State University; Peiyuan Wang, Arizona State University; Nicolas Schweighofer, University of Southern California

Motor learning is thought to decline with age, based largely on group comparisons between young and older adults. Recent data shows, however, that 'old old' adults (over age 75) do not necessarily learn a novel motor skill less or slower than 'young old' adults (ages 65–74). A nonlinear mixed-effects model of motor learning may give insight into the effects of aging by dissociating learning from other factors unrelated to learning, like within-session 'fatigue'. Non-learning-related changes are modeled as an increasing linear term that captures such performance decrements later in training, in addition to the traditional 'learning curve' that shows exponential improvements in performance early on in training. In other words, older adults' final performance at the end of a training session may not necessarily reflect their motor learning ability. This nonlinear mixed-effects model has previously quantified learning in a point-to-point reaching task, but can it 1) generalize to a more functional, real world motor skill and 2) improve our understanding of how age affects the motor system? Forty-two adults (ages 39–89; median 73 years) completed 150 trials of a functional upper extremity motor task over three days. Most improvement occurred by the 30th trial within the first day. Model results showed that age was significantly related to 1) predicted performance at trial 30 ($rho = 0.52$; $p = 0.0004$) as well as 2) the 'fatigue'-related parameter ($rho = 0.36$; $p = 0.02$), suggesting that older age was associated with more performance decrement. Once these decrements were accounted for, age no longer predicted the amount of learning; instead, learning was related to the interaction between age and specific cognitive variables. By quantifying individual differences in non-linear performance curves, these findings provide insights into how fatigue-effects may have been previously misinterpreted as impaired motor learning. These analytical techniques clarify the role cognitive impairments play in motor learning, by creating a closer correspondence between theory and analysis.

The strengths and limitations of linear mixed-effects models to explore developmental relationships between the brain and cognitive-motor behavior

Genevieve Olivier, University of Utah; Serence Paul, University of Sydney, Australia; Keith Lohse, University of Utah; Christopher Walter, University of Arkansas for Medical Science; Sydney Schaefer, Arizona State University; Lee Dibble, University of Utah

Despite the nonlinear properties of skill acquisition curves, motor learning is typically measured by comparing discrete time points (e.g., pretest and retention test). Thus, typical measures of motor learning do not detect other characteristics of skill acquisition that may be clinically meaningful. The purposes of this study were to: 1) use nonlinear mathematical models to estimate skill acquisition parameters for each participant and 2) investigate the relationship between motor skill retention and the estimated skill acquisition parameters. Twenty-seven adults (mean age 70.1 years) with Parkinson disease performed a pretest and 102 practice trials of a motor task (2448 practice steps) over three days, followed by two delayed retention tests. The task was a functional postural stepping Serial Reaction Time Task that included random sequences and a blinded imbedded repeating sequence. Participants were randomly assigned to practice either ON ($n = 14$) or OFF ($n = 13$) their dopamine-replacement medication. Statistical analyses were performed using nonlinear curve fitting and mixed-effects regression. Learning was defined as the difference in performance from pretest to both retention tests. Models failed to converge and provide exponential fits for 9 participants' random-sequence skill acquisition curves and for 6 participants' repeating-sequence data, resulting in exclusion from those respective analyses. For the repeating sequence, less impaired participants learned less than more impaired participants, and participants who adapted faster during practice also demonstrated less learning than those who adapted more slowly, although these findings were not found during the random-sequence analysis. While this method of retrospective curve-fitting has been used successfully in other diagnoses, tasks, and effectors, several challenges arose with our data. As this research moves forward, we seek to identify methods that can retrospectively model skill acquisition characteristics in this population and be used to prospectively predict skill acquisition characteristics.

The strengths and limitations of linear mixed effects models to explore developmental relationships between the brain and cognitive-motor behavior

Melissa Pangelinan, Auburn University

This talk will highlight the strengths and limitations of using advanced statistical approaches (i.e., linear mixed-effects regression [LMER]) to characterize developmental relationships between the brain and cognitive-motor behavior. Secondary analyses of data acquired from the NIH Study of Normal Brain Development will be presented. This large, mixed-longitudinal dataset consists of neuroimaging, clinical, behavioral, and demographic variables from a representative sample of individuals between the ages of 4–21 years. Structural MRI of the cerebellum, physical and neurological soft sign (PANESS), pegboard, executive function, and intelligence measures were acquired from participants at baseline (n = 400), 2-year follow-up (n = 289), and 4-year follow-up (n = 118). Prior to statistical analysis, these data were visually inspected to ensure accurate data coding, identify outliers/extreme values, and mean-center covariates of interest. Given the unbalanced/incomplete nature of these data (i.e., subjects may have a different number of visits, or data from one or more covariates may be missing within a visit), variable timing of repeated measurements, high covariance amongst repeated measures, and multiple continuous time-varying covariates, only LMER techniques were sufficiently robust/flexible to model brain-behavior trajectories. The total volume of the cerebellum was modeled with respect to within-subject age-related changes as well as group-level changes that are influenced by age, sex, and their interaction. In addition to the significant age and sex effects, time-varying correlates of interest (e.g., motor and cognitive measures) were added to the models to determine their unique association with brain development. These results replicated the findings from previous studies using cross-sectional and smaller longitudinal samples and revealed unique relationships between the brain and motor behavior. Future directions will be discussed with respect to the extension of LMER to assess multivariate relationships across development.

Sport and Exercise Psychology

"I knew they'd do that!" Contextual information, perception, and action

Symposium Organizer(s): Robin C. Jackson, Loughborough University, UK

Symposium Discussant: Robin C. Jackson, Loughborough University, UK

Symposium Overview: "I knew they'd do that!" Contextual information, perception, and action

Robin C. Jackson, Loughborough University, UK

In dynamic, competitive interactions, there is a wealth of evidence showing that expert performers are more proficient at using advance kinematic information to anticipate the actions of an opponent. Recently, researchers have established that skilled performers also use contextual information from different sources to form expectations about action outcomes before kinematic information becomes available. In this symposium we present some of the first research to examine how these two sources of information interact to support (and sometimes impair) anticipation skill. First, Rouwen Cañal-Bruland (Friedrich-Schiller-University Jena, Germany) examines whether a soccer goalkeeper's reputation affects perceptions of their height, or the accuracy of a penalty-taker's kick. Colm Murphy (St Mary's University, UK) then compares the shot options generated by expert and novice tennis players when viewing just contextual information versus both contextual and kinematic information. Third, Fabian Helm (Goethe-University Frankfurt, Germany) presents a study examining how the level of ambiguity between disguised and non-disguised handball throws interacts with use of situational probability information to influence judgments. Robin Jackson (Loughborough University, UK) then applies signal detection theory to show how advance probability information affects response bias and response sensitivity in judgments of deceptive intent, sometimes producing 'super-deceptive' actions. Last, David Mann (Vrije Universiteit Amsterdam, The Netherlands) examines how a consistent (all straight) or variable (straight or swing) sequence of cricket deliveries affects the performance and visual-motor behavior of elite and club-level cricket batters.

Actions become "super-deceptive" when preceded by (congruent) situational probability information

Robin C. Jackson, Loughborough University, UK; Hayley Barton, Brunel University London, UK

In time-constrained, interactive sports, researchers have established that prior expectations bias performer responses, resulting in better performance when an action outcome is congruent, as opposed to incongruent, with expectations. The effect of prior expectations on tasks involving deceptive actions has yet to be examined. The aim of the present study was to use signal detection analysis to test the hypothesis that situational probability information leads to a larger response bias for deceptive actions than genuine actions. We tested 15 high-skilled and 15 low-skilled soccer players as they judged whether an opponent would take the ball to the left or right. The opponent either made a single genuine move in one direction or first executed a 'step-over', faking to take the ball in one direction before taking it in the opposite direction. Before each block of 12 trials, participants were told that the probability of the player taking the ball to the left and right was 50-50, 67-33 (33-67), or 83-17 (17-83). Results indicated a stronger bias toward responding congruent with the probability information on deceptive trials than on genuine trials. Response bias increased from the 67% to 83% condition and was stronger in low-skilled than high-skilled performers. Moreover, response sensitivity decreased as the strength of situational probability information increased. The results suggest that actions become 'super-deceptive' when probability information is aligned with misleading kinematic information, resulting in more 'false alarm' responses and impaired response sensitivity.

Soccer penalty kicking behaviors are influenced by goalkeepers' reputations

Rouwen Cañal-Bruland, Jonathan Felix Best, Florian Müller, Friedrich Schiller University Jena, Germany

Even slight changes in a goalkeeper's position or height have been shown to change penalty-takers' shooting behaviors in soccer and handball. Yet, as demonstrated in many social psychological studies, height estimates of observed individuals can be subject to bias. In sports, low reputation keepers have been shown to be judged shorter than goalkeepers with high reputation. The aim of this study was to examine whether both height and reputation modulate actual kicking behavior in penalties. To this end, penalty-takers faced goalkeepers of different height (tall vs. short) and reputation (high vs. low) displayed on a life-size screen. They took actual penalties and estimated goalkeepers' height. Results revealed that height and reputation modulated height estimates. Short keepers were judged shorter than tall keepers. Similarly, low reputation keepers were judged to be shorter than high reputation keepers. Most importantly, reputation also affected kicking behaviors. Penalty-takers aimed further away from the goalkeeper (i.e. kicked closer to the posts) and missed the goal more often when facing a goalkeeper with a high reputation. Our findings therefore demonstrate that reputation influences height estimates of goalkeepers and even affects actual shooting behaviors.

Option generation and skilled anticipation behavior in tennis

Colm Murphy, St Mary's University, UK; Robin C. Jackson, Loughborough University, UK; A. Mark Williams, University of Utah

We aimed to determine the option generation strategies used by expert and novice tennis players when anticipating an opponent's intentions based on information that would normally be picked up sequentially prior to the opponent striking the ball. Altogether, 12 expert and 14 novice tennis players completed an option generation task when presented with rallies from real matches in two display conditions. Rallies were presented as videos or as animations, which were edited in such a way that participants either had access to contextual information and postural cues (videos) or solely contextual information (animation; e.g., player positioning, shot sequencing). The experts were more accurate than novices in both display conditions. Participants generated less options in the video compared with the animated condition. The expert participants generated more task-relevant and fewer task-irrelevant options than novices, with this effect being stronger in the animated than the video condition. The number of options generated was negatively related to performance in the video condition only. In dynamic, time-constrained tasks, performers adapt their option generation strategy depending on the information available. In keeping with Long Term Working Memory theory, when constrained to anticipate based on contextual information alone, effective anticipation is underpinned by being able to access both the likely outcome and potential relevant alternatives. Moreover, when pertinent postural cues become available, option generation strategies consistent with the Take The First heuristic model may be optimal.

Anticipation and the use of probabilistic information in the presence of ambiguous movement kinematics

Fabian Helm, Goethe-University Frankfurt, Germany; Rouwen Cañal-Bruland, Friedrich Schiller University Jena, Germany; David L. Mann, Vrije Universiteit Amsterdam, The Netherlands; Nikolaus F. Troje, Queen's University; Jörn Munzert, Justus-Liebig-University Giessen, Germany

Anticipating the outcome of an opponent's action is an important skill for coping with temporal demands in sport. Research has shown that athletes make use of both kinematic and situational probability information when anticipating action outcomes. However, there has been relatively little empirical work to identify the relative contributions of each source of information. Accordingly, the present study investigated whether, consistent with Bayesian integration, the weighting of the informational sources (kinematic vs. probabilistic) during the classification of disguised and non-disguised handball penalties shifts relative to the reliability of the available kinematic information. Animated avatars were generated as stimuli on the basis of the motion data from 800 penalty throws performed by elite field players (Helm, Troje, & Munzert, 2017). The ambiguity of the kinematic information available from throws was manipulated using linear morphing between a set of disguised and non-disguised penalties. In a virtual-reality environment, trained observers ($N = 23$) were asked to decide as quickly and accurately as possible whether observed throws were either disguised or non-disguised. In three different blocks, we explicitly informed participants about the performer's action preference (AP) to disguise their throw (25%, 50%, and 75%), however, the probability of a disguised throw was actually equal in each block. The number of ambiguous throws was also normally distributed across blocks. Findings revealed that, when the kinematics were ambiguous, observers relied more heavily on the probabilistic information. For the AP 25% condition, observers were more likely to report that ambiguous throws were non-disguised than for the corresponding throws in the AP 50% condition ($p < .001$). Similarly, participants classified ambiguous throws as being disguised in the AP 75% condition ($p < .001$). These findings suggest that observers rely more strongly on non-kinematic (situational probability) information when the reliability of the observable movement kinematics is less certain.

More "novice-like" gaze behavior, and decreased performance, when contextual information increases uncertainty in batting

David L. Mann, Vrije Universiteit Amsterdam, The Netherlands; Vishnu Sarpeshkar, National Sports Institute of Malaysia, Malaysia; Bruce Abernethy, The University of Queensland, Australia

Athletes can exploit contextual information to reduce uncertainty and improve performance when predicting an event outcome, but this information could also in some circumstances increase uncertainty and decrease performance. For instance, there is greater uncertainty about the arrival point of a fast-moving ball when it follows a curved/swinging path than when it follows a straight path (Craig et al., 2006). Conceivably though, if straight trajectories were to be mixed with swinging ones, then the uncertainty about the arrival point could alter behavior, even on straight trials when the ball doesn't swing. The aim of this study was to examine the degree to which uncertainty about ball-flight alters hitting performance in a dynamic batting task. Twenty-three elite and 20 club male cricket batters hit balls projected by a Pro-Batter ball-projection machine while wearing Mobile Eye eye-tracking glasses. In a straight-only condition, batters hit balls that followed only a straight trajectory, whereas in a straight+swing condition, batters hit balls that could follow a straight or swinging trajectory. A comparison across the two conditions of the identical trials that followed only a straight trajectory revealed remarkable differences in both performance and visual-motor behavior. Strikingly, hitting performance against the straight trials decreased significantly in the straight + swing condition for the elite batters ($p < .001$), but not the club batters ($p = .54$). The uncertainty in the straight+swing condition also resulted in more "novice-like" visual-motor behavior that was less predictive (Land & McLeod, 2000; Mann et al., 2013), including: gaze lagging further behind the ball ($p < .05$), fewer predictive eye movements to bounce and bat-ball contact ($ps < .05$), delayed predictive eye movements ($p < .001$), and gaze lagging further behind the ball at bat-ball contact ($p < .001$). The results show the profound effect that contextual information about event outcomes can have, not only on visual-motor behavior, but ultimately also on the performance of even elite athletes.

Motor Development

Exploring the interplay between motor competence and physical fitness over time: A developmental perspective on physical health in children

Symposium organizer(s): Till Utesch, Univ. of Muenster, Germany; Farid Bardid, Univ. of Strathclyde, Scotland

Symposium discussant: Jacqueline D. Goodway, Ohio State University

A developmental perspective on physical health in children

Till Utesch, University of Muenster, Germany; Farid Bardid, University of Strathclyde, Scotland

Motor competence and physical fitness play an important role in children's physical health and growth. In 2008, Stodden and colleagues put forth a conceptual model describing the role of motor competence in physical activity, physical fitness and weight status. Furthermore, the authors hypothesized that the relationships among these health outcomes are reciprocal in nature and over time (Stodden et al., 2008). Over the past decade, numerous cross-sectional studies have explored these relationships and have generally found positive associations between motor competence

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and other aspects of health. However, as noted by Robinson et al. (2015), there is limited longitudinal evidence on the dynamics among motor competence, physical activity, physical fitness and weight status over time as proposed by Stodden and colleagues (2008). As such, this symposium will explore developmental trajectories of physical health in children with a focus on motor competence and physical fitness. The first presentation examines the relationship between motor competence and physical fitness from early childhood to early adulthood using meta-analysis. The second presentation investigates (in)consistencies between developmental pathways of physical fitness and norm scores derived from cross-sectional data. The third presentation explores the dynamics between motor competence, physical fitness and weight status over time to gain insights into the mechanisms underlying changes in these health outcomes. The final presentation focuses on the developmental pathways of weight status and the role of motor competence and physical fitness therein.

The relationship between motor competence and physical fitness from early childhood to early adulthood: A meta-analysis

Till Utesch, University of Muenster, Germany; Farid Bardid, University of Strathclyde, Scotland; Dirk Büsch, University of Oldenburg, Germany; Bernd Strauss, University of Muenster, Germany

Motor competence and physical fitness are important for the development of positive trajectories of health over time (Robinson et al., 2015). In their conceptual model, Stodden et al. (2008) highlighted the role of both factors in physical activity. Furthermore, the authors hypothesized that the relationship between motor competence and physical fitness is reciprocal and changes over time (see also Burton & Rodgerson, 2001). Although more research investigating this relationship has been conducted recently, there is still little known on changes in associations across age. The present meta-analysis synthesizes the research on associations between motor competence and physical fitness from early childhood to early adulthood to have a better understanding on this relationship and possible changes across age. Following the PRISMA guidelines, we identified 60 studies between 1990 and 2016. Thirteen studies comprising of 27 samples and 15,101 participants aged 4.5 to 20.4 years (Mage = 12.94, SD = 4.84) were included in the analysis. A random effects model was conducted for the meta-analysis with age as a moderator using R. The association between motor competence and physical fitness was moderate to strong (r = .48, 95% CI [.38–.57], p < .001) after controlling for multiple effects including dependent samples and small sample sizes. Additionally, age was not a significant moderator of the effect size, but was positive from a descriptive point of view. The findings provide support for a medium to strong relationship between motor competence and physical fitness, which does not substantially change from early childhood to early adulthood.

(In)consistency between longitudinal developmental pathways and normative data: The case of cardiorespiratory fitness

Luis Paolo Rodrigues, Instituto Politécnico de Viana do Castelo, Portugal; Vitor Lopes, Instituto Politécnico de Bragança, Portugal

The assessment of cardiorespiratory fitness (CRF) is of paramount importance in the field of human health and sports sciences. The maintenance of satisfactory cardiorespiratory fitness levels is related with the prevention of cardiovascular disease (Ortega et al., 2008), diabetes and obesity (Dwyer et al., 2009), and school-based interventions have proved a positive effect in promoting cardiorespiratory fitness (Minatto et al., 2016). Since the more direct measurement of CRF (VO2max) is complex and expensive, a variety of indirect tests have been used in field-based protocols such as the 20-m endurance shuttle run (PACER). International normative data for the PACER is well established (Tomkinson et al., 2016). Both percentile and average values show that PACER values are expected to increase from 9-to-17 years of age, although more for boys than girls. Furthermore, CRF values in youth are expected to track into adulthood. In this presentation we will show that individual developmental pathways of PACER can be quite distinct from the widely used normative data. Two hundred and twenty nine children (56% boys) were followed longitudinally from age 9 to 15. Multilevel modelling of changes was conducted in HLM 6.0 software. Ordinary least square (OLS) regressions were used to estimate each child's linear regression equation for the PACER test. Children were clustered into three groups according to their rate of change (slope values), thus representing distinct developmental pathways (Low, Average and High Rate of Change). These three developmental pathways were tested on a hierarchical linear regression (measures within persons), resulting on a very good model fit. Outputs were compared with the normative data setting. Results showed that three groups of children with similar rate of change on their developmental PACER performance can be found, but these pathways do not fully copy with the normative tables' information. In conclusion, we suggest that developmental pathways, using longitudinal information, should be preferably used for predicting present and future outcomes.

Dynamics between motor competence, cardiorespiratory fitness and weight status in children: A cross-lagged longitudinal analysis

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

Motor competence plays a crucial role in children's overall health. In their conceptual model, Stodden et al. (2008) stipulated that the relationship between motor competence and other health-related factors such as physical fitness (which includes cardiorespiratory fitness, musculoskeletal fitness, and flexibility) changes over time. Although recent literature has supported some of the relationships proposed by Stodden and colleagues (2008), there is limited evidence on the dynamics between these health factors across childhood (Robinson et al., 2015). Using cross-lagged analysis, the present study investigated the reciprocal relationships between motor competence, cardiorespiratory fitness and weight status among 664 children aged 6–9 years, over a 3-year time period with one measurement per year (t1–t3). Children's motor competence was evaluated using the Körperkoordinationstest für Kinder (KTK) and cardiorespiratory fitness was assessed using the endurance shuttle run test (EUROFIT). Height and weight were also measured to compute BMI. Structural equation modelling with robust standard errors (p < .05, CFI = .97, SRMR = .03) revealed that motor competence (t3; R2 = .75) is predicted by prior levels of motor competence, cardiorespiratory fitness and BMI. Similarly, cardiorespiratory fitness (t3; R2 = .58) is predicted by preceding levels of fitness, motor competence and BMI. In contrast, BMI (t3; R2 = .92) is only predicted by previous levels of BMI. This study provided some evidence for the inter-relationship between motor competence, cardiorespiratory fitness and weight status over time as proposed by Stodden et al. (2008). However, motor competence and cardiorespiratory fitness were not found to be predictors of future weight status when controlled for one another. Further longitudinal and multivariate research into the dynamics between motor competence and other health-related factors is needed in order to gain a better understanding of mechanisms underlying positive (or negative) developmental trajectories of health during childhood.

Classes of developmental trajectories of body mass index: Differences in motor competence and physical fitness

Vitor Lopes, Polytechnic Institute of Bragança, Portugal; Till Utesch, University of Muenster, Germany; Luis Paolo Rodrigues, Polytechnic Institute of Viana do Castelo, Portugal

Purpose: To identify classes of different developmental trajectories of body mass index (BMI) and testing it for differences in motor competence (MC) and

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physical fitness (PF). Methods: This is a mixed longitudinal study lasting five years. Participants were N=147 of both sexes (69 girls) divided in 8 cohorts, at baseline the youngest and the oldest cohorts had 4 and 11 years of age respectively. Height and weight were assessed and BMI was calculated [weight (kg)/height (m2)]. MC was assessed with KTK, TGMD-2 and PF was evaluated with one-mile run/walk. Developmental trajectories of BMI were identified using latent class mixed modeling. Post-hoc analyses were calculated using linear models. Results: Modeling revealed four based on the information criteria minimum. However, two classes show very low numbers ($n < 6$). Therefore, two meaningful classes were identified based on modelling and content related considerations. Class 1 (36%) show larger initial BMI and a larger slope compared to class 2 (64%). No differences were identified in locomotion and object control. For Class 2 increases faster compared to class 1 ($p < .05$) and class 2 shows better physical fitness ($p < .05$). Conclusion: This study identified two meaningful trajectories for children based on their BMI development across five time points. In line with previous research, children with slower increasing BMI showed better physical performances and performance improvements. This shows the importance and interplay between multiple indicators of physical health.

Cross-cultural comparisons of perceived and motor competence and health-related fitness in children and adolescents with and without disabilities

Symposium organizer(s): Carlos Luz, Instituto Politécnico de Lisboa, Portugal; David Stodden, University of South Carolina

Symposium discussant: *Priscila Caçola, University of Texas at Arlington*

Overview abstract

Carlos Luz, Instituto Politécnico de Lisboa, Portugal; David Stodden, University of South Carolina

In the last decade, a growing number of researchers around the world have investigated relationships among physical activity (PA), motor competence (MC), perceived motor competence (PMC), health-related physical fitness (HRF) and weight status in youth (see Robinson et al., 2015). Comparing strengths of associations among variables in studies among countries is difficult as cultural and climate differences may influence how children develop. In addition, culture may influence the types of movement skills in various test batteries and may lead to differences in performance in skills by individuals in different countries as well as their relationship to other health-related variables. Due to the potential impact that culture and climate differences may have on have on children's motor development, it is critical to conduct cross-cultural studies. These studies will provide a better understanding of differences and similarities in MC and other health-related variable levels on a global level.The first presentation compares Portuguese and U.S boys and girls (average age) performance on HRF (e.g. PACER test) and MC variables (e.g. kicking velocity), The second presentation explores how MC differs in three very different European countries and discusses how differences change with age and weight status. The third presentation emphasizes the differences in performance in a new MC task (Supine to Stand) among Brazilian and U.S children and adolescents. The fourth presentation focuses on the differences between PMC and MC between Belgian and Australian adolescent girls. The last presentation is centered on the performance of Latvian and U.S. children with special needs (visual impairments) on several variables (PA, PMC e MC).The discussant will focus on the importance of gaining more insight in the country specific factors that might lead to differences in motor competence (e.g. differences in school systems, obesity rates, safety for outdoor activities, parents' attitudes, etc), and will discuss recommendations for future research.

A cross-cultural comparison of motor competence and health related fitness variables between Portuguese and American children

Carlos Luz, Instituto Politécnico de Lisboa & CIED, Portugal; Rita Cordovil, Universidade de Lisboa, Portugal; Luís Paulo Rodrigues, Instituto Politécnico de Viana do Castelo, Portugal; Zan Gao, University of Minnesota; Jacqueline Goodway, Ohio State University; Ryan Sacko, Ohio State University; Danielle Nesbitt, University of South Carolina; Rick Ferkel, Central Michigan University; Larissa True, State University of New York at Cortland; David F. Stodden, University of South Carolina

Objectives: Cultural contexts are expected to influence motor competence (MC) and health-related fitness (HRF), but the extent to which the development of these factors in childhood are similar or different across countries is not known. The purpose of this study was to compare MC and HRF data of boys and girls from Portugal and the U.S. Methods: The sample consisted of 1,218 children, between 6 and 13 years of age, from Portugal (52% boys; age = 10.14 +/– 2.13 y) and the USA (48% boys; age = 9.48 +/– 1.62 y). Raw MC variables (ball skills [kicking velocity, throwing velocity] and standing long jump [SLJ]) and HRF data (handgrip and PACER test) were assessed. The sample was analyzed according to sex and two age groups (6–9 and 10–13 year-olds). To investigate the differences between countries and interaction effects, ANOVAs were used in kicking and throwing velocity, and ANCOVAs were used for the handgrip, PACER and SLJ tests with body mass index as the covariate due to its known influence in these tasks. Results: Main effects for age ($p < 0.001$) and country ($p < 0.001$) were consistent for all variables except for girls (by country) in the SLJ. Not surprisingly, older boys and girls outperformed their younger counterparts. For both sexes, Portuguese children presented significantly higher scores in SLJ and PACER tests, and US children demonstrated significantly higher scores in handgrip and throwing velocity tests. For kicking velocity, Portuguese boys outperformed American boys, but American girls outperformed Portuguese girls. Moreover, US girls tend to be better at ball skills and the differences in ball skills between the two countries became more pronounced in the older age group. Conclusions: A clear cultural effect was noted depending on the type of task. Portuguese children (specifically boys) had better skill and HRF in tasks that involved the lower extremity whereas US children's skill and HRF was better in tasks involving the upper extremity. Such findings may tie to the sporting/cultural environment in the respective countries.

Cross-cultural differences in children' motor competence are accumulating along the age and in the interaction of body weight status

Vitor Lopes, Polytechnic Institute of Braganca, Portugal; Arto Laukkanen, University of Jyväskylä, Finland; Farid Bardid, University of Strathclyde, Scotland; Matthieu Lenoir, University of Ghent, Belgium; Tommi Vasankari, Pauliina Husu, UKK-Institute, Finland; Arja Sääkslahti, University of Jyväskylä, Finland

Objectives: The present study examined differences in 5–9-year-old children's motor competence (MC) across Northern-, Central-, and Southern European countries using the Körperkoordinationstest für Kinder (KTK). A secondary aim was to examine whether the cross-cultural differences in MC accumulate in the interaction with children's age group and body weight status determined as being normal or overweight. Methods: Data was pooled from four independent studies conducted in Finland (mean age 7.31 +/– 1.38 years, n = 360 + 432), Belgium (mean age 8.19 +/– 1.14 years, n = 1936) and Portugal (mean age 8.31 ± 1.02 years, n = 758) between years 2008 and 2016. Differences between countries in the raw scores of KTK and the interaction effects were tested by using one- and two-way analyses of covariance. Age, sex and BMI percentile were

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used as covariates. Results: Country explained significantly (9%) the variance in MC, meanwhile age (44%) and BMI percentile (5%) were significant covariates. Age and country had significant interaction effect (6%), as well as country and body weight status (2%). Conclusions: Results strengthen existing literature showing cross-cultural differences in children's MC. Based on the present results, the differences are accumulating along the childhood. Novel finding of the study suggests polarization in the development of MC between normal and overweight children is differing across countries. Further studies is needed for exploring the reasons explaining the age and body weight status interaction effects in cross-cultural differences in children's MC.

Is STS time a context-independent measurement for motor competence? A cross country comparison study (Brazil-US)

Danielle Nesbitt, University of South Carolina; Maria T. Cattuzzo, University of Pernambuco, Brazil; Ívina A. A. Soares, University of Pernambuco, Brazil; David F. Stodden, University of South Carolina

Objective: Supine to Stand (STS) time is a postural righting task that has the potential to globally (i.e., without cultural bias) assess motor competence across childhood and into young adulthood (Nesbitt et al., in press). However, STS performance must be compared across cultures to validate its potential to be a developmentally valid and context independent assessment of MC. The purpose of this study was to examine differences in STS time between 9–17-year-old children and adolescents in the United States and Brazil. Methods: Two convenience samples (N = 235) of two specific age ranges from middle childhood through adolescence (9–17 years) were included in the final data set. One sample (n = 123) was collected in the United States (US). The second sample (n = 112) was collected in Brazil. To measure STS time, children started in a supine position on the floor with their heels at least 30 cm from a wall in front of them; they were asked to stand as quick as possible and touch a designated spot on this wall. Individuals performed five trials of the STS task with no instruction or demonstrations. The time between trials was self-selected to minimize fatigue. Their average time was measured using Dartfish Software. Time was calculated from the first initial movement to the point where the participant touched the designated spot on the wall. A two-sample t-test was conducted to compare the STS time among US and Brazilian children and adolescents. Results: The mean STS-time score differences for U.S. children (M = 1.65, SD = .36) and Brazilian children (M = 1.92, SD = .43) were not statistically significant, t(124) = -0.38, p = .13. Similarly, the mean STS-time score differences for U.S adolescents (M = 1.71, SD = .31) and Brazilian adolescents (M = 1.79, SD = .42) were also not statistically significant, t(107) = -1.11, p = .12. Conclusion: Overall, findings provide evidence that STS time may be an assessment of motor competence that is not limited by cross cultural context.

A cross-cultural comparison of Australian and Belgian female adolescents' actual and perceived motor competence

Natalie Lander, Deakin University, Australia; An De Meester, Ghent University, Belgium; Lisa Barnett, Deakin University, Australia

Objectives: Low motor competence, especially object control competence (OCC), and low perceived motor competence (PMC) are potential barriers of youth physical activity participation, particularly among girls. Recent evidence suggests that youth from different cultures may differ in their motor competence, yet limited research has been conducted in adolescents, particularly in girls. Therefore, the study aim was to evaluate OCC and PMC of young, female adolescents from Australia and Belgium. Methods: The sample included 190 Australian (47% of total sample; age = 12.47 +/– .34 y) and 218 Belgian (age = 13.15 +/– .41 y) girls. OCC was measured with process-oriented measurements (i.e., the Victorian test & Test of Gross Motor Development-2) of the catch, kick and overhand throw. Raw scores were converted to percentage of maximal possible score to provide an acceptable comparison between Australians and Belgians. PMC was measured with the athletic competence subscale of the Physical Self-Perception Profile. Differences in OCC and PMC between Australian and Belgian girls were examined with an ANCOVA (controlling for age). Results: There was no significant difference in OCC between Australian (M = 63.80% of maximal possible OCC score; SD = 12.84) and Belgian girls (M = 67.09%; SD = 12.43; F = 2.29; p = .13) with both groups only achieving 2/3 of the maximal score. However, a significant, yet small difference in PMC (partial eta squared = .01) was found with Australian girls (M = 15.42 on a 4–24 range; SD = 1.64) scoring slightly lower than Belgian girls (M = 15.89; SD = 3.88; F = 4.07; p=.04). Conclusions: Typically developing children should have the capacity to consistently improve competency in their skills across childhood if provided appropriate learning environments. However, our results indicate that only circa 2/3 of the maximal OC score has been achieved, with no difference observed between countries. Therefore, motor competence (both actual and perceived) development, in early-adolescent girls should remain a global research priority.

Predictors of physical activity among Latvian and US children/adolescents with visual impairments

Ali Brian, University of South Carolina; An De Meester, Ghent University, Belgium; Aija Klavina, Latvian Academy of Sports Education Riga, Latvia; Sally Taunton, University of South Carolina; Adam Pennell, University of South Carolina; J. Megan Irwin, University of South Carolina; Lauren J. Lieberman, State University of New York at Brockport

Introduction/Objectives: Children and adolescents with visual impairments (CWVI) often report difficulties with) gross motor skills and low levels of perceived motor competence (PMC), and participating in physical activity (PA). Difficulties are often exacerbated by degree of VI and can be influenced by sex. In Latvia, there may be differences within the built environment and schools given the legal and cultural differences from the United States (US). However, how culture affects CWVI is unclear. Moreover, which factors predict PA for CWVI requires further exploration. The purposes of this study were to explore the differential effects of country on PA, PMC, and gross motor skills and to examine which factors predict PA for CWVI from Latvia and the US. Methods. CWVI ages 9-18 years (N = 35; Mage = 14.28 years, SD = .63) from Latvia (n = 18) and the US (n = 17) completed the Test of Gross Motor Development – 3, the Physical Activity Questionnaire for Children/Adolescents and the Test of Perceived Motor Competence for Children with Visual Impairments. Analyses/Results. There were no significant differences for object control skills and PA by country (p>.05). However, Latvians demonstrated significantly greater locomotor skills (p<.05) but lower PMC (p.05), but those who were blind revealed significantly greater difficulties with gross motor skills than those with mild/moderate VI across countries (p<.05). Latvians who were blind revealed the lowest gross motor skills of the entire sample and were significantly behind CWVI from the US (p.05) (F(3,31)=3.013, p=.02, R^2=.41). Discussion/Conclusion. Given the impact of PMC on PA and that Latvians revealed lower PA and PMC, intervention may be warranted. Further exploration into the cultural differences regarding Latvia and US are also needed to explain differences.

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Free Communications: Verbal and Posters

Motor Development

Effect of Object Manipulation Skills (OMS) intervention on perceived competence among elementary school girls

Diala Ammar, Mount Royal University; Dwayne Sheehan, Mount Royal University; Sonia Sheehan, Foundations for the Future Charter Academy

Creating, implementing, and evaluating programs to increase participation in physical activity across all ages, cultures, and genders is important to maintaining relevant and innovative programs in Canada's sport, recreation, and health sectors (Canadian Parks and Recreation Association, 2015). The main purpose of this study was to improve the competence and confidence for grade 3 girls who are under-represented in the sport and recreation sectors. The methodology of this project was based on the holistic principles of physical literacy and the Alberta K-12 Health and Physical Education Program of Studies (curriculum) as its foundation. The long term intent of this study was to validate an alternative method of PE delivery that will motivate girls to be more confident and participate readily in activities that require OMS. Participants' perceived competence and confidence before and after the intervention was measured using the Children and Youth – Physical Self Perceptions Profile (CYPSPP) as validated for ages 8–12 by Welk and Eklund (2003). Findings showed no statistically significant differences between males and females at pre-test, post-test, or retention time points for any scales of the CY-PSPP (all $p > 0.05$). Males had a greater increase in score than females from pre-test to post-test on the physical conditioning subscale ($p = 0.031$). Females did not improve significantly across time points for any subscales. Males improved from pre-test to post-test for the physical conditioning ($p = 0.001$) and self-esteem ($p = 0.002$) subscales. Overall, although there were slight differences in scores for some subscales, there were no statistically significant differences between males and females at any time point (all $p > 0.05$). More research is needed around effective intervention programs focused on increasing perceived competence and confidence among young girls.

Funding source: RPAD.

An exploration of how infant locomotor experience facilitates psychological change

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Despite an abundance of evidence indicating that self-produced locomotion heralds a pervasive set of changes in infants' perceptual-motor, cognitive, emotional, and social functioning, the processes by which locomotion induces or facilitates psychological advances are poorly understood. One speculation is that heightened attention to environmental properties and events during self-produced (agentic) locomotion facilitates the detection and extraction of information that certain psychological skills depend on for their construction. The current study tested this idea using a novel paradigm in which prelocomotor infants' attention was drawn toward the movement of an object they could control through a cluttered environment. Nineteen prelocomotor infants were randomly assigned to one of two conditions that involved 15 10-min play sessions over a 3-week period with a toy train. Experimental infants could control the movement of the train around a track via a joystick. Control infants played with pieces of the train set but did not see the train move. Infants were pre- and post-tested on 3 spatial-cognitive skills known to improve following self-produced crawling experience: 1) manual search for hidden objects (with and without rotation of the objects), 2) the extraction of an object's invariant shape, and 3) joint visual attention. The results showed weak effects of the experimental training. Experimental infants showed improvements on all three task, however, only the improvements on the two-position manual search task without rotation were significant $t(10) = 1.99$, $p < .05$ (one-tailed). Control infants showed either very limited or no improvement on the tasks. These findings provide limited evidence that agency and heightened attention to environmental relations may be sufficient to facilitate the development of specific psychological skills. The findings are discussed relative to the pros and cons of using this experimental paradigm to study how self-produced locomotion engenders psychological change.

Two-leg hopping and frequency matching in children with Down syndrome

Matthew Beerse, Jianhua Wu, Georgia State University

Children with Down syndrome (DS) are known for their poor balance control, and take longer to develop motor skills and display less coordinated movement patterns. The purpose of this study was to assess the ability of children with DS aged 5–11 years old to continuously hop in-place on two legs and compare their capacity to match a metronome cue to typically developing (TD) children. Nine children with DS (3M/6F) with mean (SD) age of 9.57 (1.53) years old were age- and sex-matched with nine TD children. The children with DS were shorter but had a similar body mass compared to the TD children. Subjects completed three 20-second trials of two-leg hopping in-place at a self-selected frequency. Then, subjects were asked to complete three 20-second two-leg hopping trials in four randomly-assigned metronome conditions: *preferred* (self-selected frequency), *moderate* (20% increase), *fast* (40% increase) and *slow* (20% decrease). A motion capture system was used to collect kinematic data. We conducted independent t-tests to compare the DS and TD groups during the self-selected hopping and a two-way (2 group × 3 condition) repeated measures ANOVA on the metronome conditions. Our results show that children with DS might not be able to continuously hop in-place until the age of 7 years old, and were unable to hop for as long in duration as their TD peers. Children with DS chose a faster hopping frequency driven by shorter flight times and lower hopping heights, potentially indicative of their reduced stretch reflex and muscle power. Moreover, children with DS demonstrated an increased medial-lateral center-of-mass movement during the stance phase of hopping, suggesting reduced balance control. When cued by a metronome, children with DS showed greater deviation between cued and actual hopping frequency, even at their *preferred* frequency. We postulate that children with DS attempted to modify their motor behavior in response to the cue, but either failed in recognizing the cued frequency or incorrectly coordinated their movement pattern to achieve the desired frequency.

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Children with Down syndrome display typical intersegmental coordination during turning phase of the timed up-and-go test

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Children with Down syndrome (DS) often require a longer time to develop motor skills and demonstrate less coordinated movement patterns. These motor dysfunctions can inhibit an individual's with DS capacity to

accomplish functional activities of daily living and their ability to become independent. This study aimed to evaluate the functional task of transitioning from walking to turning and back to walking found in the timed up-and-go (TUG) test between children with and without DS. The turn-around phase requires intersegmental coordination between the head, thorax, and pelvis to redirect the walking path to an opposite direction. Fourteen typically developing (TD) children (7F/7M) and seven children with DS (5F/2M) aged 5-11 years old completed the test. We separated the TUG test into phases, with the turn phase beginning after the mid-stance of the final step before the turn and ending at the mid-stance of the first step after the turn. We assessed the coordination of the segments by comparing the timing of turn onset, duration of the turn, and the average and peak angular speeds of each segment. We conducted two-way (2 group x 3 segment) ANOVAs with repeated measures. Our results indicated a similar intersegmental coordination pattern between groups, specifically the pelvis rotates before the head and the head rotates the fastest, taking the least amount of time to complete the rotation. However, the DS group took longer to complete the rotations, demonstrated reduced rotational speed, and required up to 40% of the turn phase to initiate the rotation while the TD group initiated within the first 15%. These results are consistent with typical motor behavior in individuals with DS, who often require longer times to initiate and complete movements. It has been proposed that a reliance on feedback, rather than anticipation, underlies the slower movements and initiations in individuals with DS. Therefore, it may be beneficial for children with DS to practice sequences of movement to improve their ability to anticipate transitioning from one motor task to another.

Funding source: N/A.

Estimation of typical duration of infant activities across a full day

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Background Ecological momentary assessment (EMA) involves repeated sampling of subjects' current behaviors and experiences in real time, in subjects' natural environments. EMA aims to minimize recall bias, maximize ecological validity, and allow study of microprocesses that influence behavior in real-world contexts (Shiffman, Stone, & Hufford, 2008). We are interested in using EMA to assess the activities infants are doing across days and weeks, however in order to obtain the appropriate sampling interval to capture infant activity, typical duration of activity must be determined. The aim of this study is to use caregiver-reported infant activity logs to determine the typical duration of time that infants spent in one activity before switching to a new one. Method Data were collected from 12 infants (ages 1–12 months) on 3 visits with 2 months between visits. Caregivers were asked to keep a log of the activities and positions the infants were in across a typical day, indicating the start and end time of each. We then took these activity logs (36 total) and calculated the duration of each activity. Descriptive statistics were calculated and a histogram with a bin size of 5 minutes was created. Results The mean duration was 31 minutes, median 22 minutes, and mode 10 minutes. Visual analysis of the histogram demonstrated that the most frequent duration of activity when infants were awake was 15–20 minutes. From this division, kurtosis was −1.36 and skewness was 0.24. Conclusions Our preliminary analysis demonstrated that infants tend to stay in one activity when awake for 15–20 minutes. The kurtosis and skewness values indicate that the distribution was right skewed, and had a tendency towards shorter duration of activities. This study provides information about the typical duration of time that infants spend in one activity, providing researchers with insight to determine sampling intervals in future studies. Future work will focus on analysis of the types of activity.

Funding source: This work was supported by a grant from the American Physical Therapy Association Academy of Pediatric Physical Therapy.

Improving fitness, executive functions, and perceived competence through an adapted gymnastics program of children with developmental disabilities

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This study measured the impact of a 10-week adapted gymnastics program in children with developmental disabilities with respect to 3 domains: fitness, executive function, and perceived competence. Five children aged 7–11 years diagnosed with a developmental disability (cerebral palsy = 3, Down syndrome = 1, and Sensory Processing Disorder = 1) completed the Brockport Physical Fitness Test, the Flanker and Dimensional Change Card Sort (from the NIH Toolbox), and a measure of Perceived Competence. The Brockport Fitness Test is comprised of: grip strength, isometric push-up, extended arm hang, modified curl-up, trunk lift, and back-saver-sit-and-reach. The two tasks selected from the NIH Toolbox measure attention and inhibition (Flanker) and task switching and cognitive flexibility (Dimensional Change Card Sort). Perceived competence in the cognitive/scholastic, physical/athletic, and peer/social domains was assessed using either the Harter & Pike Pictorial Scale of Perceived Competence or Social Acceptance (1984) or the Harter Self-Perception Profile for Children (1985) depending on the participant's age. Assessments were completed 2-weeks prior to and 1-week after the 10-week adapted gymnastics program. The program consisted of 1-hour sessions twice a week for 10-weeks. Significant differences across the pre-post-test assessments were observed for the isometric push-up, modified curl-up, and trunk flexibility ($p = 0.020$, 0.029, 0.017, respectively) and dimensional change card sort ($p = 0.028$). No differences were observed for the extended arm hang, grip strength, sit-and-reach, flanker, or any components of the perceived competence assessment ($p > 0.05$ for all). These findings suggest the adapted gymnastics program improved core and upper body endurance and trunk flexibility; these functions are consistently identified as areas for improvement in children with developmental disabilities. In addition, the adapted gymnastics program influenced task switching and cognitive flexibility, which may be due, in part to the dynamic nature of the program.

Funding source: NA.

IQ and comorbidities influence psychological attributes and anxiety in children with developmental coordination disorder

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Developmental Coordination Disorder (DCD) is a neurodevelopmental condition of poor motor proficiency that leads difficulties in activities of daily living. While recent research has shown significant effects of DCD on psychological difficulties, little is known about the effects of comorbidities and Intelligence Quotient (IQ) levels on psychological attributes and anxiety in children with DCD. Therefore, the purpose of this study was to explore whether comorbidities and IQ level influenced psychological attributes and anxiety in children with DCD. To that, we compared psychological attributes and anxiety for groups of children with DCD only (DCD) and with DCD + comorbidities (DCD+Co) with three levels of IQ: below average and lower extreme (IQ-B), average (IQ-A) and above average and upper extreme (IQ-AA). A total of 100 children between ages of 4 and 15 years (8.17 ± 2.49) were referred to participate in the study. Results indicated significantly higher scores of psychological difficulties for DCD+Co group when compared to DCD on the items: emotional symptoms, hyperactivity, peer problem and the total difficulties score. For anxiety, significantly higher scores were observed for the IQ-B group for the generalized anxiety, separation anxiety, significant school avoidance, and for the total anxiety disorder score. As a conclusion, results of this study showed that both the presence of comorbidity and an IQ below average may influence the psychological attributes and anxiety in children

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with DCD, but with different implications. In addition, the findings reinforce the psychological difficulties faced by the children with DCD and the consequences on depressive behavior, school dysfunction, poorer emotional functioning, and vulnerability to bullying.

Motor development in school-age children is associated with the home environment including socioeconomic status

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Background: The aim of the present study was to examine how the home environment, including socioeconomic status (SES, affects motor development in school-age children. Methods: 707 children (332 boys, 375 girls) aged between 6- to 10 years participated in the study. Motor Development was determined using the Bruininks-Oseretsky Test of Motor Proficiency (BOT-2). Parents answered the Middle Childhood (MC) Home Observation Measurement of the Environment (HOME) Inventory, and Brazilian Association of Market Research Institutes Questionnaire (for SES). Results: Children from 'Adequate' homes (HOME score), compared to 'Less Adequate,' displayed better motor behavior. Mediation and moderation analysis revealed that motor development increased as SES increased. The proportion of variance in motor development explained by SES increased from 9% to 13% when the home was added as a mediation variable. We also found that the effect of SES on motor development was moderated by age. For older children, the effect was lower than for younger children. The best model used SES as the predictor, HOME as the mediator, and AGE as the moderator variable and explained 17% of the variance in motor development. Conclusions: In summary, these findings suggest that, like previous reports with young children, the HOME environment and SES may play an important role in motor development of schoolage children. Our findings encourage the assessment of the home and interventions that take into account the home environment to improve motor development in school-age children.

Funding source: Coordination for Improvement of Higher Education Personnel (CAPES) agency.

Relationship between actual and perceived motor competence, gender and BMI in adults

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The relationship between perceived competence (PC) and motor competence (MC) has been usually studied in children and adolescents, although very little is known about how these aspects relate to adults. The purpose of this study was to examine the relationship between actual and perceived motor competence, body mass index (BMI) and gender adults. A total of 50 women and 52 men (mean age 19.8 +/– 4.5 years) volunteered to participate. Participants were assessed for actual motor competence, using the Test for Fundamental Motor Skills in Adults (TFMSA) (Jiménez-Díaz, Salazar, & Morera-Castro, 2013), perceived competence, using The Self-perception Profile for Adults (Messer & Harter, 2012), and BMI was calculated as Kg/m^2. Three predictive models were examined using multiple regression analysis. In the first model assessed, we found that MC, PC, and gender are not significant predictors for BMI ($R = 13.6\%$, $p = .608$). The second model assessed was significant, we found that MC was a significant predictor for PC ($B = .154$, $t = 2.49$, $p = .014$), explaining 24% of the variance, but BMI and gender were not significant predictors. Lastly, in the third model examined we found that gender ($R = 43\%$, $B = .943$, $t = 4.76$, $p = .001$) and PC ($R = 22\%$, $B = .314$; $t = 2.23$, $p = .020$) were significant predictors for MC; however, BMI was not a significant predictor ($R = 4\%$, $B = -.010$, $t = -0.400$, $p = .690$). Overall, these preliminary findings suggest that in adults, MC was a predictor of PC. While gender and PC were predictors for MC. Gender, MC, and PC were not significant predictors for BMI.

Comparison of preschoolers' PA between hip and ankle accelerometry: A pilot study

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

Background: The majority of accelerometry data in preschool populations has been collected from hip accelerometry (O'Neill et al., 2016). Work by Palmer et al (2017) supports ankle accelerometry as a feasible method for collecting physical activity (PA) data in preschoolers, but no work has compared children's PA when recorded from hip and ankle devices simultaneously. The purpose of this pilot study was to compare preschoolers' PA between hip and ankle accelerometry. Methods: Preschoolers ($N = 6$) from a single center wore Actigraph GT3X+ accelerometers on their dominant ankle and hip during school hours (9:00 AM to 2:50 PM) for 3 consecutive days. A researcher was onsite to ensure full-wear compliance. Data were collected at 1-second epochs. Cut points for the hip were from Evenson et al (2008) and for the ankle were from Crouter et al (2014). PA was categorized as light, moderate, vigorous, or moderate to vigorous (MVPA). Percentage of time in each PA category was calculated and the effect of site location was examined using t-tests with an a priori Bonferroni correction (i.e., $p < .05/5$ PA categories $= p < .01$). Results: Results showed that ankle accelerometry recorded more time spent in moderate (9.74% vs 5.57%, $p < .01$; 204.62 min vs 117.07 min per day), vigorous (13.31% vs 5.65%, $p < .01$; 279.58 min vs 118.73 min per day), and MVPA (23.06% vs 11.23%, $p < .01$; 484.20 min vs 235.80 min per day) than hip accelerometry. Compared with ankle placement, hip accelerometry recorded more time spent in light activity (19.94% vs 11.63%, $p < .01$; 418.69 min vs 244.22 min per day). There were no significant differences in sedentary behavior between the ankle and hip accelerometry. Conclusion: Hip and ankle accelerometry yielded significantly different time spent in MVPA and light PA behaviors in preschoolers. Future studies should continue to research the implications for device placement on recorded PA and develop cut points specifically for preschool populations.

Funding source: Momentum Center, University of Michigan.

The ability of the movement assessment for children to predict fine and gross motor development in children at a five and a half year follow up

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Purpose: The purpose of this study was to determine the long-term (5.5-year) predictive validity of the Movement Assessment for Children (MAC). Background: Many pediatric examinations of motor development attempt to detect developmental delays in infancy so that early intervention may be implemented. Some tests have shown strong predictive validity within the first 12 months of development, but no test has illustrated long-term (5 years) predictive power. The Movement Assessment for Children has demonstrated excellent inter-rater reliability, consistent test-retest scores, strong construct validity and responsiveness to change, but the predictive validity remains unknown. Methods: Eight typically developing children were recruited for this study. All participated in a previous study that assessed developmental milestones, via the MAC, at 12 months of age. Five and a half years later, the children were tested at 6.5 years of age utilizing the Bruininks-Oseretsky Test of Motor Proficiency (BOT-2) to assess their current motor development. Z-scores for the MAC and BOT-2 were calculated in order to compare the fine and gross motor subsections of each examination and determine if any correlations prevailed. A Spearman rank correlation was performed with an alpha of .05. Results: When

comparing participants' MAC scores at 12 months to their BOT-2 scores at 6.5 years, no significant correlations were found.Conclusion: Based on the results, the MAC may not predict motor function in typically developing children at a 5 and a half-year follow up, but due to the small sample size more research is necessary. Discussion: Although some scores on the MAC indicated apparent delays in motor development, all subjects exhibited fluidity of movement and variety in their movement patterns. Thus, the delays were not significant enough to prevent them from exploring their environment. These clinical observations exemplify that the quality and diversity of a child's movement may be more important predictors of future development than the time at which a child reaches motor milestones.

Fundamental motor skill proficiency of young adolescents

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This study examined fundamental motor skill (FMS) proficiency of young adolescents. One hundred and twenty five 7th and 8th grade physical education students volunteered to participate in the study (M age = 12.61 years; 55 males, 70 females). The *Get Skilled: Get Active* (2000) process-oriented motor skill assessment protocol and scoring were used to determine kick, overhand throw (OT), run, and vertical jump (VJ) proficiency. Each skill is scored by recording a 1 for each technical component successfully demonstrated and 0 for those components not demonstrated for a total possible score of six. Testing was conducted during the regular physical education class period. Following a 10 minute warm up, participants were assigned to one of four stations, each of which assessed one of the motor skills of interest. Each participant completed three trials of the respective skill while being video recorded by an experimenter for later analysis. Once all participants at each station completed their trials, groups rotated to the next station. This procedure continued until all participants completed all four skill assessments. The highest scoring trial of each participant was used in the analysis with skill performance considered competent only when all components were correctly demonstrated (as per Hardy et al., 2013). Results indicated that the highest level of proficiency was demonstrated in the VJ with 79.2% of participants scoring 6/6 followed by the OT (56%), kick (48.8%) and run (21.6%). A grade by gender MANOVA also revealed a significant main effect for gender for both the VJ and OT with male participants correctly demonstrating more components in both skills ($M = 5.79$ and $M = 5.80$ respectively), than their female counterparts ($M = 5.52$ and $M = 4.73$). In addition, a grade by gender interaction was found for VJ where 7th grade females ($M = 5.70$) demonstrated greater technical proficiency than their 8th grade counterparts ($M = 5.35$). Overall, young adolescents' FMS competence was low with a greater proficiency gap displayed by females in VJ and OT.

Self-touch: The origin of reaching emergence in infancy

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Reach onset is a crucial developmental milestone allowing infants to become active agents in their environment. Prior to reach onset, infants must develop a sense of their body and limbs in space to interact with their environment. How infants acquire such body knowledge is unknown. In an attempt to address this question, we investigated the early development of self-touch activity in 4 infants followed from 3 weeks old up to reach onset. Infants receive haptic feedback from contacted areas (i.e. their bodies or environment) as they move their arms. We hypothesized that this cycle of movement and haptic feedback forms the basis by which infants discover their bodies to orient their head and limbs to begin reaching. Infants' movements were recorded with video and motion analysis in five 5s-conditions (baseline, toys in view, sounding toys, mobile, & parent talk) while lying in supine. Touch locations and durations (on the body, floor, or in the air) were coded from the videos and movement speed and movement units were computed from the kinematics. Preliminary analyses of two infants, in two conditions (baseline & toys in view), over every other week revealed marked individual differences. The more active infant, who reached earlier, showed no differences in touch duration between body, floor, or air, and across hands or conditions. The less active infant, who reached later, spent more time with the right hand in the air or on the ground, than on himself in both conditions (p*s* <.039), and more time with the left hand in the air or on himself in the toys in view condition (p*s* <.039) consistent with the tonic-neck reflex. Despite these differences, both infants touched their upper torso the most. These preliminary results are in line with the hypothesis that early self-touch and movement activity may contribute to build proprioception, which can later aid reaching emergence. More analyses (self-touch & kinematics) and analyses of the two other infants are currently underway to provide a more complete account of infant sensorimotor activity preceding reach onset.

Pupil dilation, motor imagery, and cognitive load

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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). Participants: Seventeen undergraduate students at the UTSA 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. Results: A one-way repeated-measures ANOVA showed significant differences between the tasks ($F(4,56) = 13.45$, $p < .001$; $\eta^2 = .49$). 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 mean to assess 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.

The relationship between children's and adolescents' actual and self-perceived motor competence: A systematic review and meta-analysis

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Objectives: This study aimed to examine and summarize scientific evidence on the relationship between children's and adolescents' actual and perceived

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motor competence (AMC; PMC) and to explore whether the strength of the relationship differs depending on age and/or sex. Methods: A systematic search of 5 electronic databases was conducted in Oct 2017. Included studies were peer-reviewed studies among children and/or adolescents (i.e., 3 yrs – early 20s) with typical or atypical development that quantitatively analyzed the relationship between AMC and PMC. A risk of bias assessment was conducted for all included studies and we conducted preliminary meta-analyses for all studies that reported *r*-values (n = 57), and for subgroups according to age and sex. Results: A total of 75 studies matched all criteria. Most studies were conducted in Europe (44%), had a cross-sectional design (87%), focused on typically developing children (63%), comprised boys & girls (89%) and consisted of elementary school children (43%) or secondary school adolescents (24%). There was great variety in the operationalization and measurement of AMC and PMC among studies and several studies showed considerable risk of bias on at least one of the six assessed criteria. The studies included in the meta-analyses comprised 291 effect sizes (*ES*) representing 14,551 participants from different cohorts. Overall *ES* analysis suggested that AMC is related to PMC (*ES* = .21 [.15, .27]; $Q = 788$, $p < .001$; $I^2 = 93\%$). Despite a tendency for the *ES* to be larger with increasing age, there was no significant difference in *ES* between different age groups ($F[3,285] = 2.415$; $p = .67$) or between boys and girls ($F[2,288] = .502$; $p = .606$). Conclusions: Overall, the relationship between AMC and PMC is significantly positive in both boys and girls and for all investigated age groups. It is recommended to conduct more longitudinal and intervention studies, including in adolescents and young adults, to explore causal relationships between AMC and PMC and to examine whether the relationship between both strengthens with increasing age.

Does the strength of the correlation between adolescents' actual and perceived motor competence depend on the measurement method?

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Objectives: Despite abundant evidence of a positive correlation between youngsters' actual and perceived motor competence (AMC; PMC), there is considerable variation in the strength of the correlation among studies. Therefore, our aim was to examine whether the strength of the correlation differs depending on the measurement method (i.e., instrument used to measure PMC & measurement order [AMC 1st vs. PMC 1st]). Methods: In 400 adolescents (44% boys, age=13.23 ± .51 y) AMC was measured with the Test of Gross Motor Development-2 (Ulrich, 2000), while PMC was measured with 4 different questionnaires: the perceived physical abilities subscale of the Self-Description Questionnaire (SDQ; Marsh et al., 1983), the sports competence subscale of the Physical Self-Description Questionnaire (PSDQ; Marsh et al., 1994), the Physical Self-Confidence Scale (PSCS; McGrane et al., 2015) and the athletic competence subscale of the Physical Self-Perception Profile for Children and Youth (PSPP-CY; Whitehead, 1995). In 195 adolescents AMC was measured 1st, in 205 adolescents PMC was measured 1st. We used Fisher's r-to-z transformation and Steiger's test to examine differences in strength between correlations. Results: The overall moderate correlations between AMC and PMC ($.39 \le r \le .48$, $p<.001$) were significantly stronger when PMC was measured with the PSDQ or SDQ than with the PSCS or PSPPCY; ($1.72 \le z \le 2.32$, $p \le 0.04$). Measurement order did not affect the results, except for the PSC, for which the correlation in the group whose AMC was tested 1st was significantly stronger than in the group whose PMC was tested 1st ($z = 2.44$, $p < 0.05$). For PMC measured with the PSDQ or the SDQ, correlations were stronger among boys than girls ($2.09 \le z \le 2.13$, $p \le 0.05$). Conclusions: The strength of the correlation between AMC and PMC may vary according to PMC measurement instrument and, at least with some PMC questionnaires, to measurement order and/or participants' sex. As such, it is recommended that future studies examining PMC (in relation to AMC or other health-related outcomes) take this information into account.

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Knee joint kinematics of the pendulum test in children with and without Down syndrome

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Individuals with Down syndrome (DS) often display abnormal movement patterns compared with their typically developing (TD) counterparts. Such abnormalities can be partially attributed to their lower muscle strength and tone, ligamentous laxity, and less coordinated neuromuscular control. The Wartenburg pendulum test has been used to assess muscle response and joint resistance during passive leg movements. The purpose of this study was to compare the knee joint kinematics between children with DS and TD children during the pendulum test. Two loading conditions were included: without load (NL) and with an ankle load (AL) equaling to 2% of body mass. Nine DS (mean age: 8.4 years old, 3M/6F) and 9 TD (mean age: 8.7 years old, 4M/5F) children performed 5 trials for each condition. A motion capture system was used to collect kinematic data. Calculated variables include range of motion of the knee in the sagittal plane, the number of swing cycles, and a relaxation index defined as the ratio between the maximal flexion angle in the first swing cycle and the joint angle at the final resting position. Two-way (2 group × 2 load) ANOVAs with repeated measures were conducted for each variable. Children with DS showed greater joint resistance than their TD peers in sagittal plane range of motion (66.2 degrees in DS and 82.0 degrees in TD) during the first leg swing cycle, and the number of swing cycles (3 swings in DS and 4 swings in TD). Children with DS displayed a lower relaxation index of 1.23 compared to 1.62 in the TD children. In addition, no loading effect was found for any dependent variables in both groups. Our results suggest that although children with DS typically have lower muscle tone, they may have a higher level of muscle activation from the quadriceps than their TD peers to help stabilize the knee joint during the pendulum test. Nonetheless, children with DS used a similar strategy to complete a pendulum test when the inertia property of the leg swing increased due to an additional ankle load.

Concurrent validity of total body developmental sequences: A preliminary investigation

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Background: Physical educators' lack of time may be a barrier to assessment. Live coded assessments in naturalistic settings are needed but require examination into psychometric properties. Objectives: To examine the concurrent validity across Total Body Developmental Sequences (Total Body), Test of Gross Motor Development–2 (TGMD-2) raw scores, and product measures for jumping and kicking. A secondary purpose was to examine the concurrent validity across Total Body with product scores and age. Methods: Secondary data analyses included children (N = 60; *M*age = 8.01, SD = 2.47) from a larger data set, stratified into age bands (4–5; 7–8; 10–11 years). Long jumping and kicking were assessed using the TGMD-2 (sum score from two trials), Total Body (modal scores of 5 trials), and product measures (long jump max distance; kick max velocity). Results: Spearman correlations revealed Total Body scores significantly associate with TGMD-2 scores [kick ($r = .32$, $p < .05$) and jump ($r = .63$, $p < .05$)]

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and product measures [kick ($r = .40$, $p < .05$) and jump ($r = .65$, $p < .05$)]. One-way ANOVA's showed there was a significant, positive, linear relationship across Total Body modal scores and product measures for kick ($F(1, 3) = 3.26$, $p = .028$) and jump ($F(1, 3) = 12.63$, $p < .001$), as well as age. Kick Total Body ($F(1, 2) = 5.33$, $p = .008$); kick velocity ($F(1, 2) = 118.52$, $p < .001$); jump Total Body ($F(1, 2) = 6.36$, $p = .003$); jump distance ($F(1, 2) = 64.74$, $p < .001$). Children from the oldest age band (10–11 years) demonstrate higher product and Total Body scores. Conclusions: The Total Body scores revealed concurrent validity with TGMD-2 and product scores for kicking and jumping. The relationship among Total Body scores and product measures indicate that children with higher modes produce either greater distance jumped or higher kick velocities. Additionally, older children scored higher Total Body scores and velocities providing initial support for the developmental nature of Total Body scores. Future research needs to scale up this project and then examine its ecological validity in physical education settings.

Physical activity participation during preschool health-related summer camps

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Purpose: The purpose of this study was to compare physical activity behaviors between two curriculum-based, preschool summer camp programs. Each camp targeted different health-related themes, a motor skill camp (MC) and a nutrition camp (NC). Each camp had the same structured schedule of activities and only differed in thematic focus. Methods: Preschool children wore accelerometers at the waist during the two-week camp session. Children with at least five days of recorded wear time were included in the study. From the MC, 8 children met inclusion criteria (*M*age = 3.50 +/– 0.53 years; 62.5% male) and 12 children from the NC (*M*age = 3.92 +/– 0.79 years; 50% male). For accelerometry data, Pate et al. (2006) cutpoints were used to analyze physical activity intensities. Independent samples *t*-tests were used to examine statistical differences between camp sessions in Sedentary (SED), Light (LIG), Moderate (MOD), Vigorous (VIG), and moderate-to-vigorous physical activity (MVPA) intensities. Results: Average daily wear time for the MC was 425.71 +/– 61.90 minutes and 476.35 +/– 27.91 minutes for the NC. During the MC children spent less time SED (24.4% vs. 21.9%) and more time in LIG (39.7% vs. 38.9%), MOD (23.7% vs. 17.4%), VIG (13% vs. 11.8%), and MVPA (36.7% vs. 29.2%) compared to the NC, respectively. MOD ($t = 3.507$, $p = .003$) and MVPA behaviors ($t = 2.546$, $p = .022$) were statistically significant between groups, favoring the MC. Additionally, preschoolers spent marginally less time in sedentary behaviors during the MC ($t = -1.918$, $p = .071$). There were no statistical differences in LIG or VIG. Conclusions: Summer camps may provide a unique opportunity to target health behaviors in preschoolers; a focus on motor skills resulted in more MOD and MVPA and less SED. Summer camps focusing on motor skills may have an impact on lifelong healthy habits like increased physical activity or motor skill competence. Future work is needed with larger samples and in other preschool settings, as well as to determine the impact of MC on other health-related behaviors.

Climbing onto the mountain of motor development: Can summer success help children's fundamental motor skill status?

Jacqueline Goodway, The Ohio State University; Ruri Famelia, The Ohio State University; Emi Tsuda, West Virgina University; Ally Hodges, The Ohio State University; Ruth Chen, The Ohio State University

Summer Success (SS) is a 4-week intensive early childhood pilot program, prior to kindergarten, to remediate deficits in literacy and fundamental motor skills (FMS) found in children from economically disadvantaged environments. SS is considered a cost-effective way to address disparities in motor development that disadvantaged preschoolers face. This study examined the extent to which SS influenced children's developmental status with FMS (delayed, typically developing) prior to and following the SS program. Preschool children ($N = 46$; girls $n = 24$; *M*age = 62.04 mo., $SD = 5.18$) participated in the evidenced-based SKIP motor skill program for 270 minutes (9 × 30 min sessions) during SS. Children were pre-and-posttested on the Test of Gross Motor Development-2. Using the Gross Motor Quotient (GMQ) percentile a designation of developmentally delayed was identified for children below 25th% and typically developing for the 25th to 75th%. At the pretest, 93.5% of children were identified as developmentally delayed in FMS (Pre-GMQ%, $M = 7.00$, $SD = 8.30$). At the posttest 58.7% of children were developmentally delayed (Post-GMQ%, $M = 24.04$, $SD = 18.29$). A chi-square test was conducted to compare pre-to-posttest differences in the distribution of children who were delayed versus typically developing in FMS. There were significantly fewer children who were developmentally delayed in FMS at the end of the SS program compared to the beginning of the program (Chi-square = 34.78, $p < .001$). Overall, this study showed that in a relatively short period of time, the SKIP program significantly changed the number of children who were developmentally delayed in FMS. In spite of this positive finding there are still concerns about children's developmental status in FMS (Post-GMQ% $M = 24$). Future research needs to examine the dose of SKIP necessary to put children solidly on the mountain of motor development.

SKIPing to fundamental motor skill competence with developmentally delayed preschoolers

Jacqueline Goodway, Ruri Famelia, The Ohio State University

Many children from at-risk environments present large delays in their fundamental motor skills (FMS). Such FMS delay raises concern as early FMS competence is associated with later physical activity levels. Thus, evidenced-based programs such as the SKIP intervention that remediate FMS delay are needed. This study examined the extent to which an 8-week SKIP program remediated the developmental delays of at-risk preschoolers. Preschoolers (Age M = 54.35 mo.; SD = 3.85) were assigned to a SKIP (n = 58) or control group (n = 48). Both groups were pre-and-posttested on the TGMD-2. Using the object control (OC) and locomotor percentiles, a designation of developmentally delayed (25% or less) or typically developing (26th-100th%) was identified. The SKIP group received 16 sessions of 30 mins of OC skills. The control group received the regular preschool program. At the pretest, 93.1% of SKIP children and 82.2% of control children were delayed in locomotor skills; and 82.8% of SKIP children and 77.8% of control children were delayed in OC skills. At the posttest, 22.4% of SKIP children and 86.7% of control children were delayed in locomotor skills; whereas only 7.98% of SKIP children and 92.1% of control children were delayed in OC skills. A Chi Square analysis examined differences in the distribution of children who were delayed vs. typically developing at the pre-and-posttest. There were no significant differences in the distribution of SKIP vs. control children who were delayed in locomotor (Chi-square = 2.92, $p = >.05$) and OC (Chi-square = 0.40, $p = >.05$) skills at the pretest. After the 8-week SKIP program there were significant differences in the distribution of SKIP vs. control children who were delayed in locomotor (Chi-square = 41.85, $p = <.001$) and OC (Chi-square = 57.37, $p = <.001$) skills. This study concluded the SKIP intervention was highly effectively in remediating developmental delays by 70.7% for locomotor skills and 74.9% for OC skills whereas control children increased in the number of children demonstrating developmental delay. These findings have policy implications.

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Physical activity level changes are related to motor skill changes in infants with Down syndrome

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Purpose: Differences in motor proficiency and physical activity (PA) between those with and without Down syndrome (DS) are clear early in life and widen with age. Little is known about how these variables and their changes relate to one another, and which particular motor skills might benefit from PA during infancy. The purpose of this study was to explore how motor development, PA, and longitudinal changes in these variables interact during infancy. Method: Gross and fine motor development (BSID –III) and objective PA (accelerometer) were assessed monthly in 8 infants with DS from 1 to 6 months. PA, gross motor, fine motor, and total motor change scores were calculated between adjacent time points for each infant. Bivariate correlations between PA change scores and motor change scores were conducted. In addition, t-test analyses were conducted on each motor item of the BSID-III to understand whether infants with PA levels above or below the mean acquired specific motor items at different times in development. Results: From 4 to 5 months, gross motor change ($r = 0.848$, $p < 0.05$) and total motor change ($r = 0.490$, $p < 0.05$) were related to PA change. Additionally, from 5 to 6 months, gross motor change was related to PA change ($r = 0.775$, $p < 0.05$). At 2 months, infants with PA levels above the mean achieved ventral head control and side-to-back roll earlier than those with PA below the mean. At 3 months, infants with PA levels above the mean achieved trunk elevation in prone position while shifting weight, supported sitting, and sitting without support earlier than those with PA below the mean. Conclusions: For infants with DS, changes in PA and motor skill development are correlated in early infancy. Moreover, PA at different times in infancy can be important for selective motor skill acquisition. These results suggest that motor development is adaptable to change in early infancy for infants with DS. Overall, these results can be utilized to advocate for early PA interventions in individuals with DS to promote motor proficiency.

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The influence of risk factors on motor competence, physical fitness and BMI in childhood

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From a developmental perspective, motor competence, fitness and BMI are closely interrelated to physical activity and are key elements for healthy child development (Stodden et al., 2008). From another perspective, Sallis et al. (2006) highlight other intrapersonal (e.g., migration background) and environmental factors (e.g., quality of the district) as main influential parameters. Bringing together both perspectives, this study examines the influence of intrapersonal and environmental risk factors on motor competence, physical fitness and BMI in childhood. In a project funded by the German Ministry of Education and Research, children from kindergarten ($n = 376$), primary school class 1 ($n = 429$) and class 3 ($n = 434$) participated. Objective physical fitness data was assessed using the KiMo-Test in kindergarten (Klein et al., 2012) with five items and the Dordel-Koch-Test in schools (Dordel & Koch, 2004) with seven items. Five potential risk factors were collected by parent survey: (1) household income, (2) employment status, (3) school education, (4) BMI of the mother, (5) migrant background. For BMI, results indicate that only mother's BMI significantly predicts children's BMI (corrected by age and gender) ($F(2,89) = 3.67$, $p = .03$, $\eta^2 = .08$). For physical fitness, modeling shows significant effects of school grade ($F(1,107) = 104.81$, $p < .001$, $\eta^2 = .50$), gender ($F(1,107) = 6.53$, $p = .01$, $\eta^2 = .06$), household income ($F(1,107) = 4.69$, $p = .03$, $\eta^2 = .04$) and employment status ($F(1,107) = 6.28$, $p = .01$, $\eta^2 = .06$) for school children. Post-hoc analysis reveals a significant correlation between mother's BMI and household income ($r = .23$, $p < .001$). In sum, results show the direct effects of risk factors to children's physical health parameters. This shows that it could be beneficial to conduct health information programs for parents as well as prevention and promotion for child health especially in vulnerable target groups. Further research should focus on longitudinal monitoring of motor development and specific influencing factors.

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Neural oscillatory activity in the motor cortices correlates with developmental age and motor performance

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The process of moving involves a series of stage-like oscillatory changes in the motor cortices, which includes a beta (15-30 Hz) event-related desynchronization (ERD) during the motor planning stage, a gamma (> 30 Hz) event-related synchronization (ERS) at movement onset, and a post-movement beta rebound (PMBR). Several studies have shown that the strength of these neural oscillations tends to increase with developmental age, but how these neural oscillations are connected with the motor performance of children of different developmental ages is unknown. In this study, we utilized magnetoencephalography and advanced beamforming methods to image these neural oscillations in the motor cortices as a cohort of typically developing children (N= 29; Age range = 11–19 yrs) performed a button press with the second or third digit when an arrow was pointing to the left or right. Only the trials with correct responses were evaluated and the reaction times were collapsed across the respective digits. Our brain imaging results confirmed that the presence of a beta ERD, gamma ERS, and PMBR in the motor cortices. Our results also showed that there was a negative correlation between the child's age and reaction time ($r = -0.47$; $p = 0.01$), suggesting that the older children tended to respond faster. There also was a positive correlation between the child's age and the strength of the PMBR ($r = -0.42$; $p = 0.03$), implying that the older children had a stronger PMBR. Conversely, the strength of the beta ERD and gamma ERS were not related to the child's age ($p > 0.05$). Altogether, these results suggest that there are age-related changes in the PMBR while performing a motor task. Prior research has suggested that the PMBR is related to the stability of the internal model that is used to predict the performance of the motor system under various task constraints. Hence, changes in the strength of PMBR may coincide the development of a stable internal model as the neuromuscular system matures.

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A longitudinal examination of a structured perceptual motor program

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The ideal time for acquiring fundamental movement skills (FMS) is early childhood years. Failure to achieve FMS can have long-term negative effects as their absence may prevent children from participating in physical and/or social activities. Preschool physical education (PE) has not been

widely investigated by researchers. The National Association for the Education of Young Children (NAEYC) recommends preschoolers receive daily instruction in FMS and movement concepts, but most preschool programs do not implement structured PE that teaches FMS and movement concepts. There is little longitudinal research on the effects of (PMP) and to our knowledge none in the United States, although currently an eight-year study is being conducted in Europe. The purpose of the study was to examine the one year and five year-long retention effects on children's gross motor skills after a year-long PMP during one year of preschool, in comparison to peers that did not attend a PMP. We implemented the PMP at a preschool in the southern United States. We assessed participants (N = 50, experimental = 25, control = 25) prior to the PMP program. We then assessed children (N = 50, experimental = 25 and control = 25) in kindergarten, and again in fourth grade. Participants (N = 50) were assessed using the Test of Gross Motor Development–2nd edition (TGMD-2). Independent samples t-tests revealed the experimental group of kindergarteners showed significantly greater gains than that of the control group: Gross Motor ($t(47) = 4.69$, $p < .001$, $d = 1.37$); Locomotor ($t(47) = 3.43$, $p < .001$, $d = 1.00$); Object Control ($t(47) = 4.44$, $p < .001$, $d = 1.30$). Children that received the PMP in preschool have higher FMS scores than control peers who did not by kindergarten. Consistent with previous literature, gains for the PMP group indicate retention effects persists at the one-year time point. This study demonstrates that providing structured movement opportunities (e.g., PMP) during early years of childhood improves gross motor skills compared to same aged peers long after the completion of a PMP.

Enjoy the fun of driving! The preliminary results of motivation and the ride-on car training with two different postures in toddlers with disabilities

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Studies have demonstrated the applications of ride-on car (ROC) training in different environments are effective for enhancing psychosocial function in toddlers with disabilities. This randomized controlled trial aims to manipulate the parameters of the ROC experience by increasing the demands of postural control during locomotion and examine the effectiveness on mastery motivation and goal achievements. 22 toddlers with disabilities between 1 and 3 years were recruited from the hospitals in Northern Taiwan. The ROC training groups with two postures (ROC-sit: 7 participants, mean age: 20.9 months; ROC-stand: 7 participants, mean age: 23.9 months) received 12-week ROC training (120 mins/per session, 2 sessions/per week). The control group (8 participants, mean age: 26.1 months) received conventional therapy for the same dosage as the other two ROC training programs. Dimensions of Mastery Motivation (DMQ), and Goal Attainment Scale (GAS) were administrated before and after 12-week intervention. A two-way repeated measures ANOVA was employed to evaluate the effects of the outcomes among the three groups. There was no significant difference among groups at pre-test, including the demographic data and motivation. After 12-week intervention, only the measures of social persistence with children showed significant time × group interaction, whereas the other measures of DMQ and GAS showed no significant interaction effect. The pairwise post-hoc test showed that the participants had significantly more social persistence with children in the ROC-stand group than the control group. In addition, the post-hoc tests indicated that the participants had significantly more social persistence with the adults and goal achievements at the posttest than at the pretest in the three groups. The ROC-stand group tended to have the most positive changes on the outcomes, while the control tended have the least improvements. These preliminary findings may support the assumption that using different postures during the course of locomotion may have different impacts on children's psychosocial function.

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Validity and reliability of gross motor skill assessments in typically developing children and adolescents

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Background: An increased importance has been placed on motor competence and its association to health-related outcomes, such as physical activity and fitness. To ensure accurate and informative motor competence data is collected, valid and reliable assessments need to be used. Many options are available, but it remains unclear how well the measurement properties of these tools have been tested. The primary aim of this systematic review is to report the validity and reliability of objective gross motor skill batteries for typically developing youth populations (ages 3–17). Methods: The following inclusion criteria were used: a) the skill assessment must be for participants between the ages of 3–18 years without physical and/or cognitive impairment (e.g., autism, cerebral palsy) b) the skill assessment must be an objective measure c) at least one form of validity and/or reliability is reported d) gross motor skills are assessed. Seven databases (CINAHL Complete, PubMed, MEDLINE Complete, PsycINFO, Scopus, SPORTDiscus, Web of Science) were searched for relevant studies. In total, 15,576 articles were searched by title and abstract, 259 of which were screened in the full-text stage of the review. Results: The most commonly tested motor skill assessments were the Test of Gross Motor Development, Movement Assessment Battery for Children and the Bruininks-Oseretsky Test of Motor Proficiency. Since 2010, there has been a large increase in the number of fundamental motor skill batteries for child populations. Content validity, as well as inter-rater and test-retest reliability were most commonly reported. Conclusions: Valid and reliable motor skill assessments are important for evaluating intervention effectiveness, tracking motor competence across time and skill deficiency identification. Continued work in culturally diverse populations is warranted with predictive validity especially important to promote the continued importance of motor competence and its association to health-related outcomes.

Visual attention to instructional supports in Autism Spectrum Disorder: A case-control study

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Autism Spectrum Disorders (ASD) impacts 1 in 68 children in the United States. In addition to the core social-communication and behavioral deficits, children and adolescents with ASD display widespread motor deficits and have consistently demonstrated poor performance on commonly used clinical and standardized batteries of motor performance. However, the extent to which poor performance on movement assessments is related to assessment administration, skill instruction, and/or impairments in sensory information processing (e.g., differences in visual attention) is unknown. The purpose of the current study is to examine differences in visual attention to two visual supports (videos and task cards) for motor skill instruction in children and adolescents with and

without ASD ($n = 12$ per group). Moreover, the relationship between visual attention and potential confounders were also evaluated (i.e., inhibitory control, motor proficiency, and motor skill knowledge). Participants completed the Flanker task, BOT-2, TGMD-2, and a motor skill knowledge assessment. Participants watched one set of motor skills presented as a video and another set of motor skills as task cards (i.e., static images of key movement phases) while wearing eye-tracking glasses. Group differences were observed for the BOT-2, TGMD object control, Flanker, and motor skill knowledge ($p < 0.05$ for all). However, no group, condition, or group × condition differences were observed for normalized fixations, a measure of visual attention. Differences in inhibitory control, motor proficiency, and motor skill knowledge did not predict visual attention. Thus, despite deficits in a broad set of motor and cognitive skills, children and teens with ASD allocate visual attention to both static and dynamic visual supports similarly to controls. These results will be discussed with respect to the nature of the visual supports and directions for future basic and applied research to understand the factors affecting visual attention in children and adolescents with ASD.

From wall street to expertise development: Predicting the rise and demise of talent investment by using machine learning to identify 'game-changers'

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Previous research exploring the development of expertise has typically adopted linear methods to identify precursors of expertise. These methods involve assessing statistical differences between groups of isolated variables by way of attaching importance to variables, e.g. deliberate practice hours and expertise level (Ericsson, Krampe & Tesch-Römer, 1993). However, confining the *dynamic* nature of expertise development to *linear* investigations alone is overly simplistic, and thus insufficient in identifying true precursors of expertise. Therefore, to better understand the multidimensional and dynamic nature and of expertise development, we used (non-linear) pattern recognition analyses on a set of 93 features obtained from a sample of 13 sub-elite and 15 elite (international) cricket spin bowlers. Our study revealed that 12 developmental features discriminated between the elite and sub-elite groups, with very good accuracy. The 12 features provide a holistic, multi-faceted development profile that is discussed in line with four major theoretical areas of development: Early Development; Pathway Milestones; Domain-specific Activity; Pathway Performance Indicators. Importantly, the discriminant validity of this new model was demonstrated by its ability to correctly classify data obtained from five unseen spin bowlers with 100% accuracy, thereby adding to its generalisability, and both theoretical and applied value.

Funding source: The England & Wales Cricket Board (ECB).

Leg movement rate pre- and post-kicking intervention in infants with Down syndrome

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Introduction Children with Down syndrome have delayed development of motor skills and atypical movements. Infancy is a key time for intervention, as infants move and learn about the changing properties of their movement system. We are interested in encouraging kicking as this may have a positive effect on walking, a key later milestone. Here we measured quantity of leg movements before and after a kicking intervention. We hypothesized that leg movement rate would be significantly higher post-intervention. Methods Infants with Down syndrome (n = 9), beginning at the ages of 3 to 5 months, were placed under a commercial toy in which kicking a footplate resulted in music playing and lights flashing. The intervention was administered 20 minutes, 5 days a week, for 8 weeks. Leg movement rate was measured pre- and post-intervention using Opal wearable sensors on the ankles. They were worn for an average of 8.72 hours, ranging from 6.46 to 11.14 hours. Matlab was used to identify each leg movement (Smith et al., 2015) and adjusted to movements per hour of awake time in order to compare across different sessions. Descriptive statistics and a Repeated Measures Analysis of Variance were used to summarize data and test for a significant difference in movement rate between visits. Results The average movement rate pre-intervention was 2253 movements per hour during awake time for the right and left legs combined (standard deviation = 538). Post-intervention, the average movement rate was 2645 movements per hour during awake time (standard deviation = 655). Data were normally distributed (Shapiro-Wilk test $p = 0.39$). There was a significant difference between movement rate at the pre- and post-test visits ($F_{1,8} = 5.35$, $p = 0.049$). Conclusion The study revealed that the infants demonstrated a higher leg movement rate at the post intervention visit. Next, we would like to explore whether alternate kicking specifically, as opposed to leg movement rate, was different. We would also like to include a comparison group of infants who receive a different intervention or no intervention.

Funding source: American Physical Therapy Association Academy of Pediatric Physical Therapy.

Differences in parental behaviors of parents of young children with and without ASD in two different play settings

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Objectives: The objective of this study was to examine group differences in the parental behavior constructs of encouragement and intrusiveness in parents of young children with and without ASD in a traditional social play-based setting and a motor play-based setting. Method: Children with and without ASD between the ages of 2 – 7 years and their parents were recruited for this study (n = 18; ASD = 9 and TD = 9). To measure parental encouragement and intrusiveness, each dyad participated in two play sessions (social play and motor play) for about 10 minutes each (a combined total of about 20 minutes). A 2 × 2 (group × play setting) repeated measures of ANOVA was conducted to examine the main effects of group and play setting and the interaction effect between group and play setting on the constructs of parental encouragement and intrusiveness. Results: A 2 × 2 (group × play setting) repeated measures of ANOVA revealed a main effect of group on parental intrusiveness, $F(1, 16) = 6.48$, $p = 0.02$, indicating that the mean parental intrusiveness of parents of children with ASD was significantly higher ($M = 2.11$, $SD = 0.58$) than parents of TD children ($M = 1.61$, $SD = 0.61$) across both settings. Parental encouragement showed a significant interaction effect, $F(1, 16) = 16.84$, $p = 0.001$, suggesting that the effects of group on parental encouragement depended on play setting. Post-hoc analysis suggested that there was a significant difference between groups on the variable of parental encouragement, $t(16) = 2.29$, $p = 0.04$, indicating that parental encouragement for children with ASD was lower, compared to parental encouragement of TD children. Conclusion: The results of this study shed-light on differences in parental behaviors based on play setting. Implications about how these behaviors may influence participation in motor play for young children with and without ASD will be discussed.

Autism in infant siblings: A case study

Anastasia Kyvelidou, Creighton University

Autism spectrum disorders (ASD) is characterized by deficits in social communication and repetitive patterns of behavior. The prevalence of

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ASD is 1 in 68 children in the United States, and the average age of diagnosis is four years of age. Even though ASD can accurately be diagnosed between 2–3 years of age, it is imperative to be able to identify earlier signs of ASD to access early intervention services and thus optimize quality of life. The goal of the present study was to evaluate postural and perceptual signs of autism in the first year of life in infants at low- and high-risk for ASD. Here, we present data from an infant at low-risk for ASD that at 3 years of age received diagnosis of ASD, and from his 15 months younger sibling that participated in the study. The younger child is almost 2 years of age and he has language and communication delays, but no diagnosis of ASD. This comparison allows for a unique opportunity to examine similarities and differences in the first year of life in siblings. Their sitting posture at 6 months of age was very different. The older sibling diagnosed with ASD presented with reduced movement and variation of sitting posture. The Mullen Scales of Early Learning at 6 months did not reveal any at-risk behaviors for both infants, but the 12-month evaluation presented a totally different picture. The older sibling diagnosed with ASD was below average in gross motor behavior and very low in expressive language while the younger sibling was below average in all five scales. The perception of the parents determined by the Ages and Stages Questionnaire in terms of communication, gross and fine motor skills, problem-solving and social behavior did not reveal any concerns for their children except for expressive language for their older child that was later diagnosed with ASD. Lastly, the eye tracking evaluation for preference on shapes or social images on a screen was similar for both children, in that both preferred to look more at social images as they developed.

Funding source: National Institute of Health.

Unlocking the potential of infant motor and perceptual behavior: Data collections at home

Anastasia Kyvelidou, Creighton University

Ecological validity has typically been interpreted as the ability to generalize from observed behavior in the laboratory to natural behavior in the world. Thus, it is preferable to observe behavior in one's natural environment and where this behavior usually takes place. However, most of the times this is not feasible due to equipment utilized or experimental set up parameters. In terms of quantitative evaluation of infant postural control, the gold standard is a force platform in a standard motion analysis laboratory. Thus, the infants would need to perform in an environment they have never been before with many other equipment and devices around them. With the recent advances in technology portable force platforms offer a unique opportunity to collect data in an infant's home. We have used a Bertec portable force platform that is lightweight and connected to a USB port to a laptop computer for data acquisition. Additionally, perceptual infant behavior, as captured with eye tracking devices is usually restricted in a tight laboratory space with a highly controlled environment and visual stimuli. The eye tracking devices are usually attached to a monitor that displays some type of stimuli and it requires a long calibration procedure before the infant arrives to the laboratory as well as with the infant starting the session. We have used a Positive Science eye tracking device to collect real life eye tracking data in a home environment. It's set up is very simple and you can calibrate your data after the end of your session. We have used it to investigate whether infants would prefer to look at 2D (images on screen of shapes and children) vs 3D (objects and people in the environment) stimuli in their natural environment. Even though we successfully collected motor and perceptual data in a home environment, significant considerations should be made a priori for statistical comparisons between subjects. In conclusion, it is feasible to collect infant posture and eye tracking data in a home environment, which may unveil unknown and surprising infant behaviors.

Effects of socioeconomic status on infants' motor development and physical activity

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Infants with limited access to resources are at risk for developmental delays in language, attention, processing speed, inhibitory control, and emotion regulation. But little is known about whether access to resources hinders or benefits locomotor development during infancy. In study 1, we determined whether access to resources affects the onset of locomotor milestones and proficiency of crawling and walking. We observed 129 infants at 10, 13, 15, and 19 months of age. Based on income, SES, and parental education, we divided infants into two groups: higher-and low-resource group. 82 infants in the high-resource group had higher SES scores (Hollingshead Index), more years of parent education, fewer people per room in their homes, and more opportunities for physical activities outside the home compared with 47 infants in the low-resource group. Access to resources between the two groups were barely overlapping. With parents' retrospective reports, we found that infants in the high-resource group achieved motor milestones at a much earlier age than those with low-resource infants. But, there was no difference in crawling and walking proficiency when the two groups were compared at the same level of experience. That is, low-resource infants achieved each form of locomotion at later ages, but their rate of improvement was similar to infants in the high-resource group.We further investigated whether access to resources affects toddler's physical activity. Infants played in a large laboratory playroom (filled with various toys, carpeted stairs, and risers). The level of physical activity was scored from videos and included time in upright motion, accumulated walking steps, and total area visited. Preliminary data showed that low-resource infants move less, took fewer steps, and visited fewer areas of the playroom. The importance of discovering the actual factor that influences locomotor development is that it would help in the prevention of delays and cease any secondary effects it may cause.

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The development of project flame: A multi-component school-based movement intervention for adolescents in Ireland

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Background: Recent Irish data found that adolescents are failing to reach a basic level of fundamental and functional movement. The current research presents baseline findings between intervention and control settings, prior to the roll out of a multi-component intervention, entitled Project FLAME: Fundamental and Functional Literacy for Activity and Movement Efficiency. Methods/Design: Using a non-randomized controlled trial, a target sample of 326 participants (mean age: 14.02 ± 0.89 years old) were recruited in October 2017 from three mixed-gender sub-urban schools (two intervention; one control) in Cork, for baseline data collection, followed by a 13-week consecutive Project FLAME intervention roll out. This whole-school weekly delivered multi-component approach involved the following pillars: 1) student component, 2) specialist PE teacher component, 3) non-specialist PE teacher kinaesthetic classroom component, and 4) digital literacy component. Primary outcome measures include the assessment of fundamental movement skills (FMS), the functional movement screen (FMS™), height and mass. Separate 2 by 2 between-groups analysis of covariance (ANCOVA) were conducted to determine if differences existed between treatment groups (intervention/control) and gender at baseline, prior to intervention roll out, when controlling for age and body mass index (BMI). Results: Results of the two-way ANCOVA found that treatment and gender had no significant interaction effect ($F(1, 269) = .06$ $p = .81$) on FMS. There was, however, a main effect for gender, with males displaying higher FMS proficiency than females ($p < 0.001$).

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Similarly, treatment group and gender had no significant interaction effect ($F(1, 275) = 1.97$ $p = .16$) on FMS™. Discussion: Baseline results suggest that treatment and gender had no significant interaction effect for FMS and FMS™, after controlling for age and BMI. Following the 13-week roll out of Project FLAME, this study will provide future evidence regarding the effectiveness of school-based interventions, requiring developmentally and gender-appropriate activities.

Motor competence and executive function in children with autism spectrum disorder

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Executive function and motor competence have been found to comorbid in children with autism spectrum disorder (ASD). Researchers suggest that when children have deficits in both executive function and motor competence, they tend to be lack of inhibition of unwanted responses and behaviors, self-concept, and motivation. Thus, leads to lack of social functioning and physical activity participation. The purpose of this study was to investigate the relationship between executive function and motor competence in children with ASD. Fifteen children with ASD participated in this study. The children were all males and aged between 8–14 years. Participants' executive function was assessed using the Conners Continuous Performance Test-3 (CPT-3) and their motor competence were measured with the Movement Assessment Battery for Children-2 (MABC-2). A Pearson correlation was used to analyze the relationship between children's executive function and fine and gross motor performance. Descriptive analysis revealed that 80% of the children with ASD demonstrated delays in both fine and gross motor skills, indicating low motor competence. In addition, 61% of the children had a slow reaction time, 40% of the children's response style was accuracy over speed, and 28% of the children performed poorly in all other executive function tests such as detectability, omission, commission, and perseveration. A significant correlation was found between subtests in the CPT-3 and MABC-2 suggesting that children with low motor competence may have poor executive function. These findings are beneficial for practitioners and educators in designing future early interventions and training programs for children with ASD.

Mobility is a fundamental human right: Factors predicting attitudes toward self-directed mobility

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One aspect of motor development is self-directed mobility, defined as mobility that is controlled by an individual and may include walking or assisted ambulation through the use of mobility technology such as prosthetics, walking aids, manual wheelchairs, or motorized wheelchairs. Disability models are sets of assumptions about the cause, nature, and treatment of disability. The medical model views disability as an individual pathology that should be treated or cured. The social model views disability as a socially constructed experience. No studies have examined factors that predict attitudes toward self-directed mobility, including the influence of disability models on attitudes. Purpose. To explore how demographic factors, contact with people with disabilities, attitudes toward people with disabilities, and alignment with social or medical models of disability predict attitudes toward self-directed mobility. Methods. 1,545 students at a public university completed demographic questions, and measures of disability attitudes, disability model orientation, and self-directed mobility. Results. Predictors explained 16.60% of the variance in participants' attitudes toward self-directed mobility ($p < .001$). Significant predictors include: female gender ($\beta = -0.14$, $p < .01$), more positive attitudes toward people with disabilities ($\beta = -0.30$, $p < .001$), and social model orientation ($\beta = 0.59$, $p < .001$). Conclusions. The social model of disability was the strongest predictor of attitudes toward self-directed mobility as a fundamental right. The social model of disability offers a potential avenue for facilitating positive attitudes toward self-directed mobility through education. This may, in turn, translate to increased access to mobility technology for people with disabilities to enhance participation and health, especially if education can be delivered to rehabilitation professionals. Future work may investigate educational interventions to promote integration of treatment (medical model) and advocacy (social model) into the practices rehabilitation professionals.

Funding source: N/A.

Psychometrics of the Attitudes toward Self-Directed Mobility Scale

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One aspect of motor development is self-directed mobility, defined as mobility that is controlled by an individual and may include walking or assisted ambulation through the use of mobility technology such as prosthetics, walking aids, manual wheelchairs, or motorized wheelchairs. Pediatric physical therapists serve a critical role in advocating for children with disabilities to gain access to self-directed mobility experiences. However, pediatric physical therapists' attitudes toward self-directed mobility are unknown, in part, because no scale exists to assess these attitudes. Purpose. To determine the internal consistency and known-groups validity of the Attitudes toward Self-Directed Mobility Scale (i.e. Mobility Scale). Methods. 188 pediatric physical therapists that attended professional development workshops on self-directed mobility participated in this study to establish internal consistency. 286 undergraduate students of a required Motor Behavior course for Kinesiology majors at a public university participated in this study to establish known-groups validity. All participants completed the Mobility Scale. Selected items (4 of 9) of Mobility Scale items included: Self-directed mobility is a fundamental human right; Children that are provided access to powered mobility will experience delays in the onset of independent walking and other physical skills; I am confident I can advocate for children to gain access to self-directed mobility; Children should have the opportunity to use multiple modes of mobility based on environment or situation. Results. Internal consistency was acceptable (Cronbach's alpha = 0.75). Mann-Whitney U tests indicated that pediatric physical therapists scored significantly higher on 7 of the 9 items, and the total score of the Mobility Scale ($p < .001$). Conclusions. The present study is an important first step to providing a valid and reliable scale to assess attitudes toward self-directed mobility. Our lab is currently conducting a large-scale study of pediatric physical therapists' attitudes toward self-directed mobility.

Funding source: N/A.

Reduction of deltoid co-contraction during the development of arm swing control in children: Preliminary results

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Arm swing during upright human locomotion arises from both passive and active mechanisms. Recent work has shown that passive mechanics heavily influence the amplitude of arm swing motion, while the active shoulder muscle activities are important in maintaining the temporal coordination of arm movement. The purpose of the current study was to examine the deltoid muscle activities in children to determine the developmental process of this muscular control. To date, eight healthy children (range: 2.3 – 6.1 yrs from onset of upright locomotion) performed

over-ground walking at a self-selected, comfortable speed. Full body three-dimensional kinematics and muscle activities of the anterior and posterior deltoids were recorded. To allow for comparisons across children, anterior-posterior arm swing excursions were normalized to arm length, and muscle activity amplitudes to the peak magnitude across the stride cycle in each child. A co-contraction index was calculated using the overlapping areas of the normalized anterior and posterior deltoid muscle activations divided by the total areas of each muscle individually. Spearman correlations were performed to indicate possible relationships between the time from walking onset and the measured variables. Results suggested that walking velocity and normalized arm swing amplitude were not related to time from walking onset. Magnitudes of posterior deltoid activity did not differ between children, but a weak negative relationship between anterior deltoid activity and time from walking onset was shown when the arm was at the peak anterior position. As well, co-contraction was found to decrease with age during the anterior motion of the swinging arm. These preliminary results suggest that throughout development, children decrease co-contraction of the deltoids, likely through a reduction of anterior deltoid activity during anterior arm swing. This may indicate that younger children do not exploit the passive dynamics of arm swing during locomotion and learn this process through development.

Children's scores on the Test of Gross Motor Development–2nd and 3rd edition: A comparison study

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Purpose. The Test of Gross Motor Development (TGMD) is a normed and validated measure used to assess children's fundamental motor skills. This study compared children's scores on the 2nd and 3rd editions of the TGMD (TGMD-2 and 3) before and after a motor skill intervention. Methods. Participants were 64 preschoolers (24 girls; Mage 4.4 ± .44 yrs) from one center in the Midwestern United States. All participants completed a 5-week, 600-minute motor skill intervention. Subscale (locomotor and object control/ball skills) and total scores of the TGMD-2 and 3 were compared before (pretest) and after (posttest) the intervention using linear regression models and Bland–Altman plots. Results. Linear regression models revealed that children's TGMD-2 scores significantly predicted TGMD-3 scores at pretest and posttest on total (beta = .86, $p < .001$; beta = .92, $p < .001$; respectively), locomotor (beta = .88, $p < .001$; beta = .94, $p < .001$; respectively), and object control/ball skills (beta = .70, $p < .001$; beta = .87, $p < .001$; respectively). Bland-Altman plots showed acceptable agreement between the TGMD-2 and TGMD-3 at pretest (total Mdiff = –.09; locomotor Mdiff = –.05; object control/ball skills Mdiff = –.05) and posttest (total Mdiff = –.03; locomotor Mdiff = –.95; object control/ball skills Mdiff = –.92). The variability remained consistent across the plots, but object control/ball skills had greater variability in difference scores compared to locomotor skills at pretest (SD = 4.45 vs SD = 2.63; respectively) and posttest (SD = 4.55 vs SD = 2.67; respectively). As expected, there was a horizontal shift where the mean increased at posttest compared with at pretest. A few outliers were present in the plots for subscale and total at posttest. Conclusion. These results support that the TGMD-2 and TGMD-3 yield similar motor skill scores before and after a motor skill intervention.

Funding source: N/A.

Analysis of children's preference on two assessments of perceived motor competence

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Background: Current perceived motor competence assessments are administered using different formats (i.e., pictorial vs digital). There is a need to explore children's preferences and perceptions of these tools. This study examined preschool children's preferences between two measures of perceived motor competence: the Pictorial Scale of Perceived Movement Skill Competence (PSPMSC; Barnett et al, 2015) and the Digital Scale of Perceived Motor Competence (DSPMC; Robinson & Palmer, 2017). Methods: Preschoolers (N = 87) from a University-sponsored center participated in a single session wherein they completed both the PSPMSC and DSPMC and answered a short interview question. Preschoolers' responses to interview questions were transcribed then independently reviewed and coded by three researchers to identify overall preference and content themes. Results: A total of 69 children provided preference responses and 56.5% of children preferred the DSPMC, 33.3% preferred the PSPMSC, and the remainder had no preference. Of the 69 children, 45 children provided responses to an interview question that were eligible for analysis. A total of 66 responses (60 positive responses, 6 negative responses) were coded and included in the content analysis. The content analysis revealed five primary themes: *presentation* (41 responses), *impression* (9 responses), *skills* (6 responses), *model* (5 responses), and *other* (5 responses). The presentation theme was divided into three sub-themes: *interaction with buttons/circles* (14 responses), *presentation format* (i.e., videos or pictures, 20 responses), or *static/dynamic presentation of skills* (7 responses). Conclusion: This study provides evidence that preschool children may prefer an interactive and dynamic assessment tool when measuring perceived motor competence. Future studies should continue to explore children's preferences and perceptions of perceived motor competence measures and to consider the benefits of using a preferred measure.

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Comparison of unipedal balance performance in young male soccer players: Role of age and balance task condition

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Soccer requires unipedal balance control which may induce a functional asymmetry in balance performance, i.e., the non-dominant leg is responsible for stabilization and the dominant leg is responsible for kicking the ball. Previous studies demonstrated an asymmetry in unipedal balance performance whereas others did not (Paillard, 2017, for a review). One reason for this inconsistency may be related to players' experience and another in balance task condition (i.e., level of difficulty and/or specificity). The purpose of this cross-sectional study was to determine unipedal balance performance in young male soccer players (U12: n = 16, U15: n = 9, U19: n = 17) tested under different balance task conditions: static and dynamic balance on firm and foam ground. All soccer players practiced 4 to 5 times per week and played at the highest regional level of their age. Unipedal balance was measured with a Kistler force plate. The dependent variables were the center of pressure displacement in anterior-posterior (AP) and medio-lateral (ML) direction. Results indicated larger sway values for both legs in AP direction for the U12 players compared to the U19 players for static balance while standing on foam ground ($p < .01$; partial $eta^2 = .27$). When compared to the other age groups, the U19 players swayed less (AP direction) in the dynamic balance task condition ($p < .05$; partial $eta^2 = .16$). Postural sway in AP and ML direction was higher in the static and the dynamic balance task on the foam compared to the firm ground and that was irrespective of age group ($ps < .01$; partial $eta^2 \geq .19$). Irrespective of age group, balance performance asymmetry occurred in the ML direction in the dynamic condition ($p < .05$; $eta^2 = .13$) in favor of the non-dominant leg (i.e., stance leg while kicking the ball). Our results indicate that unipedal balance performance seems to be modulated by players' age/experience, balance task condition, and limb dominance.

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Mild cognitive impairment declines learning of a simple movement sequence

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Aging is associated with declines in cognitive functioning and motor functioning including sequence learning and memory. Theories of movement sequence learning proposed two independent processing mechanisms: one cognitive processing mechanism which is responsible for planning and organizing the elements in the sequence and the other is the motor mechanism which is responsible for the actual execution of the planned movement. Research has indicated that older adults (OA) perform movement sequences more slowly than younger adults (YA), because they have problems to group elements together to chunks to reduce cognitive processing demands. This finding indicates that cognitive processing mechanism is primarily affected by aging. The purpose of the present experiment was to determine movement sequences learning in YA and OA. In the present experiment a simple movement sequence was used which require fewer reversals than a multi-element movement sequence used in previous experiments. Chunking processes are not as important for the simple movement sequences as for more complex sequences to functionally decrease the processing demands for response execution. To reduce task complexity performers of both age groups had additional time to perform the sequence. Furthermore we were interested how mild cognitive impairment interacted with sequence learning. On day 1 participant's (27 YA; 25 OA) acquired a spatial-temporal pattern by a sequence of elbow extensions/flexions. On day 2 retention performance and the cognitive status (Montreal Cognitive Assessment [MOCA]) were assed. The results demonstrated that YA performed superior during acquisition and at the retention test compared to OA. Additional time to perform the sequence did not facilitate retention performance for the OA. For the OA the correlation between sequence performance and the MOCA was $r = .66$ ($r^2 = .43$). This finding indicated that even a mild cognitive impairment declines learning of a simple movement sequence where chunking demands on the cognitive level were reduced.

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Effect of caregiver physical interaction on characteristics of spontaneous movements in infants

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Spontaneous movements in infants are predictive of motor developmental outcomes. However, it is not fully understood how these movement behaviors vary during interactions between the infant and a caregiver. One critical interaction in the home environment is physical contact with the caregiver in which the infant is physically being held by the caregiver in different positions. The aim of this study is to investigate the effects of: (1) physical contact with a caregiver and (2) infant's position on the characteristics of spontaneous movements in them. We hypothesize that both physical contact and infant position will influence the characteristics of spontaneous movements. In order to address this hypothesis, spontaneous movements were observed in typically developing infants (Mean age = 14.11 wks; SD = 3.65 wks) for different routinely practiced caregiver-infant activities. A combination of behavioral video recording and wireless sensors were used for data collection. In each lab visit, infants were outfitted with sensors and video recorded for 3 physical contact conditions (no physical contact/caregiver holding baby and moving/caregiver holding baby while staying still), and 4 infant position conditions (back position/ tummy position/ held horizontally/held vertically). Behavioral and sensor data findings indicated a clear effect of physical contact and infant positions on the quantity and quality of spontaneous movements – frequency and peak acceleration counts were higher in the no physical contact and lying on back conditions, compared to the conditions in which the infant was held. Understanding how physical interaction influences spontaneous movements may provide insight into developmental disorders such as autism.

Inter- and intra-rater reliability during live- and video-coding of the TGMD-3

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Objective: The Test of Gross Motor Development (TGMD) is a popular assessment of gross motor ability and can be scored live during administration or later from a video recording. How live- and video-coding conditions affect the reliability of raters is currently unknown. The purpose of this study was to examine the inter- and intra-rater reliability of live- and video-coding the TGMD-3. Methods: Thirty children (16 F, 14 M), average age of 7.09 (SD = 1.50) years, were recruited from a summer physical activity camp. Participants completed the TGMD-3 and performances were recorded in digital-video. Two raters independently live-scored participant performances during the testing session. Following a period of two weeks, the two raters independently rescored the performances from the digital-video recordings. Inter- and intra-rater reliability between and within raters across conditions were examined using intra-class correlation coefficients (ICC 2,1). Results: Under live-conditions, inter-rater reliability was high for total score (ICC: 0.91), and the locomotor (0.76) and ball skills (0.94) subscales. Under video-coding conditions, inter-rater reliability was improved with high reliability for total score (0.97), locomotor subscale (0.91), and ball skills subscale (0.98). Intra-rater reliability between live-and video coding conditions was also high for total score (>0.92), and the locomotor (>0.87), and balls skills (>0.91) subscales. However, both inter- (0.56–0.98) and intra-rater (0.57–0.98) reliability ranged from fair to excellent for the 13 individual skills. Conclusion: These results indicate stronger inter-rater reliability when the TGMD-3 is coded using digital-video recordings, but high ICC coefficients were observed under both conditions. Intra-rater reliability analyses indicate both raters had high consistency across coding conditions for subscale and total scores. Individual skills with lower reliability provide information to help improve training for raters. Researchers are always encouraged to examine reliability within their specific study samples.

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Cognitive planning improved after cycling exercise in older adults with Down syndrome

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Previous research has found improvements in 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, which may alleviate the early onset of Alzheimer's disease (AD) in persons with Down syndrome. Specifically, the aim of this study was to examine if Assisted Cycle Therapy (ACT) would improve cognitive planning as measured by the Tower of London (TOL), set switching as measured by the modified Wisconsin Card Sorting Test, and spatial memory as measured by the Corsi Block Test in older adults with DS. Twenty-six participants were randomly assigned to one of three interventions over eight weeks. 1) Thirteen older adults with DS completed the ACT intervention, which is stationary cycling with the assistance of a motor to maintain a cadence at least 35% greater than voluntary cycling.

2) Eleven older adults with DS completed voluntary cycling (VC) at their preferred cadence and 3) Two older adults with DS were in our no cycling intervention. Our results showed that cognitive planning improved after ACT and VC, but not NC. Our results are discussed with respect to upregulation of neurotrophic factors that increase functioning in the prefrontal cortex that accompanies exercise.

Funding source: Project HoneyBee, ASU's Center for Sustainable Health.

Surveying caregivers about device use and infant position using a smartphone-based application: Response rates from a pilot study

Marcelo Rosales, University of Southern California; Tanya Tripathi, Virginia Common Wealth University; Stacey Dusing, Virginia Common Wealth University; Beth Smith, University of Southern California

Introduction: An emerging ecological practice for assessing infant physical activity is the use of wearable sensors. While wearable sensors provide investigators with the capability to quantify infant movement in everyday life (Smith et al. 2015), they lack the capability to qualitatively describe the context of the activity. Paper activity logs have been used in order to address this limitation, but electronic logs may be a more practical approach. Therefore, the purpose of this pilot study was to develop and assess the response rate of a smart phone based application. Methods: Researchers with knowledge of infant motor behavior developed two versions of the survey. Version 1 (V1) surveyed caregivers on 4 random days, 6 times a day, in 2-hour intervals. V1 asked about the current position and devices being used. Versions 2(a&b) surveyed caregivers for 2 or 7 consecutive days, 6 times a day, in 2-hour intervals (2a), plus one whole day survey, in a 12-hour interval (2b). V2 asked about the duration infants spent in various positions and devices in the past 2-hours or for the whole day. Thirteen caregivers with infants (1-6 months) completed one of the surveys setting described prior. Here we compare response rates from 1) consecutive days and non-consecutive days and 2) 2-hour intervals vs. full-day intervals. Results: V1 (n = 3) had a median response rate of 83.33% (max: 95.83%, min: 41.67%), while 2a (n = 10), had a median response rate of 88.69% (max: 100%, min: 57.14%). In comparison to 2a, 2b had a median response rate of 100% (max: 100%, min: 0%). Discussion: Overall, the results from our pilot study showed that survey prompting on consecutive day resulted in higher a median response rate. Also, when comparing 2-hour to full-day intervals, full day intervals produce a higher median response rate. Further development and validation of our smartphone survey should prompt participants once a day, consecutively to produce higher response rates. In addition, a comparison study between traditional paper logs and smart-phone logs are needed.

Surveying caregivers about the duration of various positions and devices used for infants: Is ecological momentary assessment necessary?

Marcelo Rosales, University of Southern California; Tanya Tripathi, Virginia Common Wealth University; Stacey Dusing, Virginia Common Wealth University; Beth Smith, University of Southern California

Introduction: The theoretical framework of ecological momentary assessment (EMA) suggests that full day recall is subject to bias. In order to address these inaccuracies, EMA provides a methodology for assessing constructs through multiple assessments during a day. However, EMA is limited by the fact that compliance decreases as participates are asked to complete more assessments throughout a day. Therefor the purpose of this study was to explore the necessity for EMA in quantifying the duration of various positions and devices used for infants, rather than one full day recall. Methods: Caregivers with infants (1–6 months) were asked to answer 2 versions of a smartphone-based survey for either 2 or 7 days. The first version (V1) was answered 6 times a day in 2-hour intervals. V1 asked about the amount of time each infant slept, ate, and spent in prone, supine, a car seat, carried, and being worn in the past 2 hours. The second version (V2) asked the participants to recall the durations of the same variables over the whole day. Answers were provided by selecting 15-minute categories (e.g. 1–15, 16–30). Paired t-tests and spearman correlations were performed comparing the aggregated sum of complete V1 survey sets and corresponding V2 surveys. Results: A data set of 10 complete days was compiled from 13 participants. Results showed no significant differences in the durations reported for all variables ($p > 0.05$). Spearman correlations found statistically significant relationships between sitting ($p = 0.012$) and worn ($p = 0.015$) duration. Discussion: These results indicate that caregivers report similar durations of sleeping, eating, position, and device use for both versions. However, the limitation to our study design is that these data are dependent and caregivers could sum prior response for the 12-hour recall. In summary, our preliminary results indicate that a single 12-hour recall is sufficient for our variables of interest; however, further validation is needed before implementation of the survey in an experimental study.

Children's metabolic expenditure during object projection skill performance

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Objective: To examine the metabolic cost (METs) of performing object projection skills in children. Methods: Children (42 age m = 8.1) participated in a within-subjects design with three nine-minute experimental sessions where participants performed kicking, throwing, and striking at three different trial intervals (i.e., 6, 12, and 30 second trial intervals). Skills were performed with maximum effort in blocks of five trials of each skill in serial order until each nine-minute session was completed. The average metabolic response (METs) during minutes 4–8 of each nine-minute session were calculated using a COSMED K4b2 portable gas analyzer. Average METs in each interval condition were calculated and a 3 (interval condition) × 2 (sex) ANOVA was conducted to examine differences in METs across groups and sex. Results: Data indicated a main effect for interval condition ($df = 2, 123$, $F = 94.36$, $p < .001$, $\eta^2 = 0.605$). Post hoc t-tests demonstrated decreasing performance interval times yielded significantly ($p < .001$) and progressively higher metabolic expenditure across the three conditions [30 sec = 4.46 (±0.75) METs, 12 sec = 6.32 (±1.30), 6 sec = 8.30 (±1.63)]. There also was a main effect for sex ($df = 1, 120$, $F = 52.28$, $p < .001$ $\eta^2 = 0.305$). Post hocs indicated boys demonstrated higher METs at each performance trial interval. The average metabolic expenditure for boys and girls respectively were 9.29 (±1.36) and 7.22 (±1.15) METs during the six second intervals, 6.98 (±1.13) and 5.60 (±1.09) METs during 12 second intervals and 4.76 (±0.68) and 4.13 (±0.70) during 30 second intervals. Conclusion: Results indicate skill practice with a maximum of one trial every 30 seconds resulted in the equivalent of at least moderate PA (>4.0 METs) and intervals of 6 seconds demonstrated vigorous (>7.0 METs) PA. While developing motor competence is important for developing long term activity habits, these data also indicate practicing/performing object projection skills, even at intervals that allow for instruction and feedback, (1 trial/30sec) is equivalent to MVPA levels in children.

Differences in physical performance and physical activity among students participating in organized sports

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The purpose of this study was to investigate differences in physical performance (i.e., cardiovascular endurance, fundamental movement skills and muscular endurance) of Finnish students in relation to their participation in organized sports among Finnish students. The participants of the study

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were 969 Finnish Grade 5 (mean age = 11.27, sd = 0.32) students (493 girls, 476 boys) who completed questionnaires regarding involment in organized sports. Students then participated in a series of physical performance tests (5) under the surveillance of research group.Statistical analysis involved formulating three groups based on the number of different organized sports students reported regular involvement (i.e. one; two; and three or more sports. Physical performance tests included tests of 20 meters shuttle run, curl-up, push-up, standing five-jumps, and combined throwing and catching. One-way Anova was used to compare group differences in physical performance variables. Results demonstrated that those children who practiced three or more sports performed better on standing five-jumps, curl-up, and push-up tests than those who practiced only one sport (p = .013–.043). Those who practiced two sports had stronger performances in shuttle-run and push-up tests (p = .003–0.013) than those who practiced only one sports. There were no differences between students participating in two sports or three or more sports in physical performance tests.Those who practiced just one sport, had less active days (at least 60 minutes/day) than those who practiced two or more sports (p = .020–0.21). There were no differences between different groups in free play time or screen time. Participants practicing only one sport had less coach-led trainings and overall training when compared to participants with two or more sports participated.In conclusion, those practising several sports had better physical performance than participants involved in only on sport.

Development and validation of a set of cognitive tasks for inhibitory control' assessment in children: Go/No-go paradigm in and app for mobile device

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Background: Executive functions are high-level of cognitive processes, such as inhibitory control, working memory and cognitive flexibility, which control goal-directed behavior and adaptive responses to novel and complex tasks. Therefore, executive functions control a range of operations and functions that are critical to everyday functioning in life, however assessing this complex function is a challenge for researchers and instruments still in needed. Specifically, investigated inhibitory control is necessary to better understand children movement acquisition, but protocols for assessment are limited. Considering the accessibily to technological resources, this dvantage, was used in the present study to develop and validate a set of cognitive tasks for assessing inhibitory control frameworked on the Go/No-go paradigm using a App for mobile device. Methods: The Go / No-go App assessment was develop to assess children thorougout presenting tasks that convey visual and auditory stimuli. Three neuropsychology' experts in the field particcipate in the avaliation of content clarity and relevance of the Go/No-go App tasks. After expert and face validity, a group of children (total: N= 230; Girs: N = 95, 41%; Boys: N = 135) aged 8 to 10 years-old, from public and private elementary schools in Brazil were assessed. Results: Experts and professionals confirmed the clarity and relevance of the four tasks (items) with high levels of agreement (values of kappa > 0.90). The Go/No-go App showed adequate internal consistency (chronbach $\alpha = 0.80$, McDonald's omega (ωt) = 0.82). In confirmatory factor analysis the factors showed the following values: Auditory motor ($\gamma = .83$), visual motor $\gamma = .72$), verbal auditory ($\gamma = .66$) and visual verbal ($\gamma = .73$). The model presented adequate adjustment indices (c2 = .478, p = .787), c2/DF = .239; RMSEA =.00; GFI = .99; CFI = 1.00; AIC = 326.9). Conclusion: The four tasks proposed to investigate the inhibitory control in children using an application (Go/No-go app) showed adequate evidence of validity.

Funding source: CAPES and CNPq.

Different and nuanced patterns of improvement in cognitive and motor functions in preschool children following a mastery motor skill intervention

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Many studies have suggested that changes in motor abilities lead to changes in cognition including executive function. However, few studies have evaluated these relationships in young children (e.g., pre-school age). In addition, several studies have linked poverty and neglect with lower cognitive abilities, learning, and academic performance. Therefore, young children exposed to poverty may be considered an at-risk population. This study examined changes in cognitive and motor function in low-income preschool children from a Head Start program resulting from a motor skill intervention. The NIH Toolbox Cognitive Battery and Test of Gross Motor Development (TGMD) were administered before and after the intervention; a control group participated in unstructured free play (30 minutes for 13 sessions). The children in the intervention groups participated in a mastery motivational climate with three different conditions: one condition emphasized motor skill instruction, one focused on physical activity and fitness, one consisted of a combination of both. A total of 75 children participated. Linear regressions were used to examine each dependent measure (post-test) with pre-test scores as a covariate (within-subject factor), group as the between-subject factor, and a group x pre-test (i.e., group x time) interaction. The motor skill group showed greater improvement in motor abilities and inhibitory control and task flexibility compared to the other groups, but the individuals that showed the greatest improvement depended on the outcome measure. For example, for executive function, the children with high scores at pre-test showed the greatest improvement, while for the TGMD, the children with low pre-test scores showed the greatest improvement. Overall, the mastery motivational climate focused on motor skill development lead to improved cognitive and motor skills, but the pattern of effects on these two types of skills is different and nuanced.

The impact of object size on children's motor planning skills

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The movement context has been shown to influence second-order planning and the end-state comfort effect (the tendency to prioritize a comfortable final hand position as opposed to an initial one). Recent work revealed that 5- to 7-year-old children, albeit demonstrating the least end-state comfort compared to older children (age 8 to 12) and young adults, displayed more end-state comfort in pure pantomime compared to pantomime with image/object as guide, and actual object use. One possible explanation for this counterintuitive finding was that the "adult-sized" object being manipulated in actual use altered the way young children approached the task. Studies of first order planning have indeed revealed object size in relation to hand size to influence the kinematics of reach-to-grasp. Thus, it is possible that physical characteristics (i.e., small hands, large glass) led children to disregard the end goal of the task, and prioritize a comfortable start state posture. To test this hypothesis, object dimensions were manipulated in an overturned glass task requiring second order planning. Typically developing 7- to 8- (n = 15, mean age = 8.24 years) and 9- to 10-year-olds (n = 15, mean age = 9.69 years) performed the task with 8 glasses, each with a different circumference (15.5 cm, 17 cm, 18.5 cm, 20 cm, 21.5 cm, 23 cm, 25 cm, 27 cm; 3 trails/glass). Analysis revealed a significant interaction between group and object size ($p < .05$); however, no clear pattern of results could be discerned from the data. Seven- to 8-year-olds displayed the least ESC with the second largest glass (25 cm), and evidence of ESC with the largest glass (27 cm) did not differ from any other sized glass. No differences emerged within 9- to 10-year-olds as a function

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of object size. Interestingly differences emerged between the two age groups when acting with the 17 cm and 20 cm glasses, such that 7- to 8-year-olds displayed more ESC. Findings likely reflect the preliminary nature of this investigation, and clearly further research is warranted.

Funding source: University of Windsor Internal Start-up Grant.

Gross motor proficiency of 4 to 15-year-old Canadian children in Calgary, Alberta

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Developing proficiency in fundamental movement skills is necessary for games and sports, cognitive ability, psychosocial health, and daily living. The objective of this study was to investigate the gross motor development (GMD) of 589 4 to 15-year-old typically developing Canadian children using the Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (BOT-2). Specifically, does a sample of Canadian children fall within the established American norms? Participants were within the normal range for GMD (scale score range 11-19). However, upper limb coordination (M = 13.5) and balance (M = 14.3), failed to meet the average scale score (15). Bilateral coordination (M = 17.1) and running speed & agility (M = 16.8) showed the best results. BMI was associated with balance ($p = 0.013$), running speed & agility ($p < 0.001$) and strength ($p < 0.001$). Age was associated with all five subtests (all $p < 0.05$) and gender was not associated with any subtests. This study can serve as a baseline for other researchers studying GMD in Canadian children and youth.

Funding source: Government of Alberta, Canada.

The influence of motor competence and obesity on physical activity and fitness among children with intellectual and developmental disabilities

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Objective: Given the increased prevalence of obesity among children, research efforts have shifted to understanding ways to influence trajectories of health. The contributions of motor skill competence to participation in physical activity (PA) and improved levels of health-related physical fitness provide a conceptual framework to guide these intervention efforts. This research examines the relationship among these variables in a sample of children with intellectual and developmental disabilities (IDD) who are at an increased risk for obesity. Children with IDD also have impaired performance of motor skills, decreased participation in PA, and lower levels of health-related physical fitness. Methods: This research included 23 children (19 boys, 4 girls) with IDD, ranging in age from 7 to 12 years (x = 9.46 years). Diagnoses included autism spectrum disorder (n = 14), Down syndrome (n = 2), fragile-x syndrome (n = 2), fetal alcohol spectrum disorder (n = 1), and global developmental delay (n = 4). The relationships among motor skill competence (TGMD-3) and levels of obesity, PA participation (GT3X accelerometers), and health-related physical fitness (Brockport Physical Fitness Test) were examined. The sample was divided into quartiles to examine the influence of motor skill competence and obesity on MVPA and components of health-related physical fitness. Results: Based on BMI percentiles, 3 children were overweight and 4 obese. Pearson Product-Moment correlations do not support relationships between motor competence and time spent engaged in MVPA for children with IDD. However, motor competence and obesity were significantly related to components of health-related physical fitness. Children with IDD who were overweight or obese ran significantly fewer shuttles on the 20m PACER. Children with low motor competence held the isometric pushup for significantly less time. Conclusion: Intervention efforts to promote trajectories of health among children with IDD need to be multifaceted and may need to consider additional barriers to participation.

Funding source: n/a.

"You throw like a girl!": Young children's gender stereotypes about motor competence

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Objectives: Determining if children hold stereotypes about motor skills may influence sex differences in motor skill performance. The purpose of this study is to examine whether young children hold stereotypes related to the performance of locomotor and object control skills. Methods: We recruited children ($N = 83$) ages three to six years olds ($M_{age} = 55.24$ months, SD=6.94; $girl = 44$) from a Head Start center in the southeastern United States to participate in the study. All children completed two measures: 1) an assessment of fundamental motor skills via the TGMD-2 and 2) an assessment of their stereotypes associated with motor skills using a modification of the Children's Occupations, Activities and Traits Measure (COAT) that was modified to assess motor skill stereotypes. Results: Results for awareness revealed a main effect for participant sex for both locomotor, $F(1,82) = 4.67$, p =.034, eta^2 = .54, and object control skills $F(1,82) = 8.00$, $p = .006$, eta^2 = .89. Findings demonstrate that girls were more aware of stereotypes associating boys with better object control and locomotor skills. Results for stereotype-endorsement revealed a main effect for sex for both locomotor, $F(1,82) = 9.44$, $p = .003$, eta^2 = .10, and object control skills $F(1,82) = 6.12$, $p = .015$, eta^2 = .69. Results reveal that girls endorsed stereotypes indicating that boys can perform both locomotor and object control skills. Results for flexibility indicated no main effect of sex for locomotor skills, $F(1,82) = 2.40$, $p = .125$, eta^2 = .02. However, results indicated a main effect for sex on stereotype flexibility regarding object control skills $F(1,82) = 7.44$, $p = .008$, eta^2 = .83. Conclusion: Findings indicate that boys and girls did not demonstrate differences in their flexibility in thinking about stereotypes associated with locomotor skills. However, girls were less flexible than boys in their attitudes towards object control skills. Results demonstrate the importance of addressing gender-based stereotypes in young children by providing activities that reinforce motor skill opportunities for boys and girls.

Posture and play: How infants use their bodies to interact with their surroundings in the first two years

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Locomotor progression provides infants with increasing postural options, which broadens their active discovery, interactions with, and explorations of their environments. Here, we examined to which extent progression from sitting to walking affects the range of interactions infants entertain with their surroundings during play. We observed 13 infants in 10-min laboratory free play sessions, held biweekly from 6 to about 17 months. The room was equipped with objects to elicit fine and gross motor exploration. At 15-sec intervals, we used The Observer XT to video-code infants' targets of interaction (e.g., objects, furniture, their mothers), postures (e.g., sitting, standing), and types of interactive behaviors with targets: passive involvement (e.g., holding), fine motor manipulations (e.g., spinning), or gross motor exploration (e.g., climbing). We also identified moments when infants transitioned from one target to another to understand whether they changed or maintained postures through those target transitions. During the *pre-locomotor* period, infants used sitting postures predominantly to engage in fine motor manipulations of targets ($p < .001$). When they transitioned

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between targets, they did so while maintaining their posture. In the *crawling* period, infants' use of sitting postures for focused fine motor manipulations declined ($p < .009$). Now infants began using kneeling/squatting postures for fine motor manipulations of targets and also used passive involvement ($p < .001$). During the *walking* period, infants used sitting and standing postures mainly for passive involvement with targets ($p < .014$), whereas kneeling/squatting postures continued to be used for passive involvement and fine motor manipulations ($p < .001$). During the locomotor periods, infants' transitions from one target to another usually also involved a change in posture ($p < .001$). Infants use their bodies as tools for discovery. As they gain locomotor skills and postural experience, they diversify their postures to interact with their surroundings in increasingly varied ways.

The Test of Gross Motor Development–3rd edition: Validation of instructional sensitivity

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Objective: Researchers interested in studying the effects of various independent variables on gross motor skill development in children have to feel confident in selecting and using measuring instruments that are sensitive to change in performance. Seldom do test developers validate the instructional validity of their instrument. The TGMD demonstrated excellent instructional validity in its original edition (Ulrich and Ulrich, 1984). Any time a test instrument is modified in a new edition, all psychometric properties must be re-evaluated. The Test of Gross Motor Development-3 has been re-normed and re-evaluated with the exception of instructional validity. The aim of this investigation is to evaluate the instructional validity of the TGMD-3 in typically developing children. Methods: 36 children in kindergarten (n = 12), first (n = 13) and second grades (n = 11) participating in elementary physical education for 84 minutes weekly were pre tested and then post tested following 10 weeks of instruction. The TGMD-3 was employed in this study following standardized procedures. Results: The mean age for boys in this study was 6.69 years (.87) and for girls was 6.56 years (1.02). Significant group differences (pretest vs post- test means) were observed for the locomotor skill subtest, ball skill subtest, and total TGMD scores in each grade and for the combined total sample at the .01 level. Girls scored a little higher on the locomotor skills subtest on the pre-test and post- test while boys scored significantly higher on the ball skills subtest on the pre-test and post-test. Conclusion: Based on this study with 5–7 year- olds enrolled in kindergarten, first, and second grades, children made significant improvement in their gross motor skills during 10 weeks of instruction, and the TGMD-3 was sensitive to this significant improvement in performance. These results provide initial evidence for instructional validity of the TGMD-3 for typically developing children. Future research needs to be conducted for other ages and for various disability groups.

Motor developmental windows and trajectories of preterm and full-term infants in the first year of life

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Background: Motor development is represented by periods of motor skills' acquisition, adjustment and variability. The objectives of this study were analyzed and compare biological and health characteristics and motor skill acquisitions' trajectories of preterm and full-term infants during the first year of life. Methods: 2579 infants (1361 preterm) from 22 states were assessed using the Alberta Infant Motor Scale. Multivariate General Linear Model, t-Tests, ANOVA, and Tukey post hoc were used. Results: Age by Groups significant interactions were found for motor scores. Follow up tests revealed that full-term infants presented higher scores in prone, supine, sitting and standing postures that require complex trunk control from 9 to 10 months of age; although, this advantage was observed for sitting from the second month of life. Discussion: During the first trimester preterm infants demonstrate higher scores in the supine and standing postures. Regarding to motor trajectories, from newborn to 12 months, the periods of higher motor acquisition was similar between full-term and preterm infants for prone (3-to-10 months), supine (1-to-6 months), and standing (6-to-12 months). However, for siting posture full-term infants demonstrated higher periods of acquisitions from the first to 7 months of life, whereas for preterm infants a shorter period was observed (3-to-7 months). Conclusion: Although the periods of higher motor acquisitions were similar, full-term infants demonstrated higher scores in more control' demanding postures. Intervention for preterm infants need goes beyond the first months of life and includes guidance Funding source: CAPES and CNPq.

Associations between gross motor skills and cognitive development in Australian toddlers

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Purpose: The early years of life are critical for motor and cognitive development. More research is needed to better understand the associations between the control and development of motor and cognitive tasks. This study aimed to examine the association between gross motor skill development and cognitive development in children aged 11 to 29 months. Methods: This cross-sectional study involved 335 toddlers (aged 19.80 ± 4.08 months, 53.7% boys) recruited from 30 Early Childhood Education and Care services in NSW, Australia. Gross motor skills were assessed using the Peabody Developmental Motor Scales 2nd Edition (PDMS-2). The gross motor quotient (GMQ) and subtest standard scores were used for analyses. Cognitive development was assessed using the Bayley Scales of Infant and Toddler development – 3rd edition (Bayley-III). The standard score was used in the analyses. A one-way ANCOVA was conducted to assess associations between gross motor skills and cognition controlling for childcare center, sex, age, body mass index and socioeconomic status. Results: The average standard score for cognitive development was 11.45 ± 3.03. For gross motor skills, the average GMQ score was 96.41 ± 9.84. There was a significant effect of gross motor skills on cognition, $F(2, 260) = 12.245$, $p < 0.001$. Both locomotion and object manipulation had a significant effect on cognition, $F(2, 266) = 14.607$, $p < 0.001$ and, $F(2, 265)=9.039$, $p < 0.001$ respectively. Conclusions: Gross motor skills and cognition are associated in this sample of toddlers. Results reinforce the need for early commencement of gross motor skill promotion as this might be important for cognitive development in the early years.

Funding source: Early Start, Australian Research Council.

Physical activity during different physical education instruction environments

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Background: Physical education (PE) aims to educate children to become physically literate and active for life. Fundamental movement skills (FMS) are an essential component of physical literacy. Research has demonstrated

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mastery motivational climates are effective in increasing physical activity (PA) and FMS in children. To date few studies have examined the effects of mastery climates on PA levels during PE in primary school children. The purpose of this study is to examine the effects of different mastery climate PE environments on PA during PE lessons. Methods: This 10-week randomized trial included 45 children (mean age = 9.0 ± 0.5 years, 48.9% boys) from a primary school in the United States. Participants were randomly assigned to one of three mastery climate environments: 1) FMS 2) PA and 3) combination (FMS + PA). The environments were implemented three times per week during the regularly scheduled PE lessons for 30–40 minutes. PA was measured randomly during 14 of the 38 PE lessons (36.8%) using accelerometers and the average was used for analysis. A one-way ANCOVA was conducted to determine the differences in PA during PE lessons between the environments. Results: There was a significant effect of instructional climate on moderate to vigorous PA (MVPA; $F(2, 40) = 7.730$, $p < 0.001$) and vigorous PA (VPA; $F(2, 40) = 4.372$, $p < 0.019$) after controlling for sex and age. Post-hoc analyses revealed children in the FMS environment had significantly higher MVPA levels than children in other environments and higher VPA levels than children in the PA environment (all $p < 0.05$). Conclusion: A FMS mastery climate environment during PE lessons is effective in increasing the amount of time spent in MVPA and VPA. Besides the positive effects on PA, improving FMS is also beneficial for several health- and developmental-related benefits such as weight status, self-perceptions and cognitive development. Therefore, introducing FMS mastery climate environments in PE lessons might be an important avenue to increase PA, as well as other health- and developmental-related benefits.

Age-related changes in visual MT/V5 cortical oscillations are associated with visuomotor task performance

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Cortical processing in visual MT/V5 is necessary for tracking movement and performing reliable visuomotor transformations. Although the role of this cortical area is well recognized, changes in its activity across development and the association of this cortical area with motor control is not well understood. This study used magnetoencephalography and advanced beamforming methods to image the neural oscillations in the visual MT/V5 area as a cohort of typically developing children (N = 29, Age Range = 11–17 yrs.) viewed a random array of coherently moving black dots. Separately, the children also performed a visuomotor behavioral task that consisted of generating isometric knee extension forces that animated a box to ascend vertically in order to match targets that were between 5–25% of the child's maximum force. Our brain imaging results revealed that occipito-temporal neural oscillations had a pattern of alternating theta/alpha (5–10 Hz) event related synchronizations (ERS) and beta (15–25 Hz) event related desynchronizations (ERD) that were time locked with the moving dots. In addition, there was a negative correlation between the child's age and the strength of the beta ERD (rho= –0.68; $P < 0.001$) in the visual MT/V5 cortices. There also was a negative correlation between the child's age and time to match the target (rho = –0.48; $P = 0.013$), and a negative correlation between the strength of the beta ERD and the velocity of the force production (rho = –0.48; $P = 0.013$) and time to match the target (rho= 0.57; $P = 0.002$). Overall, these results indicate that the strength of the neural oscillations in the visual MT/V5 cortical area were associated with better performance on a visuomotor task. Moreover, they show that older children tended to have stronger beta ERD and were able to perform the visuomotor task better. Altogether, our results suggest that there might be key maturational changes in the visual MT/V5 cortical area that are associated with the development of motor skills in children.

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Screen-time usage and fundamental motor skill competency in preschool children

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Purpose: The purpose of this investigation is to examine the relationship between fundamental motor skills (FMS) and screen-time usage in preschool-age children. Methods: 88 preschoolers (*M*age = 3.4 +/– 0.5 years; 47% male) from 8 preschools in the Southeastern region of the United States were included in the analysis. Screen-time usage inside and outside of preschool (via proxy and direct observation) was measured as well as FMS competency with the Test of Gross Motor Development – 3rd edition (TGMD-3) and the Movement Assessment Battery for Children – 2nd edition (MABC-2). Mixed linear models were calculated to examine the association of FMS scores with total screen time, type of screen, and presence of a TV in the child's bedroom. Models controlled for age (TGMD-3 scores), sex, and household income, with childcare center as a random effect. Results: Preschool children acquired 4.3 +/– 3.2 hours of screen-time daily and 31% of children examined had a TV in their bedroom. Average TGMD-3 total raw scores were 36.5 +/– 11.5. Average MABC-2 total percentiles were 32.3 +/– 26.6. Children with higher total screen-time had marginally lower MABC-2 manual dexterity scores (beta [SE]: –2.0[1.1]; $p = 0.0877$). Children who exhibited higher scores on the MABC-2 aiming and catching subscale tended to watch more TV (7.6 [3.7]; $p = 0.04$) and had a TV in the bedroom (–32.3[11.0], $p = 0.004$). Preschool children's screen-time was not significantly related to TGMD-3 total score or subscale scores (i.e., locomotor or ball skills). Conclusion: Preschool-age children are spending over four times the recommended amount on screen-based devices. In preschool-age children, manual dexterity seems to be the only FMS that is negatively impacted by higher total screen-time. There is evidence indicating that even when controlling for household income, some increased screen time is associated with higher levels of FMS. Longitudinal work is needed to examine the impact of prolonged exposure to screens and if this may impact FMS development or other health-related variables in young children.

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How does the discovery of a non-obvious perceptual property impact perceptual-motor exploration of objects in infants?

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Research has highlighted the cyclical relationship between perception and action during object exploration. The current studies aimed to investigate whether infants would come to discover a non-obvious perceptual property in one of two objects when exploring them repeatedly via looking, reaching, and manipulation, and how competing visual information would affect this discovery. In study 1, 17 infants aged 11 months were presented with two objects, first out of reach, and then within reach to allow manipulation up to 10 trials. The objects' obvious features only differed in color, but one object was filled with rice and would make noise when shaken, a perceptual property that could only be discovered by object manipulation. Eye-tracking was used to measure gaze on the objects while out of reach and video recording was used to analyze object manipulations. For each trial, we identified: the object fixated first, object looking durations, which object was contacted first, object contact durations, and object shaking durations. All durations were normalized out of the trial duration. Comparisons between objects revealed no overall differences in looking, but infants shook the filled object more than the unfilled one ($p < .002$). Generalization of this

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selection was tested with novel shapes in 6 trials. Results showed that infants continued to shake the filled object more ($p < .001$) and also maintained more contact with that object than the unfilled one ($p < .010$). Eighteen 11-month-olds participated in study 2, in which the only methodological difference was that the unfilled object was painted with polka dots. In this study, the only statistical differences found were more first fixations ($p < .028$) and accumulated looking to the unfilled/detailed object ($p < .0001$) vs. the filled/plain object. Findings from both studies showed that in absence of competing visual salience, infants were able to discover the object with the non-obvious perceptual property through manipulation. With such competition, infants showed no differences in how they manipulated the objects.

Funding source: NASPSPA Graduate Student Research Grant.

Dimension identification and item reduction in the ALESA: A pilot study in female youth athletes

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Purpose: We examined the construct validity of the 8-item Advanced Lower Extremity Sports Assessment (ALESA) by identifying its underlying motor dimension(s) in female youth athletes through Item Response Modeling. In addition, a revised short-form ALESA may be achieved by appropriate item reduction. Methods and Results: Thirty 12- to 17-year-old female youth athletes were recruited from local youth soccer teams. All participants performed the ALESA which includes eight single leg hopping/balance tests: single leg hop (SLH), single leg triple crossover hops (SLTCH), side hops (SH), figure of eight hops (Fig8), modified agility T-test (MAT), single leg squats (SLS), single leg hops: stick series (SLHS), and single leg balance (SLB). The raw data of the ALESA subtests (i.e., 150 cm hopping distance in the SLH test) were transformed to a dataset of polytomous responses (0 as below average, 1 as good, or 2 as excellent). RStudio software (Ver. 1.0.136) was employed to implement the exploratory and confirmatory analyses by using the SIRT and TAM packages respectively. From the exploratory analysis comparing with the 1- to 4-dimensional item response models, only the 2-dimensional model (Detect Index: 6.76) was selected for further confirmatory analysis. Subsequently, the results indicated that the 2-dimensional Generalized Partial Credited model was better than the Rasch model for the revised ALESA, removing SLS, SH and MAT subtests, due to the better model fit (smaller maximum Chi-square) and acceptable local independence (Q3 index: -0.39 ~ 0.14). Conclusion: Our results support the hypothesis that the ALESA assesses two underlying motor abilities (the dynamic mobility [i.e., the Fig8] and functional stability [i.e., the SLHS]) for female youth athletes. Additionally, the short-form ALESA (the SLH, SLTCH, Fig8, SLHS, and SLB), for the polytomous response data still showed to have satisfactory construct validity.

A comparison of sleep behavior, physical activity, feeding, and weight in 6-month old infants

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Introduction: Burgeoning infant physical activity (PA) research suggests connections between PA and concurrent growth. Infant sleep also appears important for both global development and obesity risk. In older children, sleep is related to PA, and both variables are important in obesity etiology. It is thus plausible that these relationships also exist during infancy; however, this has not been clearly investigated. The purpose of this observational study was to examine the relationship of sleep behavior to PA, feeding behavior and infant growth. Method: 22 six-month-old infants were measured during a 24 hr period in their home. Sleep and PA data were collected with both parent report and accelerometry (Actigraph GT3X-BT). Feeding behavior was measured via a parental log. Infant weight and length were measured using an infant scale and infantometer. Sleep behavior was summarized as total number of nighttime awakenings, minutes of nighttime wakefulness, and total sleep duration. PA was summarized as total minutes of time spent in high and low intensity quartiles, based on individualized accelerometer count ranges. Results: Results were assessed using bivariate correlations and ANOVAs. Sleep duration significantly related to minutes of PA in the lowest quartile ($r = -.524$, $p = .012$), feeding modality [$F(2,19) = 3.756$, $p = .042$], frequency of nighttime feeding [$F(3,18) = 4.963$, $p = .011$], and weight-for-length z-scores ($r = -.481$, $p = .024$). Infants accumulating more minutes of sleep spent less time in low-intensity PA, received mixed feedings (formula and breast fed), had fewer nighttime feedings, and had lower weight-for-length z-scores. Frequency and duration of nighttime awakenings did not relate to PA, feeding behavior or infant growth. Conclusion: While previous literature has positively linked both sleep and PA to other infant developmental factors, the way sleep behavior and PA interact has not yet been investigated. This knowledge benefits the scientific community by examining two modifiable factors that influence healthy growth and development in infancy.

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Motor Learning and Control

The influence of attentional focus instructions on the learning of a balance task in individuals with visual impairments

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The purpose of this study was to examine the effects of attentional focus instructions on the learning of a continuous balance task in individuals with profound visual impairments. Participants had either acquired or congenital visual impairments, including complete blindness, low vision in both eyes, or blindness in one eye and low vision in the other. Participants were randomly assigned to one of three attentional focus groups including internal focus (i.e., focus on the feet), external focus (i.e., focus on the platform), and control (no instructions). The task was to ride a Pedalo (Pedalo® Reha-Bar S) forward for a distance of 7 meters. On day 1, the participants performed 20 practice trials with attentional focus instructions given before each block of 5 trials. On day 2, two learning tests were conducted in which participants were asked to ride the Pedalo forwards and backwards as fast as possible (6 trials each), without receiving any attentional focus instructions. Task performance was measured as the amount of time it took to ride from the start to the finish line. Results indicated that the group who were given the external focus instructions outperformed both the internal focus and control groups during the learning tests. These findings suggest that external, relative to internal or no focus instructions, facilitates motor learning in individuals with visual impairments, highlighting the independency of external focus benefits from vision. This work was partially supported by the Czech Science Foundation (GAČR 18-16130S).

Learner controlled amount of practice with fixed inter-trial interval benefits learning

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Allowing control over aspects of the practice environment has been found to facilitate learning. One manipulation that learners appear to benefit from is controlling the amount of practice. Post et al. (2014) found that self-control over the amount and pacing of practice benefits learning to a greater extent than learners without such control. However it is uncertain if the benefits of self-control observed in the prior study were related to participants' ability to control the number of practice trials or the pacing at which the practice was completed. The purpose of the present study was to investigate the effects of self-control amount of practice while holding the inter-trial interval constant. Participants practiced two five-digit sequential timing tasks and were semi-randomly placed into a self-control (SC: n = 15) or yoked group (YK: n = 15). SC participants were allowed to manipulate the amount of practice completed during acquisition and YK individuals received the same amount of practice as their SC counterpart. Following practice individuals took a 10 minute break prior to completing retention and transfer testing. Practice was analyzed with mixed factors ANOVAs and retention and transfer were analyzed with separate univariate ANOVAs. Participants decreased absolute, constant, and variable error during practice ($p < .001$), but groups did not significantly differ ($p > .05$). During retention SC had significantly lower absolute error ($p < .05$). SC also had significantly lower absolute error ($p = .05$) and variable error ($p < .05$) during transfer. Analysis of response time when executing a trial revealed no main effect ($p > .05$). However, a block by group interaction was significant ($p = .05$). This was caused by SC having longer response times at the beginning of practice and decreasing that time to a similar response time as YK at the end of practice. The results of the current study suggest a benefit to allowing learners control over the amount of practice similar to previous research (Post et al., 2012; 2014) even when the inter-trial interval is held constant.

Gait, executive function, and falling in older adults

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Older adults (OA) with a fall history walk slower, have shorter step length, and show increased variability, but how cognitive components affect gait variables in older adults with (FALL) and without a fall history (NOFA) is not fully understood. Understanding how executive function demands contribute to falls is imperative to improve care of fall prone OA. A study was designed to investigate gait parameters during single task (ST) and dual-task (DT) performance in OA with and without a fall history. 648 healthy OA (55-95 years) were divided into two groups; reporting a fall in the past year (N = 142; FALL) and having no history of falls (N = 506; NOFA). Participants were instructed to walk at a normal pace two 6-meter laps (ST) and to perform this task while counting backwards by 7 (DT). A Gait Rite measured several gait variables and variability was estimated by calculating the coefficient of variation (CV). FALL differed in ST significantly from NOFA on CV stride velocity, CV stance time, CV stride time, CV stride length, CV step time, and CV step length. FALL differed in DT significantly from NOFA on CV stride velocity, CV stride length, CV step length, double support load time, double support time, single support time, stance time, swing time, and stride time. PCA for ST and DT yielded both 5 components, but different ones, explaining 83.1% and 84.6% of variance respectively. These results corroborate previous findings showing gait characteristics of older adults with and without fall history differ. Furthermore, gait characteristic changes differ between these two groups when a task that increases executive function demands is added. This suggests that investigating ambulatory fall reduction protocols for OA should include dual task conditions. Further research is needed to understand which gait characteristics change and how characteristics change between walking without and with an executive function demanding task. This understanding will help determining which variables should be assessed to predict falls in older adults and possibly be targeted to reduce falls.

Performing a visual-motor stone-stepping task on a hard and compliant surface: Effect on balance and target accuracy

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Adaptive locomotion relies on sensorimotor integration, specifically the input of somatosensory and vestibular information to detect changes to the body and vision to perceive changes to the environment, in order for

the motor system to act accordingly. The objective was to determine if the ability to perform adaptive locomotion during a stone-stepping task was affected by differences in accuracy of the somatosensory information. It was hypothesized that inaccurate somatosensory information would affect overall performance due to a negative influence on balance control. Differences in the accuracy of the somatosensory information was accomplished by having participants (n = 24) perform the task on a foam surface (mean age: 21 years) or on flat ground (mean age: 20.9 years). Participants walked along a 6m pathway while stepping on 12 irregularly placed footprints. Footprint location was consistent on both surfaces with the 9th footprint projected onto the surface from a ceiling-mounted projector. Stepping on the 8th footprint triggered the 9th to shift 15 cm anterior, posterior, medial, lateral, or not at all. Foot placement location on the shifted step was always compared to the no shift condition. Other dependent measures included: minimum dynamic stability margin (DSMmin; minimum ML distance between the COM and BOS during single support), time to DSMmin (the difference in time from single support to DSMmin), and trunk pitch and roll variability. Contrary to the hypothesis, performing the task on foam did not significantly affect the ability to accurately place one's foot on the shifted step nor change trunk pitch and roll variability. However, there was a significant increase in DSMmin and a significantly slower time to DSMmin from the trigger step to the step after the shifted step, which indicates an increase in stability. The findings suggest that individuals were most likely able to upregulate vision in compensation for inaccurate somatosensory information by fixating on stable reference points (i.e. footprints) to allow vision to stabilize the trunk.

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Is intensity a critical factor in motor rehabilitation for Parkinson's disease?

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The identification of scientifically-validated exercise rehabilitation strategies to improve the motor (and sometimes cognitive) symptoms of Parkinson's disease has become an important topic for movement scientists. Interestingly, the types of interventions are highly variable (for example, boxing, Swedish mountain climbing, Tai Chi) and hence are rarely based on targeting an identified underlying mechanism. Recently, tandem bicycling (expert cyclist lead and PD cyclist follow) has been studied (Alberts et al., 2015, 2016), with the notion that individuals with PD are 'forced' to perform at a higher intensity that their brains will allow. In contrast, Tai Chi and PD SAFEx are argued to be equally effective even though they involve much lower intensities. Thus, the current study compared treadmill training with i) a high rate of movement (RATE) to, ii) training with a high weight-bearing load (MAGNITUDE) and a control group, to match the groups for their high-level of intensity. Despite the groups being matched for intensity, frequency and duration, only the RATE group significantly showed a significant improvement (19.5%) in their clinical motor performance (UPDRS-III 23.35 ± 8.13 to 18.85 ± 7.17, $p < .01$). Interestingly this group also revealed upper limb motor improvements (12.00 ± 5.39 to 9.15 ± 4.14, $p < .01$), even though treadmill training was with the lower limbs. These results will be compared to the (20%+) improvements achieved by lower intensity exercise interventions (Beck et al., 2018), with the goal of identifying one common underlying mechanism between all of these interventions. Further, these findings will then be applied to predict the effectiveness of two martial arts interventions with low vs. high intensity (tai chi vs. karate) that are currently being studied.

Funding source: Canada Foundation for Innovation.

Discovering new methods for improving balance over varied conditions

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Vision plays a significant role in balance. Since nerve fibers from the eyes interact with the vestibular system, researchers have hypothesized that occluding vision in sighted individuals would force the vestibular system to compensate for the loss of visual input resulting in improved balance over time after an initial increase in errors (Nagy, et al., 2007; Giagazoglou, et al., 2009). The goal of this study was to determine whether the absence of sight results in an overall or a quicker rate of improvement over sighted training. The University IRB approved this study. The testing was performed on the Biodex Balance System SD. Twenty-eight male and female subjects were pre-tested on the Limits of Stability (LOS) which tracks postural sway and then paired based on their scores. Participants were randomly assigned to the blindfolded or the non-blindfolded group. The second test was the modified-Clinical Test of Sensory Integration of Balance (m-CTSIB). This test evaluates stability and sway throughout four different conditions (two of which are with eyes closed). The participants were reevaluated every two weeks during the 5-week training period and completed a post-test during the sixth week. The training consisted of balance and core exercises. The sessions occurred twice weekly and were led by one of the researchers. An independent t-test revealed no significant difference in LOS scores by group but there was an overall improvement in participant scores ($p = .0001$) and the m-CTSIB sway index with eyes closed on the foam surface significantly improved ($p = .009$). A repeated measures ANOVA was conducted with the data from the m-CTSIB tests. A Greenhouse-Geisser correction factor was used. There was a significant difference in the balance scores across time, $p = 0.0001$. However, there was no significant difference in the treatment (blindfold) effect, $p = 0.105$. Our findings did not support blindfolded balance training, but participants reported improved balance.

Evaluation of feedback helpfulness enhances skill acquisition during yoked feedback condition

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The positive effects of self-controlled feedback on the acquisition of motor skills have been extensively reported (see Wulf, 2007, and Sanli et al., 2013, for reviews). It has been argued that a self-controlled feedback schedule is beneficial to motor skill acquisition because it allows learners to tailor their feedback schedules to their needs (Chiviacowsky, & Wulf, 2002). This idea implies that during SC feedback schedules, learners evaluate their performance and the potential extrinsic feedback, then deciding if the extrinsic feedback would be helpful. Therefore, the purpose of this study was to verify the impact of the evaluation of feedback helpfulness on a yoked feedback condition. 57 volunteers were quasi-randomly assigned to either self-controlled feedback (SC), yoked feedback (YK) or yoked feedback with evaluation of feedback helpfulness (YE) groups. The task required participants to perform a modified golf putting task with the non-dominant hand to a target 6ft away. Points were awarded based on the distance of each putt to the target. Participants completed 7 blocks of 10 trials and saw the target only between blocks. Participants received feedback on 3 trials per block according to their feedback group. In addition, the YE participants were asked after each trial, but before receiving feedback, if feedback would be helpful in that trial. After 24-hr, participants completed a 10 trial retention test and a 10 trial transfer test with the target placed 5ft away. No feedback was provided during retention

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or transfer testing. The results of a Group) x Block ANOVA, with repeated measures for Block, indicated an effect of Block ($p < .01$), indicating all groups improved during acquisition. The results of a Group × Test ANOVA, with repeated measures for Test, indicated an effect for Test ($p < .01$); Transfer>Retention) and Group ($p = .017$). In this case, YK performed worse than SC ($p = .007$) and YE ($p = .029$) groups during retention and transfer testing.

Considering the effect of process and outcome oriented attentional focus cues

Kevin A Becker, Nick A Levine, Emily D Herbst, Texas Woman's University

A number of studies suggest an external focus of attention improves motor performance and learning relative to an internal focus (Wulf, 2013). Bell and Hardy (2009) reported that a distal external focus (e.g., ball flight) leads to more accurate golf chipping than a proximal external focus (e.g., club face angle at impact) for skilled golfers. These foci do differ in terms of distance from the body, but they also differ in whether they focus on the movement process (e.g., club face angle) or an outcome that occurs after the movement is complete (e.g., ball flight). The purpose of the present study was to determine if internal and external foci that reference outcomes are more effective than those that promote a process focus. Seventeen experienced weight lifters performed deadlifts for maximal speed at 60% of an estimated 1RM. They performed three trials each using an internal-process focus (IP), internal-outcome focus (IO), external-process focus (EP), and external-outcome focus (EO) in a counterbalanced order. Peak bar velocity was the primary dependent variable. A one-way ANOVA indicated a main effect of focus ($p = .001$), with EP producing higher velocity than IO ($p = .004$) and EO ($p = .015$), but not differing from IP. IP also led to higher velocity than IO ($p = .003$). These results contribute interesting findings to the literature. In contrast to Bell and Hardy's (2009) findings, the external-process focus condition outperformed the external-outcome condition. A key difference in the studies is that the task goal for golf is outcome oriented (e.g., accuracy), while the task goal here was process oriented (e.g., bar velocity). It is possible that an external focus most closely aligned with the task goal optimizes performance.

The presence of vision impacts attentional focus effects in a balancing task

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Attentional focus effects have generally been thought to be independent of vision, but some researchers have challenged that viewpoint (e.g., Maurer & Zentgraf, 2007). It has been hypothesized that an external focus may promote the use of more exteroceptive feedback (e.g., vision), and if vision is not present it is unclear if the performance advantage remains. Recent studies using blindfolded participants have demonstrated an external focus advantage when performing discrete tasks (Abdollahipour et al., 2016; Land et al., 2013). However, when children with visual impairments (VI) performed a continuous balancing task, only children with a moderate VI benefited from an external focus, while those with a profound VI did not differ between an internal and external focus (McNamara, Becker, & Silliman-French, 2017). The purpose of this study was to determine if the absence of vision influences the effectiveness of an external focus when balancing on a stability platform. Participants ($N = 32$) were randomly assigned to either a blindfolded or sighted group. All participants completed four familiarization trials, lasting 20 seconds each. Next, three 20 second trials using an internal and external focus were completed in a counterbalanced order. Root mean square error (RMSE) was analyzed in a 2 (Vision) × 2 (Focus) mixed-model ANOVA. A main effect of vision was present with sighted participants having lower RMSE than blindfolded participants ($p < .001$). The main effect of focus was non-significant, but the interaction of vision and focus was significant ($p = .004$). Sidak post-hoc tests indicated an external focus advantage for sighted participants ($p = .029$), but an internal focus advantage for blindfolded participants ($p = .042$). Our results suggest that for a balancing task reliant on sensory feedback, an external focus only improves performance when vision is present. It appears when vision is obstructed, an internal focus improves balance performance, perhaps by aligning more closely with the sensory feedback (e.g., proprioception) that is available.

Getting Ireland's children moving: Examining fundamental movement skills in Irish school children as a key component for physical literacy

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Recent reports from the World Health Organisation predict Ireland to be 'the most obese nation in Europe by 2030". In addition to this stark warning, recent research findings suggest that the country's adolescents are falling short of physical literacy. With physical literacy being recognised as a key driver in lifelong physical activity participation, phase one of the Moving Well-Being Well study has assessed primary school children (5–13 years) in all aspects of the currently accepted physical literacy model. Areas of assessment included; fundamental movement skills (FMS) proficiency, perceived motor skill competence, motivation and confidence measures, health related fitness measures, body image, wellbeing and physical activity participation. FMS proficiency has been associated with beneficial health outcomes, and is most successfully developed during early school years, and as such is a central component of this study. Data was collected nationwide ($n = 2098$, male 53%), and findings show that 77.5% of children scored between 'very poor' and 'below average' in FMS proficiency. There was no difference between children attending urban and rural schools, but notably, when socioeconomic status is taken into account, the schools in middle and upper-class neighbourhoods scored significantly higher ($p < 0.001$) than those in the so called disadvantaged areas. The results also show significantly higher ($p < 0.001$) FMS proficiency for children who achieve high levels of moderate to vigorous activity (MVPA), over those who are less active. Findings suggest that Irish primary school children fail to exhibit age-appropriate FMS proficiency. This low level of motor skills proficiency can have direct negative implications for future participation in physical activity. These findings are being used to create the structure of the Moving Well-Being Well intervention aiming at addressing these deficiencies.

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Effects of muscle size and sex on fractionated reaction time

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Fractionating reaction time (FRT) chronometrically separates central from peripheral processing, allowing for analysis of variables that may influence either. The primary purpose of this study was to determine the effect of muscle size 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 muscle size condition (small or large) alternated by blocks. The foreperiod duration was 2500 ms and remained consistent for all trials. 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. The sEMG signals of the

abductor pollicis brevis (APB) of the thumb and the lateral triceps brachii (LTB) on the right upper extremity were measured as the small and large muscles, respectively. Employing a counter-balance of condition by block, participants responded with either a rapid thumb press of a key on a Serial Response Box or a rapid downward stroke with the palm on a foot pedal. Results demonstrated significantly shorter times ($p < .05$) with the APB for RT, premotor time, and motor time relative to the LTB. It indicated that muscle size affected both the central and peripheral components of information processing. A sex difference emerged when grouping muscle sizes, with males demonstrating significantly shorter RT, $F = 23.15$, $p < .05$ and PMT, $F = 20.98$, $p < .05$, relative to females. These results suggested a favorable sex bias for males when predictability of stimulus occurrence was high. Further, a significant relative-timing difference was observed between the muscles, with the duration of PMT being significantly longer for the APB and the duration of MT being significantly longer for the LTB, $F = 20.08$, $p < .05$. It provides direct evidence in opposition to the notion of effector independence in the GMP.

Pre-crastination and procrastination effects appear in a reach-to-grasp task

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Rosenbaum, Gong, and Potts (2014) tested participants on a simple task with a fascinating result. Participants walked down a 16' alley and passed by four pillars on the left and four on the right. A bucket was placed on one of the pillars on the left and one on the right. The 16 combinations of bucket placements were tested on different trials. Participants were instructed to pick up and carry whichever bucket seemed easier. Rosenbaum and colleagues predicted that participants would prefer to procrastinate and pick up the bucket closest to the *end* of the alley. Surprisingly, 257 participants over nine experiments preferred the bucket closest to the *start* of the alley. The preference to choose the first bucket and exert more physical effort to carry it a long distance was called pre-crastination. We wanted to explore the sensorimotor mechanisms of the pre-crastination effect by testing it in a set up that would facilitate measures of cognitive processing and trajectory analysis. We attempted to replicate the pre-crastination effect in a reach-to-grasp paradigm. Twenty-five participants reached down a 35-cm alley with their dominant hand and choose to grasp either a 3.1 cm block on the left or the right. We were surprised that about half our participants were clearly pre-crastinators (n = 13) and the other half were clearly procrastinators (n = 12). We, therefore, divided the participants into two groups based on whether they had a positive or negative correlation between the probability of choosing the right target and the approach score. The grand mean coefficients of determinations for the pre- and procrastinators were .89 and -.86. Interestingly, reaction time of the pre-crastinators (95% confidence interval, [304, 347]) was significantly shorter than the procrastinators ([341, 493]), $t(23) = 2.6$, $p = .01$, $d = 1.03$. Movement time of the pre-crastinators ([817, 1028]) and the procrastinators ([815, 1091]) was comparable, $t(23) = 0.1$, $p = .93$, $d = .03$. Trajectories will be analysed to determine whether they can differentiate the pre- and procrastinators.

The role of actor vs observer in reciprocal upper extremity sine wave tracking

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A recent series of experiments has demonstrated that tracking a sine wave template during practice, specifically reciprocal motion of the upper extremities, leads to faster and more harmonic motion when later transferred to a self-paced/goal directed Fitts target task compared to participants who practice the Fitts task paradigm alone (Boyle et al., 2012, 2013, 2014, 2015, 2016). As interesting as these behavioral observations have been, what are still not fully understood are the unique sensory system (vision, proprioception, etc.) contributions in this modified (enhanced) motor program? In the following study, 40 participants (10 per condition) were first administered a 15 trial Fitts task pre-test. The instructions of the task were to move a visually displayed cursor in-and-out of two defined target areas as fast and accurate as possible. The movement of the cursor was executed by flexing and extending a custom built robotic arm bar system in the horizontal plane. Following the pre-test, participants were randomly assigned to an Actor or Observer role and then subdivided in to separate training groups, Sine or Fitts. In the Sine condition, the Actor made reciprocal motions of the arm bar in order to trace a displayed sine wave template (6 peaks). The Observer is positioned adjacent the Actor directly on the left side with full view of the arm motion as well as the target display. Following training, a 15 trial post-test was administered to all participants. The results replicate the previous sine wave findings, in that the Sine-Actor participants showed a significant improvement in not only movement speed but an improvement in smoothness as well. The Fitts-Actor as well as Fitts-Observer showed little changes in kinematics from pre-test to post-test. The Sine-Observer, while not showing the sine wave effect of faster movement times previously seen, did however, present a significant enhancement in the smoothness of the movement, indicating the visual feedback provided a form of experience that modified the goal directed Fitts task in the post-test.

The effect of movement complexity and limb selection on the performance of an audiovisual choice reaction time task

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Motor responses to audio-visual stimuli are an everyday task important for communication. A previous study in our lab unexpectedly found shorter reaction times for more complex reach to point movements as opposed to key press responses. The present study explored this finding by examining the interaction between movement complexity and knowledge of the limb using a two-choice reaction time task with visual targets and auditory stimuli. Twelve young adults (20–24 years; 7 females/5 males; 9 right-handed) sat at a height adjustable table with a touchscreen monitor and EyeLink 1000plus gaze-tracker (500 Hz) in the tower arm mount configuration. Participants were shown two visual animal targets (2 degrees of visual angle) located 18 degrees into the peripheral vision and asked to select the animal that matched the sound as quickly and accurately as possible. Four possible response types were blocked and counter-balanced: key-press, key-release, single hand dominant reach to point and bilateral reach to point. Reaction time (RT) and movement time (MT) of the eye and hand were collected via custom software designed using Experiment Builder (SR Research). Eye RT did not vary based on response type, however the primary saccade took significantly longer in both conditions that included pointing movements when compared to key-press or release. There was also a significant main effect of movement type for Hand RT, but not MT. Responses were initiated more quickly when the dominant hand was known in advance when compared to the button release and bilateral reach to point conditions. Hand MT did not differ between the unilateral and bilateral conditions. Overall movement planning was affected by response complexity as primary saccades were longer in order to accurately locate the target area when a reach to point movement was performed. On the other hand, the preparation time (RT) needed for limb movements was primarily impacted by the knowledge of the limb, rather than movement complexity.

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Action-related auditory cues add to visual anticipation in tennis

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Visual information is crucial to successful anticipation in tennis. The aim of this study was to examine whether the sound of a tennis ball being struck by a racket would change anticipatory judgments of its trajectory. To this end, experienced tennis players were invited to watch videos of tennis rallies from the semi-final of the Australian Open 2016 between Djokovic and Federer. Each clip was presented three times, and the intensity of the sounds produced when the racket hit the ball was systematically manipulated within each of the repetitions of the original clip. Participants were asked to predict where the ball would land in the opponent's half. The results revealed that the louder the sound of the contact between the racket and ball, the longer participants predicted the ball's trajectory to be. Our findings show that action-related auditory cues significantly modulate predictions of the outcome of strokes in tennis.

An acute bout of exercise can protect procedural memory

Jing Chen, Hakjoo Kim, Taewon Kim, David Wright, Texas A & M University

Consolidation of a procedural skill is inhibited when practice is immediately followed by a period of declarative learning when testing of procedural skill performance occurs across a wake period. It has been proposed that the interference occurs because procedural and declarative learning systems share neural resources and the interference is removed when relevant "brain states" are changed (i.e., functional connectivity) which occurs during sleep periods (Brown & Robertson, 2007). Exercise has been shown to reduce retroactive interference between two procedural skills when inserted between practices of the two skills (Rhee, et al., 2016). What is unknown is if exercise can reduce interference between procedural and declarative learning. The present work addressed this issue by inserting exercise intervention between the procedural and declarative learning. In this experiment 36 participants were randomly assigned to 3 experimental conditions which addressed what occurred after procedural skill practice, (a) word list recall that required declarative learning (DL), (b) vowel counting that didn't involve declarative learning (VC), and (c) word list recall that required declarative learning followed by a brief bout of cardiovascular exercise (Ex+DL). A test of the extent of offline performance improvement for the procedural skill was made 6_hrs after practice. Results from the DL and VC conditions replicated those of Brown and Robertson (2007) revealing that declarative learning impeded procedural consolidation across a wake period. This was revealed by offline performance improvement for the VC condition that was larger than that observed for the DL condition. Those individuals that experienced exercise between procedural skill practice and declarative learning led to a return of the procedural consolidation. One interpretation of these data is that exercise changes that ongoing brain state during learning (e.g., increased M1 excitability). Ongoing work is examining this possibility using transcranial magnetic stimulation (Ostadan et al., 2016).

Submovement as a function of space-time constraints in discrete aiming tasks

Ya-Chun Chen, Tsung-Yu Hsieh, Jui-Chun Fang, Yeou-Teh Liu, National Taiwan Normal University, Taiwan

The role of the submovement during rapid aiming tasks has been traditionally viewed as a main factor for movement accuracy. Different numbers and types of submovement that derived from movement kinematics reflected different processes of control and resulted in particular function of speed and accuracy trade-offs (linear and logarithmic). Here we systematically investigated the effect of two classic task paradigms (time-minimization task and time-matching task) with similar range of average movement velocity on the generality of the number and characteristics of submovement in discrete aiming movement. Sixteen participants all completed discrete line drawing tasks of 2 tasks × 5 conditions (5 target times from 300 ms to 1500 ms; 5 square spatial targets from 40 mm to 1 mm) each with 20 trials of 30 cm in distance. The order of the 2 tasks were counter balanced among the participants and the 5 conditions were randomly assigned for each participant. The numbers and 5 types of submovements (no submovement, pre-peak velocity, post-peak velocity, undershoot, and overshoot) were determined based on a set of algorithm. The 2 way repeated measure ANOVAs showed a significant interaction effect of tasks and conditions on total numbers and all 5 types of submovement ($ps < .05$). The total number of submovements increased from the highest average velocity condition to the lowest average velocity condition for both tasks. The lowest average velocity condition of the 2 tasks were dominated with the submovements of pre peak and post peak types that characterized motion fluctuation whereas in the highest average velocity conditions the overshooting submovements were more frequently observed that may be viewed as reflecting the motion termination. Overall, our results show different characteristics of submovements in discrete aiming tasks arising from multiple control mechanism to fulfill the specific task constraints.

Proficient brain activity in superior golf putting performance: An insight from the EEG and psychomotor efficiency

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Psychomotor efficiency has been linked to processing efficiency during sports performance. Proficient cortical activity in the sensorimotor area has been related to the level of psychomotor efficiency during superior action execution. This study proposes sensorimotor rhythm (SMR), 12–15 Hz of the electroencephalogram (EEG) in the sensorimotor area, may be used to investigate psychomotor efficiency in golf putting performance. Method: Thirty-six pre-elite golfers in Taiwan were recruited to perform 40 putts while EEG and putting accuracy were recorded. Results: The data exhibit the best putting performance is associated with higher SMR power during the last second before action initiation compared to the worst putting performance. No other changes were observed on the neighbouring frequency bands, such as theta and low beta bands in both performances, indicating SMR was the prominent component which separated the best putting performance from the worst one. Conclusions: This finding suggests that reduced interference from sensorimotor processing, as reflected by higher SMR power, may lead to better psychomotor efficiency during the putting preparation. We conclude that SMR may be a promising component to understand psychomotor efficiency underlying putting performance. Future studies are recommended to evaluate the beneficial effects of SMR in sports performance via neurofeedback training to develop an efficient and effective protocol based on SMR activity.

Posture control on movement variability in discrete line drawing task

Hock Leong Chew, Yeou-Teh Liu, Tsung-Yu Hsieh, National Taiwan Normal University, Taiwan

Posture is the basis of all movement since all movement is initiated from and ended with a posture; even simple limb movement requires certain degree of postural control. Postural stability is normally observed through center of gravity (COG) sway upon performing the task. The purpose of the study was to examine the effect of postural stability on discrete line-

drawing task. Eight participants performed the line drawing tasks on a vertically oriented drawing board. The task goal was to draw a 30 cm horizontal straight line at 300 ms and 2500 ms times with 3 stances (sitting, standing with both feet close together, and tandem) and 2 distances (one arm length and one forearm length) between the body and the drawing board. The drawing tasks were performed on an electronic drawing board of black background with a 2 mm and a 1 mm squared areas marking the start and the target. Visual feedback on time and space were available to the participants after each trial. All participants performed 20 trials for each condition. The 3-way repeated measure ANOVAs were used to analyze the effect of stance, distance and speed of the line-drawing tasks and their interactions on constant error, absolute error and variable error of the space and time. The result showed a significant interaction between stance and speed on spatial constant error, $F(2, 14) = 3.89$, $p < .05$). When performing the slow speed line drawing tasks, participants overshot the target in the tandem stance whereas no bias observed when they were seated. Under the fast speed condition, no difference was observed on the spatial constant error between the 2 stances. The findings of the study indicate the strong effect of postural stability on the simple limb tasks. The characteristics of simple limb movement are the product of the task constraints and postural control. Future studies should emphasize on the interactions between the task constraints and the postural stability in order to fully appreciate the contribution of posture on the simple limb tasks.

Relatedness affects dopaminergic activity and motor learning

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Relatedness represents the need to experience satisfaction regarding interpersonal acceptance and closeness and has been identified as a fundamental psychological human need (Deci & Ryan, 2000, 2008). In several different domains, higher relatedness to others such as parents, teachers, peers, or coaches has been directly correlated with higher levels of positive affect and intrinsic motivation, with both factors being associated with increased dopamine activity. In the present experiment, we tested the effects of relatedness on the learning of a gymnastic skill and observed dopamine activity, indexed by eye blink rate (EBR), as a possible mediator of these effects. Two groups of young adults practiced a task in which they were required to learn a specific movement form of a gymnastic skill. Before practice, participants in the relatedness support condition (RS group) received instructions emphasizing acknowledgment, caring, and interest in the participants' experiences, while participants in the relatedness thwart condition (RTh group) received instructions emphasizing disinterest in the participant as a person. EBR was counted while the participants observed a 1-min demonstration video during practice. One day after practice, participants completed a transfer test. The results demonstrate higher EBR during practice and enhanced movement form of the gymnastic skill in the transfer test in the RS group relative to the RTh group. The findings show that relatedness support benefits gymnastic skill learning and reveal dopamine as an underlying mediator of relatedness effects. This study was partially supported by the Czech Science Foundation (GAČR 18-16130S).

Optimizing vertical jump performance

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In the OPTIMAL theory of motor learning (Wulf & Lewthwaite, 2016), 3 factors are postulated to facilitate motor performance and learning: Enhanced expectancies (EE) for performance (e.g., positive feedback), autonomy support (AS) (e.g., giving performers choices), and an external focus (EF) of attention on the intended movement effect. The purpose of the present study was to examine whether EE, AS, and EF would have immediate benefits for motor performance. More specifically, we asked whether implementing these factors consecutively would lead to further increases in performance. The task participants were asked to perform was a countermovement jump, which requires effective whole-body coordination for maximal force production. Participants were randomly assigned to the optimized or control groups. All participants performed 4 blocks of 5 trials. The first block was used to assess baseline performance. On each of the following 3 blocks, participants in the optimized group were given different instructions. They included positive social-comparative feedback (EE), choice of a figure on the ground (red triangle, green square, and blue pentagon) within which participants performed the jump (AS), and instructions to focus on a marker attached to their waist (EF). The order of the EE, AS, and EF conditions was counterbalanced across participants. Control group participants performed all 4 blocks under the same (control) condition. The results showed that the optimized group outperformed the control group on blocks 2-4. Moreover, the optimized group's jump height increased with each addition of another variable. In contrast, jump height did not change across blocks in the control group. Thus, EE, AS, and EF had additive or incremental benefits for performance. The findings corroborate the importance of key variables in the OPTIMAL theory for motor performance.

The utility of the pre-crastination phenomenon to explain behaviours during a collision avoidance task

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When walking towards a goal and instructed to complete a secondary task (i.e., pick up one of two items), individuals consistently choose the closest option, regardless of the extra physical effort required (Rosenbaum et al., 2014). This phenomenon has been termed pre-castination, which is thought to be the result of the appeal to reduce load on working memory. The purpose of this study was to determine if pre-castination drives individuals' behaviours when a secondary decision-making collision avoidance task was introduced. The current study required young adults (18–25 y, n = 10) to walk along an 8 m pathway towards a goal and pass through or circumvent an aperture, created by two vertical poles positioned equal distance from the midline, 5 m from the start. Participants must choose to pick up one of two crates, which were either weighted (~5% body weight) or unweighted, located 3 m before and 3 m after the aperture. Participants completed two blocks (weighted or unweighted crates) of 40 randomized trials. Within each block of trials the gap between the poles (aperture widths) was randomly set to be between 0.8 and 1.8× shoulder width. By adding a secondary decision-making task, it was hypothesized that individuals would choose to pass through the aperture before picking up a crate, ultimately rejecting the pre-castination phenomenon. Results showed that four participants consistently chose to pick up the crate first and then deal with the aperture (i.e., pass through or around), three participants consistently chose to pick up the crate after dealing with the aperture and the remaining participants consistently chose to pick up the first crate when it was unweighted and chose to pick up the second crate when it was weighted. The results from the current study suggest that an individuals' behaviours are not support by the phenomenon of pre-castination, rather they are based on remaining consistent. Therefore, individuals are unlikely to deviate from the manner in which they complete a task if their initial behaviours were sufficient to complete the task successfully.

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The effects of attentional focus on jump kinematics for those with chronic ankle instability

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Individuals with chronic ankle instability (CAI) exhibit high injury-risk proximal lower limb kinematics during jump tasks. An external focus (EF) has been shown to alleviate these aberrant biomechanics in other clinical populations. The purpose of this study was to determine if an EF could facilitate safer retained biomechanics for those with CAI. Ten participants (7 m, 3 f; 22.8, ±2.82 yrs) with CAI participated in this study. Participants were randomly assigned to an internal focus (IF) or EF group and completed a series of single leg jumps for distance. All participants completed a 5-minute warm up, followed by 3 baseline jumps on the injured and healthy leg. Next, all participants completed 4 blocks of 5 jumps on each leg. A cone was placed 4.57 m in front of the participants in the EF group and they were told to, "jump as far as you can, when you are jumping, I want you to think about jumping as close to the cone as possible." Participants in the IF group were told to, "... think about extending your knees as rapidly as possible." Participants returned 24 hours later to complete 3 retention jumps on each leg in which the cone was removed and no attentional focus instruction was provided. Participants were markered and peak knee flexion angle during landing in the sagittal plane were obtained using 3D kinematics. Separate independent *t*-tests were used to analyze differences in peak knee flexion angle for the EF and IF group at retention. Significant differences did not exist between EF and IF in both healthy and injured leg, $p > .05$, but peak knee flexion angles were notably larger for the EF compared to the IF for both the healthy (EF: $M = 79.83$ deg, $SD = 7.51$; IF: $M = 66.5$ deg, $SD = 8.36$, $d = 1.22$) and injured leg (EF: $M = 79.62$ deg, $SD = 17.143$, IF: $M = 61.32$, $SD = 12.54$, $d = .80$). Larger knee flexion angles are associated with biomechanics that are less prone to injuries and may help absorb force from the injured and uninjured ankle. These results indicate that an external focus can be used to elicit safer biomechanics in those with CAI.

An investigation into the relationship between locomotor dynamics and overall fall-risk

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Variability observed in physiological systems is thought to be a consequence of the interactions occurring between the various components that affect the system. Analyses measuring how the structure of the variability (nonlinear dynamics) changes over time have been posited to reflect the health of the system. Many interpret the results of these analyses to indicate the system's health by means of its adaptive capacity. While there is ample indirect evidence to support this notion, no studies have directly tested this postulate. Of particular interest is the locomotor system, which must adapt to real-world environments to maintain upright stance. This study examined the relationship between steady-state locomotor dynamics and overall fall-risk. Healthy older adults ($N = 40$, 75 ± 4.9 years) completed the Activities-specific Balance Confidence Scale, Berg Balance Scale, and Simple Reaction Time Test, from which a measurement of overall fall-risk was derived. Next, participants walked for 15-minutes at a self-selected pace on a motorized treadmill and measurements of locomotor nonlinear dynamics (detrended fluctuation analysis, sample entropy, recurrence quantification analysis, and lyapunov exponent) were calculated from full-body 3-D kinematics collected at 100Hz. Bivariate correlations measured the association between each nonlinear metric and overall fall-risk. Stride time sample entropy ($2.0 \pm .06$) was the only metric that was significantly correlated to overall fall-risk ($.17 \pm .04$), $r(38) = .56$, $p = .0070$). This suggests that participants who exhibited more random locomotor dynamics (i.e., higher sample entropy) had the highest fall-risk. Due to the high levels of randomness observed with those most vulnerable in the population, these results fall in line with previous experiments. Further research will focus on ways to reduce random locomotor dynamics to determine if an associated reduction in fall-risk is observed.

Attentional focus effects on the performance of a continuous whole-body task with object manipulation

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An external focus has been shown to facilitate motor skill performance (Wulf, 2007, 2013). Results have been mixed for expert performers, however, who have also reported using complex attentional strategies (Fairbrother, Post, & Whalen, 2016; Wulf, 2008). Additionally, little is known about focus effects on continuous whole-body coordination tasks involving object manipulation. The purpose of this study was to determine the effects of attentional focus cues on single-rope speed jumping by experts and novices. The cues directed attention toward the upper (UP) or lower (LB) body and either internally (IN) or externally (EX). 30 experts and novices completed bouts of speed jumping under control (CON) and experimental conditions (UPIN, UPEX, LBIN, LBEX). Jumps and Errors were recorded for each trial. Jumps were analyzed using a 2 (group: expert v. novice) × 5 (condition) ANOVA with repeated measures on the last factor. Errors were analyzed using a 2 (group) × 5 (condition) Chi Square. Compared to CON, jumps were significantly lower under UPIN, UPEX, and LBIN for experts (all $p < .02$) and under LBEX for novices ($p < .001$). In addition, jumps were significantly lower under UPEX than LBEX ($p = .049$) for experts. The Chi Square analysis was significant ($p < .05$). Experts committed more errors under UPEX compared to CON. Errors were similar in the other conditions. Novices committed more errors under LBIN and LBEX and fewer under UPIN and UPEX compared to CON. The study provided evidence that directing attention to control of the body or the controlled object (rope) disrupted performance for experts. For novices, performance was facilitated by directing attention to the hands or the object, but was disrupted by directing attention to a lower-body outcome (foot sounds). These findings may reflect differences in automated whole-body coordination and are consistent with the *constrained action hypothesis* (Wulf, McNevin, & Shea, 2001) despite not supporting an external focus benefit.

The effect of transcranial direct current stimulation on time to exhaustion performance in trained cyclists

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The central executive system is known to moderate exercise tolerance and fatigue. Non-invasive brain stimulation techniques have previously been used to demonstrate this regulation of exercise tolerance and fatigue. Anodal transcranial direct current stimulation (tDCS) is one such technique shown to improve exhaustive performance in cyclists. Despite these findings, the neurophysiological mechanisms underlying this performance change has been seldom specified. The present study examined the effect of anodal tDCS on time to exhaustion (TTE) cycling performance. It was hypothesized that TTE performance would be improved with anodal compared to sham stimulation and that altered corticospinal excitability in the motor cortex as well as associated brain regions would moderate these performance improvements. Peak power output (PPO) was determined by an incremental cycling task during a familiarization period.

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On two laboratory visits, separated by a minimum of 48 hours, 14 elite male cyclists received an intervention; 13 minutes of 2.0 mA anodal tDCS, or sham tDCS condition, in a double-blind randomized order. Transcranial Magnetic Stimulation (TMS) was used to measure corticospinal excitability pre and post-tDCS. Electromyography (EMG) was recorded for both legs throughout the experiment. Participants completed a TTE at 80% of PPO, maintaining 80 rpm. TTE was terminated when they dropped below 70 rpm > 5 seconds. No improvement of mean TTE was seen in the anodal-tDCS condition (mean TTE = 617 s ±208) compared to sham (mean TTE = 597 s ±224). Similarly, no differences were seen in post/pre corticospinal excitability; anodal (mean motor-evoked potential (MEP) = 1.30 mA ± 0.474), and sham (mean MEP = 1.49 mA ±0.995). The current findings suggest anodal tDCS does not improve constant load exhaustive cycling performance or alter corticospinal excitability through acute mechanisms. However, the lack of an effect may be due to very small performance change thresholds experienced by trained cyclists or inter-individual responses to tDCS.

Are cognitive-motor integration deficits in children with concussion history linked to motor learning deficits?

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Cognitive-motor integration (CMI) tasks require the implementation of a cognitive rule to perform the necessary motor action, e.g., when we look to the right but have to move to the left (i.e., decoupling of vision and action). We use this ability often during our daily life and in sport activities. A previous study showed CMI deficits in children with concussion history (CWCH) during task performance requiring CMI. However, it is not known whether motor learning, a critical factor in acquiring such skills, was affected by concussion and thus possibly a contributing factor to CMI deficits. We re-analyzed the data set to investigate whether increased motor learning demands affect the previously found CMI deficits in children with concussion history across a series of trials.We analyzed 30 CWCH (M=14 months post-concussion; M=13 years old) and 30 age-matched controls with no concussion history (CTL). In the CMI task, participants slid their finger along a horizontal touch screen to move a cursor on a vertical screen from a central target to one of four targets. In addition, cursor- and hand movements were 180° reversed, i.e., moving the finger to the left resulted in a rightward movement of the cursor. The CMI task condition included 20 trials with 5 trials in each target direction. We analyzed movement preparation, timing, and execution variables of the first block (trial 1-4) and last block (trial 17-20) to investigate short term motor learning (i.e., performance changes from the 1st to the 5th block) differences between the groups.ANOVA revealed performance improvement across blocks ($p < 0.05$), thus motor learning occurred, but the block by group interaction did failed to reach significance (all $p > 0.05$). Thus, short-term motor learning was not altered in CWCH during this CMI task, while average CMI-task performance across all trials was affected. The combined findings suggest that CMI deficits in CWCH are independent of deficits of short-term motor learning. This study enhances our understanding of mechanisms contributing to neurological changes post-concussion.

Those who expect to teach a motor skill cannot perform better under high pressure

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When learners practice a motor skill expecting to teach it to another person, they show superior motor learning (posttest performance). Yet, learners also show an increase in declarative knowledge about the skill, which is associated with worse performance under pressure. Thus, it is possible the advantage of expecting to teach is lost when performing the skill under high pressure, due to increased reliance on declarative knowledge. To test this hypothesis, we had 82 participants perform a golf putting pretest, followed by an acquisition phase where participants either practiced with the expectation of teaching another participant (teach group) or practiced with the expectation of being tested on their putting (test group). The next day, participants performed low and high pressure posttests in a counterbalanced order. Participants were instructed to "do their best" on the low pressure test, whereas in the high pressure test they were told that the top-five most accurate putters would receive a monetary reward and that they were being video-recorded for analysis by a professional golfer. After the final posttest, participants reported any declarative knowledge about putting concepts they recalled, and what concepts they were using during posttests. Results revealed the teach group exhibited superior putting accuracy in the low pressure posttest, but not the high pressure posttest. This was due to the teach group performing worse under high pressure than low pressure (i.e., choking under pressure). Further, the teach group recalled more putting concepts after posttest, indicating superior declarative knowledge, but they did not report greater usage of these concepts during posttests. The increase in declarative knowledge did not mediate the choking effect. Taken together, results suggest practicing a motor skill with the expectation of teaching benefits learning, but this advantage is lost when performing under high pressure. However, the reason for the skill breakdown under high pressure remains unclear, as declarative knowledge did not mediate the choking effect.

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Discrimination reaction time and decision making

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Quick reaction time is essential for successful performance in many sport-like situations. The present study aimed to investigate the effect of environmental stimulation complexity on discrimination reaction time (DRT) and decision-making by using the QuickBoard, as foot step response is required. Forty-four college students (M = 17 and F = 27) aged from 19 to 30 (M = 23.0 years old; STD = 3.4) were recruited to participate in the study. Participants were asked to react to a visual stimulus by stepping on the designated spot on the QuickBoard as fast as possible. The participants were tested individually under seven different visual stimulation conditions from simple to more complexed situations, such as responding to either single- or multiple-color signals. A one-way ANOVA with repeated measures on test condition was conducted to examine whether there would be significant differences on DRT between different conditions. The results showed a significant test condition effect, $F(6, 25) = 23.98$, $p < .01$, suggesting that the more complicated visual stimulus test conditions, the greater DRT would be observed. Moreover, the post-hoc test revealed that the number of the stimulus colors that individuals were required to react increased, the greater delay of DRT. However, no such a delay on DRT for no response needed in the test conditions. These data verified that the speed of cognitive process, which includes analyzing environmental stimulus information, making a decision, and preparing for actions, is critical for fast, successful and effective movement responses. Applications on training strategies for athletes in sports and patients in rehabilitation are discussed.

Differential effects of dual tasks across learning a finger-sequence

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Theories of motor learning postulate that at the beginning of learning, attentional resources are needed to control the movement (Proctor & Dutta,

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1995) and are focused on the movement. With practice, motor execution becomes more automatic and attentional resources are freed to deal with extraneous stimuli. Accordingly, research shows differential effects of dual tasks: Performance of novices is found to benefit from movement related- and harmed by extraneous dual-tasks, whereas experts' performance is harmed by movement related- and benefits from extraneous dual tasks (e.g. Beilock et al., 2002). This study examined the intraindividual process of attention shifting across motor learning of finger-sequences. Participants (N = 32) had to learn a short and a long finger-sequence (3 vs. 6 keys). After learning the order of keys (Phase 1, 60 trials per sequence) participants had to type the sequences as quickly as possible under 2 kinds of blocked conditions (Phase 2, 16 blocks of 2x 12 trials): A tone was presented at one of the 3/6 keys and participants after the trial had to indicate the pitch (high vs. low: "extraneous") or the location (key 1-3/1-6: "movement") of the tone. Conditions were presented in alternating blocks. Dependent variables were Initiation Time (IT), total Movement Time (MT) and Accuracy in the dual tasks (ACC). Expected interactions between blocks and conditions were only found for IT for the short sequence ($F(7,203) = 3.053$, $p = .004$) and for the ACC of both sequences, (short: $F(7, 203) = 5.961$, $p < .001$; long: $F(7, 203) = 7.017$, $p < .001$), with decreasing ACC in the "movement" dual-task. In line with theory, ACC indicates that as participants' execution became more automatic, they paid less attention to execution. IT and MT indicate that here attention may play a more important role during action planning (IT), not execution (MT). Missing effects in the long sequence could indicate that learning was too short to let execution become automatic. Findings thus at least partially support previous findings from inter-individual comparisons.

Different degrees of choice influence self-controlled feedback effects on motor learning

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Research has shown that self-controlled knowledge of results (KR) facilitates motor learning (e.g., Chiviacowsky & Wulf, 2002). In practical settings, the desire for receiving KR or not may at times be overridden by an instructor who feels the choice does not support learning. The purpose of this study was to examine the effects of self-controlled KR when some requests were denied. 48 participants were assigned to one of four groups: self-control (SC), yoked (YK), self-control restricted (SC-R), and yoked restricted (YK-R). The SC group received KR whenever they requested it. The SC-R group was also allowed to request KR after any trial. For 33% of trials, however, the participant's preference was denied. Acquisition consisted of 60 trials of three key-pressing tasks. Retention and transfer occurred approximately 24 hr after practice. Acquisition data were analyzed using a 4 (group) x 6 (block) ANOVA with repeated measures on the last factor. Retention and transfer data were analyzed using a 4 (group) × 2 (test) ANOVA with repeated measures on the last factor. The number of KR requests by the SC and SC-R groups were analyzed using a 2 (group) × 2 (acquisition half) *Chi Square*. Results for performance measures showed a significant effect for block in constant error (CE) indicating improvement with practice for all groups ($p < .001$). Retention and transfer results showed a significant effect for group in CE ($p = .028$). *Post hoc* procedures revealed that the SC-R group was more accurate than the YK-R group ($p = .027$) whereas the SC and YK groups did not differ. The *Chi Square* was significant ($p < .01$). The SC group requested KR after more trials (668) than the SC-R group (437). These findings provided evidence that the benefits of SC extended to a situation in which participant choice was at times denied. Although the SC group was given choice, electing to receive KR on most trials may have reduced the salience of those choices, eliminating any benefit relative to the YK group.

Characteristics of movement variability in time minimization tasks and time matching tasks

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The functions of logarithmic and linear speed and accuracy trade-offs have been hypothesized to be resulted from the spatially constrained movement and temporally constrained tasks with different range of average movement velocities. The current study examined the relative characteristics of the spatial and temporal variability with similar range of average movement velocity in the time matching paradigm (temporally-constrained) and time minimization paradigm (spatially-constrained) of discrete aiming tasks. Time matching tasks required participants matched 5 imposed time criteria (300, 600, 900, 1200, & 1500 ms) with 10% bandwidth while making their movement endpoint as close to the target as possible. For the time minimization tasks, participants were required to hit 5 imposed square targets (side lengths of 40 mm, 20 mm, 10 mm, 5 mm, & 1 mm) with minimum movement duration. Sixteen participants performed 20 trials for each task-condition combination. The average coefficient of variation (CV) of movement time and spatial accuracy over 5 conditions as well as the rate of change (slope) of the movement time variability and spatial accuracy variability over increasing average velocities were examined. The 2 (task) × 2 (spatial/temporal variable) repeated measure ANOVAs were used to examine the effect of tasks and space/time variables. The results showed a significant interaction effect for both measures, $ps < .001$. The slopes and CVs of temporal variables were smaller in the time matching tasks than in the time minimization tasks. For the spatial variables, the CVs in time minimization tasks was significantly lower than that in the time matching tasks while no significant difference was found in slopes. These findings suggested that different movement properties were emerged from the task constraints that reflecting characteristics of task category.

The state of behavior change techniques in virtual reality rehabilitation of neurologic populations: A systematic review

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Neurologic rehabilitation aims to restore function and improve quality of life in those with an injury to the nervous system. The use of virtual reality (VR) has emerged as a useful tool to enhance physical rehabilitation interventions and outcomes. While motor learning principles are commonly used to design VR rehabilitation programs, relying only on principles of change in the motor domain may limit the adoption and effectiveness of the VR program. A more holistic approach would be to reconceptualize VR rehabilitation programs in terms of their Behavior Change Techniques (BCTs), which take a multi-domain approach to describe the smallest ingredients in an intervention designed to change behavior. This systematic review investigated ways VR is used in neurologic rehabilitation to improve motor performance, and systematically coded those interventions for BCTs used. Keyword searches were performed using SPORTDiscus and psycINFO, which yielded 220 articles. Studies were selected for inclusion if they directly investigated the role of VR in motor outcomes of neurologic populations, which yielded 16 studies. BCT coding was conducted using the Behavior Change Techniques Taxonomy v1. All studies reported significant improvements in motor performance outcomes. Regarding BCTs, VR interventions using graded tasks (scaling task difficulty to create optimal challenge) and interactivity (connection between user actions in the real world and outcomes in the virtual world) demonstrated improved outcomes in motor performance overall. Most studies included in this systematic review lacked a complete investigation into the efficacy of the VR training, making it difficult to

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describe the full utility of BCTs in VR rehabilitation. Nevertheless, this systematic review suggests that a multi-domain approach in implementing VR-based motor rehabilitation using BCTs could be useful. Rather than using BCTs post-hoc to describe past research, future research could benefit from incorporating BCTs into the design process of VR interventions to produce optimal rehabilitation potential.

Differences in subjective and objective motor imagery in children with developmental coordination disorder

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Motor imagery provides a unique window on the integrity of movement representation. It has been shown that children with Developmental Coordination Disorder (DCD) experience problems with tasks that are thought to rely on an internal model of movements; such as motor imagery, action planning and rapid online control of movements (Adams et al., 2014). Therefore, the purpose of this study was to compare objective and subjective motor imagery ability between typically developing children (TD) and DCD children. Ninety-three children with ages between 7 and 12 years were tested to determine their status as TD (n = 50) or DCD (n = 43). The Movement Imagery Questionnaire (MIQ-C) was used to assess subjective imagery while the Florida Praxis Imagery Questionnaire (FPIQ) was used to assess objective imagery. A 2×3 repeated measures ANOVA was conducted for groups (TD/DCD) and the three subscales of the MIQ-C (internal, external and kinesthetic), and another for 2×4, for groups and the FPIQ subscales (position, object, kinesthetic and action imagery). Results indicated that DCD children scored significantly lower ($p < .05$) on objective imagery than TD children, but there were no significant differences between the groups on subjective imagery. The findings suggest that DCD children only have problems associated with formation of motor images, not perception of their imagery abilities. Further studies should be directed towards implementing the FPIQ as a therapeutic modality for children with developmental coordination disorder (DCD).

The role of proximal body information in skilled anticipation: The effect of kinematic interchange on anticipatory judgments in tennis

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In tennis, when anticipating the direction of the opponent's shot, skilled tennis players may use the kinematic information of their opponent's proximal body parts (body parts excluding the racket-arm) to anticipate the subsequent movements of the distal body parts (Fukuhara et al., 2017). However, few attempts have been made to show the functional role of proximal body information underpinning skilled anticipation. To address this issue, we used an interchange approach (e.g., Williams et al., 2009) wherein the relationships between the proximal and distal movements of an opponent were changed. Computer graphic (CG) images of forehand strokes with interchanged kinematics of distal body parts were used. Thirteen skilled and 12 novice tennis players were asked to anticipate the shot direction (left or right) by observing two types of CG tennis shots (non-interchanged and interchanged) under five different temporal occlusion conditions (-270 ms, -180 ms, -90 ms, 0 ms, and +90 ms). The correct answer was considered to be the outcome corresponding to the movements of the distal body segments. The results showed that, for skilled players, in the absence of ball-flight there was a significant decrease in anticipation accuracy when the relationship between the proximal and distal movements was disrupted. Moreover, in the interchanged condition anticipation accuracy did not exceed the 50% guessing level (chance), with accuracy in the 0 ms occlusion condition significantly below chance, demonstrating a preference to rely on proximal information. In contrast, in the novice players, the interchange of distal information did not alter anticipatory performance. These results show that skilled but not novice players rely on proximal body information to anticipate shot directions, and that skilled players may even prioritise the use of proximal over distal information.

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Observational uses of athletes with disabilities

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Observational Learning (OL) is the ability to learn new motor skills through watching others or oneself. Cummings and colleagues (2005) developed the Functions of Observational Learning Questionnaire (FOLQ) which identifies three reasons why athletes use observation: (a) skill, (b) strategy, and (c) performance. Previous research shows that able-bodied athletes use the skill function most often, followed by the strategy function then the performance function (e.g., Wesch et al., 2007). While there is an abundance of research with the able-bodied athlete population, to our knowledge research has yet to investigate athletes with disabilities when it comes to why they use OL. Therefore, the purpose of this research is to examine the use of OL in athletes with disabilities using the FOLQ as well as to gain a deeper understanding of OL within the disability sport population. As such, participants completed the FOLQ and responded to interview questions focusing on disability athletes' reasons for their use of OL, preference of model type (i.e. who they prefer to observe), and other areas that the FOLQ may not capture. Preliminary analysis of 32 participants (Mage = 36.9; SD = 18.16), indicated a significant effect for Function ($F(2, 60) = 20.34$, $p = 0.00$, $eta = 0.40$, power = 1.00). Specifically, participants scored significantly higher on the skill function ($M = 5.39$, $SE = 0.22$) than the strategy ($M = 4.85$, $SE = 0.20$) and the performance function ($M = 3.88$, $SE = 0.28$). The difference between the strategy and performance functions was also significant. At this time, interviews transcriptions are being scrutinized to determine themes. The results of the FOLQ questionnaire and interview themes will be discussed and should provide a clearer picture as to the use of OL and may point toward the direction of future research.

Mental workload assessment during simulated upper extremity prosthetic performance under various conditions of cognitive and motor challenge

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While mental workload has been widely studied during cognitive-motor tasks performed by healthy individuals, a more restricted effort has studied this notion in a motor rehabilitation context. Despite many efforts to make prosthesis control intuitive and functional, it can still be challenging for upper extremity amputees to perform basic daily activities. Prior work focused on mental workload assessment has generally modulated the task difficulty without specifically manipulating the cognitive and motor demands separately. Assessment of mental workload due to cognitive and/or motor demands can inform the underlying attentional mechanisms engaged during performance and the development/evaluation of upper extremity prosthetics. Thus, this work is a first step to study changes in mental workload under various levels of motor and cognitive demands during upper extremity performance in healthy individuals with a simulated

disability. Ten healthy individuals performed a task requiring them to select and place colored blocks on matching targets. The task was executed under normal and braced (participants' wrists and fingers were restrained to simulate a prosthetic hook grasp) conditions and under two levels (easy, hard) of cognitive (one or two block colors) and motor (large, small targets) demands. Mental workload and performance were assessed via surveys (NASA Task Load Index) and computing the number of blocks transported within a 2 min. period, respectively. The findings revealed increases in motor and/or cognitive demand led to elevated mental workload and a decreased performance in both normal and braced conditions, although a greater frustration and effort along with larger performance decrease were observed for the latter. Also, increases in cognitive compared to motor demand tended to impact the cognitive-motor performance more. This work provides a basis to further understand the underlying cognitive-motor control mechanisms during upper-extremity performance under varying cognitive and motor demands in healthy as well as amputee populations.

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Lower extremity coordination patterns between traditional and cluster training during back squat

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Coordination is an important control strategy for organizing the multiple redundant degrees of freedom in the human motor system. Identifying deviations from typical coordination patterns may give insight into common compensation strategies of resistance training. Specifically, cluster training (CLU) decreases fatigue, allowing for proper form, peak power output, and velocity maintenance during high intensity activity, and thereby encouraging the preservation of normal coordination patterns. The purpose of this study was to investigate the effect of CLU on lower extremity (LE) coordination patterns in 9 resistance-trained males during back squats. Subjects completed traditional training (TRD) or CLU at 80% one-repetition maximum (1RM) 48 hours after a 1RM assessment. The TRD condition involved 4 sets of 6 repetitions with 180 seconds (s) of inter-set rest. The CLU condition involved 4 sets with 2 clusters of 3 repetitions in each, 30 s of intra-set rest, and 150 s inter-set rest. Subjects returned 72 hours later to complete the other condition. Modified vector coding was used to bilaterally analyze sagittal plane couplings: foot-shank, shank-thigh, and thigh-trunk. Circular statistics were used for the analysis of angular data comparing trial 3 and 4 from each set of squats ($p < 0.05$). The results of the HARRISON-KANJI test revealed significant differences in the right shank-thigh coupling for condition ($p = 0.0004$) and in the left shank-thigh coupling for condition ($p < 0.0001$) and trial ($p = 0.0154$). Significant condition by trial interactions were observed in the right ($p = 0.0006$) and left ($p = 0.0007$) shank-thigh couplings. Additionally, significant differences in condition were observed for the right ($p = 0.0171$) and left ($p = 0.0039$) foot-shank couplings. No other significant differences were found. Comparing TRD and CLU results in LE segment coordination differences, likely related to the CLU intra-set rest. Interactions of trial and condition further suggest that fatigue affects intersegmental coordination as individuals attempt to maintain proper form.

The role of dynamic and structural cues for interference in action and perception

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In daily life, we are asked to adapt our motor behavior to the constantly changing conditions in our environment. This adaptation can be influenced by the perceptual processing of observed actions. Since many years, it is suggested that both action and perception are represented on a higher processing level that shares a common code (Prinz, 1997). Based on this knowledge, research on motor resonance shows that observing biological motion influences simultaneously executed actions (Kilner, Paulignan, & Blakemore, 2003). Biological motion provides both movement-related dynamic and structural cues (Mather & Murdoch, 1994). However, there has been no conclusive evidence on how these different information interfere with our motor system. Accordingly, the present study examined whether the effect of interference (motor resonance) differs in terms of the different types of biological motion information. 19 right-handed participants (*mean age* = 24.3 years, *SD* = 2.6) rhythmically performed lateral arm movements while watching point-light displays of similar movements. The displays differed with respect to the presence of dynamic and/or structural cues. Kinematic data were recorded by means of an optical motion capture system. The results showed that participants assimilate their movement behavior to the observed displays that contained dynamic but no structural cues ($p < 0.01$). In addition, movements were rhythmically more in time when observing displays that contained dynamic cues in general ($ps < 0.001$). Therefore, it is concluded that dynamic (motion) cues play an important role in interfering with our motor system while observing the movements of others.

Acute effects of assisted cycling therapy on upper extremity motor function after stroke

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Background: Stroke is the most common cause of long-term disability in the United States (US). Assisted Cycling Therapy (ACT) at cadences of about 80 rpm has been associated with improvements in motor and clinical function in other clinical populations. The acute effects of ACT on motor function of persons with stroke have not been investigated. Objectives: The purpose of this cross-over trial was to compare the effects of ACT, voluntary cycling (VC), and no cycling (NC) on upper (Box and Blocks Test) extremity motor function in adults with chronic stroke (age: 60 ± 16 years; months since stroke: 96 ± 85).Methods: Twenty-two participants (female = 6, male = 16) completed one session each of ACT, VC, and NC on separate days in counterbalanced fashion. Results: Upper extremity function on the paretic and non-paretic side seemed to benefit more from ACT than VC or NC (all $p < 0.05$). Trend analyses revealed a positive relationship between ACT cadences and improvements in motor function ($p < 0.05$). Conclusion: ACT appears to benefit paretic and non-paretic motor function acutely. Faster cycling cadences may be associated with greater benefits.

Funding source: Arizona State University Graduate and Professional Student Association.

Investigating the whole body coordination patterns of 3 ball juggling

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Three-ball juggling is a bi-manual motor skill that requires tossing and catching 3 balls with 2 hands in a tightly constrained space and time. Three-

ball cascade juggling is characterized by a figure-8 pattern of the 2 hands alternating the tossing and catching movement and is considered to be the basic juggling skill. The 3-ball shower juggling involves the 2 hands throwing the balls at the same time and the 3 balls form a loop between the tossing and catching movement. Three-ball shower juggling is considered to be more difficult than the 3-ball cascade juggling. The purpose of the study was to investigate the whole body coordination patterns of 3-ball cascade and 3-ball shower juggling of different skill levels. Ten participants with different juggling skills performed at least 6 cycles of 3-ball cascade juggling for the study. One of the skilled participants also performed 6 cycles of 3-ball shower juggling. A magneto-electronic motion digitizing system (IGS-190) was used to record the 3-D relative positions of the body segments at a frequency of 60 Hz, and the joint angles of the shoulders (abduction-adduction and flexion-extension), elbows, wrists, hips, knees, and ankles were derived from the SIMI motion movement analysis system. Time series of the 14 joint angles were submitted to SPSS 21.0 for Principal Component Analyses (PCA). The PCs were further consolidated when the dominant frequencies of the projections of 2 PCs are the same. The results showed that 2-4 PCs were required to account for 40-63% variance, and that the first PCs were mainly related to the arm movement of juggling in both types of juggling. In addition, the number of variables involved in the first component seemed to be related to the skill level, that is, the lower the skill level, the more variables in the juggling related PC. The results of the study support the freezing-to-freeing degrees of freedom direction of coordination development proposed by Bernstein (1967).

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Using joint entropy to discriminate between time matching and time minimization movement accuracy tasks

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There are two experimental paradigms that have predominantly used spatial (time-minimization task) or temporal goals (time-matching task) for studying the effect of speed-accuracy trade-offs. The purpose of the study was to investigate the spatial-temporal performance differences between the two types of discrete aiming tasks. The time minimization task and two time matching tasks were used in the experiment. Each type of the experimental tasks had 5 space-time conditions. One of the time matching tasks had 5 goal times whereas the other time matching task used only one goal time but controlled with different average movement velocities. Twenty participants each performed 100 trials for each task-condition combinations. The 3 (task) $\times$ 5 (condition) repeated measure MANOVA was used to examine the effects of tasks and space-time conditions on movement time, spatial errors and temporal errors. The results showed a significant interaction effect, $p < .001$. Performing an aiming movement task under similar space-time constraints resulted in similar spatial and temporal performance variability and space-time joint entropy only in the fastest condition. The differences of performance properties of the tasks increased when average movement velocity decreased under the same spatial and temporal constraints. The results suggest that the task-related differences of movement performances are related to the task-specific characteristics for time-constrained and space-constrained tasks. The joint entropy is an emergent property that captures the different distributional features of the system that resulted from these two categories of aiming tasks.

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Using coordination tasks to screen people with a history of mTBI

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National Institute of Neurological Disorders and Stroke (NINDS) and National Institute of Health (NIH) declared mild Traumatic Brain Injury (mTBI) as a major public health problem due to its severe sequela (NINDS and NIH, 2002). The large white matter tracts like the corpus callosum (CC) have been shown abnormal with multiple mTBI (Chamard et al., 2017; Caeyenberghs et al., 2011) which impacts people's ability to perform coordination tasks. Therefore, coordination tasks might be used to screen people with a history of mTBI. In the current study, we recruited 8 young adults with a history of mTBI (3 males and 5 females, age = 21.75 +/– 4.03 years, mTBI history = 38.33 +/– 32.11 months) and another 8 gender-matched healthy controls (age = 20.63 +/– 2.45 years) to perform three coordination tasks: 1) visual discrimination of coordination at 0° and 180°, 2) unimanual visual-motor coordination at 0°, 180°, and 90°, and 3) bimanual coordination at 0°, 180°, and 90°. Their discrimination thresholds (at 0° and 180°), unimanual and bimanual performance (at 0°, 180°, and 90°), and learning rates of unimanual and bimanual coordination (at 90°) were all assessed at baseline, 2-month later, and 4-month later. The results did not show any group difference in each task measure in each testing phase ($p > 0.05$), however, given the small sample size in each group, the effect size (Cohen's d) for the group factor was calculated. The unimanual visual-motor coordination task at 180° (mean d = .74, $F1,14 = 2.54$, $p = .13$) and 90° (mean d = .54, $F1,14 = 1.19$, $p = .29$) showed effect sizes greater than .50, suggesting that the unimanual visual-motor coordination task (at 180° and 90°) could be potentially used in the future to examine people with a history of mTBI if a larger sample size is accessible.

Does the prompt that a participant receives for feedback contribute to the learning advantage of self-controlled practice?

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Providing learners with choice during practice enhances motor skill learning. Currently, two views exist to explain such benefits; one in which self-controlled (SC) practice is said to satisfy psychological needs for autonomy and competence, thus increasing intrinsic motivation and subsequent learning (motivational view). Conversely, proponents of an informational view propose that SC practice engages learners in response evaluation processes that enhance learning. In SC feedback research, participants in the SC group are prompted after each trial "Would you like feedback?", whereas yoked participants are simply provided feedback. This gives rise to a methodological confound because it is possible that the prompt engages participants in response evaluation processes, and thus, it is not only the choice aspect that differentiates the two groups. Thus, we addressed this prompt confound by comparing self-control (SC), yoked with no prompt (YNP), and yoked with prompt (YP) groups (n = 20 per group) who were tasked with learning a spatiotemporal motor skill with a specific movement time (MT) goal during a 6-block acquisition phase. Motivation measures were completed after blocks 1 and 6. During acquisition, the SC group chose when they wanted feedback, while participants in the yoked groups were not provided this choice. The YP group was prompted to consider whether feedback would be useful on those trials in which it was provided, whereas no prompt was given for the YNP group. Learning was inferred by examining absolute constant error (|CE|) of MT during 24-hour no-KR retention and transfer tests. No |CE| MT differences were found during acquisition or for measures of motivation; however, there was a trend for less |CE| MT in retention and transfer for the SC (M=87 & 157 ms) and YP (M=126 & 144 ms) groups as compared to the YNP group (M=181 & 209 ms). Although our findings suggest that SC benefits are reduced due to a prompt that is assumed to induce response evaluation processes, the lack of significance prevents us from strongly supporting one view over the other.

Getting into the swing of things during childhood: A hand-eye coordination paradigm

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Hand-eye coordination is a key component of everyday life and underpins successful engagement in many activities of daily living. More specifically, hand-eye coordination is an essential component of physical activity participation. The ability to coordinate with external stimuli has been widely studied in adults in laboratory-based settings as well as field-based research. However, little is known about these processes in children and even less when it comes down to understanding how these processes change as age increases. This project examines children's performance in a rhythmic unimanual coordination task using a handheld pendulum. Participants (aged 6, 9 and 11 years) manipulated the pendulum at 3 frequencies (preferred frequency, +20% of preferred and -20% of preferred frequency) in coordination with 3 stimuli (Visual, Auditory and Multisensory – ie Visual-Auditory combined). Results showed that children's coordination levels and movement variability improved with age, however still fell below those observed in adults. The maturation process of each of the stimuli (visual or audio) does not occur at the same rate. Children demonstrated preferences for visual stimuli or multisensory stimuli compared to auditory stimuli on their own. In conclusion, children's hand-eye coordination levels were found to follow the typical maturation process and improve with age. Further to this, findings suggest the potential benefit of multisensory information for hand-eye coordination in children. For those tasks, adults' performance does not improve with multisensory information suggesting a direct benefit of redundant sensory information during the hand-eye coordination maturation process.

Funding source: Irish Research Council.

Quiet eye duration is dependent on the margin for error: A field test of skilled rugby goal kickers

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Quiet eye (QE) refers to the duration of the final fixation on a target prior to initiation of a motor response. Previous research on self-paced skills has shown that quiet eye duration is longer for successful than unsuccessful attempts (e.g., golf putts). However, there is limited research on how vision and action interact during far aiming tasks, and even less on the relationship between task difficulty and quiet eye duration. Rugby goal kicking is a skill in which task difficulty is influenced by both the force required (kick distance) and the angle between the left post, kick position, and right post (post angle). The purpose of this study was to systematically manipulate kick position to investigate the relative influence of kick distance and post angle on quiet eye. Ten high-skilled rugby union goal kickers attempted two place kicks from each of 12 field positions, representing easy (post angle = 10 degrees), intermediate (post angle = 7.5 degrees) and difficult (post angle = 5 degrees) kicks from both the left and right side of the field. Eye gaze was monitored using a SensoMotoric Instruments mobile eye tracking glasses (v2) and the players' routines were recorded at 50Hz in HD, using a Panasonic HC-V770 video camera. We analysed the final fixation toward the posts (QE posts), the final fixation on the ball (QE ball), and concentration time (CT) prior to the run up. Analysis revealed a significant effect of kick difficulty on QE posts ($p < .01$), and CT ($p = .01$), but not QE ball ($p = .72$). QE posts was shorter for easy kicks ($M = 2.30$ s) than for intermediate kicks ($M = 2.67$ s) and difficult kicks ($M = 2.88$ s). CT was shorter for easy kicks ($M = 8.71$ s) than for intermediate ($M = 9.85$ s) and difficult ($M = 9.72$) kicks. The implications of these results for the definition of QE, and for protocols for 'quiet eye training', are discussed.

Cortical correlates underlying changes in mental workload and motor performance during multiple training sessions under various levels of challenge

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The allocation of attentional resources is a crucial element of effective cognitive-motor performance. Although a large body of work has examined the changes in mental workload under various levels of task difficulty during motor performance, few studies have examined the brain correlates underlying the variations of mental workload and performance during motor learning over multiple practice sessions. Thus, this work aims to further examine the cerebral cortical dynamics using electroencephalography (EEG) to assess variations in mental workload during a flight simulator task practiced under two levels of difficulty over four days using an interactional approach. During training, subjective mental demand and task difficulty and flight performance were examined via the NASA Task Load Index and deviation measures of heading and speed, respectively. Theta and alpha band activities were computed from the collected EEG signals. As predicted, over the four training days, results revealed that subjective mental workload reduced while performance improved. Additionally and as expected, EEG theta and alpha power increased across practice visits suggesting elevated working memory engagement and overall neural efficiency, respectively. Furthermore, alpha power and a ratio of theta/alpha revealed expected positive relationships with task difficulty. Also, an unexpectedly consistent theta power was observed across levels of difficulty, possibly resulting from a saturation of working memory due to the highly complex nature of the task. Finally, the lack of a difficulty × practice interaction for both theta and alpha powers indicate that, during learning, these cortical processes were refined at a similar rate for both levels of difficulty. Generally, this effort confirms and expands previous investigations by revealing that, while there was an increase in cortical recruitment under elevated difficulty, a similar degree of learning occurred across both practice difficulties.

Funding source: The Lockheed-Martin Corporation, USA.

Working memory engagement during self-controlled practice: An EEG study

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Previous research indicates that self-control of task difficulty during practice can more effectively promote learning than under externally-controlled practice conditions. This effect may be due, in part, to working memory engagement. The present study investigates this notion using electroencephalographic (EEG) measures of working memory engagement, specifically frontal theta power. It was hypothesized that the self-controlled practice group would report higher levels of mental demand and show elevated working memory engagement throughout practice as well as display increased performance improvement on a 24hr-delayed retention test compared to a yoked group with no control over task difficulty. Thirty-two novice participants were divided into two groups (self-controlled and yoked) to learn the cognitive-motor skill of golf putting over the course of

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three days. Theta band power was calculated from the EEG time series that were collected throughout the experiment, while self-reported mental demand was also assessed using the NASA Task Load Index. Upon accounting for expected covariates, the self-controlled group achieved a significant performance improvement from baseline to retention in terms of the number of on-target putts while the yoked group showed no such difference. Furthermore, EEG results revealed that the self-controlled group tended to exhibit elevated theta power relative to the yoked group across all regions and visits, while no effects were found using self-report. These results suggest that the self-controlled group exhibited more working memory engagement during practice than the yoked group which may have contributed to increased levels of performance improvement. The lack of significant self-report results highlights the importance of a multimodal approach in assessing complex cognitive constructs such as working memory. These results provide early support for the notion that elevated working memory engagement is a potential mechanism by which self-controlled practice has a positive effect on learning over externally-imposed practice.

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Exploring the relationship between otolith function, sensorimotor integration, and postural control in chronic mild traumatic brain injury

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Mild traumatic brain injury (mTBI) is common in sport contexts as well as following motor vehicle accidents and falls. Previous work has examined saccular function of the otolith organ using Cervical Vestibular-Evoked Myogenic Potential (cVEMP) in mTBI patients; however, the Ocular Vestibular-Evoked Myogenic Potential (oVEMP), a recent technique, examines utricular function and may provide further insight into the overall otolith organ function following concussion. Utricular dysfunction has been linked to poor postural control and sensorimotor integration in individuals with vestibular loss, but this has not been reported in the mTBI population. Therefore, the purpose was to measure otolith function and explore its relationship with postural sway and sensorimotor integration in chronic mTBI. Fifty-one controls and 22 chronic mTBI participants completed the cVEMP, oVEMP, Sensory Organization Test (SOT), and quiet stance as measured by an inertial sensor. Vestibular dysfunction was observed by a lower amplitude ($p < 0.05$) and a trend for greater asymmetry (p=0.07) of the cVEMP in the mTBI compared to the control group. No differences in the amplitude or asymmetry of the oVEMP were observed between groups (p>0.05). Deficiencies in sensorimotor integration, as detected by the composite score of the SOT ($p < 0.001$), and poor postural control, as evidenced by a trend for greater root mean square in the medial-lateral direction during standing (p=0.06), were apparent in the mTBI compared to the control group. Although all of the cVEMP and oVEMP parameters were correlated ($p < 0.05$), and the SOT was correlated to sway ($p < 0.001$), no relationships between vestibular parameters and sensorimotor integration or sway were identified (p>0.05). Altogether, no link between otolith function and posture or sensorimotor integration was observed, suggesting that deficits in sensorimotor integration and posture may stem from other central or peripheral mechanisms.

Funding source: Department of Defense.

Medication and trial duration affect posture and pointing during a standing repetitive pointing task in parkinson's disease

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The aim was to determine the effects of levodopa medication on the performance of a repetitive pointing task while standing, and to investigate the optimal trial duration in individuals with Parkinson's disease (PD) compared to older adults. Seventeen individuals with PD (5 freezers) and 9 older adults stood on force platforms for 30 s and 120 s while performing a bilateral repetitive pointing task, tracked by motion capture. PD participants were assessed on and off medication and older adults were also assessed on separate days. Results revealed that: 1) PD participants were more unstable on than off medication, as supported by greater center of pressure root mean square in the medial-lateral direction, greater velocity in the medial-lateral and anterior-posterior directions, and greater range in the medial-lateral direction; 2) longer trial durations yielded greater center of pressure range in the medial-lateral and anterior-posterior directions and greater coefficient of variation of finger pointing on the least affected side; 3) PD participants were more unstable than controls as shown by a larger range in the medial-lateral direction; 4) off medication, freezers presented with greater stiffening than non-freezers, such that less range and root mean square in the anterior-posterior direction emerged; and 5) an association between upper- and lower-body freezing emerged as the freezing of gait questionnaire and pointing asymmetry as well as the coefficient of variation of pointing on the most affected side were correlated. Therefore, levadopa may increase instability during a repetitive pointing task. Longer trials may provide a better depiction of sway by discriminating between those with and without neurological impairment. The greater restrictive postural strategy in freezers compared to non-freezers is likely a factor that augments fall-risk. Lastly, the link between freezing of gait and upper-limb movement indicates that freezing may manifest first in the lower-limbs.

Contextual interference effect on acquisition and transfer in fundamental motor skills in young-adults

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The contextual interference effect (CIE) has been studied among different age groups and in a variety of motor skills. Nonetheless, it has not been explored in fundamental motor skills in adults. The aim of this study was to examine the CIE on acquisition and transfer on fundamental motor skills (FMS) in adults. Seventeen young-adults ($M = 20.00$ yr., $SD = 2.09$) volunteer to participate in the study. Performance on FMSs was assessed using the Test of Fundamental Motor Skills in adults (TFMSA), which is a process-oriented test that assess 10 FMSs. At pretest and acquisition, participants were assessed in distance jump and overarm throw; and for transfer test in strike a stationary ball. After pre-test they were randomly assigned into two groups: blocked practice (BP) and random practice (RP). The training period lasted 1 session, they practiced 20 trials for jump and 20 trials for throw. During training, BP performed 20 trials of one skill, before performing 20 trials of the second skill. RP performed 20 trials of each skill in an alternated order. Immediately after training session, they were assessed in acquisition; and 10 minutes after for transfer. A 2 (group) by 2 (measurement) analysis of variance with repeated measures indicated a significant interaction for jump ($F_{(1,15)}$= 6.889; $p = 0.019$), no significant interaction was found for throw. Main affects showed that both groups increased performance on both skills in acquisition test. A *t-Student* indicated that RP performed better, on strike, that BP in the transfer test

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(t = -2.408; p = 0.029). In conclusion, CIE was found in the transfer test in young-adults.

Balance as a predictor toward independent cycling

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Learning to cycle is a milestone for children, often obtained with difficulty. Fundamental movement skills (FMS) are generally developed in early childhood. Children have the developmental potential to progress to the mature stage of most FMS by the age of 6, at which point they are able to combine FMS to produce specialised skills in sports and recreational activities like cycling. However, children most commonly achieve success in cycling independently between 3 and 5 years, when they have not yet reached mastery levels. While balance, a component of FMS, has often thought to be essential in cycling; this may be a misconception as 3–5 year olds have not yet reached the level of ability necessary to combine and refine balance skills to produce the skills necessary to cycle. Thus, this study investigates if balance is a contributing factor to cycling independently. Seventy-two children (3.7 years old +/– 0.5) were assessed pre and post a 5 week intervention. Ability to cycle independently was measured using a traditional bike. If the child was able to cycle without assistance (tester not holding onto the bike for 3 or more revolutions) they were given a score of 1 and if they could not a score of 0. No children were able to cycle independently at pre-intervention. Balance ability was measured using the balance subset of the Movement Assessment Battery for Children, second edition (MABC-2). All children attended 10 cycling lessons over 5 weeks. A linear regression was run to assess whether balance level at pre-intervention predicted if a child would be able the cycle independently post-intervention. Balance ability did not predict cycling independently (r^2 = .002, p > .05). The current results would suggest that the FMS component of balance is not a contributing factor to cycling independently. Future research should further investigate (i) if cycling is an independent skill not associated with FMS proficiency and (ii) if other cycling specific balance assessments relate to learning to cycle.

Funding source: Irish Research Council; Yvolution Ltd.

Response biases: The influence of the contralateral limb and head position

Deanna Kennedy, Charles Shea, Texas A&M University

Two experiments were designed to determine response biases resulting from the production of force in the contralateral limb and changes in head position. In both Experiments, participants were required to react with one limb while producing a pattern of force defined by a sinewave template (experimental conditions) or observing a cursor move through the sinewave pattern (control). In Experiment 1, participants had to react with both their right and left limbs while their head was in a neutral position. In Experiment 2, participants had to react with their left limb while their head was positioned laterally to the left or right. Participants were told to produce a rapid force pulse with their reacting limb while continuing to track the sinewave pattern with their contralateral limb or observing the cursor move through the pattern. The signal to perform the force pulse was a change in the color of the waveform. The reaction time stimulus occurred once in each trial and was presented at one of six locations on one of the six cycles comprising the sinusoidal waveform. Reaction time was calculated as the time interval between the color change of the waveform and the initiation of the response. The results of Experiments 1 and 2 indicated mean reaction time for the left limb was significantly influenced by force production in the right limb. During left limb reactions, reaction time was faster for trials in which both limbs initiated force simultaneously as compared to trials in which the left limb initiated force while the right limb was producing or releasing force, regardless of head position (Experiment 2). Mean reaction time for the right limb was not influenced by force production in the contralateral limb (Experiment 1). These results are consistent with the notion that neural crosstalk is asymmetric in nature with the dominant limb exerting a stronger influence on the non-dominant limb than vice versa. However, a similar asymmetric influence was not observed with head position.

Quiet eye and motor performance: Testing the "optimal duration" hypothesis

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Particularly in targeting tasks, the final fixation duration before movement initiation (Quiet Eye, QE) reliably predicts motor performance (Vickers, 2016). In this regard, an optimal QE-performance relation has been assumed (e.g., Behan & Wilson, 2008), meaning that short and very long QE durations deteriorate performance. This hypothesis was put to empirical practice by testing throwing accuracy as a function of short, long, and very long QE-duration conditions. In addition, QE-performance curve fittings were conducted to assess the actual relation between those variables. In each of two experiments, 22 sport-science students threw balls as accurate as possible at virtually target disks that were displayed at 8 different moments in time before movement initiation (ranging from 400 ms to 3200 ms). Throwing performance and gaze behavior were assessed with a 10-camera VICON system (200 Hz) and an integrated eye-tracking system (EyeSeeCam, 220 Hz). Radial error (mm) and QE duration (ms) were calculated as dependent measures. For the curve fittings, the actual data for each participant were individually fitted to linear, quadratic and decayed exponential functions. While the results showed a successful QE manipulation in relative values, particularly in the very long QE-duration conditions the intended QE durations were not reached. For throwing performance, less accurate throws were found in short (M = 165 mm) vs. long (M = 140 mm) but no further performance differences in very long QE-duration conditions. Likewise, the curve fittings revealed performance improvements until 2000 ms but no further notably performance differences until 4000 ms. The results emphasize the mutual coupling between perception and action as the demands of the motor task restricted the intended QE maximization. Furthermore, the relation between the QE and performance seems to be best described by an exponential decay that rather supports a response-programming function of the QE (Gonzales et al., 2015). Further theoretical considerations and the transfer into practice will be discussed.

Field location and player roles as constraints on emergent 1-vs-1 interpersonal patterns of play in football

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Previous research has suggested that ecological constraints, such as specific field locations, can shape emergent performance behaviours. Here, we investigated effects of field locations on patterns of play that sustained decision-making of players in 1-vs-1 phases of play in football, when attackers were required to beat defenders and shoot at goal. Male, U-16 yr old players (n = 15) from a regional amateur team participated in the study. Using positional data obtained from remote sensor technology, we calculated the values of the relative distance between an attacker and defender to the centre of the goal and the relative angle between the centre of the goal, each defender and attacker, to assess decision-making in the 1 v 1 dyads. Results revealed that values of interpersonal distance (ID) between players

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were constrained when performing in field locations nearer the goal. Higher values of ID were observed in midfield locations, compared to the left or right flanks. Additionally, values of the relative angle between competing players and the goal were greater in the midfield location, than in the left or right field areas. Our findings suggest that manipulating key task constraints on attacker-defender dyads, such as different locations on field during practice, can help players learn how to detect functional information for decision-making in 1-vs-1 game sub-phases of football.

Priming performance on a ball tossing task via movement contingent sensory effects

William Marshall Land, University of Texas at San Antonio

Anticipation of the perceptual consequences of a movement is considered to play an important role in the planning, execution, and control of voluntary actions. Research has shown that when a movement consistently produces a specific sensory effect during learning (i.e., movement contingent sensory effect), the sensory feedback can subsequently be used to prime and facilitate performance of that action. To date, the research supporting movement contingent sensory effect priming has largely been based on reaction time paradigms utilizing simple motor tasks (e.g., button press). Consequently, the aim of the present study was to examine whether movement contingent sensory effects could be used to prime and facilitate motor performance on a more complex ball-tossing task. The ball-tossing task was performed across two consecutive days, and consisted of an acquisition phase and a test phase. During the acquisition phase, participants (N = 30) practiced an underhanded ball tossing task to a near and far target (N = 360 total, n = 180 each distance). Tosses that landed near the target immediately produced an auditory feedback tone upon landing, with unique tones for both the near and far target. In the test phase, the auditory tones preceded the toss and served as imperative stimuli for the tossing task. The test phase consisted of three tossing conditions (corresponding, non-corresponding, and control) in which the participants responded to the tones by tossing the ball to either the corresponding or non-corresponding target associated with the tones during learning. Findings indicated that both accuracy and consistency of ball tossing improved when the toss was preceded by the corresponding auditory feedback associated with the successful execution of the action during learning. The present study extends previous research by showing that complex actions consisting of multiple degrees of freedom can be primed via movement contingent sensory effects.

The effect of outcome estimation specificity on motor practice

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Research has indicated that enhancing the ability of learners to evaluate and estimate the outcomes of movements can be beneficial to learning and performance on a motor task. Building upon this, the present study examined whether the specificity of outcome estimations during training moderates the benefits observed from estimation practice. Participants trained on a ball-tossing task in which vision of the outcome was removed immediately upon ball release. Subsequently, participants provided an estimate of the landing location prior to being provided with feedback of the actual outcome. The task was performed under one of three estimation conditions. The specific estimation group provided an exact prediction of the landing point, whereas the general estimation group indicated whether the ball landed short/long and left/right of the target, while a control group did not provide an estimation. Although past research has generally supported the benefits of estimation practice, the present findings indicate that specificity of estimation may moderate this benefit. Specifically, results indicated that the tossing accuracy of the specific estimation group was significantly worse during the early stages of learning compared to the general and control groups. This finding may reflect an increased cognitive burden on attentional resources resulting from the greater requirements for precise outcome estimations. Importantly, the initial performance decrements associated with providing specific outcome estimations diminished over the course of task practice as estimation ability improved. Results also indicated that participants tended to exhibit a positive bias in their estimations of outcome, with predictions approximately 36.4% closer to the target than the actual outcome. Overall, these findings suggest that implementing specific outcome estimations as part of training may have a negative impact on performance until estimation ability improves.

Local muscle fatigue increases motor time in fractionated reaction time

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The main aim of the research was to determine how acute and local muscle fatigue affected fractionated reaction time (FRT) including premotor time (PMT) and motor time (MT). In addition, the study was to investigate the change of neuromuscular activities on the fatigued muscle. 14 healthy and right handed college students signed an informal consent prior to conducting a visual-motor reaction task. Each participant was asked to response to a visual stimulus on a 21" computer screen by extending the right triceps to depress a footswitch integrated into a Serial Response Box. A customized system was developed to collect the surface EMG of the lateral triceps brachii (agonist) using Biopac and the reaction time of visual-motor task using E-Prime, simultaneously. All Participants practiced the task alternatively with 2 blocks of fatigue protocol and 2 blocks without fatigue protocol, totally 8 blocks with 8 trials for each in the experiment. The acute and local muscle fatigue was induced by lifting a dumbbell at 80% 1 RM continuously until task failure right before each fatigue block. The interval between fatigued blocks and non-fatigued block was 2 min in order to ensure the recovery of the acute muscular fatigue. Compared to the non-fatigued, participants showed a significant longer MT ($F = 38.54$, $p < .01$) on the blocks with the fatigue protocol, although no difference was detected on RT ($F = 2.26$, $p = .16$) and PMT ($F = 0.19$, $p = .67$). The analyses of sEMG revealed a significant decrease on frequency ($F = 34.16$, $p < .01$) and a significant increase on iEMG ($F = 23.64$, $p < .01$) for the fatigued blocks relative to the non-fatigued. The present findings of the EMG amplitude and frequency, consistent with the previous research, provided valid evidences for the technique of the fatigue protocol in this experiment. More importantly, this study indicated that an acute bout of local muscle fatigue induced slower peripheral process on the neuromuscular recruitments, as the evidence of increased MT, but no effect on the central component of the information processing.

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Locomotor adjustments during stair ascent in children with Down Syndrome: Comparison between walking and crawling strategies

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Down syndrome (DS) is the most common genetic condition and causes delayed motor development. Children with DS often show poor balance and less efficient gait patterns. When negotiating obstacles or stairs, they often choose a conservative strategy (such as crawling) over an advanced strategy (such as walking). The purpose of this study was to examine motor strategy and spatiotemporal parameters in children with DS while ascending stairs of different heights. Fourteen children with DS (4M/10F, mean age: 8.6 years) participated in this study. They walked along a 5-meter walkway and used a strategy of their choice to ascend 3-step staircases of

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different heights: 17 cm (LS), 24 cm (MS), or 31 cm (HS). Five trials were collected for each stair condition. A 3D motion capture system was used to collect spatiotemporal data. Vertical toe clearance and horizontal toe velocity were calculated when the leading or trailing toe was above the outer edge of the stair. Three-way (2 strategy × 3 stair × 2 foot) mixed ANOVA were conducted on the dependent variables. Results show that children with DS primarily walked up the stairs (65%) in the LS condition, nearly equally chose the walking (47%) or the crawling (51%) strategy in the MS condition, but mainly crawled up (79%) in the HS condition. Regardless of motor strategy, children with DS generally decreased toe clearance and horizontal toe velocity with stair height. Further, children with DS displayed a higher toe clearance for the leading foot than for the trailing foot. Between the two motor strategies, there was no difference in toe clearance or horizontal toe velocity. This suggests that although walking is a more advanced strategy than crawling, children with DS might control the trajectory and speed of their foot similarly regardless of motor strategy to ensure a safe clearance of stairs both vertically and horizontally. Our results also indicate that children with DS may not be able to scale their toe clearance appropriately to different stair heights due to their physical and motor limitations.

Measuring cortical 1/f noise in a motor learning paradigm: Effects of difficulty, performance, and time.

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Introduction: Within the power-spectral density of a time-series signal, the power per frequency interval is often inversely proportional to the frequency. This decline in the power spectral-density can be defined by the function 1/f^α, where 'f' is the frequency and 'α' is a scale parameter that determines the slope of the decline in power. If all frequencies are equally-represented (i.e., 'white' noise where α is equal to zero) this is thought to reflect a decoupling of neural oscillators and increase in neural-noise. To our knowledge, the utility of this measure in motor learning paradigms has not been explored. Methods: This paper presents a secondary analysis of EEG data from 60 novice participants who were pseudo-randomly assigned practice a complex motor task in a self-controlled group (choosing the difficulty of practice from block-to-block), or to a yoked group, where the difficulty was matched to the self-controlled group. Using linear mixed-effect regression, we explored tonic differences in the 1/f slope during rest, and phasic changes in the 1/f slope during practice as a function of block, difficulty, and group. Results: Analysis of the 1/f slope during rest revealed spatial differences in the intercept of the linear function (from anterior to posterior), but non-significant spatial differences in slope. During practice, there were significant interactions between block, difficulty, and group. Thus, the prevalence of neural noise appears to depend on the difficulty of practice, the stage of practice, and the choices made by participants. Conclusion: This first foray into the utility of 1/f noise in motor learning studies showed a relatively reliable measure that was sensitive to a number of task relevant variables. Previous research has shown neural-noise to be extremely relevant in aging, and we argue that further research is justified to explore the utility of this measure in motor learning/control contexts.

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Effect of feedback within a novel virtual reality obstacle crossing environment

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Obstacle crossing is crucial to safe ambulation. Our previous research showed that virtual reality obstacle crossing training results in improved real-world obstacle negotiation in terms of foot clearance over the obstacle. However, it is unknown why the virtual obstacle crossing led to these changes in the real-world. This study determined whether real-world foot clearance improvements differed after virtual obstacle training with different types of feedback. Young healthy adults were split into a Knowledge of Results (KR) group (n = 10, 21.3 ± 0.95 yrs) and a Knowledge of Performance (KP) group (n = 10, 21.5 ± 3.63 yrs). Each group crossed 25 virtual obstacles (5 practice trials and 20 virtual obstacles). The virtual environment was shown on a projection screen in front of a treadmill and consisted of a virtual walking path, virtual feet, and a virtual obstacle. The walking path and the feet moved in real-time as the participants walked on the treadmill and they were instructed to step over the virtual obstacle as it approached them. The KR group had a performance counter showing total number of successful and failed obstacle crossings. The KP group had a color change of the virtual foot that contacted the obstacle. Each group performed a pre- and post-training test of 10 real-world obstacle crossings. There was a significant effect of time from pre- to post-training ($F(4,15) = 3.74$, $p = .03$), but no significant effect of group ($F(4,15) = 0.68$, $p = .61$). Follow-up univariate tests showed trail limb radial clearance ($F(1,18) = 5.27$, $p = .03$), lead limb peak elevation ($F(1,18) = 13.90$, $p = .002$), and trail limb peak elevation ($F(1,18) = 5.63$, $p = .03$) drove this effect of time. These results suggest that there is not a difference in performance when given KR or KP in this type of novel virtual reality environment. Feedback within virtual reality seems to give enough information regardless of type to improve real-world obstacle clearance. Future studies will examine this further by adding a no feedback and a combined feedback group.

A virtual environment can be as good as a real one to improve real-world skill when hitting a ball

David Mann, Maaike Dunnink, Robin Bense, Jeltje Loomans, Vrije Universiteit Amsterdam, Netherlands

Virtual reality (VR) provides unprecedented opportunities to control the learning environment during motor skill acquisition, particularly when presenting scenarios that would not be possible in the real world (Gray, 2017). However, it is unclear whether VR would result in transfer, whereby the skills learned in VR would improve the real-world skills they are designed to replicate. This is particularly the case for interceptive hitting tasks where the learner must hit a moving target (e.g., a baseball or tennis ball), with neuropsychological evidence suggesting that a movement to intercept a virtual object will rely on a different neural pathway to that used when intercepting an actual object (Milner & Goodale, 2008). The aim of this study was to establish the degree to which a virtual environment could be used to improve real-world skill in hitting. Thirty-eight novice participants took part in a two-day training program designed to improve skill when playing table tennis with the non-dominant hand (to minimise effects of previous experience). Participants were allocated to one of four training groups: a *real-life* group who trained against a live opponent, a *VR* group who did equivalent training using an X-Box Kinect, a *real-world + VR* group who combined the two approaches, and a *control* group who did no training. Participants performed a pre- and post-test of real-world table tennis skill, returning shots from a ball-machine, to quantify the magnitude of training effects (Liao & Masters, 2001). The results revealed a significant interaction between training group and test-time ($p < .001$), with all groups except the control group improving their performance from pre- to post-test. Remarkably, the improvement for the VR group was indistinguishable from those for the real-life and real-life + VR groups ($p = .30$; effect sizes $d = 1.5$, 1.4, 1.3 respectively). The findings suggest that the conditions necessary to support learning in hitting can be found in virtual environments, showing that VR offers a promising means to test and train real-world interceptive skill.

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Quiet eye is not responsive to throwing darts of different weights even when the weight differences can be perceived

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Previous research suggests that when movement properties need to be regularly reparameterized in throwing to variable target locations, quiet eye is longer than when throwing to a fixed target location, when reparameterization is not necessary (Horn et al., 2012). Less known is whether quiet eye is responsive to the need to reparameterize for varying weight projectiles, and whether it is necessary to consciously detect weight differences in order for those weights to impact quiet eye duration. In this experiment participants (n = 15) threw darts of three weights (20, 22, and 30 g) in four conditions: fixed and variable target location (three targets) with small weight variation (20 and 22 g darts) and fixed and variable target location with large weight variation (20 and 30 g darts). In each condition the participants threw five of each weight dart in random order. At the end of the testing we verified whether the participants could correctly identify the three darts by holding them. We hypothesized that supporting past research, throws using variable target locations would be associated with longer programming quiet eye than those to fixed locations. We also predicted that throws using darts of larger weight variation would result in longer quiet eye than those of low weight variation. No differences were found between the four conditions for programming quiet eye, online quiet eye, or time to quiet eye onset (all $p > .05$). There were also no differences in radial error in the four conditions ($p > .05$). Results suggest that even with conscious somatosensory perception of weight differences, additional programming time is not required during quiet eye. Instead, we suggest that participants make early adjustments to dart weight before the target is even presented.

Analysis of gait while overcoming an obstacle in exercise practicing and non-practicing elderly

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With aging, gait pattern tends to change, reducing important functional capabilities, making the elderly more susceptible to falls. However, the practice of physical exercise has been presented as an important means to minimize these effects. In this context, little is known about the magnitude of the influence that different types of physical exercise may have on the elderly when overcoming obstacles during gait. The objective of this study was to analyze the gait with overcoming obstacles by elderly people practicing different modalities of physical exercises. Fifty-three elderly (25 males and 28 females), with mean age of 66.98 years, were divided into four groups: Resistance training group (GTR – n = 14), Water aerobics group (GHD – n = 15), Group of tennis players (GTN – n = 12) and Group of non-practitioners (GNP – n = 12). The groups were submitted to three gait trials with obstacle overcoming and the following kinematic variables were evaluated: step length, step width, center of mass (CM) mid-lateral (ML) displacement amplitude and CM displacement velocity, in the step before, during and after overtaking an obstacle. For data analysis, we used Two-Away Anova with repeated measures and Tukey's post hoc ($p < 0.05$). The results indicated significant differences in the step width variable, before and after overcoming the obstacle $F(1, 49) = 18.69$; ($p = 0.01$), this difference was observed for GTP. For ML amplitude, there were differences between groups: $F(3, 50) = 6.04$; ($p = 0.001$), with GTR, GTP and GHD showing lower ML displacement when compared to GNP ($p < 0.05$). The variable CM velocity $F(3, 50) = 5.46$ ($p = 0.02$), there were differences between the groups, GTN/GHD and GTN/GNP. The groups showed differences in gait variables, with postural adjustments to the obstacle. GTN presented more positive results in the gait with obstacles. Weight training and tennis were the modalities that presented more positive results in gait with obstacle overcoming in the elderly.

Animated instructional presentations can cause symptoms of motion sickness

Anthony Mayo, San Francisco State University; David Anderson, San Francisco State University; Thomas Stoffregen, University of Minnesota

Teachers and trainers use software applications to convey instructional content to help students achieve learning objectives. Some of these applications enable instructors and instructional designers to create animated material with optic flow characteristics similar to those found in fixed-based simulator devices, virtual reality simulators, and video games. A side effect associated with optic flow in these contexts is motion sickness (Kennedy, Berbaum, & Lilienthal, 1997; Stanney & Hash, 1998; Stoffregen, Hettinger, Haas, Roe, & Smart, 2000; Stoffregen, Faugloire, Yoshida, Flanagan, & Merhi, 2008). Anecdotal evidence suggests that animated instructional presentations may cause symptoms of motion sickness in the classroom (Salter, 2012). Two experiments were conducted to investigate this phenomenon. In Experiment 1, undergraduate students were exposed to either a presentation with low optic flow (LOF) characteristics or one with high optic flow (HOF). In Experiment 2, students viewed presentations with either HOF or moderate optic flow (MOF) attributes. In both experiments, a Simulator Sickness Questionnaire (SSQ) (Kennedy, Lane, Berbaum, and Lilienthal, 1993) was used to assess motion sickness. In addition, a quiz was administered to assess learning. Wilcoxon Matched-Pairs Signed Rank Tests were conducted to determine differences in ranking of PRE- and POST-SSQ scores. In Experiment 1, the difference between PRE- and POST-SSQ scores was significant for participants who viewed a HOF presentation ($z = -2.914$, $p < .05$), while the difference in PRE- and POST-SSQ scores for those who viewed a LOF presentation was not ($z = -1.805$, $p = .071$). In Experiment 2, the difference between PRE- and POST-SSQ scores was significant for both groups – HOF ($z = -3.771$, $p < .05$) and MOF ($z = -1.968$, $p < .05$). In both experiments, no differences in quiz scores between groups were found. These results suggest that moderate to high amounts of optic flow in animated classroom presentations can cause symptoms of motion sickness in students who view them.

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Effectiveness of a novel target grid method for obtaining 2-D error scores

Ben Meyer, Shippensburg University

Over two decades ago, Hancock et al. (1995) provided appropriate analysis techniques to measure and quantify 2-D error values in performance studies, but many investigators have continued to utilize 1-D methods. In a recent 2-D error value study, Carter et al. (2016) had participants toss Koosh balls to a target painted on a gym floor. Experimenters used a measuring tape to obtain X and Y coordinates of the tossed balls to the nearest centimeter. This method can take considerable time and effort. The purpose of this study was to create and assess a target grid method that will enable investigators to more easily obtain 2-D data in performance studies. It would be prohibitive for many investigators to paint targets on a gym floor, and even then there are challenges in having the gridlines positioned accurately. A novel method was developed whereby grids (10 cm distance between lines) were printed on vinyl banner targets. Each half of the grid was printed on a 0.9 m by 1.8 m vinyl banner. The two banners were attached to each other to create a 1.8 m by 1.8 m square target. At the time of creation, each square grid cost approximately 40 US Dollars. The grids were tested in an undergraduate motor behavior course for numerous laboratory activities (e.g., constant and varied practice, vision versus no-

vision, dominant versus non-dominant limb, etc.). Participants indicated that the target grid method was superior to the measuring tape method in many ways: (1) experimenters did not have to get down on their hands and knees to position the measuring tape; (2) smaller chance of getting disoriented relative to positive and negative X and Y axes; and (3) faster data collection. Researchers who utilize target grids similar to those discussed here will be able to examine numerous motor behavior variables that have been improperly analyzed in past studies (see Fischman 2015). In addition, classroom practitioners will be able to efficiently conduct laboratory activities that allow students to effectively examine accuracy, bias, and consistency measures in performance tasks.

A comparison of two techniques for obtaining 2-D error scores

Ben Meyer, Shippensburg University

Recently, emphasis has been placed on using appropriate methods to measure and quantify error values in performance studies (Fischman, 2015). Some investigators have utilized bulls-eye targets painted on gym floors, using a measuring tape to obtain X and Y coordinates of objects thrown to the target. It takes considerable time and effort to acquire data using such a method. The purpose of this study was to compare measurement time (and accuracy, bias, and consistency of tosses) of a measuring tape method versus a target grid method. It was hypothesized that the target grid method will result in faster data collection with little difference in performance measures. Fifty undergraduate student participants performed Koosh ball tosses with their dominant hand to a target grid located at a 5 meter distance using an underhand technique. Five blocks of six attempts were performed with participants receiving feedback about all tosses. All ball landing positions were measured using two techniques: (1) measuring tape (to the nearest centimeter) and (2) visual estimate of coordinates using lines on the target grid (to the nearest five centimeter value). Mean measurement time for a block of six attempts was significantly smaller ($p < 0.05$) using the target grid method (37 +/− 16 sec) than using the measuring tape method (64 +/− 23 sec). Performance measures did not differ significantly between the methods; radial error = 37 cm, bivariate variable error = 33 cm, subject-centroid radial error = 20 cm. The group centroids were very similar: measuring tape = (3.6, -4.0); target grid = (3.5, -3.8). The results of this study will help investigators obtain 2-D error scores for throwing tasks much more efficiently than past techniques (and just as effectively in terms of accuracy, bias, and consistency). Researchers who utilize target grids in their projects will be able to examine a wide range of motor behavior variables that have been analyzed improperly in previous studies.

The effect of exercise on a choice reaction task in an athletic population

Jaime Mitchell, Michael Cinelli, Wilfrid Laurier University

Vision is the primary source of sensory input when making adjustments to locomotion. Perception-action coupling occurs as individuals obtain information about the environment and plan routes around obstacles or towards goals. In sport, this integration of perception and action occurs simultaneously with physical activity. Increased arousal (i.e. as a result of exercise) causes narrowing of attention, and allows for the elimination of irrelevant information. The purpose of this study was to determine the effect of moderate intensity exercise on the performance of an aperture choice reaction task (CRT). Varsity football players (n = 18) were randomized into an exercise or rest group. The participants were instructed to walk (in VR) along an 8m path while two avatars jogged towards them on converging angles, creating perceived aperture widths of 0.8, 1, 1.2, 1.4, 1.6, and 1.8× shoulder width at the theoretical time of crossing. At 2s prior to the theoretical contact, the screen went blank and the participants quickly identified whether they could have passed through the two avatars by rotating their shoulders or not. The exercise group completed a 12 min graded cycle ergometer protocol, followed by the CRT again. The rest group performed 12 min of quiet sitting before competing the CRT a second time. The results from the participants' accuracy in judgements revealed a significant difference in the proportion of trials with perceived rotation between aperture widths ($F = 45$, $p < .001$). An interaction effect was also observed between test time and group ($F = 4.13$, $p = .05$), such that the rest group's performance on the CRT task did not change from before to after quiet sitting, while the exercise group improved from 70% to 79% correct judgments after completing the 12 min moderate intensity bike protocol. In conclusion, all participants were able to accurately identify the perceived passability of apertures in VR, however the moderate intensity exercise group showed an improved ability to judge the passability of apertures while the rest group were protected from a learning effect.

Funding source: NSERC.

The influence of time spent in beginning and end-state postures on grasp choice

Rachel Modersitzki, Breanna Studenka, Utah State University

The choice to end a movement with a comfortable posture (the end-state comfort; Rosenbaum & Jorgensen, 1992) often elicits adoption of uncomfortable beginning postures, demonstrating advanced planning. Many factors may influence the choice of a comfortable end-state posture including the greater precision afforded by movement at joint angle mid-ranges. Typically, the time spent in end-states is not explicitly constrained, but is likely longer than time spent in beginning states due to either greater precision or task demands. This experiment tested how the relative time required to hold a beginning- or end-state posture influenced the choice of posture. We predicted more comfortable postures would be adopted for positions held longer regardless of the state of the grasp. Participants completed four conditions: unconstrained beginning and end state, constrained beginning state, constrained end state, and constrained beginning and end state. Participants moved a wooden dowel from one location to another with either a thumb up or thumb down posture and placed a specified color down. Eight trials required a rotation of the object, allowing for evaluation of motor planning. A conductive object and surface allowed us to measure reaction time, movement times, and grasp times. Most participants chose to end comfortably regardless of the time required for the beginning state grasp. A smaller group of participants appeared to minimize the effort of motor planning by choosing to execute the first movement quickly and waiting to plan the second movement until they had completed the first grasp, which sometimes led to a thumb-down posture at the end-state. This strategy is supported by the finding that these participants also exhibited shorter reaction times and/or shorter movement time to the first object, indicating less planning was occurring prior to the first grasp. These results demonstrate both the robustness of end-state comfort in motor planning, and also diversity in planning strategy.

Funding source: n/a.

Keep your "head" on the ball: The relationship between gaze behavior and temporal error in baseball batting in a virtual environment

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Previous studies investigating gaze behavior during demanding interceptive tasks such as cricket and baseball batting have demonstrated that expert batters exhibit unique gaze behaviors: earlier and more accurate

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predictive saccades (Land & McLeod, 2000), biphasic predictive saccades and/or egocentric head tracking (Mann et al., 2013), and longer pursuit eye-movements (Bahill & LaRitz, 1984). Whilst the evidence from these studies was based on findings when comparing groups (i.e., inter-personal differences using expert-novice comparisons), here we show the contribution of gaze behavior to interceptive performance based on intra-personal variability in gaze and temporal hitting errors. Using a case-study approach (see also Land & McLeod, 2000), two professional baseball players performed 45 trials of baseball batting in a virtual environment, including 15 fastballs (140 km/h), 15 curveballs (120 km/h), and 15 change-ups (120 km/h) that arrived at various spatial locations, and were presented in a random order. Results showed that both batters had very small temporal errors when hitting the ball (-0.3±13.7 ms and 0.4 ±14.6 ms). Crucially, the degree of temporal error could be predicted, at bat-ball contact, by the magnitude of the deviation of gaze from the ball (DeltaGaze: r= 0.62 and 0.76), and head relative to the ball (DeltaHead: r=0.58 and 0.74). The accuracy of interception was more closely related to the alignment of the head with the ball than it was for gaze, with the intercept value for the regression between temporal error and DeltaHead closer to zero (-7.3 and 20.6 ms) than those with DeltaGaze (15.3 and 32.2 ms). These data suggest that temporal error was minimized when the head and ball were aligned at contact. The findings support the idea that gaze behavior, including head movements, is likely to contribute to timing performance in interception. Moreover, at least at the moment of bat-ball contact, the head direction is likely to be more important than the gaze direction (i.e., where eyes look at) in order to minimize temporal error.

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Neuroactivity during imagery of the same movement delineates kinesthetic and visual movement imagery abilities as screened by questionnaires

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Movement imagery (MI), the deliberate cognitive simulation of physical movements, continues to be a primary focus in the sport sciences gauged predominantly by self-report measures. The increased use of brain imaging technology (e.g., fMRI) has provided initial evidence of the neural correlates of different types of MI, but continued cross-validation of self-report and neural measures is needed. To further inform theory and research designs in sport, exercise and rehabilitation sciences, this study examined the construct validity of the Movement Imagery Questionnaire-3 (MIQ-3) using self-report and neural data. First, the relationship between the MIQ-3 and Vividness of Movement Imagery Questionnaire (VMIQ-2) was examined among 200 right-handed, college-age males. Then, based on high MIQ-3 scores on each scale (n = 14), fMRI data was collected during real-time imagery of the MIQ-3 arm rotation task evaluated for each condition (kinesthetic [KI], internal visual [IVI] and external visual imagery [EVI]). Inter-scale correlations between like scales of the MIQ-3 and VMIQ-2 were -0.53(KI), -0.59 (IVI) and -0.58 (EVI). Neurologically, both central and imagery-specific patterns of brain activation were found providing biological validation of imagery abilities delineated in the MIQ-3: KI activated frontal areas, motor areas and subcortical parts of the cerebellum, IVI activated motor areas and the superior parietal lobule, and EVI activated the parietal lobule and occipital cortex. The results complement previous results on females to provide added neural support for the existence of the KI, IVI, and EVI abilities measured by the MIQ-3, and to a lesser extent the VMIQ-2. Next, research should compare neural activity between male participants screened as good and poor imagers to determine if good imagers are more efficient (i.e., a confined neural network in distinct areas) than poor imagers (i.e., larger, less defined network) to further validate self-report measures.

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Dual-task training and dual-task performance in sequence learning

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Two experiments involving a dynamic 16-element movement sequence were designed to determine effects of dual-task training on sequence learning. During sequence execution participants had to perform a secondary task. The secondary-task was a manual response to two auditory stimuli presented at the elements 7 and 12. In Experiment 1 participants were randomly assigned to a single-task or a dual-task training group. In the dual-task training group participants were instructed to perform the movement sequence and the secondary task with equal priority. In Experiment 2 1-day and 4-days of dual-task training was contrasted. Learning in both experiments was assessed after a retention interval (24 hrs) by comparing the practiced sequence to an unpracticed sequence under a dual-task and a single-task condition. The results of Experiment 1 showed that performance of the single-task training group was superior compared to the dual-task training group. However, performance of the unpracticed sequence was impeded for both groups under single-task and dual-task condition. This result demonstrated that after 1-day of practice a movement sequence can be learned under dual-task training, but dual-task interference was still present. The findings of Experiment 2 indicated that the 4-days practice group outperformed the 1-day practice group on the retention test at the practiced and the unpracticed sequence under single-task and dual-task condition. However, performance of the practiced sequence was superior compared to the unpracticed sequence irrespective of the amount of practice and practice condition. These results suggested that extended dual-task training improved sequence learning and reduced dual-task interference. However dual-task interference was still apparent.

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Dual-task cost and cognition in patients with chronic mTBI

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Dysfunction following mTBI has been previously described in cognitive and motor domains, however, limited study has been conducted across both areas in populations with persistent balance symptoms following injury. In this abstract we provide preliminary findings comparing 15 persons with chronic mTBI (10 female, 40 ± 13 years, 67 ± 3 kg, 1.7 ± 0.4 m) with 15 healthy controls (9 female, 40 ± 13 years, 67 ± 4 kg, 1.7 ± 0.5 m). Chronic mTBI participants had self-reported balance complaints persisting more than 3 months following a clinically diagnosed mTBI. Participants completed the Automated Neuropsychological Assessment Metrics (ANAM) test and a dual-task of walking while completing a continuous Auditory Stroop. Prior to undertaking the dual-task walk, baseline single-task walking and a seated Auditory Stroop condition were collected in order to calculate the dual-task cost. ANAM composite score, dual-task cost on cognition (reaction time and a throughput score of accuracy/correct response time), and dual-task cost on gait speed were assessed. Between group differences were assessed using Cohen's *d* effect sizes. Medium effects suggested that the chronic mTBI group performed worse on the ANAM composite score (*control* = .27 ± 1.26, *mTBI* = –.47 ± .99, *d* = .66) and experienced a greater dual-task cost on cognition (reaction time [*control* = −1 ± 11%, *mTBI* = 9 ± 22%, *d* = −.57] and throughput score

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[*control* = 2 ± 5%, *mTBI* = −6 ± 27%, *d* = .51]), while a small effect suggested healthy controls may have incurred a greater dual-task cost on gait speed (*control* = −4 ± 6%, *mTBI* = −1 ± 6%, *d* = −.39). Preliminary findings suggested cognitive differences, and difficulty in dual-task function may persist in chronic mTBI patients who complain of balance impairment. Of note is the lack of dual-task cost on gait speed in chronic mTBI – although the chronic mTBI walked slower in both conditions (single-task *d* = −.55, dual-task *d* = −.29), their dual-task gait speed was not as compromised as their cognitive response. These results help explain functional deficits contributing to difficulties in complex activities in chronic mTBI patients.

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Exploring the neurophysiological mechanisms determining the regulation of difficulty in self-controlled practice

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Introduction: Evidence shows that self-control of task relevant parameters during practice results in superior learning, however the neurological mechanisms underlying this effect remain unclear. To investigate these effects, we collected electroencephalography (EEG) during practice of a complex motor task. Specifically, we measured frontal alpha asymmetry (FAS) and midline frontal theta (MFT), as indices of approach-motivation and cognitive effort, respectively. Previous studies have focused on learning, but the goal of this study was to investigate the motivational and cognitive processes that influence how participants choose to regulate practice difficulty. Methods: Sixty novice participants were pseudo-randomly assigned to either a self-controlled group, in which participants chose the difficulty level of each practice block, or to a yoked group, where the difficulty was matched to the self-controlled group. After the pre-test at the lowest difficulty level, participants completed 19 practice blocks. Results: Linear mixed-effect regression controlling for time revealed that FAS decreased with task difficulty ($p < 0.001$). FMT decreased with score ($p = 0.004$), increased with difficulty ($p = 0.021$), and decreased across blocks ($p = 0.045$). The decision to increase difficulty depended on interactions between group, score, difficulty and block (p's<0.01). Conclusion: The negative relationship for FAS suggests that approach motivation decreased at higher difficulties. Further, controlling for each other, MFT showed a negative relationship with score and block, and a positive relationship with difficulty. These results are consistent for MFT as a correlate of cognitive effort, and perhaps a useful index of functional difficulty. The decision to increase difficulty during practice depended on interactive effects of time, current difficulty, and current level of performance. Critically, interactions with group suggest that these choices really do individualize practice (i.e., participants are not broadly making "good" choices that benefit all participants).

Avoidance behaviours of young adults during a collision course with an approaching person

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The ability to perceive motion of an approaching object and make appropriate adjustments to avoidance behaviours is critical to safe locomotion in a dynamically changing environment. Information regarding optical expansion allows individuals to successfully avoid obstacles under a multitude of settings. Avoidance behaviours are affected based on physical (i.e. human versus inanimate) and/or movement characteristics of obstacles. The purpose of the study was to determine the avoidance behaviours of young adults during a collision course with an approaching person. Young adults (N = 20, 10 males) and a human (female) confederate were instrumented with IRED markers (NDI Optotrak) on the trunk to calculate the location of the Centre of Mass (COM) over time. Participants and the confederate began each trial facing each other on opposite ends of an 8m path. Participants were instructed to walk towards a goal located along the midline behind the confederate without colliding with the approaching confederate. The confederate walked towards one of four final positions: 1) to the left; 2) to the right; 3) in line with the participant's starting position; or 4) stop after 2 m. Medial-lateral COM positions of the participants were used to determine the time at which they avoided the confederate. Time of avoidance was used to examine the theoretical time to contact (TTC) had the participants not deviated from the collision course. TTC was significantly greater when the confederate stopped 2 m from their start position compared to all other final positions ($F = 6.64$, $p > .001$), suggesting the lack of uncertainty in the confederate's behaviour allowed the participants to initiate an avoidance earlier. Furthermore, males displayed significantly greater TTC than females ($F = 6.68$,$p > .05$), suggesting that males require more personal space when avoiding an approaching female. Time of avoidance was most likely determined by an optical expansion threshold and was influenced by the confederate's characteristics (i.e. path selection) and the participants' sex.

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The impact of autonomy of support on attentional focus during instruction in balance tasks

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The motor learning benefits for using an external focus of attention (EF) are well documented, showing that EF leads to greater performance compared to internal focus of attention (IF) (Wulf, Höß, & Prinz, 1997). Recently OPTIMAL theory showed when autonomy of support (AS) is included in a testing environment, it aids performance (Wulf, Chiviacowsky & Cardozo, 2014). Currently there are limited studies that have examined EF and AS together. The purpose of this study is to investigate AS and EF instructions during a dynamic balance task. Twenty six healthy adults (22.0 ± 3.44 years), participated in this study. Participants were randomly assigned to one of three conditions (1) Choice: participants chose the tape color that was placed on the side of the stabilometer (EF); (2) Yoked: matched to group one; (3) Control group. Participants completed two baseline trials; eight practice trials with EF, two retention trials, and two transfer trials. Samples were taken at 20 Hz. Participants were told to focus on keeping the tape level while performing the task. Tape was placed on the stabilometer during practice trials and was removed for retention and transfer trials. A 3 (Groups) × 2 (Time: Retention & Transfer) ANOVA with repeated measures on the last factor was performed to assess between group differences on the stability of stabilometer platform (i.e. Absolute value from 0). No significant differences were seen between the three groups $F(2,46) = 86.87$, $p > 0.05$. Although not significant, improvement was seen within subjects over time. Baseline was significantly greater than both retention and transfer ($p < .05$). We believe due to sample size, the typical EF results are not represented. Further, it seems for this task that cueing with an EF does not aid in performance. This could be related to poor balance strategy causing them to focus on their internal aspects of movement.

The effects of practicing a motor skill in virtual reality

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Little is known about how practicing a motor skill in virtual reality compares to physically practicing the same task. The aim of this study

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was to compare the motor learning effects between these two forms of practice. Participants (N = 68) were split into two groups; physical practice (n = 35) and virtual reality practice (n = 33). The protocol for each group involved two consecutive days of practice which included identical testing phases at the beginning and the end of each day of acquisition. During each testing phase, participants were required to putt a golf ball 10 times on a carpeted surface. Between the testing phases, groups practiced golf putting according to their assigned group for a total of 50 putts. The physical practice group practiced the task in the lab on three miniature-golf style holes of varying difficulty. The virtual reality group practiced the task using the Oculus Rift system and the game Cloudlands VR Minigolf on holes designed to mimic those practiced by the physical practice group. Both days of practice were identical and consisted of testing and practice phases each day. The only difference between the two groups was the environment in which they practiced the skill (i.e., physical practice or virtual reality). A 2 (condition) × 4 (test phase) repeated measures ANOVA was used to test if significant differences existed between the experimental conditions. The results of this test revealed that there was a significant main effect for test phase but there was not a significant effect for condition. Post-hoc testing indicated that both groups improved their putting accuracy similarly during the course of the study. The results of this study indicate that virtual reality practice was equally effective when compared to traditional physical practice for improving motor performance in a golf putting task.

Learner-controlled pace of practice in isolation does not yield the self-control effect

Phillip G. Post, Christopher A. Aiken, Michael C. Hout, Jessica Madrid, New Mexico State University

Research has shown that allowing control over the amount of practice facilitates motor learning. Post et al. (2014) allowed participants to control the amount of practice within a fixed time period, essentially allowing for the control over the pace of practice. The yoked participants received the same amount of practice with the same pacing as their self-control counterpart. What is not yet understood is if the amount of chosen practice or the pacing drove the results of the experiment. In the current study we investigated the effects of control over the pacing of practice while holding the amount of practice constant across both groups. 46 Individuals practiced 15 blocks of two different sequential timing tasks. The self-control group (n = 23) manipulated the pace of practice and the yoked group (n = 23) received the identical pace of practice as a self-control counterpart. On a single trial, a self-control participants would push a button indicating that they were prepared for the next trial. A warning signal was given followed by a "go" signal. Individuals were told that they did not have to respond as quickly as possible, but to begin when ready, enabling the researchers to measure participants response time to start each trial. During acquisition both groups significantly improved their timing performance as evidenced by significantly lower absolute, constant, and variable error from the beginning to the end of practice ($p < .05$). Participants also significantly decreased their response time to initiate their movement sequence from the beginning to end of practice ($p < .001$). Following acquisition participants performed a 10 minute delayed retention and transfer test. Groups did not perform significantly different from one another on the retention or transfer tests ($p > .05$). Based on the results of this study it does not appear that control over the pacing alone during practice is sufficient to find the self-control effect. Research should continue to investigate the role that choice over the amount of practice plays on skill learning.

Training deceptive actions to enhance action perception: attack is the best form of defense

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Deceptive actions are valuable in sport, because they can be used to alter the ability of an opponent to anticipate the direction in which an actor will move or type of action they will perform. Attempts using perceptual training to improve the ability to anticipate deceptive actions have largely been unsuccessful (Güldenpenning, Steinke, Koester & Schack, 2013). However, because perception and action share common origins in the brain, it seems plausible that training athletes to perform deceptive actions might also help them to perceive them (Pizzera & Raab, 2012). The aim of the study was to examine whether training that enhances an individual's ability to perform deceptive actions would influence their ability to anticipate the deceptive actions of others. Two groups of school-level rugby players anticipated the impeding running direction of video-based opponents during a pre-, post- and retention test. During a training phase, a deception-training group physically trained their ability to perform deceptive actions, and a control group received no training. By post-test, the deception-training group became more sensitive to deceptive actions, improving their overall anticipatory performance significantly ($p < .001$) irrespective of the actions they viewed. The improvements of the deception-training group were retained following a four week retention interval. These findings support the common-coding theory (Prinz, 1997) and suggest that performers wanting to improve their perceptual anticipation of an action should consider physically practicing the same action.

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The effects of using attentional focus in a virtual reality environment

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The benefits of adopting an external focus attention (EF) relative to an internal focus (IF) has been shown to facilitate motor skill learning (Wulf, 2013). One limitation is the majority of the studies have been conducted in a controlled environment. To increase external validity, virtual reality (VR) has recently been used in a lab setting. However, AF effects has not been investigated in a VR setting. Also, studies showed task difficulty was a moderator of AF effects (e.g., McNevin, Shea, & Wulf, 2003). However, no study examined this relationship using a fine motor skill. This study investigated the applicability of AF as task difficulty changes in VR. Eighteen healthy young adults (22.0, ± 2.52 yrs) participated in this study. Participants wore 3-D goggles and moved a cube between two targets in VR at a specified speed (Fast = 120 bpm, Slow = 80 bpm) for the following conditions: Baseline, EF-Fast, EF-Slow, IF-Fast, IF-Slow. The instruction for EF was "focus on moving the cube as accurately as possible." For IF, instruction was "focus on moving your arm as accurately as possible. Separate 3 (Condition) × 2 (Speed) ANOVA with repeated measures on both factors for the right and left target in accuracy (mm) was used the analysis. Significant results was found in the interaction between Condition and Speed ($F1.27,21.53 = 9.22$, $p < .01$, partial Eta = .35) on the left target, but failed to show significance on the right target accuracy. Post hoc analysis revealed no difference in a slow tempo. However, EF had significantly less errors ($M = 0.05$ mm, $SE = .57$) than IF ($M = 10.97$, $SE = .72$) and Baseline ($M = 13.97$, $SE = .96$), $p < .01$ for both. No difference was found between Baseline and IF. The results of the study

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supported the previous studies that EF effects are emphasized as tasks become more difficult and AF relationship was consistent in VR.

Improving acquisition of manual wheelchair skills: An EEG study using motor learning principles

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Yearly, more than 130,000 people in the US have a lower extremity amputation. Efficient acquisition of motor skills required to maneuver a wheelchair is necessary for these individuals' quality of life. Thus, it is crucial to find practical ways to enhance this learning process. Recent research has revealed that having the expectation to teach a motor skill to another person enhances the learning of that skill. Specifically, participants who study/practice with the expectation to teach exhibit superior performance on posttests compared to participants who study/practice expecting to test. In the present study, we applied this paradigm to learning manual wheelchair operation. On Day 1, participants completed a pretest of wheelchair skills (forward and backward slalom course) to determine baseline skill level, and then were assigned to one of two groups. One group studied/practiced the wheelchair skills with the expectation to teach the skills to another participant the following day, while the second group studied/practiced with the expectation of being tested on the skills (n of trials = 10/skill for both groups). Participants' electroencephalography (EEG) was recorded during pretest and practice to examine neural correlates of wheelchair skill acquisition (EEG results are pending). All participants completed a posttest 24 h later. Time to complete the course was utilized to evaluate motor learning at posttest, controlling for pretest time. Results revealed a main effect of phase (pre/posttest), test type (forward/backward), and a Phase x Test Type interaction ($ps \leq .001$), but no main effect or interaction involving group ($ps \geq .551$). The participants improved from pretest to posttest, with significantly greater improvement for the backward test compared to the forward test. Though no effect of group was revealed, this wheelchair skill acquisition paradigm could be used in the future, as learning effects were revealed. However, future paradigms should include more practice trials, which may increase the likelihood of experimental conditions affecting learning.

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The role of distality on single leg stance

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Regulation of posture involves attentional processes and the application of internal or external attentional foci have been linked with accuracy and quality of a movement while executing the skill. Relevant dimensions in this context are either the visual proximity/distality of the movement effect or the body-related proximity/distality of the controller. Previous data from our lab suggested better balance performance while controlling the laser pointer light with a laser pointer attached to the head further distal than a proximal one during 10 sec balance tasks. This study further investigates the role of the distality of the visual movement effect (i.e. the laser pointer light) by manipulating the target distance of 2.5 m (W2.5) and 5 m (W5) and B) increasing difficulty of the single leg stance (SLS) balance tasks (hop into stance, step into stance with three half squats, and stance on an airex pad) and increasing duration (30 sec).Repeated measures design was used (n = 18; 10 m, 8 f) to investigate effects of two aspects of distality on balance performance in SLS tasks (hop, step, airex). Balance performance was quantified by multiscale entropy (MSEN) measures and overall complexity index (CI) of the centre of pressure (COP) trajectory as well as sway area, sway velocity, anterior-posterior (AP), and medio-lateral (ML) sway. Statistical analysis employed generalized mixed model and repeated-measures ANOVA. All sway variables and MSEN measures indicated increased values for W5 compared to W2.5 ($p < 0.05$ which can be interpreted as better balance performance. No significant differences were seen between focus conditions for the sway variables while only the CI of AP sway and sway area shape (PSI) indicated better performance for distal over proximal focus for the step ($F(1, 204) = 4.462$, $p = 0.036$). In conclusion, during prolonged static and dynamic single leg stance, directed attentional focus influenced balance related sway measures and complexity of postural fluctuations increased with a distal external point of focus.

The temporal integration of information during anticipation

Oliver R. Runswick, University of Chichester, UK; André Roca, St Mary's University, UK; A. Mark Williams, University of Utah; Allistair P. McRobert, Liverpool John Moores University, UK; Jamie S. North, St Mary's University, UK

When performing actions under severe time pressure, the ability to accurately anticipate is vital to performance. Skilled anticipation is underpinned by the use of both kinematic cues and contextual information. However, there have been few published reports examining how, and when, these two sources interact during anticipation. In this study, 18 skilled and 18 less-skilled cricket batters anticipated deliveries from bowlers in a video-based simulation task where the footage was occluded at four time points relative to ball release. Participants rated the importance of each source of information when making their judgements at each occlusion point. Skilled batters anticipated the deliveries significantly more accurately than the less-skilled group at all occlusion points including when no kinematic information was available ($p < 0.05$). The skilled group judged the use of contextual information to be more important to anticipation than the less-skilled group. Kinematic cues were only considered important to anticipation in the final moments of the bowling sequence (i.e., immediately prior to ball release), whereas contextual information was used throughout the action, albeit mostly by the skilled group. Findings enhance our understanding of the processes underpinning anticipation and present implications for the design of training programs to improve anticipation.

Why do bad balls get wickets? The role of congruent and incongruent information in anticipation

Oliver R. Runswick, University of Chichester, UK; André Roca, St Mary's University, UK; A. Mark Williams, University of Utah; Allistair P. McRobert, Liverpool John Moores University, UK; Jamie S. North,, St Mary's University, UK

Skilled anticipation is underpinned by the use of kinematic and contextual information. However, few researchers have examined what happens when contextual information suggests an outcome that is different from the event that occurs. We predicted that when contextual information is *congruent* with the eventual outcome then anticipation would be facilitated, particularly in skilled performers. In contrast, when contextual information is *incongruent* with the following event, we hypothesised this leads to a confirmation bias on kinematic information and results in decreased anticipation accuracy. We expected the effect to be larger in skilled performers who are more able to utilize context. Altogether, 18 skilled and 18 less-skilled cricket batters anticipated deliveries from bowlers using a temporally occluded video-based task. A consistent level of contextual information was presented across all trials, however, by manipulating event outcome, we created conditions whereby contextual information and event outcome were either congruent or incongruent with one another.

There was a significant skill by condition interaction ($p < 0.05$). The skilled group anticipated significantly more accurately than the less-skilled group on the congruent trials. Both groups anticipated less accurately on incongruent trials but the skilled participants were more negatively affected than the less-skilled group. When event outcome is incongruent with the contextual information that precedes it, the ability of skilled performers to anticipate is negatively affected. Skilled performers place greater emphasis on contextual information and confirmation bias potentially negates the use of the kinematic information that emerges later. Findings enhance understanding of anticipation and suggest that all sources of contextual and kinematic information should be included in training environments.

Postural strategies when performing a manual task on an unstable support surface

Hoda Salsabili, Satyajit Ambike, Marissa Munoz-Ruiz, Jeffrey M Haddad, Purdue University

Multiple degrees of freedom are utilized and controlled when performing standing manual tasks so that balance is maintained and manual task goals are achieved. These types of standing goal-directed behaviors are complex given the postural demands of the task can either afford or hinder the completion of the manual task. When standing on a stable support surface, posture is controlled in a manner that facilitates manual behavior (Haddad et al. 2012). For example, postural sway is tightly constrained when performing a precision manual task so that manual accuracy is maintained. However, when standing on an unstable surface, individuals may adopt alternative control strategies to meet the demands of a manual task or allow a decrement in manual task performance in an attempt to prioritize posture. The purpose of this study was therefore to examine how the control of posture and manual control adapts when performing a manual precision task while standing on a narrow support surface. Twelve healthy participants (25±4.2 yrs) performed a fitting task that required them to grasp, transport, fit, and hold a block in a small or large opening for 5 s. Center of pressure (CoP) SD, mean anterior-posterior (AP) position of the CoP, and SD of the block position while held within the opening was calculated. CoP SD was larger when holding the block within the large (3 mm) compared to the small (2.7 mm) opening (p=0.042). Block position SD was larger when holding within large (3.3 mm) compared to the small (2.4 mm) opening (p=0.001). Finally, when standing on the narrow support surface, the mean position of the AP CoP location translated backwards by (40 mm; $p = 0.0001$). No interaction between opening size and support surface width were observed in any of the variables ($p > 0.05$). Young healthy adults successfully perform a difficult postural and manual task without the need to prioritize either behavior. Interestingly, CoP translation occurs independent of sway reduction, suggesting individuals adjust posture before reducing sway to maintain the accuracy of the manual task.

Comparison of vestibular function in sitting and standing

Jennifer Sansom, Central Michigan University; Allison Zilch, Michigan Medicine - University of Michigan; Karen Lomond, Central Michigan University

As individuals age, function of the visual and somatosensory systems decline, making the vestibular system increasingly important for controlling balance and preventing falls. Current protocols testing vestibular function are performed while seated, but most falls occur when standing. Purpose of our study: examine vestibular function in seated versus standing. We tested 24 (18-26 yrs), healthy participants (12F/12M) during 4 vestibular-specific tests (i.e., Static Visual Acuity (SVA), Perception Time Test (PTT), Dynamic Visual Acuity (DVA), and Gaze Stabilization Test (GST)) on the Neurocom Balance Manager in sitting and standing for head movements in yaw, pitch, and roll directions. Order of testing postures and conditions were randomized. Variables measured included: SVA, perception time, logMAR (visual acuity) for DVA and GST, and GST average head velocity. Sitting SVA and PTT were not significantly different or associated to standing (all $p > .05$). Sitting DVA logMAR for head movement in pitch direction significantly correlated with sitting DVA logMAR values for head movements in yaw ($r = .80$, $p = .00$), roll ($r = .50$, $p = .01$), and standing DVA logMAR for yaw ($r = .47$, $p = .02$), pitch ($r = .43$, $p = .04$), and roll ($r = .67$, $p = .00$). Sitting GST logMAR and average head velocities in all 3 directions was not significantly different or associated to standing values (all $p > .05$). Significant correlations found for logMAR suggest function of the vestibular system remained similar despite changes in posture or direction of head movement when stimuli were presented dynamically for DVA. No relationship found for vestibular function when stimuli were fixed for GST. Interestingly, sitting pitch DVA had significant associations with gaze stability for DVA in standing and head movements in yaw and roll. Our results provide preliminary evidence of typical vestibular function in sitting and standing for 3 planes of head movements in young, healthy adults.

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Motor imagery of single, double and joint actions

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In joint action tasks (e.g., acrobatics, team sport, orchestra) two or more individuals interact and coordinate their actions in space and time to achieve a desired shared outcome (Sebanz et al., 2006). One of the key components of this interaction is the capacity to share, predict and adapt to incoming sensory information about another's behavior and, eventually, to form integrated representations of self- and other-related actions in real time (Vesper et al., 2017). Studies show, that joint action is achieved by mental simulations that allow co-actors to predict their own and their partner's actions using their own motor system (Wolpert et al., 2003). In two experiments we investigated joint action motor imagery using an extended version of the Controllability of Motor Imagery Test (CMIT, Schott, 2013). Participants were given a sequence of motor instructions (single: for themselves; double/joint: for themselves and a second individual). After imagining the corresponding movements, participants were asked to select the image that matches their imagined body positioning. Experiment 1 investigated whether athletes from technical-compository vs. high-energy sports ($n = 40$, 14 men, 26 women; age 21.4 ± 1.81) and experiment 2 whether younger ($n = 16$, 7 men, 9 women; age 22.4 ± 1.59) and older adults ($n = 16$, 7 men, 9 women; age 68.6 ± 5.48) differ in their motor imagery ability of single, double, and joint action coordination. The results showed significantly better performance only in the joint action condition for athletes from technical-compository sports compared to athletes from high-energy sports. Moreover, younger adults were significantly more accurate and faster in all three conditions of the extended CMIT than older adults. These findings suggest that mental simulation is not only a functional resource for coordinating in real time with another agent, but depends on specific expertise and overall working memory performance.

Do you see what I see? Neuroactivity breadth and depth differentiate good movement imagers from those self-reporting lower abilities

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Building on psychometric evidence of kinesthetic (KI), internal- (IVI) and external-visual (EVI) imagery abilities, functional magnetic resonance

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imaging (fMRI) measures of real-time motor imagery of questionnaire movements support intra-individual neural network delineation of the three modes. Although self-report studies have consistently shown higher imagery abilities are associated with positive affect and superior performance, fewer studies compare neuroactivity location and intensity between good and poor imagers. The current study contrasted neural network efficiency of male participants screened with the Movement Imagery Questionnaire-3 (MIQ-3) as having 'good' (n = 14) and 'poor' (n = 16) KI, IVI and EVI abilities, with the expectation of a more defined neural networks in good imagers. Independent t-tests confirmed good and poor imagers significantly differed in KI, IVI and EVI MIQ-3 and VMIQ-2 scores ($p < .05$). Results of a blocked design isolating the neural responses during four randomized experimental conditions (KI, IVI, EVI and REST) (counterbalanced for condition), indicated a specific neural network in some, but not all, instances. Good imagers showed more robust activity than poor imagers (i.e., lateral occipital cortex, precuneous cortex) when imagery abilities were aggregated. Specifically, although activity was confined, good imagers showed greater activity in the left precuneous cortex and right lingual gyrus and frontal operculum cortex compared to poor imagers during KI, greater activity in the left precuneous cortex and lingual gyrus during EVI, and greater activity in the left precuneous cortex and right frontal operculum cortex during IVI. These findings are inconsistent compared to prior female data suggesting that good male imagers do not display increased activity in relevant motor areas compared to poor imagers. Subsequent studies should consider performance effects in conjunction with self-reported and biological imagery data, as well as evaluate gender differences to inform the precision of imagery interventions.

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Evaluation of cerebral cortical networking as a measure of cognitive workload during dual-task walking under various levels of challenge

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While prior work has examined cognitive workload by assessing the magnitude of cerebral cortical networking during upper-extremity performance, no such examination has been conducted during locomotion. Thus, this study examined whether changes in the magnitude of cerebral cortical networking could serve as an index of cognitive workload during dual-task walking. EEG was collected from fourteen uninjured participants as they performed an easy and a hard cognitive task, both while seated and walking on a treadmill in a Computer Assisted Rehabilitation Environment. Cortical networking was assessed via the weighted phase lag index with a scalp montage centered over the motor planning region (electrode Fz). This montage is often used in cognitive-motor studies to evaluate connectivity between the motor planning and other regions. However, while dual-task walking involves cognitive-motor processes, walking is often considered automatic and may require limited motor planning compared to upper-extremity performance. Therefore, advanced statistical network and machine learning algorithms able to capture more detailed patterns of cortical connectivity over the entire scalp (without being limited to electrode Fz as a reference) was also employed. Although the more exhaustive method revealed additional networks not captured using the traditional montage, both revealed a modulation of cortical communication in the theta and alpha bands for the performance condition (seat vs. walk) and cognitive task difficulty (easy vs. hard), respectively. Overall, the connectivity modulation suggests i) larger engagement of neural network functions (e.g., working memory, attentional control, action monitoring, sensory integration) during elevated cognitive-motor demands and ii) that this approach can index the level of cognitive workload during dual-task walking. This work was funded by the CRSR (awards HU0001-11-1-0004 and HU0001-15-2-0003) and the DoD-VA EACE. Views expressed are those of the authors and do not reflect the official policy or position of the U.S. Government.

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Changes in motor performance, mental workload, and self-efficacy throughout longitudinal training of arm reaching movements

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Numerous studies have assessed mental workload to understand the allocation of attentional resources throughout performance of a cognitive-motor task. However, only a limited number of studies have investigated mental workload in the context of motor learning throughout longitudinal training. Although the examination of mental workload during motor learning is critical to understanding the underpinnings of cognitive-motor mechanisms, psychological factors such as the notion of self-efficacy are also crucial. Therefore, this work aimed to examine the concomitant changes in performance, mental workload, and self-efficacy throughout practice of a novel reaching task. By employing limited head movements, participants learned via a human-machine interface to control a virtual robotic arm within a two dimensional workspace. Participants could move their heads in eight directions (i.e., up, down, left, right, and diagonally) to reach the targets, which appeared randomly throughout the workspace. Kinematic performance, mental workload, and self-efficacy were assessed on each of the eight training days. Overall, as individuals progressed through training, the results revealed that: i) motor performance and self-efficacy improved while mental workload decreased and ii) the dynamics of motor performance, mental workload, and self-efficacy tended to differ throughout training. Namely, although additional analyses are needed to further examine these dynamics, with respect to the first day of training, performance improved faster than the decrease in mental workload, while self-efficacy seemed to be the slowest to exhibit improvement. This work is presently being extended through the use of electroencephalography (EEG) to assess attentional reserve and cortical effort, which combined can index changes in mental workload throughout motor practice and learning. As a whole, this work contributes to inform cognitive-motor mechanisms as well as the design and training of assistive technologies and prostheses.

The neural correlates underlying the use of contextual and kinematic information processes during anticipation

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Anticipation is the ability to accurately predict the outcome of an opponent's actions ahead of the act itself. This ability relies on at least two broad sources of information, namely low-level kinematic information from the postural orientation of opponents and high-level contextual information related to the event. No data exist to demonstrate how neural activity supports the use of these two information sources in expert athletes. Using electroencephalogram (EEG), we assessed neural activity in 15 expert and 15 novice cricket batters when anticipating deliveries from bowlers in a

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video-based simulation task where the type of information presented to participants was manipulated. Trials were occluded immediately after the ball release and anticipation measured by marking predicted ball location on scaled diagrams. Altogether, 120 videos clips were displayed across the three conditions, including 24 clips where participants were only exposed to contextual information (game situation and field setting), 24 clips where only kinematic information was provided (bowler shown) and 72 clips with both information sources provided. The electro-cortical changes were evaluated using time frequency analyses. Preliminary results demonstrated that expert batters showed better anticipation accuracy across the three conditions. While there was no difference in anticipation accuracy between the contextual and the kinematic condition in the expert batters, the novices were better at anticipating in the kinematic condition compared to the contextual condition. Both groups were more accurate when both contextual and kinematic information sources were presented. The EEG data showed a decrease in the power of the alpha band (8-13 Hz) over sensorimotor areas in the kinematic condition, while in the contextual condition alpha synchronisation was observed over more frontal sites. Findings have implications for those interested in identifying and enhancing the neural mechanisms involved in anticipation.

Upper limb muscle synergy for damping behavior during object transport in healthy young individuals

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Walking while transporting an object requires anticipatory control of grip force and coordinated movement of upper limb to counterbalance inertial forces. Studies have shown that continuous adjustment of grip force and synchronized displacement of the trunk and transported object contribute to this damping behavior. However, it is still unknown how the muscles function to produce the damping behavior during object transport. The purpose of this study was to identify the upper limb muscle synergies used to transport an object and to determine if any asymmetry is present between the dominant and non-dominant arms. The bilateral activations of eight upper limb muscles of seven healthy young right-handed adults were recorded using surface electromyography (EMG). EMG recordings from the dominant and non-dominant arms were decomposed separately into underlying muscle synergies using non-negative matrix factorization. A linear fit method was used to determine the number of synergies to retain for the analysis and factor clustering was performed using the best matching scalar product of the synergy loadings. Three synergies were retained from the analysis and these accounted for 87.3% and 88.6% of the variance in the original EMG recordings in the dominant and non-dominant side, respectively. In both sides, two temporal patterns were most consistent between participants. The first of these patterns suggested the trapezius, anterior deltoid, and biceps brachii reached peak activation prior to heel contact and the second pattern showed that the brachialis, flexor carpi radialis, flexor digitorum superficialis, and extensor digitorum communis reached peak activation approximately at heel contact. There was no asymmetry between limbs and similar synergies were presented. Our preliminary results suggest that shoulder and elbow joints were stabilized first by the recruitment of the upper arm muscles prior to heel contact, followed by the wrist and finger muscles to maintain the stability of the object against to the perturbation caused by the impact of heel contact.

Effect of attentional focus in track sprint start

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In track and field events, instructions are usually to do with the internally focused orientation of the positions and forms of body segments. Research on the effect of attentional focuses, however, has demonstrated general superior performance outcomes from the instructions that adopt external attentional focus over internal attentional focus. The purpose of the study was to examine the effect of instructions with different attributes of attentional focus on the performance outcome of the track sprint start for sprinter and non-sprinter athletes. Six national level sprinters and five national level non-track-and-field athletes participated in the study. All the participants performed 3 trials of a 10 meter sprint with starting blocks in both attentional focus conditions. The order of the attentional focus conditions was counter balanced within the group. A high-speed digital camera was used to capture the entire 10 meter sprint event and the time from the start signal to the crossing of the finish line from the video was used as the performance outcome. The 10-meter sprint time was analyzed using a 2×2 mixed design ANOVA. The results showed a significant interaction effect between the training background and the attentional focus condition, $F(1, 9) = 6.375$, $p < .05$. A superior performance from the externally focused condition was found in the sprinters whereas a shorter sprint time from the internally focused condition was observed for the non-track-and-field athletes. Reviewing the videos revealed that the non-sprinters decreased the speed before they crossed the finish line. Thus, it is possible that the finish line presents a barrier to the non-sprinters. Future studies may adopt a no-finish line design to further explore the influence of the attnetional foci on the performance of sprint start.

Varying self-controlled frequency of modeling schedules does not affect scores on cognitive representation assessments of a pirouette

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When teaching motor skills, knowing practice conditions that yield the most effective learning is of interest to practitioners. In terms of action observation, observing a model after each physical attempt of the skill (100% frequency of modeling; FoM) has been shown to be the most effective. When learners self-control (SC) when they observe a model during practice, however, they choose a low FoM (e.g. > 10%), but do as well as an imposed 100% FoM group. We were interested in exploring whether SC learning conditions that led to greater FoM would affect motor learning differentially. Based on Bandura's (1986) conceptualization of observation, in which observing a model is argued to develop one's cognitive representation (CR), we report on two tests that tapped into CR development as a result of varied self-controlled FoM conditions. Participants, tasked with learning a pirouette during a 60-trial acquisition phase, were randomly assigned to one of four groups, all of which were given choice over when to observe the model, but under the constraints of a 25%, 50%, or 75% FoM schedule, or with no constraint imposed. One CR test involved a correct and an incorrect image of the pirouette appearing simultaneously on a computer screen and participants identified the incorrect image, as well as why it was incorrect. The second test involved selecting 6 correct images from a 6×6 array of images in which 30/36 images showed imperfect execution and 6 showed perfect execution. These CR tests were completed at pre-test, after 15, 30, and 45 acquisition trials, and at post-test. Both measures showed similar improvements for all groups in performance across acquisition ($p < .001$) as well as significant learning effects, as assessed by pre-post test comparisons ($p < .001$). As such, it can be concluded that combined physical and observational practice enables the development of a cognitive representation of the pirouette, yet the frequency with which the model was viewed under the varied self-controlled schedules does not moderate these effects.

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Effect of fatigue on a smartphone-based measure of dynamic balance control

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Balance tests are commonly used to characterize neuromotor dysfunction after head trauma or other neurological changes, but the extent to which fatigue influences balance is not well understood. This study examined the influence of fatigue on dynamic balance using a newly developed smartphone app designed for field-based balance testing. Participants (N = 11, 24.9 ± 4.4 yrs) completed the dynamic balance protocol before and four times after (every 5 min for 20 min) a standardized fatigue protocol that included jogging, sprints, push-ups, and step-ups. The dynamic balance protocol consisted of stepping-in-place for 60s with a smartphone attached to the leg, which was completed under two conditions (eyes closed and lateral headshaking). The device recorded thigh orientation data that was used to derive temporal and spatial variability metrics (standard deviation of stride time and peak thigh flexion, respectively). Rating of Perceived Exertion (RPE) data were also collected at each time point as a proxy of fatigue. A significant main effect of RPE was observed, $F(4,36) = 26.8$, $p < .001$, with RPE increasing from the pre-test (8.0 ± 1.3) to the 0–5 min post-test after the fatigue protocol (13.2 ± 2.6), remaining elevated in the 5–10 min post-test (10.1 ± 1.6), and returning to pre-test levels in the 10–15 min (8.9 ± 1.2) and 15–20 min (8.6 ± 1.3) post-tests. Dynamic balance variability did not change in the temporal domain from the pre-test (.03 ± .01 s) after the fatigue protocol ($p > .05$), but decreased in the spatial domain from the pre-test (3.1 ± 1.2 deg) to the 10-15 min (2.4 ± 0.7 deg) and 15–20 min (2.3 ± 0.6) post-tests, $F(4,36) = 3.7$, $p = .01$. Dynamic balance variability in the head shake condition did not change from the pre-test in the temporal (.03 ± .02 s) or spatial (2.5 ± 0.6 deg) domains after the fatigue protocol (both $p > .05$). Thus, temporal domain variability is stable after a fatigue protocol, allowing researchers in a field-based setting to more confidently use the dynamic balance protocol tested here without needing to accommodate fatigue as a confounding factor.

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Random, timed and self-paced: How preparation time affects the loading of the body prior to flight in a two-footed forward leap

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Although numerous studies have replicated Fitts speed-accuracy trade-off relationship in reciprocal and discrete tasks, little research to date has examined the applicability of this lawful assessment on whole body ballistic tasks, for example jumping. A study by Juras et al., (2009) suggests that the lawful relationship is violated in this task (ballistic jumping) by showing no differences in movement time based on target width decrease. Additionally, the authors also suggest that the kinematics of the jump are pre-programmed prior to the execution of the movement. A recent study by Boyle and colleagues (2016) furthered this idea by highlighting the height of the participant center of mass (Hcom) and its inverse relationship with the index of difficulty (ID). As the ID went up, the Hcom went down. The authors suggest the self-paced nature of the task may be causing the effect. In the following study, three conditions involved participants making two footed forward jumps to targets of 6 in. and 3 in. width, at 30% and 60% maximal horizontal distance (MHD). Additional categories regarding the control characteristics of the "go" signal were divided in to: Selfpaced, Timed and Random. Three values of velocity kinematics (initiation, flight, and total time), were of interest as well as participant center of mass height (Hcom) and flight trajectory of Hcom. The tentative results agree with the previous studies by showing a decrease in Hcom as ID increases. This effect was most pronounced in the Selfpaced condition and interestingly executed at the least proficiency, given the Timed condition produced the fastest movement times followed by Random and then Selfpaced. Further investigation of the flight trajectory may highlight online control differences.

Fractal gait training in older adults with auditory and visual cues

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The timing of gait is altered by aging, resulting in a decrease in adaptability and increased fall-risk. To address this, physical therapy may include rhythmic auditory stimulation (RAS), which is sound or music to which the patient attempts to synchronize their gait. Previous research of RAS has shown little support for fall-risk reduction, possibly due to the medium and structure of the cues. To address the deficit in literature, 29 older adults 60-90 years old (79.2 ± 4.9 yrs) were recruited and divided into groups that received either an auditory only cue, visual only cue, or a combined auditory-visual cue during gait training. The cues prescribed the instant that participants were to be at heel strike during walking, and the timing between each cue was programmed to be fractal to mimic the biological variability typically observed in the gait of younger, more adaptive adults. Specifically, the cue timing was pink noise, as defined by detrended fluctuation analysis (DFA) alpha equal to 0.98. The groups participated in three 10 minute walking phases on a treadmill with bars in the following conditions: 1) pre-test (no cuing), 2) training (synchronization with the cue) and 3) post-test (no cuing). The post-test was to assess for fractal gait retention. Only the group with the auditory cue demonstrated significant changes of phase ($F(2,30) = 6.9$, $p = 0.007$). DFA alpha increased from the pre-test (0.79 ± .07) to the training phase (0.88±0.08), and remained elevated in the post-test (0.87 ± 0.10). The results indicate that an auditory cue is superior to the visual and combined auditory-visual cues for an older adult population during fractal gait training on a treadmill. Future research will include 1) a portable data collection of overground gait to determine if similar results are found in a more ecologically valid mode of training, 2) examine the dose response effect by altering the frequency, intensity, and duration of fractal gait draining with and older adult population, and 3) incorporate standardized balance testing to validate the impact on fall-risk.

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Size perception and performance outcome in a dart-throwing task under psychological pressure

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Motor behavior couples with several types of environmental information perceived by actors. The phenomenon in which perceptions are distorted based on the actors' psychological variables including motivations, wishes, and anxieties is called dynamic perception, and many athletes experience this under psychological pressure of competition. The effects of pressure on the perception of target size before (pre-performance judgement) and after (post-performance judgement) a dart-throwing task and the relationship between size perception and performance outcome in the task were experimentally investigated. Healthy novice female university students (N = 20) participated in the experiment. Performance contingent competitive cash rewards and comparative others were used as pressure manipulations in the pressure condition. Results indicated that psychological and physiological stress responses were successfully

induced, as indexed by significant increases in state anxiety and heart rate under pressure. Moreover, there were no significant differences in pre- and post-performance size perception between pressure and non-pressure conditions for means of all participants. However, participants with reduced throwing accuracy in the pressure compared to the non-pressure condition perceived the target to be smaller under pressure in post-performance judgement. It is possible that attentional change including conscious processing and distraction, as well as kinematic changes led to the decrement of motor skills performance that might have caused perceptual distortions under pressure. An exploratory multiple regression analysis to identify factors leading to perceptual distortions of the target size under pressure indicated that participants reporting larger trait anxiety judged the target to be smaller in only pre-performance judgement.

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Look out! How do footballers' search for opponents during evasive tasks?

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The ability to identify and evade opponents can be critical to successful performance in sport. Recent research has highlighted the need to examine the role of perception when performing evasive manoeuvres. Perceptual expertise literature investigating visual search strategies (VSS) during tactical tasks show that non-experts serially direct their vision towards discrete objects or locations (target control). Experts, however, perform fewer fixations of longer duration (context control) that has been suggested to be more efficient as it reduces cognitive load. Therefore, this study aimed to compare VSS of Australian football players performing evasive tasks at a high and low-level. Players were ranked according to evasive reaction time and accuracy of evasive direction taken, with players in the top and bottom 33 percentile compared. Game-like scenarios depicting one-vs-one (1v1), two-vs-two (2v2), and three-vs-three (3v3) environments were displayed using a life sized, three-dimensional simulation system. It was hypothesised that high-level (HL) players would evade oncoming opponents earlier and more accurately, compared to low-level (LL), and would exhibit context gaze control. HL players exhibited significantly faster evasion onset times, with no differences in response error observed between groups. Corresponding VSS showed no differences in number of fixations was observed between groups. However, LL players showed a significant change between scenario conditions, with an increase in the mean number of fixations and mean fixation duration in the 3v3 scenario. Preliminary results suggest that while HL performers may retain context gaze strategies during scenarios of a greater complexity, VS strategies are not solely responsible for superior evasive performance.

Comparison of postural stability of college students with and without autism spectrum disorder

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Balance is an important fundamental motor skill and a precursor to the development of complex gross motor skills; unfortunately individuals with Autism Spectrum Disorder (ASD) display decreased postural stability when compared to typically developed peers. Deficits in balance may contribute to the frequently described poor motor skills and sedentary lifestyles for individuals with ASD. Purpose: The purpose of this study was to assess postural stability among college students with and without ASD. Methods: Twenty college students (10 with ASD) participated in the study. Balance was assessed using two Kistler force plates during four conditions: eyes open double-leg, eyes closed double-leg, eyes open single-leg, and eyes closed single-leg. Three 30 second trials were completed for each condition. Postural sway was assessed as the center of pressure (COP) sway area (mm2). Assumptions of normality were not met, thus the Mann-Whitney U test was used to compare sway area between groups (ASD vs. without ASD) for each condition. Wilcoxon signed-rank test was used to evaluate differences between conditions within groups. Results: When compared to participants without ASD participants with ASD displayed greater sway during double-leg stance with eyes open (ASD 781.27 mm2 vs no ASD 346.85 mm2; $p = .05$) and eyes closed (ASD 1121.27 mm2 vs no ASD 349.48 mm2; $p = .03$), and greater sway during both single-leg stance conditions however the difference did not reach statistical significance. Both groups displayed greater sway during single-leg stance conditions compared to double-leg stance ($p < .01$). Individuals with ASD also exhibited greater sway during double-leg stance with eyes closed compared to eyes open $p < .01$); however, there was no significant difference in the two conditions for participants without ASD. Conclusion: Young adults with ASD displayed greater postural sway during double- and single-leg stance compared to matched peers. Interventions targeting postural stability to improve balance and increase the ability to engage in physical activity.

Examining the impact of physical activity on motor proficiency and cognition in children with autism

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Purpose: Previous studies have demonstrated a positive impact of physical activity (PA) on motor competence and cognition in children with typical development. However, similar studies in children with autism spectrum disorder (ASD) are scarce. The purpose of the pilot study was to examine the impact of a 12-week PA intervention (basketball training) on motor proficiency and cognition functions (inhibition and working memory) in children with ASD.Methods: This study was conducted in two special schools in Hong Kong. 31 children with ASD were recruited and randomly assigned into two groups: intervention or control. The intervention group participated in a 12-week basketball training intervention (2 sessions per week, 45 minutes per session, for 24 total sessions), while those in the control group attended 24 story-telling sessions (2 sessions per week, 30 minutes per session) to control for the potential effects of participant-staff social interaction. Motor proficiency assessment (Bruininks-Oseretsky Test of Motor Proficiency -2nd edition, BOTMP-2) and neuropsychological assessments (Go/No-go task and digit memory tasks) were used to assess motor competence and cognitive functions before and after the intervention.Results: For motor competence, significant improvements in the total motor composite and two motor-area composites were revealed in the intervention group ($ps < .001$) but not in the control group ($ps > .05$). For cognition functions, significant improvement in inhibition control was found in the intervention group ($p < .001$) but not in the control group ($p > .05$). No significant improvement in working memory capacity was documented in either group ($ps > .05$).Conclusions: The findings suggest that PA may be a good therapeutic intervention to help ameliorate the motor and cognitive impairments in children with autism.

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Upper selection in a preferential reaching task: The influence of lateralization and balance control

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There are a number of factors that influence our decision of which limb we choose to use in any given action. When objects of interest are placed in either left or right hemispace, adult preferred hand use is typically found to decrease as they perform actions in hemispace that is contralateral to their preferred hand. The purpose of this study was to investigate the effects of balance control on upper limb selection in a preferential reaching task. We hypothesized that the dominant hand would be selected for most tasks, but that a challenge to the balance system might result in an increase in the selection of the dominant hand. Participants (n = 10, 18-25 years) performed a preferential reaching task while seated, standing on flat surface, and standing on a foam surface. Seven FitLights were arranged in a semicircular configuration (0, +30, +60, +90, degrees) on an adjustable height table 30 cm from the participant. Each light illuminated 5 times in a random order and the participants were instructed to reach out with either hand and touch the light to extinguish it. Hand kinematics were recorded using an NDI Optotrak system. Results revealed that the switch point for proportion of right hand reaches occurred at 0 degrees for all conditions, such that lights located along the midline and in right hemispace were extinguished with the participants' right. A two-way (condition x light location) repeated measure ANOVA revealed that the proportion of right hand reaches to each light did not differ across conditions ($F = 1.12$, $p = .36$). In conclusion, changes to balance control has no effect on the proportion of right hand reaches, but rather the location of a target relative to one's midline will determine one's preferred hand reach.

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Testing the functionality of peripheral vision in a mixed-methods football field study

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In football, experts seem to use peripheral vision to simultaneously monitor a number of players (Davids, 1984, Williams, & Davids, 1998). However, there is no study so far, in which the relevance of peripheral vision was investigated in complex football game situations. Consequently, a mixed-methods field study in football with 3 vs. 3 football situations was created to test players' decision-making and interview them about their perceptual strategies.10 high-skilled and 10 low-skilled players were tested in 32 different game play scenarios. They played the central defender and were instructed to prevent the attacking team from scoring a goal in 3 vs. 3 situations. Peripheral-processing demands were manipulated, for example, in 1 vs. 1 or give and go situations with relevant events off the ball where the run of another attacker must be detected for correct decisions. In order to measure the participants' use of peripheral information, they were equipped with a GoPro head camera to analyze the number of players in their field of view. A scene camera was used to examine the percentage of correct action responses. After every second situation, interviews were conducted to assess underlying perceptual strategies. Response accuracies and the number of players in the field of view were analyzed with independent t-tests.High-skilled players outperformed the low-skilled players in decision-making with 83.5% ($SD = 13.88$) compared to 55.5% ($SD = 7.21$) correct responses, $t(1,18) = 5.66$, $p < .01$, $d = 2.53$. For the number of players in the field of view, no significant differences were found between the two skill groups, $t(1,18) = 0.78$, $p = .44$, $d = 0.38$. The results show, that high-skilled players outperform low-skilled players in game situations that require the use of peripheral vision. However, since groups had a similar number of players in their visual field, differences might be explained by attention rather than gaze, which is supported by the interview data and statements like "I positioned myself in a way that allowed me to *perceive* actions of other players".

Representation and learning in manual action

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Research showed that cognitive structures differ as function of expertise, age or health situation. However, recent studies show that cognitive structures change in direction of functional representations during skill acquisition. The present study examined the cognitive structures of a complex manual action over the course of learning. To investigate if cognitive structures change during skill acquisition, we conducted a learning situation of a complex movement and measured mental representation structure prior, between, and after the practice phase. More specifically, novices practiced tying a cross knot for 15 days, 5 minutes per day. Mental representation structure was measured by means of structure dimensional analysis of mental representation (SDA-M). Outcome performance was assessed by analyzing accuracy, success, and speed. Results revealed significant differences of cognitive structures over time with integrating all cognitive movement elements in the structure, as well as significant improvements in task performance. These findings suggest that motor learning is accompanied not only by adaptations of cognitive skill representations, but also by integration of more movement related knowledge.

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Self-control effects during a reduction of feedback availability

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Studies of self-control effects have demonstrated that giving people choice regarding some aspect of the instructional setting facilitates motor learning compared to when such choices are controlled by the experimenter (e.g., Post, Aiken, Laughlin, & Fairbrother, 2016). Thus far, however, experimental designs have failed to incorporate common features seen in applied settings such as group practice in some sports. In such settings, the provision of self-control over feedback may be less effective if the instructor is working with other learners and not always available to deliver requested feedback. The purpose of the present study was to examine the effects of self-controlled feedback when delivery was constrained by a predetermined schedule (simulating a reduced level of instructor availability). 48 participants were assigned to one of three groups: self-control (SC), yoked (YK), and 100% knowledge of results (KR100). The SC group was allowed to request KR after half of the trials (according to a pre-determined schedule). Acquisition consisted of 72 trials on a key-pressing sequence with three different goal times. Retention and transfer occurred approximately 24 hr after practice. Acquisition data were analyzed in separate 4 (group) x 6 (block) ANOVAs with repeated measures on the last factor. Retention and transfer were analyzed using separate univariate ANOVAs comparing groups. Acquisition results revealed significant effects for trial block for constant error (CE), absolute constant error (ACE), and variable error (VE) indicating improvements with practice for all groups (all $p < .001$). No group differences were detected during acquisition or retention. During transfer, the SC group displayed significantly lower ACE than the YK and KR100 groups ($p = .025$). This study provided evidence indicating that self-control of KR facilitates learning even when choices are constrained by limited instructor availability.

Application of cross-recurrence quantification analysis to characterize finger entrainment during rhythmic tapping

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One of the goals of rehabilitation after neurological insult such as brain injury (TBI and stroke) is to restore finger individuation to improve fine motor skills (e.g. tying shoe laces, typing, and buttoning). The goal of this study was to develop a quantitative method to characterize the ability to individuate finger movement using cross-recurrence quantification analysis (CRQA). Young adults (N = 8) practiced a rhythmic finger air tapping task using the middle and ring fingers of the dominant and non-dominant hand. These fingers were selected because they are more difficult to move independently. 3D motion of each fingertip was recorded using motion capture (CodaMotion). Rhythmic tapping was paced at 500 ms, lasted 12 s, and performed 5 times per finger. We analyzed the degree to which each moved finger entrained the other fingers using CRQA on finger vertical velocity. Mean diagonal line length (ML) from CRQA was used to characterize entrainment between the fingers. This measure quantifies the average duration (in samples) that the two fingers move similarly in their respective phase spaces. Greater ML values indicate greater degree of finger entrainment. Movement of the ring finger entrained the little finger more strongly than the movement of the middle finger on both dominant and non-dominant hand, while the movement of the middle finger entrained the index finger stronger than the movement of the ring finger. Middle finger movement entrained the ring finger stronger on the dominant than the non-dominant hand ($p = 0.02$). This handedness effect was stronger in subjects with previous musical experience. There was no handedness difference for the ring finger movement. The pattern of entrainment between the fingers was consistent with previous literature, suggesting that our method is a valid assessment of finger coupling. However, direct comparison to other methods is still needed. Objective assessment of finger individuation proposed here may serve as a sensitive and simple metric to track recovery of fine motor function after neurological insult.

The effect of open and closed kinetic chain exercise on dynamic knee valgus during activity in women

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The most common type of overuse knee pain is patellofemeral pain syndrome (PFP). Research has linked PFP in women with decreases in hip strength during activities like ascending and descending stairs. A lack of hip strength can increase valgus at the knee, which over time can stress the knee joint, causing PFP and other injuries. The newly understood relationship between knee pain and hip strength 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 CKC and OKC exercise on dynamic knee valgus during activity in females. Participants were randomly assigned to one of three groups; an 8-week, 24 session CKC exercise intervention (n = 10), an 8-week, 24 session OKC exercise intervention (n = 10), and a control group (C) (n = 10). Pre and posttests included measurement of dynamic knee valgus during a) single-leg squats, b) stair accent, and c) stair decent. Kinematic analyses using a frontal plane projection were completed via 2D videography. Dynamic knee valgus was computed considering the angle between a line from the anterior superior iliac spine to the patella, and another line from the tibial tuberosity to the patella. CKC and OKC 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 in valgus displacement between pre and posttest did not differ among groups in the single-leg squat (range= -2.5 – -1.3 deg.), $F(2,27)=0.114$, $p=0.892$, stair ascent (range= -2.5 – 2.3deg.), $F(2,27)=1.97$, $p=0.16$), or stair descent (range= -0.1 – 1.0 deg.), $F(2,27)=0.296$, $p=0.746$. In summary, neither CKC or OKC exercise influenced dynamic knee valgus during activity in females.

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A constraints-based approach to influencing kinematics of the golf swing: Implications for instruction

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According to a constraints-based approach to human movement, motor actions are influenced by a confluence of individual, environmental, and task characteristics (Newell, 1986). While practitioners in the movement sciences become more aware of the benefits of limiting verbal instructions and attentional demands within learning environments, a constraints-based framework for skill acquisition may provide strategies for practitioners to enhance the skill acquisition process. The purpose of this experiment was to investigate the effect of differential task constraints on kinematics of the golf swing. It was hypothesized that participants would modify their kinematics based on the task constraints associated with the goal. To investigate this, golfers were asked to hit golf balls to a target with a specified golf club. Male and female participants, experienced a counterbalanced order in which the face of the golf club was preset to 30 degrees left of the target (closed), 30 degrees right of the target (open), and in-line where the club face was pointed at the target (normal). A one-way ANOVA with Tukey post hoc tests, revealed a significant change in swing kinematics. Specifically, participants in both the open and closed conditions reoriented the face of the golf club at impact so that the ball started on line to the target as assessed by a Doppler ball launch monitor. Three-dimensional kinematic analysis of the lead wrist demonstrated a significant difference in wrist flexion at ball impact. These adjustment in kinematics, without verbal instructions informing participants to do so, illustrate how participants of the study modified their swing kinematics to orient the face of the golf club at the target. The results of the study demonstrate the utility of a constraints-based approach to skill acquisition for the purposes of reducing or eliminating the need for movement-based instruction. The results of the study highlight the emergence of appropriate kinematics to achieve or match the requirements of the action goal.

The effect of attentional focus instruction on mechanics and performance

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The literature related to attentional focus is consistent stating that External Focus (EF) of attention (directing attention to the effects of the movement) is superior to learning and performance (Wulf, 2013). An External focus of attention has been proven to improve performance in a single leg jump, and increases knee flexion (Gokler, et al,2014), but does not show similar results for other risk factors such as knee valgus movement. This study compared the effects of EF instruction on performance (EFP) and mechanics (EFM). We predicted externally focused cues related to landingmechanics may improve performance and mechanics. Twelve males

(22.42, ± 3.55 yrs) and 12 females (20.42, ± 0.90 yrs) participated in this study. All participants performed 3 baseline drop jumps, 3 EFP jumps focusing on their performance of the vertical jump and 3 EFM jumps focusing on pushing the red tape apart and the green tape forward. Vertical jump height was measured with Vertec and landing mechanics were measured using a 2-D kinematic software (Kinovea). Separate 2 (Gender) x 3 (Condition) ANOVA with repeated measures on the last factor was conducted for performance and landing mechanics. The results showed the main effect on Condition in performance ($F_{2,44} = 19.29$, $p < .01$, partial eta =.47). *Post hoc* analysis showed the EFP ($M = 48.85$ cm, $SE = 1.90$) jumped higher than EFM ($M = 45.22$, $SE = 1.61$) and baseline ($M = 46.33$, $SE = 1.93$). No difference was found between baseline and EFM. For landing mechanics, the EFM had significantly greater knee maximal angle ($F_{2,44} = 24.08$, $p < .01$, partial eta =.47) and fewer valgus angle at initial contact ($F_{2,44} = 342$, $p < .05$, partial eta =.14). The results showed that using EF specific to mechanics improved landing mechanics compared to baseline. This could be important in coaching and rehabilitation fields as a way to prevent or rehab injury.

Comparison of attentional focus instructions on mechanics in a gross motor skill performance and landing quality

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The benefits of an external focus of attention (EF) compared to an internal focus of attention (IF) on motor performance and learning have been well documented (Wulf, 2013). Previous literature examined EF cues on performance. However, it has become complacent practice among practitioners to use IF cue. The purpose of this study was to investigate EF about bodily movements. Twenty males (22.0, ±2.19 yrs) and 20 females (22.0, ±3.87 yrs) performed 3 drop jumps in each of the following counterbalanced conditions: Baseline, EF, IF and EF,IF combined. Green tape was placed on the tips of the participants' shoes and red tape was placed on their mid-patella. During baseline, participants were told to 'do their best'. The EF condition, was told "when landing from the box, focus on pushing the red tapes forward and pointing the green tapes forward". The IF condition was told "when landing from the box, push your knees forward and point your toes forward." The EF, IF combined were given both s ets of instructional cues. Thevertical jump performance was measured with the Vertec, and landing mechanics was measured using LESS (Landing Error Scoring System). A separate 2 (Gender) x 3 (Condition) ANOVA with repeated measures on the last factor for performance and landing mechanics with alpha set *a priori* at .05 was used for data analysis. The results on performance revealed the main effect on Condition ($F_{2,38} = 4.45$, $p < .02$, partial eta = .11). *Post hoc* with pairwise comparisons with Bonferroni correction revealed the EF ($M = 44.41$ cm, $SE = 1.57$) was better than IF ($M = 43.11$ cm, $SE = 1.51$), $p < .01$, whereas no difference was found between the EF and CON or IF and CON. Landing mechanics also showed the main effect on Condition ($F_{2,76} = 4.43$, $p < .02$, partial eta = .10). *Post hoc* analyses showed the EF showed significantly less landing error scores relative to the baseline, $p < .01$. EF instructional cues were beneficial to performance and landing mechanics. This furthers the knowledge on EF cues and how it contributes to technique and performance.

Saccades attenuate body sway despite muscular fatigue negatively influencing proprioception

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Muscular fatigue, which reduces force output and position sense, often leads to increased sway and potential imbalance. In contrast, saccadic eye movements can attenuate sway better than fixating gaze on an external target. The goals of this study were to determine whether the use of saccades could compensate for the increased body sway in a fatigued state and to better understand the contributions to fatigue-induced increased sway. Methods: We compared the effects of gazing at a fixation point (FP) and performing saccades (SAC) on body sway while 24 young adults stood as still as possible. Participants in either a Narrow or Wide base of support (BOS) performed 3 trials for each eye movement condition (SAC, FP) in 3 states (non-fatigued—NF, stretched—S, and fatigued—F). Extreme plantar- and dorsi-flexion induced stretch. Calf rises to exhaustion induced ankle fatigue. Recordings of shoulder and ankle markers were monitored at 60 Hz. Effects of group, state, and eye movement condition on the primary variable, the difference in minimal and maximal body angles during a trial in the anterior-posterior direction (dAPangle), were determined using a mixed model ANOVA. Number of anticipatory saccades was determined by state. Results: SAC and being the in Wide group significantly decreased dAPangle compared to FP and being in the Narrow group, respectively. F increased sway compared to NF and S states, which were similar. Number of anticipatory saccades did not influence dAPangle and were not affected by state. Conclusion: Reduced force production, which accompanies F and S states, did not account for increased body sway associated with acute bouts of ankle muscle fatigue. Increased position sense associated with muscle stretching apparently compensated for any reduced force output for S, while the decreased position sense explained the increased body sway associated with F. Use of anticipatory and/or ensuing attentional demanding saccadic eye movements during quiet stance can help reduce body sway under various states and possibly influence age-related postural declines.

Reactive driving performance following stroke

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In the US, up to 5 million stroke survivors drive. Driving is a complex task that involves visual information processing and neuromotor control that are often severely affected following stroke. Despite such deficits, driving ability after stroke is poorly understood and rehabilitated. The goal of this study was to determine the contribution of visual information processing and motor control to reactive driving performance after stroke. Reactive driving is a key component of car following task and involves responding to environmental unexpected stimuli with fast and precise movements. In a simulated driving environment, chronic stroke (N = 15; age=67.94 ± 9.64 yrs) and age-matched adults (N = 15; age=69.23 ±13.09 yrs) performed a reactive driving task that required responding to unexpected brake lights of the car ahead. All stroke participants performed the simulated driving task with the affected leg and the controls used the right leg. We determined the contribution of visual information processing by quantifying the pre-motor response time as the time between the onset of the visual stimulus and activation of tibialis muscle. We determined the contribution of the neuromotor control by quantifying the motor response time as the time between the activation of tibialis muscle and the brake force onset. Our results suggests that stroke participants exhibit impaired reactive driving as compared to healthy individuals. The pre-motor response time was not significantly different between the groups (stroke = 510 ms ±152.40, control=502.11 ms ±115.46 ms; $p > 0.05$). However, the motor response time was significantly increased in the stroke group compared to controls (stroke = 465.79 ms ± 100.71, control=377.15 ms ± 67.96 ms; $p < 0.01$). These findings suggest that reactive driving performance following stroke is primarily limited by a longer motor response time. Thus, neuromotor impairments but not the visual information processing contributes to reactive driving deficits following stroke.

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Learning with Lego: Observational learning of a complex motor task with partially occluded field of vision

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While surgical training focuses heavily on teaching complex motor skills, various challenges of the surgical environment can limit the applicability of methods from other domains. Surgical trainees spend years observing procedures being performed by others, but it remains unclear whether watching novice or expert performance is better for learning surgical tasks (LeBel et al., 2017; Harris et al., 2017). While an external focus of attention is often superior for learning (Wulf et al., 2010), the visual field in surgery is often partially occluded from trainees. We investigated differences in performance of a complex task with a partially occluded field of view when observing one's own performance or the performance of an expert.Participants watched a video of an expert building a complex LEGO structure, and were then asked to build the structure in three minutes, aided by a photo of the design for the first minute. Next, participants either re-watched the expert video or watched their previous attempt and were then given another try, again aided by a photograph in the first minute; this was repeated for one final attempt.Data were analysed using two repeated-measures ANOVAs, with time to complete task and number of errors as outcome variables. Our analysis revealed a main effect of trial number, with both groups completing the task faster ($F(2,24) = 6.77$, $p < .01$) and with fewer errors ($F(2,24) = 8.88$, $p < .02$) on the last trial compared to the first two trials. There were no significant differences in performance between groups. However, inspection of the data suggests those in the expert-observation group were faster and made slightly fewer errors than those in the self-observation group.In contrast with other studies, our data showed no differences between the groups. This can perhaps be explained by participants' fields of view being partially occluded. Future work will explore concepts of observational learning in the absence of critical visual cues in surgical training.

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Women athletes' reported pre-season and early-season injury impact on training volume and perceived performance expectations

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Injury has been identified as a significant setback in sport that can be a barrier to athletic progress and skill development. However, the prevalence of injury and competitive season timing has not been considered in concert with training volume and performance perceptions. We collected detailed information on pre-season and early-season injury to assess if there were group differences between injured and uninjured athletes in training volume and performance expectations. The participants were 121 women athletes between 16 and 35 years of age ($M = 22.07$, $SD = 4.87$) competing in team and individual sports from local to international levels [1.00-7.92 years of sport-specific experience ($M = 10.50$, $SD = 6.02$)] They completed an online survey one to five days before their first regular season competition and were asked to report and describe any injury in the past 6 months, as well as their current injury status. Athletes were separated into three injury status groups: (1) uninjured: 58 athletes reported no injuries, (2) previously injured: 49 athletes reported an injury in the past 6 months, and (3) currently injured: 14 athletes reported an injury in the past 6 months and a current injury. One-way ANOVAs were conducted to compare the effect of injury status on athletes' training volume and perceived performance expectations. There were significant differences between groups for completed training volume [$F(2, 118) = 4.44$ $p < .05$], the discrepancy between scheduled and completed training volume [$F(2, 118) = 13.07$, $p < .001$], and perceived performance expectations for the first regular season competition [$F(2, 118) = 4.81$, $p < .01$]. Currently injured athletes had lower training volume, a greater discrepancy in training volume, and lower performance expectations than uninjured athletes, as well as lower training volume than previously injured athletes. The results of this study highlight that pre- and early-season injuries are common for women athletes and that their injury status is related to their training volume and sport performance expectations.

Women athletes' early-season self-compassion, sport performance perceptions, and well-being

Margo E. K. Adam, University of Saskatchewan; Noreen Murphy, Saskatchewan Sport Inc.; Leah J. Ferguson, University of Saskatchewan

Self-compassion, an adaptive self-attitude, has been suggested to be a valuable resource for women athletes during challenges and difficulties. Extending compassion to the self has been related to lower levels of negative psychological states (e.g., self-criticism) and higher levels of psychological well-being (e.g., autonomy) for women in sport. However, past research has not considered timing of the competitive season, which could differentially impact athlete performance perceptions and well-being. The purpose of this study was to examine the relationships between early-season self-compassion in women athletes' sport performance perceptions and well-being. The participants in this study were 179 women athletes ($M_{age} = 21.96$ years, $SD = 4.87$). Data was collected through an online survey that was completed within 5 days of the first regular season competition, and included measures of self-compassion, sport performance perceptions, and well-being. Data analysis included bivariate correlations and hierarchical regressions. Self-compassion was correlated with global performance perceptions ($r = .22$, $p < .01$) and perceived competition preparedness ($r = .16$, $p < .05$), as well as autonomy and relatedness, mastery, meaning, vitality, body appreciation, and intuitive eating (rs = .22 - .45, ps < .05). Self-compassion also contributed unique variance beyond self-criticism in women athletes' global performance perceptions, autonomy and relatedness, meaning, vitality, body appreciation, and intuitive eating (R^2 *Delta*s = .03 - .08, ps < .05). The results of this study highlight that self-compassion may play an important role in women athletes' sport performance perceptions and well-being at the start of their competitive season. Given these findings, future researchers might consider fostering self-compassion early-season as a way to promote constructive performance perceptions and well-being for women athletes. (Supported by the Social Sciences and Humanities Research Council of Canada; SSHRC) Funding source: Supported by the Social Sciences and Humanities Research Council of Canada; SSHRC.

The muscular ideal: Measuring muscle dysmorphia in weightlifters and athletes

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An emerging area in body image research is Muscle Dysmorphic Disorder (MDD), a type of Body Dysmorphic Disorder (BDD). It is popularly known as "Reverse anorexia" or "Bigorexia" by the media. It consists of a preoccupation with not being sufficiently muscular or lean (when this is not the case). Sports wrestling & body building gyms are a breeding ground for muscle dysmorphic disorder (Choi, Pope, Olivardia, 2002; Baghurst & Kissinger, 2009). There is a fine dividing line between normal "body-building" and muscle dysmorphic disorder. Normal body-building is a rigorous lifestyle but unlike MDD it is not a preoccupation with muscles that are too puny. It does not cause significant distress or interfere in one's life. To further the research in this area, this study used three instruments, the Muscle Dysmorphia Inventory (MDI), Male Body Attitudes Scale (MBAS), and a general exercise habits questionnaire. The purpose was to describe a group of weightlifters and athletes and to determine any significant differences. The university IRB approved the research. Sixty male participants completed the questionnaire. Mann-Whitney U Analysis revealed that weightlifters had significantly higher scores than athletes. Mean scores for the MDI test were 105.1 for weightlifters and 81.7 for athletes (mid-range = 85). A higher score from this test indicates more symptoms of MD. Mean scores for the MBAS test were not statistically different. Means for both weightlifters (90.4) and athletes (93.9) were above the mid-range of 60 which is desired. A lower score represents higher tendencies of MD. There were 10 areas of differences in exercise and health habits including supplement use and time spent working out. The results support findings from previous studies (Grieve, 2007). Expanding the sample with competitive weightlifters and other male-dominated training groups such as MMA is warranted. We also recommend examining if sexual preference plays a role. While MD is not always a visually obvious disorder but can possibly destroy their social and emotional well-being.

The overtraining trap: How physical fatigue impairs physical and mental recovery

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Recent studies in sport show that detachment, getting a physical, cognitive, and emotional break from the demands of training/competition, is

positively related to physical and mental (i.e., cognitive and emotional) recovery. However, (high) sport-related demands, and subsequent fatigue, can also interfere with recovery. Therefore, the present study investigated different antecedents (i.e., training demands and well-being) of detachment among elite athletes. The study employed a within-person design over a one-week period. Eighty-six elite athletes (M_{age} = 21.3; SD = 3.8) completed a daily survey at two time points (after waking up, T1; after training sessions, T2). Variables included training demands (measured at T2), well-being (e.g., fatigue, cognitive vigor, positive affect; measured at T2), and detachment (physical, cognitive, emotional; measured at T1, previous day). Multilevel SEM analyses showed that daily physical demands were related to physical fatigue, which in turn was negatively related to physical detachment and cognitive detachment during time in recovery. Moreover, physical fatigue partially mediated these relations. Cognitive demands were negatively related to positive affect, whereas emotional demands were negatively related to cognitive vigor. These findings illustrate how physical fatigue can interfere with both physical and mental recovery processes. This points towards an 'overtraining trap', in which high physical fatigue consumes one's attention, leaving little room to think about anything else, which in turn interferes with detachment. Athletes are encouraged to use (mental) relaxation skills, particularly on physically demanding days. Ultimately, this will likely promote recovery from physical fatigue and help achieve total recovery. Furthermore, it is important to educate athletes about ways to switch off mentally, even when tired.

Non-sport need satisfaction promotes elite athletes' health and well-being: A cross-sectional survey and diary study

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Need satisfaction can be fulfilled through experiences in different domains (e.g., sport, family, leisure). However, most studies investigating the role of need satisfaction in relation to athletic well-being have focused on the 'immediate' sport setting as a source of need satisfaction. Therefore, the aim of the present investigation was to investigate (1) the importance of non-sport need satisfaction (i.e., outside the sport domain) for elite athletes' health and well-being, and (2) which leisure time activities contribute to daily well-being (i.e., recovery state) via non-sport need satisfaction. A cross-sectional survey study (Study 1) and a daily diary study (Study 2) were conducted. In Study 1, seventy-eight elite athletes from team and individual sports completed an online survey. In Study 2, sixty-six elite athletes completed a daily survey at two time points, after waking up (T1) and at bedtime (T2), during 8 consecutive days. Study 1 showed that both sport-specific and non-sport need satisfaction were negatively related to fatigue and positively related to athlete engagement. Only non-sport need satisfaction positively predicted resilience. In Study 2, daily satisfaction of the needs for autonomy, competence, and relatedness, and time spent on low-effort activities positively predicted recovery state at bedtime. Satisfaction of the need for competence fully mediated the relation between time spent on mandatory activities and recovery state. Satisfaction of the need for relatedness mediated the relation between time spent on social activities and recovery. These findings support the notion that it is important to take into consideration what happens in different aspects of an athlete's life when investigating athletic health and well-being. It is important for athletes to have a social environment inside and outside sport that can satisfy their basic psychological needs. This can be a challenge, however, since due to psychological and social immersion in their sport, social interactions often take place with people from within the sport environment.

Self-compassion and sport performance

Nikki Barczak, University of North Carolina at Chapel Hill; Amber Mosewich, University of Alberta; Robert C. Eklund, Florida State University

Self-compassion is currently a popular topic in sport psychology, largely due to its association with adaptive cognitions, motivation, and behaviors, which can impact performance (Ferguson et al., 2014, 2015; Mosewich et al., 2013). However, little is known about the direct relationship between self-compassion and performance. The purpose of this study was to investigate the associations between self-compassion and performance. High school swimmers (N = 113, age: M = 15.53 years, SD = 2.23) completed the Self-Compassion Scale (Neff, 2003), which assesses the three components of self-compassion (self-kindness, common humanity, and mindfulness) as well as three components in opposition (self-judgement, isolation, and over-identification) and recorded performance information online. Relative performance was calculated for each individual's most recent competitive event and either their previous personal record (PR) or their existing PR using the USA Swimming Power Point Calculator. Mindfulness, self-judgement, and over-identification were significantly (ps < .05) associated with previous or existing PR (r = .21-.25). Common humanity and over-identification (r = .18-.19) were significantly associated to the difference between previous PR and existing PR. Those higher in common humanity and those higher in over-identification swam faster, indicating improved performances. The findings regarding faster PRs were both expected and unexpected, as mindfulness is thought to aid athletes, while self-judgement and over-identification are assumed to hinder (Mosewich et al., 2013). With this ambiguity, further research is needed to more clearly understand the influence of self-compassion on performance. The present study was retrospective and descriptive in nature but potentially advances understanding of self-compassion in relation to performance in sport. The relationship between self-compassion and performance should be of considerable interest for athletes and coaches who may fear the construct might limit sport pursuits (Ferguson et al., 2014; Sutherland et al., 2015).

Linear and nonlinear trajectories of athlete resilience during competitive training

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Resilience is a dynamic coping process that can occur in different outcome trajectories, ranging from chronic dysfunction to resilience (Bonanno, 2004). Among athletes, resilience is how well one adapts to stressors such as training or competition (Fletcher & Sakar, 2013). Athletic adaptation has been linked to sport-specific coping strategies such as coping with adversity and peaking under pressure as well as with individual stress appraisal (Smith et al., 1995). The purpose of this study was to examine athlete resilience processes over time during competitive training and to probe coping and stress as predictors of resilience trajectories. American collegiate club sport athletes (N = 61; M_{age} = 19.4 years, 31 males, 30 females) completed valid and reliable psychometric assessments at baseline, two-, four-, and six-week follow-ups. Multilevel fully random linear growth modeling of athlete resilience yielded significant differences at baseline and over time (τ_{00} = .12, τ_{10} = .02, p < .05). A significant nonlinear, quadratic model indicated that each value of the predictor, by time point, has an individual slope (lrt(4)=25.9, p < .0001). Further analyses found stress, coping with adversity, and peaking under pressure as significant time-varying covariates of resilience, t(177) = -3.81, 4.61,

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3.70, all $p < .001$, respectively. No gender differences were found, $t(179) = -1.20$, $p > .05$. In total, athletes differed in initial levels of resilience and nonlinear changes over time, which may be crucial in understanding how to predict and promote resilience through the ongoing stressor of sport participation. Due to the differences in individual baseline scores, future research should investigate individual levels of adaptability before a stressor to best predict resilience trajectories. Data from this study demonstrate that, as stress and coping predictors vary through training, they may influence the nonlinear change in athlete resilience. This information is important for best fostering resilience to influence individual performance and wellbeing during training.

Prospective examination of social identity, mental toughness, and overuse injury, and development of the test of intentions to reduce effort

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Based on social identity theory, the purposes of this study were: 1) assess support for hypothesized relationships between social identity constructs, mental toughness, and overuse injury severity, and 2) conduct initial validation of a measure of susceptibility to higher overuse injury severity, the Test of Intentions to Reduce Effort (TIRE). Participants were backpackers who attempted to hike the Appalachian Trail, a mountain trek over 2,000 miles. Before their attempts, participants (N = 283) completed online measures of social identification (i.e., In-group Identification; Leach et al., 2008), social identity content adapted to hiking (Barker et al., 2014), mental toughness (i.e., Mental Toughness Index; Gucciardi et al., 2015), and the TIRE. After their attempts, 170 of the participants completed measures; 136 reported overuse injury occurrence. Pre-hike scores of social identification and social identity content significantly correlated with overuse injury severity. A hierarchical moderation analysis revealed that mental toughness scores moderated the relationship between social identification scores and severity outcomes; those high in mental toughness and social identification reported higher severity than those high in mental toughness and low in social identification. Regarding the second purpose, exploratory factor analysis of TIRE scores revealed a two-factor model, consisting of intentions to reduce effort due to low-level overuse injury pain, and due to all overuse injury pain levels. TIRE scores exhibited construct and predictive validity. Additional research is needed to assess other psychometric properties of TIRE scores and to determine generalizability to other physical activity contexts. The findings have practical implications in identifying individuals with higher susceptibility to overuse injury severity and theoretical implications in providing evidence that social identity theory is applicable to the study of overuse injury. This initial effort may ultimately assist in reducing overuse injury occurrence and severity.

Perceptions of exertion and affect during different physical and sedentary activities in children

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Both acute and chronic forms of physical activity have been shown to positively impact cognition, particularly in young children (Verburgh et al. 2014). However, the type of activity to elicit the largest improvements in cognition has not been evaluated. Physical activities that are cognitively demanding and enjoyable have been suggested by many (e.g. Best 2010, Diamond & Ling, 2016) as activities likely to produce the largest gains in cognition when compared to more traditional forms of aerobic activity. However, to test this hypothesis, we first must establish physical activities that children find cognitively engaging and fun. The purpose of this study was to evaluate children's perceptions of physical and mental exertion and affect during different activities with varying levels of physical and cognitive demands. Children ages 6 to 8 years (n = 48) were randomized in pairs to one of three 20-min conditions: a cognitive activity of playing a seated game of Connect 4; an aerobic activity of running to and from a pylon placed 45-ft in front of the participants; or a dual cognitive-exercise activity playing a game of Connect 4 where children were asked to run forward 45-ft to a large Connect 4 board. In 4-min intervals throughout the activity, participants were asked to rate their perceived mental and physical exertion using Borg's CR0-10 scale (Borg, 1998) as well as their affect using the Feeling Scale (Hardy & Rejeski, 1989). Children in the cognitive condition reported lower levels of physical exertion compared to the exercise and dual conditions (d=-1.6, p < .001). Children in the cognitive and dual conditions reported higher levels of mental exertion when compared to the exercise group, however this was not significant (d=0.57, p = .30). Children in the dual condition reported significantly higher affect, compared to the cognitive and exercise groups (d=0.85, p = .04). Therefore, an active game of Connect 4 represents a fun, cognitively-engaging physical activity that may be used in a controlled setting to evaluate its impact on cognition.

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Online social norms as predictors of self-efficacy and physical activity: The role of sharing about physical activity on social media

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Social norms have been related to physical activity (PA) and self-efficacy (SE). Both descriptive norms (ie., what others do) and injunctive norms (ie., what others approve) for social networks have been examined. When evaluating the interaction of social media (SM) users and information shared over SM, the relationship of social norms with both SE and PA behaviors require further exploration. The purpose of this study was to examine the role online social norms play in predicting moderate to vigorous PA (MVPA), coping SE, and scheduling SE for those who share about PA on SM and those who do not share. A convenience sample of 105 undergraduate kinesiology students self-identified as either sharers of PA on SM (n = 39, 34.5%) or non-sharers (n = 66, 58.4%). Participants completed a cross-sectional survey that assessed PA (Godin & Shephard, 1985), coping and scheduling SE (Rodgers & Sullivan, 2001) and single items measures of descriptive and injunctive norms with reference to the members of their online social network. Multiple regressions were used to predict SE and MVPA using sharing status, either descriptive or injunctive norms, and a norm by sharing status interaction. The regressions predicting coping SE were significant for both descriptive norms ($R^2 = 0.093$, p = .023) and injunctive norms ($R^2 = 0.099$, p = .018) and in both cases, the interaction was significant (p < .05). Those who shared about PA on SM showed a positive relationship with coping SE for both descriptive norms (b = 6.5, p = .027) and injunctive norms (b = 12.5, p = .017). Those who did not share about PA on SM showed no relationship between norms and coping SE (p > .05). The regressions predicting scheduling SE and MVPA were not significant (p > .05). Findings suggest that online social networks may contribute to developing perceptions of coping SE for those who share over social media. Future studies should explore other functions of these online social networks as they relate to SE and PA behaviors to provide further insight as to why people post about PA on SM.

Older adults' experiences of group-based physical activity: A qualitative study from the 'goal' randomized controlled trial

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In light of the pervasiveness of inactivity among older adults, as well as the health benefits that they stand to derive from regular physical activity, there is a pressing need to develop and evaluate interventions that can support older adults' involvement in regular physical activity. This qualitative study examined the experiences of older adults that took part in one of two efficacious group-based physical activity programs as part of the GrOup-based physical Activity for oLder adults (GOAL) randomized controlled trial (clinicaltrials.gov identifier: NCT02023632). In the GOAL Trial, participants were randomized to one of three conditions: similar age same gender (SASG), similar age mixed gender (SAMG), or 'standard' mixed age mixed gender (MAMG) control exercise group conditions. Older adults ($N = 31$; $N_{men} = 17$, $N_{women} = 14$; $M_{age} = 70$ years) were purposively sampled from the two experimental conditions (SASG, SAMG) and involved in semi-structured interviews, with 16 participants from the SASG condition and 15 participants from the SAMG condition. The data were subjected to thematic analysis. The results revealed the emergence of 12 lower-order and three higher-order themes that reflected (a) the benefits and challenges of exercising with peers, (b) the group as a means of addressing participant vulnerabilities, and (c) group exercise and the physically active body. This qualitative study highlights the importance of social connections that exist within the age-matched physical activity programs, as well as some of the challenges that exist for older adults in participating in community-based physical activity programs. Implications for intervention, program planning, and future research are discussed.

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Aging, men, and body image: How men aged 65+ perceive, experience, and manage their aging bodies

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Age-related body changes have been shown to shape an individual's body-related perceptions, cognitions, emotions/affect, and behaviours in later life (Bailey et al., 2016; Bennett et al., 2017; Hurd Clarke, 2011). However, the bulk of the later life body image research has attended to women, and little is known about older men's body-related experiences. The purpose of this study was to examine how men aged 65 and older perceived, experienced, and managed age-related changes to their health, body function, and appearance. A thematic analysis (Clarke & Braun, 2016) of semi-structured interviews with 17 men aged 65 to 82 revealed three main themes pertaining to their aging body-related experiences. Some men expressed authentic pride in their abilities to remain healthy, independent, attractive, and socially engaged as they aged, yet others exuded hubristic pride and engaged in downward social comparisons to others their age whom they perceived to be less physically able and attractive. Participants concomitantly experienced self-conscious emotions of shame and guilt in relation to their inability to retain the physically fit and muscular cultural ideal. Physical activity was an important way in which the men managed their bodies. While they derived health benefits and pleasure from activity, they also exercised and played sports to connect with others and to cope with a shift in identity since retirement from work. Finally, the men discussed their ongoing efforts to manage their weight through dieting, healthy eating, physical activity, consistent scale monitoring, and feedback from significant others. They positioned their weight management as a way to take responsibility for their health, and shamed others whom they perceived to be obese. Findings highlight the importance of considering the complex, interrelated, and positive and negative cognitions and emotions involved in men's negotiation of the physical changes accompanying aging.

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Motor abilities predict executive functions in pediatric cancer survivors: Results from the Brainfit study

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Survival rates for pediatric cancer have increased up to over 80% due to both improved diagnostic tools as well as treatment. However, Pediatric Cancer Survivors (PCS) frequently suffer from late effects including impaired motor abilities as well as cognitive deficits e.g. in the executive functions (EFs). Although motor abilities have been linked to EFs in the healthy population, no study to date examined this relationship in PCS. Therefore, the aim of this study was to investigate late effects in PCS focusing on the predictive value of motor abilities on EFs. In total, 81 children and adolescents (32 PCS, 49 healthy controls) between 7-16 years of age ($M = 11.14$; $SD = 2.35$) participated in the Brainfit study. Motor abilities were assessed using the German Motor Performance Test (aerobic fitness, strength, power, coordination, flexibility), core EFs using the Stroop task (inhibition, shifting) and the Corsi Block task (updating). EFs were transformed into a composite score. Background variables (age, gender, socioeconomic status, IQ) did not differ between groups. Independent *t*-tests revealed significantly lower performance in aerobic fitness ($p = .003$), coordination ($p = .003$) and in EFs ($p = .024$) in PCS. Additionally, a linear regression analysis including both groups revealed that motor abilities ($\beta = .32$, $p = .013$) significantly predicted EFs ($R^2 = .075$, $F(2, 79) = 6.43$, $p = .013$). When looking at the contribution of the distinct motor abilities in each group separately using a multiple regression analysis, no significant predictors were found for EFs in healthy controls. In PCS however, coordination ($\beta = .49$, $p = .001$) significantly predicted EFs ($R^2 = .48$, $F(5, 26) = 4.84$, $p = .003$). Results show that late effects in specific motor abilities and EFs are evident and seem to be strongly interrelated in PCS. Therefore, interventions targeting motor coordination and consecutively cognitive abilities are highly relevant for the rehabilitation of late effects in PCS. In particular when considering the potential of physical exercise to enhance EF performance.

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Psychosocial consequences of parental involvement in youth sport: A systematic review of the literature

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The understanding that parents can influence the youth sport experience of their children has led to considerable examination of parental involvement

in sport in the last decade. The purpose of the current study was to systematically review research examining the psychosocial consequences of parental involvement in youth sport. A literature search yielded a total of 5147 articles. Following screening and exclusion of articles based on pre-specified criteria, 153 articles were included in the final review. Overall, articles highlighted consequences of parental involvement that aligned with four broad themes, namely motivational consequences (including basic psychological needs, goal involvement, and continuation), affective consequences (e.g., enjoyment and anxiety), psychological wellbeing (e.g., vitality, perfectionism, and body image), and psychological development (e.g., coping and moral development). Generally, an authoritative/autonomy-supportive parenting style yielded adaptive psychosocial consequences in athletes, as did a parent-created motivational climate that emphasised task/mastery. Furthermore, parenting practices including active involvement, encouraging feedback, and being readily available for support enhance athlete motivation and positive affect. In contrast, parents who are critical and provide a lack of support inhibit the psychological wellbeing and development of their children. Results also highlight the need for parents to be flexible and adapt their practices in accordance to their child's needs. Although it is well understood from the literature that parents can impact on multiple aspects of the child's youth sport experience, there are areas that require further attention. For example, there is scope to study the impact of specific parenting practices that are nestled within particular parenting styles. Furthermore, few studies have sought to understand the impact of parents' involvement jointly within a spousal dynamic. Expanding the literature in such a way is necessary in order to strengthen the current evidence base.

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Assessing need supporting, thwarting and indifferent coaching styles: Development and validation of a new multidimensional measure

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To date, Self-determination Theory (SDT; Deci & Ryan, 1985; Ryan & Deci, 2002) based measures of the contextual environment in sport have focused on athletes' perceptions of coaching styles that support and thwart their basic psychological needs. Existing measures of need thwarting fail to distinguish between actively thwarting and passive or indifferent ways in which coaches communicate with their athletes. This distinction is potentially important, as need thwarting is more likely to result in need frustration, while need indifference is more likely to lead to need dissatisfaction, thus warranting a separate assessment. This series of studies outlines the development and validation of a new multidimensional measure designed to simultaneously assess athletes' perceptions of coaches' need supporting, thwarting, and indifferent interpersonal styles. Study 1 focused on item development, selection, and content validity. Quantitative and qualitative data was obtained from 20 competitive athletes and eight academic experts, where 54 items were deemed clear and applicable to sport. In Study 2, both confirmatory factor analysis and exploratory structural equation modeling were employed to test various competing models. A 22-item, three-factor structure (supporting, thwarting and indifferent styles) using exploratory structural equation modeling demonstrated acceptable fit and standardized factor loadings. Study 3 is in progress and aims to replicate this factor structure in an independent sample of athletes. Additionally, evidence for the nomological network of the sub scales of the new measures and positive and negative outcomes will be also be presented. By demonstrating refined terminology and conceptualization of the key constructs in this area, this new multidimensional measure can have widespread utility in examining supporting, thwarting, and indifferent coaching styles and their independent contributions to need satisfaction, frustration, and dissatisfaction, adaptive and maladaptive types of motivation, and various behavioral, cognitive, and affective outcomes.

The effect of non-verbal behavior and game context on expectations of success and psychological attributes

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Non-verbal behavior has been found to be a powerful factor influencing behavior and perception within sport. Players and coaches change their non-verbal behavior as a function of winning and losing during competition. Individuals have learned to correctly infer who is winning or losing simply by watching non-verbal behavior of athletes (Furley & Schweizer, 2014). Greenlees et al. (2005a; 2005b) have found that dominant body language leads to favorable ratings and outcome expectations, and that athletes displaying dominant body language are rated as more difficult to beat than those displaying submissive body language. Whereas previous research has examined the effect of body language in static or pre-game situations, the current study explored individual's perceptions of their opponents' non-verbal behavior within a competitive scenario. Participants (N = 103) were randomly assigned to one of six conditions based on body language (dominant/submissive) and game context (winning/losing/tied). Game context was operationalized through a written scenario whereas non-verbal behavior was manipulated via video-recoded scenarios. Participants then rated the expectation of success and psychological characteristics (e.g., confidence, assertiveness, focused) of the target player in the video/scenario. A 2*3 factorial MANOVA revealed a significant main effect for non-verbal behaviour, as dominant body language target players were rated as significantly higher on both expected performance outcomes and psychological characteristics than their submissive counterparts. These results are consistent with previous research that showed sport participants displaying dominant body language are viewed more favourably than those who display submissiveness. Furthermore, they extend our understanding by showing that this occurs when contextualized during competition much like observations prior to competition, and this effect operates independently of specific game context.

I can see it in your face: Exercisers' and non-exercisers' automatic affective valuations of exercise

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Affective-Reflective Theory (ART) of physical inactivity and exercise is a dual-process model and assumes that exercise-related stimuli trigger automatic associations and a resulting automatic affective valuation (i.e., the tacit assignment of positive or negative valence, in contradistinction to a reflective evaluation) of exercise. This study tested the hypothesis that exercisers' and non-exercisers' affective valuation of exercise-related stimuli can be detected by facial expression analysis. Participants (144 exercisers and non-exercisers) viewed a randomized series of 60 rectangular exercise-related and control picture stimuli on a computer display. The thirty different pictures were displayed once in an upright and again in a tilted position (1 degree to the right). Participants were instructed to briefly smile in response to tilted pictures and frown in response to upright pictures (vice versa for half of the participants). Facial expression valence was inferred from variation (video-recorded during the 3 seconds after stimulus onset) in 33 facial landmarks using iMotions Affectiva™ software. Exercisers were significantly faster in displaying facial expressions

with positive valence after exercise-related stimuli (than they were after control pictures), whereas non-exercisers were significantly faster in expressing negative valence after the same exercise-related stimuli. Due to the observed very short reaction times (valenced facial expressions were detectable ca. 600 ms after stimulus onset) and reaction time latencies (60 to 100 ms delayed onset of valenced facial expression after exercise-related vs. control primes), these intra-individual differences provide evidence that facial action is, at least in part, inflexibly linked to affect (i.e., without substantial mediation through higher-order cognitive processes), and that automatic positive and negative affective valuation of exercise-related stimuli corresponds with exercise behavior and physical inactivity.

The effect of music on performance and affects: What's next?

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Music helps performance in physical activity (Aslett, Van Der Merwe, & Kruger, 2017). Listening to music during activity can improve affects, attention focus, and levels of exertion (Razon, Hutchinson, & Basevitch, 2017). Typical use of trained samples within most research however renders these findings challenging to generalize to broader population within field settings. Two studies tested the differential effect of music in sedentary populations within field settings. For Study 1, sixty young adults (33 male and 27 female; Mage = 22.21, SD = 3.49) completed a handgrip-squeezing task at 30% maximal squeezing capacity. In the course of their squeezing, participants either had vision and self-selected music, vision and no music, no vision and self-selected music, and no vision and no music. Rate of perceived exertion and attention focus were measured at 30s intervals. For Study 2, twenty-seven young adults 019 male and 17 female; Mage = 22.11, SD = 5.12) completed three separate running trials, each of one mile. In the course of their run, they listened to either self-selected music, researcher-selected music or no music at all. Affective responses were measured before, during, and after each trial. Mile time was recorded at task completion. A single open ended item to gauge participants' music type preference was administered following the final running session. Repeated Measures ANOVAs indicated that participants who listened to music perceived less fatigue and diverted their attention longer from the task ($p < .05$). Music type did not have an effect on time on task ($p > .05$). Qualitative analysis revealed that most participants preferred self-selected music for increased motivation, focus, comfort, and enjoyment compared to the other music conditions. Implications for upcoming research into the additive effects of music and other modalities (e.g., video) will be discussed (Chow & Etnier, 2017). Recommendations for best use of music with sedentary and high-risk populations will be outlined. 2029/ 2100 Funding source: N/A.

Longer, further, faster: Associations between fitness and executive functions in children

Emily Bremer, McMaster University; Jeffrey D. Graham, McMaster University; John Cairney, University of Toronto

Ample research supports the positive relationship between physical fitness and executive functioning (EF) in children (e.g. Pontifex et al., 2011), yet levels of cardiorespiratory fitness (CRF) has been the primary focus of this work. Other aspects of physical fitness (i.e., muscular strength and muscular power [MP]), shown to positively relate to aspects of health, have received very limited attention. Given that co-activation occurs between brain regions governing motor behaviour and cognition during the performance of both motor and cognitive tasks (Diamond, 2000; Leisman et al., 2016), we hypothesized that MP will also be related to EF. The purpose of this study was to examine the associations between CRF, MP, and EF in 11-13 year old children. As part of baseline testing for a larger intervention study, participants' (n = 180, 48% male) CRF was assessed with the 20-metre shuttle run test (Leger et al., 1984, 1988) and MP was assessed with standing long jump performance. EF was assessed the next day with a modified Eriksen Flanker task (Eriksen & Eriksen, 1974). A series of linear regression models were used to examine the association between CRF and MP, respectively, on flanker performance, while controlling for age and sex. As predicted, results indicated that response time was predicted by CRF, age, and sex (models significant at $p < .01$). Similarly, response time was also predicted by MP, age, and sex (models significant at $p < .001$). Importantly, CRF and MP were significant independent predictors of EF with higher CRF (beta = -1.359, std. err. = .560, $p < .01$) and higher MP (beta = -1.368, std. err. = .398, $p < .001$) resulting in a quicker response time. However, CRF and MP were not significantly associated with accuracy on the flanker task. These findings support the close relationship between aspects of physical fitness and EF in children. Importantly, findings show that other aspects of fitness (i.e. muscular power) are also related to EF and support the idea of co-activation between brain regions as a potential mechanism for this association.

Predictors of autonomous motivation for adolescents with visual impairments from the United States and Latvia: A cross-cultural examination

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Objectives: Previous studies grounded in Self-Determination Theory found strong evidence that adolescents' need satisfaction, and more specifically their competence satisfaction, is positively associated with their autonomous motivation for and their engagement in physical activity (PA). The current study examined whether this positive association is also present in adolescents with visual impairments. Methods: In a sample of 23 American and 16 Latvian adolescents (56.4% boys, age=13.97±.2.24 y) competence satisfaction and autonomous motivation for PA were measured with the Basic Need Satisfaction Scale and the Behavioral Regulation in Exercise Questionnaire, respectively. Independent samples t-tests were conducted to examine differences in competence satisfaction and autonomous motivation according to sex (i.e., boys vs. girls), classification of visual impairment as defined by the United States Association of Blind Athletes, and country of residence (USA vs. Latvia). Furthermore, a linear regression analysis was conducted to examine whether and to what extent adolescents' competence satisfaction predicts their autonomous motivation for PA. Results: No significant differences in competence satisfaction or autonomous motivation for PA were found between boys and girls or between adolescents with different classes of visual impairment. However, American adolescents had higher scores for competence satisfaction (M=4.27, SD=.78, t[37]=4.15, $p < .001$) and autonomous motivation (M=4.43, SD=.69, t[37]=4.86, $p < .001$) than the Latvian adolescents (M=2.98, SD=1.15 and M=3.29, SD=.79, respectively). Competence satisfaction positively predicted 47% of the variance in autonomous motivation for PA (adjusted R^2=.47; F = 34.73; $p < .001$). Conclusions: Adolescents with visual impairments have overall high levels of autonomous motivation for PA and that their competence satisfaction predicts their autonomous motivation for PA. Future research should examine

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environmental and cultural variants to better understand cross-cultural differences in motivation.

The impact of contextual priors and anxiety on performance effectiveness and processing efficiency in anticipation

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Expert athletes are able to integrate prior contextual knowledge with emergent visual information to make complex predictive judgments about the world around them, often under heightened levels of uncertainty and extreme time constraints. However, few researchers have examined the impact of anxiety on such contextual priors when forming our anticipatory judgements. Some researchers suggest that high anxiety causes a greater reliance on environmental information (Cocks *et al.*, 2015), while others suggest individuals become more biased by prior contextual information under high anxiety (Nieuwenhuys *et al.*, 2012). Alternatively, Runswick *et al.* (2017) recently suggested that the processing of contextual information may not interact with levels of anxiety. We tested these contradictory hypotheses by examining the combined impact of contextual priors and anxiety on anticipatory judgements in soccer. Using life-sized video simulations of 2-versus-2 soccer scenarios, 12 expert soccer players were required to predict the direction of an oncoming attacker. Performance effectiveness (response accuracy) and processing efficiency (mental effort score) were measured under four conditions: no contextual priors (CP) and low anxiety (LA); no CP and high anxiety (HA); CP and LA; and CP and HA. Contextual priors were provided verbally and referred to percentage likelihood of the opponents' outcome; left (65%) or right (35%). Providing contextual priors about the opponents' action tendencies did not diminish processing efficiency scores, $p = .72$, but benefited performance effectiveness, $p = .01$. Processing efficiency scores significantly decreased in the high anxiety conditions compared to the low anxiety conditions, $p < .01$, but this did not impact performance effectiveness, $p = .15$. There were no interactions between contextual priors and high anxiety for both performance effectiveness, $p = .39$ and processing efficiency, $p = .77$. In summary, it is proposed that contextual information does benefit performance and the use of such information does not interact with anxiety levels.

Overcoming the effects of mental fatigue on physical activity with performance monitoring

Denver Brown, Steven Bray, McMaster University

Highly effortful cognitive control exertion leads to mental fatigue and impairs subsequent physical performance. Performance monitoring can attenuate negative carryover effects for cognitively-demanding tasks performed in succession, but has not been investigated for exercise performance following cognitive control exertion. The purpose of this study was to examine performance monitoring as a moderator of the relationship between cognitive control and adherence to vigorous-intensity exercise reflective of current public health physical activity guidelines. Using a Williams design, participants ($N = 36$) completed four 20-minute sessions of self-paced, cycling exercise. Exercise was preceded by 10-minute high or low cognitive control manipulations crossed with concurrent heart rate (HR) feedback (performance monitoring) or no feedback during exercise in a 2 (cognitive control) X 2 (performance monitoring) factorial arrangement. HR and ratings of perceived exertion (RPE) were recorded during each exercise session. Findings showed mental fatigue was significantly greater following high cognitive control exertion ($p < .001$). A 2 X 2 repeated measures ANOVA showed participants exercised at a lower average HR in the high cognitive control condition with no HR feedback ($M = 154.68$), however, receiving performance feedback following high cognitive control exertion enabled participants to attain higher HRs ($M = 159.97$) similar to the low cognitive control conditions with ($M = 160.$ 13) and without feedback ($M = 161.02$). RPE was greater with performance monitoring ($p < .05$), but there was no effect of cognitive control exertion ($p > .5$). Results suggest that performance monitoring increases perceived effort, but when fatigued, enables people to better self-regulate using feedback to guide behavior. Without feedback, fatigued people may down-regulate exercise intensity based on perceived effort alone. Findings have implications for the use of behavioral-monitoring devices to mitigate the effects of mental fatigue and improve training adherence.

Funding source: SSHRC; McMaster ARB Grant.

Examining the impact of behavioral counselling on psychosocial mediators for physical activity among children with epilepsy

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Physical activity provides several beneficial effects for health outcomes and quality of life among adults with epilepsy; however, children with epilepsy participate in lower levels of physical activity than typically developing peers. Motivational counselling, targeting psychological mediators of physical activity behavior change, is an effective component of physical activity interventions, although such methods have not been extended to physical activity promotion for children with epilepsy. This study reports effects of a behavioral counselling intervention targeting self-regulation and self-efficacy among children (aged 8-14) with epilepsy. The study is a sub-analysis of data from a 12-month, multi-site, randomized controlled trial in which participants ($n = 122$) were randomized to a no-treatment control group or a 6-month intervention consisting of 11 telephone-mediated behavioral counselling sessions using evidence-based behavior change techniques (BCTs) to target psychological mediators (self-efficacy and self-regulation) of physical activity. Participants completed self-report measures of psychological mediators at baseline and after the 6-month intervention. A 2 (Time) X 2 (Group) repeated measures ANOVA showed the intervention group increased action planning ($p = .068$, $d = .46$) and self-efficacy for action planning ($d = .33$). Changes in coping and recovery self-efficacy were not significantly different ($ps > .20$). Results suggest motivational counselling combined with BCTs including self-monitoring, goal setting, and feedback can effectively enhance physical activity cognitions. However, these effects may be more pronounced for action planning for where, when and what physical activities children with epilepsy will attempt to do. Results from the larger trial will determine whether changes in action planning and other mediating variables account for changes in physical activity participation and if evidence-based physical activity interventions can be effective for improving quality of life and other important health consequences for children with epilepsy.

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Increasing physical activity levels among nurses through a web-based intervention: What type of motivation plays a role?

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Background: Low physical activity (PA) levels can negatively affect nurses' health and wellbeing. Given the low PA levels nurses report, the need for brief and economical interventions designed to increase their PA levels is clear. We developed a web-based intervention which utilized motivational strategies to increase nurses' PA levels. The intervention provided nurses with feedback from an activity monitor coupled with a web-based individual, friend or team PA challenge. On theoretical and empirical grounds, we hypothesized that nurses' motivation for PA would affect the efficacy of our intervention. In this randomized trial, we examined whether nurses' motivation at baseline was associated with changes in PA levels during the intervention. Methods: Participants were 76 nurses (97% female; mean age = 46 years, SD = 11) randomly assigned to one of three PA challenge conditions: (1) individual, (2) friend, or (3) team. Nurses completed a questionnaire assessing motivational regulations for PA at week 1, and wore a Tractivity activity monitor at week 1 and during the 6-week intervention. We analyzed data using multilevel modeling for repeated measures. Results: Nurses' PA levels increased (linear estimate = 9.99, $p < .05$), but the rate of change decreased over time (quadratic estimate = -1.58, $p < .01$). Whereas there were no differences in PA levels between the PA challenge conditions ($p > .53$), nurses with more autonomous motivation engaged in more PA during the intervention (estimate = 22.65, $p < .01$). Controlling motivation was not associated with PA levels ($p > .68$). Conclusion: Our findings provide evidence that an intervention incorporating self-monitoring and PA challenges can be effective in increasing nurses' PA levels. Also, largely consistent with motivational theories and prior research, they suggest interventions incorporating strategies promoting autonomous motivation for PA should be developed and tested.

Fitness as a moderator of the aging and cognition relationship: An ERP study

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As a result of genetic and lifestyle factors, cognitive function is either maintained or declines as individuals age. Reaction time (RT) slowing occurs during unsuccessful aging and has been associated with global and domain-specific cognitive impairment. However, it is currently unknown which temporal aspects of information processing may lead to RT slowing. Notably, a large body of evidence suggests that maintaining an active lifestyle may protect against cognitive decline. Although fitness is a known moderator of age-related cognitive decline, its influence on the temporal aspects of information processing is less understood. The purpose of the study was to probe the relationship between aerobic fitness (VO2 peak) and cognitive function among younger and older adults using stimulus categorization (P3) and motor response preparatory (LRP) processes. A total of 102 younger (n = 54; 18-45 yrs) and older (n = 48; 46-70 yrs) adults completed a visual oddball task during the recording of event-related potentials (ERPs), followed by an aerobic fitness test. Behavioral performance along with P3 and LRP components were obtained from the modified oddball task. Across the sample, there was a relationship between age and RT, $r = .48$, $p < .001$, but not for accuracy, $r = .07$, $p = .51$. Age was also associated with delayed LRP latency, $r = .25$, $p < .05$. To examine fitness as a moderator of age and cognition, stepwise regression analyses revealed significant moderation such that the interaction between age and fitness percentile accounted for a significant proportion of variance in P3 latency, Delta$R^2 = .05$, $p < .05$, $t(98) = 2.1$, $p < .05$. That is, as fitness level increased there was an overall decrease in P3 latency. These findings suggest that fitness may protect against delays in cognitive processing that occur during early stimulus categorization stages of information processing. Future research should focus on earlier ERP components and other psychological factors (e.g., stress) that may influence the relationship between fitness and cognition across the lifespan.

Talent identification errors in elite male basketball: A longitudinal examination of the influence of relative age and physical growth potential

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Sport systems place increasing emphasis on the identification of talent at young ages but such efforts are problematic when knowledge about variability in the magnitude and timing of growth and development are not adequately considered. The present study examined age- and developmentally-related sources of potential error in appraising talent in elite basketball players. The relative age effect refers to a categorization error within the talent identification process in which differences in chronological age among young athletes are not adequately recognized as contributing factors to variability in their performance level. Physical growth potential refers to the extent of likely remaining physical growth to age at peak performance for any individual. A longitudinal design was applied to assess the extent to which relative age and physical growth potential (height gain and wingspan/height ratios) explained variability in career success of elite (top 150 players each year) male high school players for 10 years. National high school ranking and eventual NBA draft selection slot were indicators of talent estimates at two points in time. A weighted composite index used currently accepted analytical indices (e.g., PER, VORP) of career success. Univariate and multivariate analyses revealed important findings. High school recruiting rank was significantly related to relative age and favored older players within any given high school class. Second, a relative age reversal effect was present at the professional level as players who had been relatively younger during high school outperformed previous talent estimates at the NBA level. Third, a greater wingspan/standing height ratio was associated with greater career success relative to previous talent estimates and was associated with greater height change since high school, thus reflecting later physical maturation. Costly errors can occur in the talent identification process for elite male basketball players due to a lack of appreciation for relative age and timing of physical growth and development.

Moral disengagement during injury evaluations among National Collegiate Athletic Association (NCAA) athletic trainers

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One of the toughest decisions that an athletic trainer (AT) can encounter is whether or not to remove an injured athlete from competition. Considering recent high-profile reports of malpractice and negligence by NCAA ATs (e.g., Alesia, 2017), it is prudent to investigate psychological mechanisms that may influence ATs' decision making. During high-pressure decisions to remove an injured player from competition (e.g., star player with the

game on the line), ATs may undergo a cognitive process known as moral disengagement, which involves convincing the self that ethical standards do not apply in a particular context (Bandura, 1991). In sport, moral disengagement has been examined among athletes to help explain negative behaviors, such as risk taking (e.g., Boardley, 2011), but the phenomenon has not been examined among ATs. The purpose of this study was to uncover profiles of NCAA ATs who are more likely to morally disengage while evaluating injuries. Utilizing an online survey, we sampled 187 ATs (M_{age} = 31.8 years; SD = 9.23) from 134 universities across the United States. Participants completed measures of moral disengagement, the sport ethic, commitment, social identity, and sport-contesting orientations. Cluster analysis was used to identify homogenous subgroups of participants based on study variables, and a two-cluster solution emerged as optimal. Cluster one (n =94), scored significantly higher on the sport ethic and sport-contesting orientations, but lower on commitment and social identity compared to cluster two (n = 93). An independent samples t-test revealed that moral disengagement was highest (t(185) = 19.59, p < .001, d = .69) among ATs who fit into cluster one. These results advance our understanding of psychological processes behind ATs unethical decisions to play injured athletes. This initial study provides some indication that ATs who conform to sport ethic norms (e.g., no pain, no gain), and who tend to view sport competition as 'war' are more likely to morally disengage during injury decisions.

Funding source: Utah State University's Graduate Research and Creative Opportunities Grant.

A longitudinal investigation of athletic buoyancy and emotions in university club-sport athletes

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Objective: Athletic buoyancy represents athletes' ability to handle everyday setbacks and challenges. Anxiety is considered a major determinant of athletic buoyancy, yet researchers rely on cross-sectional designs without examining other emotions. The purpose of this study was to examine relationships between athletic buoyancy and sport emotions over time. Method: Students from 15 club-sport teams at a large university (N = 308; M age = 20.16, SD = 1.8; 59.4% male) completed established surveys that examined athletic buoyancy and sport-related anxiety, anger, dejection, excitement, and happiness at two time points approximately two months apart. Latent variable modeling was used to assess longitudinal measurement invariance and examine structural relations between athletic buoyancy and emotions over time. Results: Model testing supported configural, weak, strong, and strict longitudinal measurement invariance. Strict measurement invariance constraints were maintained in subsequent model testing to enhance power. The final panel model produced an adequate fit to the data, chi^2 (604) = 940.527, CFI = .913, TLI = .909, RMSEA = .043. Autoregressive paths were robust. Cross-lagged paths revealed that excitement predicted change in athletic buoyancy (beta = .24, p < .001), and that anxiety (beta = –.20, p = .05) and athletic buoyancy (beta = –.12, p < .01) demonstrated significant reciprocal effects. This model explained 33.4% and 26.6% of the variance in time 2 athletic buoyancy and anxiety, respectively. Conclusions: Expanding our understanding of athletic buoyancy may have important implications for athlete wellbeing. Consistent with previous literature, anxiety was a strong negative predictor of athletic buoyancy. Further, anxiety appears to share a reciprocal relationship with athletic buoyancy over time. Additionally, excitement significantly predicted athletic buoyancy. Findings suggest that further research on emotions, particularly positive activating emotions, is needed to fully understand relations between emotions and athletic buoyancy.

Examining the factor structure of a survey of adult-oriented coaching practices

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Adults are the fastest growing cohort of athletes in North America, yet little research has been conducted to understand how coaches work with adults (Masters Athletes). Qualitative research (Callary, Rathwell, & Young, 2015, 2017, in press) has shown that the psycho-social context of coaching adults is unique, with specific needs and coaching approaches. The purpose of this study was to examine the factor structure of a measurement tool asking coaches to self-report how frequently they use approaches that are commensurate with adult teaching principles. 321 coaches (218 m, 103 f; M yrs coaching adults = 18.09, SD = 13.08; from Canada (n = 232), USA (n = 59), UK (n = 18), Australia (n = 10), New Zealand (n = 1), and China (n = *1)* responded to a survey comprising 38 items from a sport-modified adult learning Instructional Perspectives Inventory (M-IPI; Lubin, 2013), and 51 items from the Adult-Oriented Coaching Practices Survey (AOCPS) built from qualitative findings for Masters athletes and coaches (Callary et al., 2015, 2017). After combining data from the M-IPI and AOCPS, a parallel factorial analysis (O'Connor, 2000) determined that six factors best represented the data. Further exploratory factor analyses (maximum likelihood rotation method) were performed. Through an iterative process, high cross-loading items (>.32) and low loading items (<.32) were removed and the model was retested after each removal. The final model had six factors (47.4% variance), no problematic cross loadings, and all items met minimum loading criteria. The six factors included: trusting and valuing athletes (18.7%); individualizing and considering athletes' experiences (11.4%), being sensitive to athletes' uniqueness and effort (6.3%); establishing coaching credibility (3.9%); facilitating discussion (3.7%); and supporting athlete choice (3.3%). Discussion focuses on the nature of the resulting coach-report survey instrument, its utility for examining congruent associations with athletes' perceptions of adult-appropriate coaching behaviors, and further validation steps.

Funding source: Social Sciences and Humanities Research Council of Canada.

Sport, exercise, and performance psychologists as proxy-agents for exercise

Caleb Campbell, Alison Ede, Tiffanye Vargas, Leilani Madrigal, California State University, Long Beach

The current study is exploratory in nature and is the first to consider Sport, Exercise, and Performance Psychologist's (SEPP) as proxy-agents for exercise. The primary focus is on three questions: who would be interested in using a SEPP as a proxy-agent for exercise, do certain factors influence interest, and what specific self-regulatory mental skills are certain people interested in learning from a SEPP. Two hundred and twenty-eight participants anonymously completed a survey online through Qualtrics. To answer the first question, participants in the age ranges of 18-22 and 23-49 were most interested and participants in the age range of 50 and higher were least interested. Participants who reported making less than $20,000 a year were the most interested, and participants who reported making more than $150,000 were the least interested. Participants who identified as being in the contemplation and action stages of change showed the most interest, whereas participants in the maintenance stage of change showed the least. To answer the second question, self-regulatory efficacy negatively influenced interest, whereas proxy-efficacy positively influenced interest. For the final question, participants were most interested in learning skills to manage their energy, and least interested in help reducing anxiety

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towards exercise from a SEPP. This study's findings are important to the growing body of research regarding the best practices to embed long-term commitment to exercise behavior in individuals.

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Having chronic pain and trying to be active: Is resiliency related to differences in adherence-related psychosocial factors and physical activity?

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Adults with chronic pain struggle to participate in physical activity (PA), which is a key non-pharmacological strategy for pain self-management. Identifying individual-level changeable factors that contribute to differences in adherence-related psychosocial variables and PA participation is needed. One such factor may be resiliency, which involves an individual's abilities to adapt well to adversity and sources of stress, including significant health challenges like chronic pain. It may be that more resilient adults with chronic pain report more beneficial levels of adherence-related psychosocial variables and higher PA participation than less resilient individuals. Thus, the study purpose was to investigate differences in adherence-related variables, including pain intensity, depressive symptoms, fatigue, pain acceptance, pain anxiety, self-efficacy to schedule and plan PA, self-efficacy to overcome pain-related barriers, and actual PA among adults with higher and lower resiliency. Participants were 311 adults (Mage = 38.94 +/– 13.02 years) who completed an online survey. A between-groups MANCOVA comparing groups with higher (n = 166) or lower (n = 145) resiliency, after controlling for age and body mass index, was significant (p < .001, partial eta-squared = .32). Follow-up analyses revealed that compared to the lower resiliency group, the higher resiliency group reported significantly: (a) higher self-efficacy to schedule and plan PA and to overcome pain barriers, pain acceptance, and PA participation (p's <= .01, partial eta-squared >= .02); and (b) lower pain intensity, depressive symptoms, fatigue, and pain anxiety (p's <= .03, partial eta-squared >= .02). Study findings are the first to illustrate that adults with chronic pain who are more resilient report a pattern of more beneficial adherence-related psychosocial factors and overall PA participation. If findings are supported in future research, then interventions that foster resiliency may help adults adhere to physical activity and better self-manage their chronic pain.

Differences in pain coping cognitions among adults with chronic non-cancer pain who are inactive, insufficiently active, and sufficiently active

Miranda Cary, Nancy Gyurcsik, University of Saskatchewan

For adults living with chronic pain being active is an effective self-management strategy. Yet, they struggle to meet the public health recommendation of 150+ minutes/week of moderate- vigorous physical activity (MVPA). Not surprisingly, pain is a frequently reported barrier to physical activity. To date, little research has examined whether adults who differ in MVPA levels also differ in modifiable pain coping cognitions. Thus, the study purpose was to investigate whether adults who were sufficiently active (>= 150 MVPA mins/week), insufficiently active (<150 MVPA mins/week), or inactive significantly differed in the pain coping cognitions of: (a) psychological flexibility, which involves people's capacity to be present and adapt to demands, like pain, in order to pursue a valued goal; (b) pain anxiety, which is the anticipation of pain from activity participation; and (c) self-efficacy to cope with pain and related barriers, like stiffness, to being active. Participants were 316 adults who completed an online survey (*M*age = 38.94; *SD* = 13.02). A between-groups MANCOVA comparing sufficiently active ($n = 122$), insufficiently active ($n = 105$), and inactive ($n = 89$) groups on pain coping cognitions, after controlling for body mass index, was significant, ($p < .001$, partial eta-squared = .09). Follow-up analyses revealed that the activity groups significantly differed on all variables (p's < .001, partial eta-squared >= .07-.14). The inactive group reported the poorest pattern of pain coping cognitions, including significantly higher pain anxiety and lower psychological flexibility and self-efficacy, compared to the two MPVA groups (p's < .04). The insufficiently active group reported significantly lower psychological flexibility and self-efficacy compared to the sufficiently active group (p's < .001). Findings illustrated an increasingly helpful pattern of pain coping cognitions among more active individuals. Thus, helping adults learn pain coping cognitive skills may be effective in advancing their MVPA levels, resulting in better pain self-management.

Exploring the relationship between aerobic fitness and activation of the locus-coeruleus

Madison C. Chandler, Amanda L. McGowan, Jan W. Brascamp, Matthew B. Pontifex, Michigan State University

Aerobic fitness has been associated with superior performance on cognitive assessments requiring attentional control; however, the neural mechanisms underlying this relationship have yet to be determined. One such mechanism may be that aerobic fitness serves to modulate the locus-coeruleus norepinephrine system which is involved in regulating alertness and attention. However, at present we have little understanding of the relationship between the physical health attribute of aerobic fitness and activity of the locus-coeruleus brain region. Accordingly, the present investigation examined the association between aerobic fitness and pupillometric assessments of both tonic (i.e., baseline) and phasic (i.e., task-evoked) activation of the locus-coeruleus in response to a flanker task in a sample of college-aged adults (N = 78). In the flanker task, participants were asked to attend to a centrally presented stimulus nested among an array of flanking stimuli and to respond based on response mappings (e.g., press the left button if the middle letter is an M, and the right button if it is an N). Inhibitory control demands were modulated by manipulating the congruency of the flanking stimuli and alternating the stimulus-response mappings. Throughout the behavioral flanker task, participants' tonic and phasic pupillary responses were measured using an EyeTribe infrared eye-tracker. Following completion of the cognitive and pupillometric assessment, a VO_2max test was performed to determine individuals' aerobic fitness percentile. Hierarchical regression analysis controlling for demographic factors revealed that greater aerobic fitness was associated with faster reaction time and superior response accuracy ($p's \leq 0.05$). However, no association with aerobic fitness was observed for either tonic pupil size or phasic pupillary reactivity ($p's \geq 0.7$). These findings suggest that although aerobic fitness is associated with superior performance on an attentionally demanding task, this association is not the result of differential activation of the locus-coeruleus.

Exercise types and white matter microstructure in older adults: A diffusion tensor imaging study

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Higher cardiorespiratory fitness (CRF) levels have been consistently related to measures of better brain health, suggesting that engaging in aerobic exercise (e.g. running, walking) might be an effective approach for enhancing white matter (WM) microstructure of brain across an individual's lifespan. Recent studies have also shown that exercise with higher

motor fitness (i.e., Tai Chi) is associated with improved brain microstructure. Despite the positive associations, however, comparing the differences between running and Tai Chi training in relation to enhanced white matter microstructure, is a less well understood area of research. Therefore, the study examined the differences between exercise types' effects on WM microstructure. Fifty-six healthy adults with experience in running (n = 19, mean age = 59.52), or Tai Chi (n = 20, mean age = 59.60) completed the study. We compared the effects to those with irregular exercise as a control group (n = 17, mean age = 58.18). All participants underwent a cognitive assessment and physical fitness measurements. Fractional anisotropy (FA), an index of WM microstructure, was assessed using diffusion tensor imaging (DTI). We found that adults in the running group had higher FA values in the right superior fronto-occipital fasciculus, compared to those in the Tai Chi group. However, neither the running nor the Tai Chi groups exhibited any significant differences regarding improvements in WM microstructure, as compared to the control group. We concluded that older adults specializing in running training may have enhanced protection of specific brain regions. Future research should consider larger sample sizes in order to further ensure the relationship between exercise types and improved white matter microstructure in older adults.

Psychosocial factors on the upper extremity reintegration into life after hemiparetic stroke: A pilot study

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After a stroke, people encounter impairments, activity limitations and participation restrictions. However, efforts have been focused mostly on reducing impairments. With the consideration of independence and quality of life, activity and participation are relatively important. Previous studies found that chronic stroke survivors still have difficulty in merging the paretic arm into life. Yet, it is essential to be able to use the arm again in a meaningful way. The current evaluation emphasizes impairments and may have ignored the impact of psychosocial changes to upper extremity functions in life. Therefore, the study was to explore the influence of psychosocial factors on activity and participation domains of upper extremity after stroke. Ten people with chronic hemiparetic stroke participated and completed the assessments and questionnaires. The activity and participation domains of upper extremity recovery were assessed by Motor Activity Log (MAL) and Stroke Impact Scale (SIS), respectively. Taiwan Depression Scale (TDS) and Confidence in Arm and Hand Movements (CAHM) were used to indicate the psychological factors. Social Support Questionnaire (SSQ) and Reintegration to Normal Living Index (RNLI) were used to indicate the social factors. The Spearman correlation coefficient was used to examine the relationship between upper extremity recovery and psychosocial factors. The mean age was 57.80±13.88 years old and the mean score of upper extremity Fugl-Meyer Assessment was 47.9±8.27. CAHM (r=0.850, $p = 0.004$) and SSQ (r=0.929, $p < 0.001$) were significantly correlated with MAL. SSQ (r=0.718, $p = 0.029$) and RNLI (r=-0.882, $p = 0.002$) were significantly correlated with SIS [activities during a typical day]. There was no correlation between TDS and MAL or SIS. The confidence in using the upper extremity, social support, and perception of reintegration to normal life may play a critical role in the reintegration of upper extremity into life after stroke. The findings may provide a more comprehensive picture of the meaningful recovery of upper extremity in daily life.

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The influences of physical self-perception and social relationship to intrinsic motivation for physical education

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Physical education is not only a setting for adolescent to construct their physical capability perception, but also provide opportunities emerging their physical capability and social comparing in front peer. The purpose of this study was to examine the connection between physical self perception (physical self concept and social physique anxiety) and motivational process in physical education (PE). Method: 300 female and 275 male physical education students (Mage = 15.58) completed questionnaires measuring physical self concept, social physique anxiety, social relationship (autonomous support from PE teacher, peer accept), psychological need for PE, intrinsic motivation for PE. Results of T-test and MANOVA revealed that male scored significantly higher on physical self concept, peer accept, perceived autonomy need satisfaction, perceived competence need satisfaction and intrinsic motivation than female. Female scored significantly higher on social physique anxiety than male. Structural equation modeling revealed that (a) physical self concept was indirectly related to intrinsic motivation through social relationship and psychological need satisfaction, (b) social relationship was indirectly related to intrinsic motivation through need satisfaction(female: $\chi 2/df = 2.25$, RMSEA = 0.065, NFI= 0.97,GFI= 0.97; male: $\chi 2/df = 2.36$, RMSEA = 0.071, NFI= 0.98,GFI= 0.97). The result support for SDT (self-determination theory) on PE and extend SDT by physical self perception and social relationship for PE. Both personal and social factors impact motivational process in physical education.

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The development and validation of dancer resilience questionnaire

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ABSTRACT The Development and Validation of Dancer Resilience Questionnaire Choi Eun · Chung Ji-Hye · Kim Mi-Sun · Lee Bo-Ram (Sookmyung Women's University)The aim of this study was to review resilience in dancing and develop and validate the Dancer Resilience Questionnaire (DRQ) for Korean dancers. In order to develop the questionnaire for dancers, the resilience theory and research in the field were reviewed. With the qualitative process, preliminary questions were created. A total of 118 items was constructed and eighty one items were selected under nine sub-domains of resilience in dancing, which are emotional control, impulse control, causal analysis, interpersonal relation ability, empathy, communication skills, self-extendibility, self-optimism, thanks, and life satisfaction. By the explorative factor analysis with 200 high-school and professional dancers, we found 27 items on 6 factors for DRQ, which are casual analysis, empathy, life satisfaction, self-extendibility, thanks, and communication skill. In addition to the exploration approach, we verified the structural validity of DRQ with a sample of 467 of high-school and professional by confirmatory factor analysis. The predictive validity was also tested and showed the sufficient level of relationship with self-management and sport motivation scales. In conclusion, DRQ was developed as a valid test for measuring the resilience of Korean dancer. This study showed that DRQ can be used to evaluate the resilience in dancing. Finally, the study discussed the necessity to develop an education program for enhancing resilience in dancing and follow-up theoretical studies to improve the resilience in dancing.

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Perceived coaching behaviors and athlete burnout: The mediating effects of team communication and the coach-athlete relationship

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The study aims were (a) to investigate the relationships between perceived coaching behaviors and athlete burnout, and (b) to examine the mediation effects of team communication and the coach-athlete relationship on the relationships between coaching behaviors and athlete burnout. The conceptual model of this study assumed that perceived coaching behaviors (i.e., autonomy-supportive and controlling coaching behaviors) would affect team communication, and these would, in turn, affect athlete burnout through the mediation of the coach-athlete relationship. Three hundred forty seven Korean active collegiate athletes from 10 sports participated in the study (Mage = 21.63 yrs, SD = 1.43, and Mexp = 9.45 yrs, SD = 2.42). The participants completed six questionnaires: a demographic questionnaire, Athlete Burnout Questionnaire, Coach-Athlete Relationship Questionnaire, Scale of Effective Communication in Team Sports, Controlling Coach Behaviors Scale, and short version of the Sport Climate Questionnaire. The results of the final model indicated that autonomy-supportive coaching was positively related to team communication (.48), whereas controlling coaching were negatively related to team communication (-.13). Team communication was negatively related to athlete burnout (.14). Autonomy-supportive coaching was significantly related to both the coach-athlete relationship and athlete burnout (.76 and -.21, respectively), whereas controlling coaching was only related to athlete burnout (.38). Significant indirect effects were observed. The bootstrapping results indicated that the relationship between autonomy-supportive and athlete burnout was mediated by team communication and the coach-athlete relationship. The findings of this study contribute to the current understanding of the relationships between perceived coaching behaviors and athlete burnout and shed light on the important roles of team communication and the coach-athlete relationship on the relationship.

The relationship between intrinsic and extrinsic religion and competitive anxiety

Amanda Clark, Leilani Madrigal, Alison Ede, Tiffanye Vargas, California State University Long Beach

Athletes are constantly exposed to pressure to perform during competition which may be a problem to those who perceive competition as a threat or athletes that struggle with confidence. These athletes often experience anxiety as they doubt their ability to rise to the challenge (Cao, Price, &Stone, 2011). In these tough situations athletes may often turn to religion to cope. Religion can be separated into two orientations, extrinsic and intrinsic orientation. Intrinsically religious individuals live out their religion seeking ways in which they can honor their belief. Extrinsically religious individuals use religion only to accomplish their own needs such as protection and comfort. The goal of the study is to determine if there is a negative relationship between religiosity and anxiety as well as determine if there is a difference in competitive anxiety (i.e., somatic and cognitive anxiety) among intrinsically religious and extrinsically religious individuals. We also looked at what types of coping methods athletes used in order to manage their anxiety. A total of 84 Christian or Catholic identified collegiate athletes from three teams (i.e., football, basketball, softball) completed a survey one week prior to their upcoming competition that included a demographic questionnaire, the Age- Universal I-E Scale 12, and the Revised Competitive Anxiety Inventory-2. Results indicated that there was no significant relationship between religion and competitive anxiety but there was a significant relationship between intrinsic religiosity and confidence $r = .261$, $p < .02$. There was no significant difference between intrinsic and extrinsic religiosity on somatic anxiety, cognitive anxiety, or confidence, $p > .05$. Qualitative analysis showed that athletes reported using prayer, music, imagery, positive self-talk, breathing, distraction and socialization to cope with their anxiety. Future research should consider how religiosity may influence confidence in sport as well as what type of coping methods are related to increased confidence.

How can academic and community partners support healthy eating and physical activity programs in childcare and early-learning centers?

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There are national recommendations for children's physical activity (PA) and nutrition practices, such as consuming five or more servings of fruits and vegetables, and engaging in an hour of PA per day (CDC, 2017). Only 24% of Indiana youth achieve the recommended amount of PA, and nearly 45% of Indiana youth report consuming fruits and vegetables less than once per day (CDC, 2017). School-communities are partnering with state and local organizations to increase opportunities for children to regularly engage in these practices (CDC, 2017). This study is the first phase of a community-based participatory research (Israel et al., 1998) project with Partnership for a Healthy Hamilton County coalition. Our goal was to identify how to work with childcare and early-learning centers to promote children's engagement in healthy eating and PA practices. To inform the roles of academic and community partners, the research purpose was to explore how to support childcare and early-learning centers' healthy eating and PA programs and partnerships. Drawing upon interpretive description methodologies (Thorne, 2008), 13 Indiana childcare providers (e.g., directors, kitchen staff) participated in one-on-one interviews. The thematic analysis revealed three areas for support. Academic and community partners can support programs by *Developing or Acquiring Resources for Centers* like examples of classroom PA-delivery, and funding sources. Partners can also contribute by *Providing Program Planning Services and Resources*, such as co-developing PA programs with teachers, and budgeting and meal-planning with kitchen staff over time. To support programs by *Creating Networking Opportunities,* partners can initiate idea-sharing events and mentor-mentee programs between centers. These findings will inform the development of center, and academic and community partnerships that will ultimately facilitate opportunities to promote children's healthy eating and PA practices. The practicality of the findings within our context, and recommendations for other partnerships will be discussed.

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Testing the processes by which yoga may support physical activity motivation

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It is critical to identify factors that effectively foster the autonomous motivation that is needed to sustain long-term physical activity behavior. Yoga is a powerful mind-body exercise shown to foster significant improvements in a number of variables that support autonomous motivation for physical activity, including physical self-perceptions, internal reasons for exercise and mindfulness. Based on self-determination theory (SDT), the experience of state mindfulness is proposed to be a mechanism

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that fosters autonomous motivation though the support of psychological needs. Therefore, the purpose of this study was to test the mechanisms by which yoga supports physical activity motivation. The mediating role of psychological needs (i.e., perceived competence and autonomy) in the relationship between state mindfulness and physical activity motivation was tested using latent growth curve analysis. Participants in credit-based 16-week yoga classes ($N = 121$, 89% female, Mage = 20.3, $SD = 2.4$) completed measures of motivation-related variables at the beginning and end of the 16 weeks and completed state mindfulness assessments immediately following class every two weeks across the semester. Model fit was good (RMSEA = .04, CFI = .97). The intercept of mindfulness significantly predicted psychological needs ($B = .46$, $p < .01$) but the slope did not. Psychological needs predicted autonomous motivation ($B = .60$, $p < .01$) controlling for baseline autonomous motivation. 48% of the variance in psychological needs was explained and 67% of the variance in autonomous motivation was explained. The results of this study provide preliminary empirical evidence of the processes that explain the relationship between yoga and physical activity motivation. Such information is critical for determining the utility of moving forward in the development of yoga intervention protocols that are aimed at supporting physical activity behavior.

The effect of brain synchronization training on golf putting performance

Debra Crews, Paul Karoly, Arizona State University

Neurofeedback training is increasingly more popular in sport. The purpose of this study was to test whether increasing or decreasing brain synchronization (whole brain coherence) prior to motion influences golf putting performance. Researchers (Babaloni, et al., 2011; Harung, 2012; Harung, & Travis, 2012) have shown that EEG coherence (two EEG locations) improves sport performance; however, whole brain coherence (more than two locations) has not been tested. Volunteer golfers (males =12, females = 9; age = 36.19+18.68 years; handicap = 6.45+7.43) completed 10, 12 foot putts before and after neurofeedback training (15 trials) with either correct feedback (increasing synchronization) or incorrect (decreasing synchronization) feedback. The order was randomly assigned. A competition condition followed, in which golfers attempted to equal or increase putts made from their baseline putting. All golfers completed one more training with correct feedback (15 trials), plus 1 minute of cycling to increase heart rate before competition. Brain measures and neurofeedback training was administered using a modified Emotiv 14 sensor headset and a patented algorithm combining 8 sensors at once to train whole brain coherence (audio feedback). Results indicated that the order in which golfers received feedback influenced performance. Correct feedback first showed significant increases in putts made from the baseline to competition, 33.71 + 24.94 to 38.86 + 18.73, $F(1,19) = 5.96$, $p = .025$., but not for incorrect feedback first golfers. The EEG data indicating the level of synchronization for the correct vs. incorrect feedback first also showed significant differences from the baseline to competition, $F(1,19) = 4.50$, $p = .047$. A moderate level of increasing synchronization was best for golf putting performance. Future research might tease out skill level effects and possibly reduce the number of locations in the brain for successful neurofeedback training.

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Step up: Exploring the effectiveness of social norm prompts on stair use in a university setting

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Point-of-decision prompts (PODP) are effective health promotion tools used to increase stair use (Bauman et al., 2016). However, majority of these prompts motivate individuals to take the stairs by focusing on personal reasons associated with stair use, such as health or calorie expenditure. Another factor that has gained increased attention in the physical activity literature are social norms. According to focus theory (Cialdini et al., 1990), norms refer to two different types of social information: one refers to what is typical and normal within the group (descriptive norm) while the other refers to what is perceived to be desirable behavior (injunctive norm). While research has shown descriptive norm-focused PODP to decrease elevator use (Burger & Shelton, 2011), no research has compared the effectiveness of social norms-focused messages versus the traditional health-focused prompts on stair use. As such, the purpose of this study was to explore the impact of social norm-focused prompts on stair use when compared to health-focused prompts. Stair and elevator use were measured at baseline (no prompt posted) and post-intervention (1 week post-installation of prompts) to determine change in the proportion of individuals entering the stairs. A total of 8,007 counts were recorded over 4-weeks, with 1851 counts of individuals entering the stairwell, and 6,156 counts of individuals entering the elevators. Chi-square analyses revealed that the social norm-focused prompts increased the proportion of individuals entering the stairwell by 3.13%, chi^2 (1, N = 4215) = 5.82, $p < .05$, 95%CI [0.565-5.70]), whereas the health prompt did not significantly increase the proportion of individuals entering the stairwell (+0.5%), chi^2 (1, N = 3794) = 0.17, $p > .05$, 95% CI[-2.17-3.33]). Results provide preliminary evidence that social norms-focused prompts may be a beneficial health promotion tool to increase stair use in a university building.

Funding source: School of Health Sciences, University of South Australia; Sansom Institute for Health Research.

Exploring the relationship between athletes' self-compassion and perceptions of their teammates' self-compassion

Alyson J. Crozier, University of South Australia, Australia; Amber D. Mosewich, University of Alberta; Leah J. Ferguson, University of Saskatchewan

Self-compassion reflects an individual's attitude of kindness and understanding toward oneself, and has historically been conceptualized as an internal experience (Neff, 2003). Despite this, recent qualitative research has indicated that one way women athletes learn how to be self-compassionate is by observing their teammates' behaviors when they experienced similar adversities in sport (Ingstrup et al., 2017). In a similar vein, it may be that athletes' perceptions of how often teammates are self-compassionate may influence their own self-compassion. This perception of others' behavior is termed the descriptive norm (Cialdini et al., 1990). While some research has shown descriptive norm perceptions to be related to athlete effort (Spink et al., 2013), no research has examined the relationship between descriptive norms and athlete self-compassion. In addition, the majority of sport research on self-compassion has focused on women athletes, and the role of self-compassion among men athletes is unclear. As such, the purpose of the current study was two-fold: (1) to explore the relationship between athletes' self-compassion and perceptions of their teammates' self-compassion (descriptive norm), and (2) to examine whether gender moderated this relationship. Team sport competitive athletes ($N = 116$; age: M = 22.9 years; SD = 4.61) completed an online survey assessing their descriptive norm perceptions and self-compassion. Hierarchical regression analyses indicated a positive relationship [$F(2,113) = 16.52$, $p < .01$], with descriptive norms explaining 24% of the variance in self-compassion. The more it was perceived that teammates were engaging in self-compassion, the more likely athletes reported also being self-compassionate ($\beta = .60$). There were no significant main or interaction effects of gender ($ps > .05$), suggesting that the relationship is similar for men and women athletes. Coaches and sport psychologists should encourage men and women athletes to be more

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self-compassionate, with group-level interventions a potential avenue for future research.

Parent conditional regard and the development of perfectionism in adolescent athletes: The mediating role of competence contingent self-worth

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Despite evidence highlighting the debilitating nature of perfectionism in sport, very few studies have examined how it develops. In explaining the development of perfectionism, theorists emphasize controlling parental practices in family contexts replete with conditional regard. This study, then, tested the role of parent conditional regard in the development of perfectionistic strivings and perfectionistic concerns among adolescent athletes. It also tested the mediating role of competence contingent self-worth in these associations. One hundred and forty eight (Mage = 15.12 years, SD = 1.64) adolescent athletes competing at regional level or above in their primary sport completed measures of multidimensional perfectionism, competence contingent self-worth, and parent conditional regard. Structural equation modelling showed that perfectionistic strivings and perfectionistic concerns were positively predicted by parental conditional regard. Furthermore, competence contingent self-worth mediated both relationships. The findings are the first to suggest conditional regard from parents is important in the development of perfectionism among adolescent athletes because these behaviors contribute to contingencies of self-worth that are based on the demonstration of competence.

Examining associations between affective states and physiological responses before, during, and after competitive cycling time trials

Paul Anthony Davis, Andreas Stenling, Umeå University, Sweden

Sport is an emotional performance domain where athletes' affective states can vary dramatically before, during, and after competition. Further, intense emotions are associated with physiological changes that may amplify biological responses manifested from the execution of physical tasks underlying performance. Fluctuations in perceptual cues (e.g., affective states, perceived exertion) and physiological responses (e.g., blood lactate, heart rate) can influence performance and vary dramatically in relation to competition. However, the pattern of these fluctuations and potential associations between perceptual cues and biological responses may also diverge during task execution with differential implications for performance. Data collected from highly trained athletes (N = 25; Mage = 25.4) during a competition (i.e., maximum total distance) comprised of three 7-minute cycling time trials, were analysed with longitudinal multilevel modelling. Results showed that affective states were negatively associated with perceived exertion at the within-person level and negatively associated with heart rate at the between-person level within each trial. Blood lactate and heart rate were positively associated at the between-person level, whereas heart rate was positively associated with perceived exertion at the within-person level. The anticipation of more pleasurable affective states predicted less decline in affective states, but not physiological responses, during each trial. Anticipated affective states prior to each trial were also associated with affective states upon its completion. These findings suggest associations among perceptual cues and physiological responses may differ depending on the level of analysis (between- vs. within-person level associations), and anticipated affective states prior to performance may influence affective states during and after task execution. Future research may attempt to manipulate anticipated affective states (e.g., via previous performance feedback) to gauge if athletes' affective states during and after competition can be augmented.

Funding source: Idrottshögskolan Umeå University.

The impact of partner performance on emotions in doubles racquet sports

Sarah Deck, The University of Western Ontario; Craig Hall, The University of Western Ontario; Philip M. Wilson, Brock University

Athletes report experiencing a number of emotions during competition, such as, joy, serenity, relief, hope, disappointment and pride (Martinent & Ferrand, 2015). Different athlete's may experience different emotions, based on one's appraisal of the situation or environment (Lazarus, 1991; 2000). To date, this line or research has received limited research attention in sport dyads. The purpose of this study was to understand the role of a partner's play on the emotion of athletes in doubles racquet sports (i.e., tennis, badminton, and squash). Using a post-test only, randomized experimental design (Trochim, 2006), data was collected from participants (N = 103) on a single occasion. A Multivariate Analysis of Variance, as well as follow-up Analyses of Variance revealed significant differences between groups in subjective emotions based on whether their partner was playing poorly, their partner was playing well, or whether their partner was perceived as playing their normal game (control group). The results showed that athletes scored higher in anger and anxiety when their partner is playing poorly, and when their partner is playing well athletes had higher scores in happiness and excitement. Overall, these findings imply that athlete's emotions may change based on how their partner is playing. These results provide a foundation to look at emotional reactions (action tendencies) and coping in this specific population.

Social perceptions, sport-specific coping, and burnout in American collegiate club athletes

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Athlete burnout, as characterized by emotional and physical exhaustion, reduced accomplishment, and sport devaluation (Raedeke, 1997), represents an important psychosocial health outcome for athletes. Social perceptions, both positive and negative, are important temporal contributors to athlete burnout (e.g., DeFreese & Smith, 2014), with coping efforts having potential to moderate their impact (Raedeke & Smith, 2004; Schellenberg et al., 2013). To better understand these associations over time, the purpose of this study was to examine sport-specific coping (e.g., overcoming competitive adversity) as a potential moderator of the relationship between social perception variables and burnout utilizing a 6-week longitudinal design. It was hypothesized that, after controlling for perceived stress, coping over a season would exacerbate and buffer the temporal social support–burnout and negative social interactions-burnout relationships, respectively. American collegiate club sport athletes (n = 61; M_{age} = 19.4 years, 31 males, 30 females) were tracked over six weeks of active practice. Participants completed valid and reliable psychometric assessments of study variables at baseline, two-, four-, and six-week follow-ups. Multilevel linear modeling yielded significant between-athlete variation in the coping-burnout relationship over time (random effect = 0.04, $p < .05$). Stress (fixed effect = 0.25, $p < .001$) and coping (fixed effect = -0.63, $p < .01$) were significantly associated with burnout over the season. Negative social interactions-coping moderation was also supported (fixed effect = 0.17, $p < .01$), such that as higher levels of coping were endorsed, the positive negative social interactions-burnout relationship was buffered. This study showcases the importance of sport-specific coping efforts across the competitive season to athlete burnout perceptions and their complex interplay with athlete social

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perceptions. Results provide support for the potential utility of addressing coping skills in interventions aimed at reducing burnout in sport settings.

Training histories and developmental trajectories of Australian para table tennis athletes

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A recent systematic review highlights the distinct gap in the literature pertaining to Para sport athletes' development and expertise (Dehghansai et al., 2017). A clear understanding of athletes' training and sporting history is important for optimizing their development and performance environments. The objective of this study was to extend our understanding of Para sport athletes. Sixteen (13 male) Australian Para Table Tennis athletes (13 male; age 28.44 ± 7.31 years; experience 13.44 ± 9.40 years) completed the Developmental History of Athletes Questionnaire (DHAQ), a comprehensive questionnaire containing sections pertaining to athletes' demographics, sporting career, milestones, training history, and family background (Hopwood, 2013). In addition, this questionnaire, originally created for able-bodied sport, was modified for Para sport athletes by adding two sections: impairment information, and barriers and facilitators. Six athletes had an acquired impairment with a wide variance in age of injury onset (average 12.53±10.76 years). Preliminary data suggest the most common method of introduction to the sport was through rehabilitation centers/physicians, and most athletes started participating for fun and enjoyment but remained due to a sense of accomplishment and the competitive environment. Common initial and persistent barriers were dependence on others (i.e., transportation) and high expenses associated with the sport (e.g. equipment, competition). While there were general trends evident in athletes' developmental trajectories and training histories, a significant amount of variability between athletes existed. Athletes invested the majority of their training hours in coach-led, sport-specific training environments (59% of total training hours) but free-play/unstructured activities had the highest correlation with number of medals attained across athletes' careers (r=.60). The findings from this project may enhance current systems, inform coaches and key shareholders, and shape environments to maximize Para sport athletes' development and performance.

Funding source: Australian Paralympic Committee.

Child affective and working memory responses to social exclusion differ by aerobic fitness level

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A natural feature of childhood is social exclusion — the process where a person is put into a condition of being alone or is denied social contact (Blackhart et al., 2009). Being excluded is particularly challenging for young people because of their developing self-regulation and coping skills. Transient responses to social exclusion can include maladaptive changes to affect and working memory (Hawes et al., 2012; Sebastian et al., 2010). Because not all children demonstrate such maladaptive responses, there is value in exploring individual characteristics that may differentiate responses. Aerobic fitness is positively linked to self-regulatory processes that may assist in coping with social exclusion. Accordingly, the purpose of this study was to determine if aerobic fitness moderates affective and working memory responses to social exclusion. Healthy girls (N = 35, 10.4 +/− 1.2 years) completed measures of affect and working memory performance after respectively being included and then excluded by a computer game. Participants then completed an aerobic fitness assessment on a motor-driven treadmill to measure VO2 max (40.8 +/− 7.0 ml/kg/min). Results showed social exclusion significantly decreased pleasant affect, d = -1.0, 95% CI [-1.5, -0.5]; however, working memory performance increased from inclusion to exclusion, d = 0.6, 95% CI [.30, .90]. Moderation analyses showed greater aerobic fitness to be associated with smaller decreases in pleasant affect, beta = .40, 95% CI [.22, .58], and larger increases in working memory performance for the more challenging of two working memory tasks, beta = .37, 95% CI [.08, .61]. Results suggest that responses to social exclusion are less pronounced for girls with higher aerobic fitness levels. Collectively, findings suggest higher aerobically fit girls may better regulate the demands of social exclusion than lower aerobically fit girls. This research more broadly extends understanding of how aerobic fitness may benefit the well-being of children.

Work-related stressors, health, and psychological well-being among sports coaches

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Background and aims: Sports coaching offers a unique context for research on work-related stress, partly because of the volatile and results driven nature of this profession. Given the positive and negative outcomes of good and poor psychological well-being (PWB) respectively, researchers have called for research on coaches' PWB. However, limited research exists in this area and work with women coaches is particularly sparse. With the lack of validated measures to assess work-related stress among coaches also in mind, this study aimed to assess the factor structure of An Organizational Stress Screening Tool (ASSET; Cartwright & Cooper, 2002) with a sample of women coaches. Further, we aimed to examine the work-related stressors that coaches experience and how these stressors relate to their health, PWB, engagement, and organizational commitment. Methods: Following ethical approval, an online version of ASSET was distributed to 217 coaches (Mage=36.69, SD=11.99 years; Mexperience=9.21, SD=6.36 years). The data were analyzed using exploratory factor analyses (EFA), Cronbach's alphas, multiple regressions, and structural equation modelling (SEM). Results: EFA revealed a four-factor structure of work-related stressors (isolation, work-life balance, job security, workload). Multiple regressions highlighted that work-related stressors depend on coaches' contractual status and coaching role. SEM demonstrated that isolation at work was the only stressor to predict PWB; that work-life balance, workload, and job security predicted health strain; and that PWB predicted commitment. Despite experiencing many stressors, the coaches were engaged with their roles. Conclusions: The findings offer the first assessment of women coaches' work-related stressors in relation to factors that may determine their health, PWB, engagement, and commitment. The findings can be used to optimize coaches' experiences and maximize health and PWB. Federations should create opportunities for coaches to develop meaningful work relationships and, thus, minimize isolation.

Funding source: Leeds Beckett University.

Self-determination theory and physical activity in Chinese adolescents

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Recent studies have well documented exercise motivation from the perspective of self-determination theory (e.g., Teixeira, et al., 2012). However, few research applied self-determination theory (SDT) for

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exercise participation of adolescents, especially in Chinese population. The present study was to investigate the relationship between SDT and physical activity among Chinese adolescents. Specifically, structural equation modeling was employed to test a hypothesized model for the adolescents' physical activity, based on SDT including variables from perceived autonomy support for exercise settings, goal content for exercise, exercise causality orientations, psychological need satisfaction in exercise, and behavioral regulation in exercise. 519 participants (Age: M=15.49, SD=2.15) from secondary schools in a urban setting of China voluntarily completed five SDT-related questionnaires (PASSES, GCEQ, ECOS, PNSE, & BREQ-2) and Physical Activity Rating Scale-3 (PARS-3). PARS-3 is a self-reported questionnaire for intensity, time, and frequency of physical activity. After data collections, structural equation modeling software (AMOS 17.0) was used to analyze the hypothesized model. The results demonstrated a good fit to the model [$\chi 2$=796.78, df =308, p = .00, TLI=.93, IFI=.94, CFI=.94, NFI=.91, RMSEA=.06]. The findings indicated that autonomy support perceived from exercise environment, intrinsic goal for exercise, and autonomy orientation of exercise enhanced the participants' satisfaction of the basic psychological needs (autonomy, competence, & relatedness). In turn, the satisfaction of these psychological needs positively predicted autonomous motivation towards physical activity of Chinese adolescents. In summary, the results of the present study provided the first evidences for SDT and its application to physical activity in Chinese adolescents.

Perceptions of youth sport specialization: Content analysis across differing patterns of participation

Justin DiSanti, Michigan State University; Emily Wright, Michigan State University; Melissa Chase, Miami University; Karl Erickson, Michigan State University

Youth sport specialization has garnered significant attention in both the academic and popular domains due to the developmental nature of this phenomenon, the increasingly professionalized climate of youth sport, and empirical findings linking early specialization to a range of negative outcomes (Horn, 2015; Vealey & Chase, 2015). Despite this potential for adverse developmental impact, early specialization has persisted in recent years (Bell et al., 2016), leaving a large degree of uncertainty regarding the gap between expert recommendations (i.e., Côté, Lidor, & Hackfort, 2009) and sport participation practices. Using the Developmental Model of Sport Participation (DMSP, i.e., Côté, 1999) as a conceptual framework, 948 undergraduate participants who were former athletes completed a measure which detailed their sport history from early adolescence through early adulthood. Based on whether they specialized or played multiple sports during each age-based stage of the DMSP, participants were sorted into three participation pathways – Early Specializers (single sport prior to middle school and continued specializing through high school), DMSP-Elite (multiple sport participation prior to high school, then narrowing to single sport), and DMSP-Recreational (continued multiple sport participation through high school). Participants responded to open-ended questions detailing their decision-making process for choosing one or multiple sports for each stage of their participation. Results from analyzing these responses indicate that youth athletes' perceptions of their ability, affect associated with their participation, and agency to make their own decisions are emergent themes which influence the selected pathway and differentiate positive from negative developmental experiences. This study provided critical insight regarding when and why youth athletes choose to specialize, how their selected participation pattern may impact their holistic development, and illuminated multiple promising avenues for practical application and further research.

The relationship between state self-esteem and self-compassion over time

Urska Dobersek, University of Southern Indiana; Abbey Huffine, University of Southern Indiana; Mindy Mayol, University of Indianapolis; Lee Everett, University of Indianapolis

This study examined seasonal changes in state self-esteem (SSE) and self-compassion (SC) among student-athletes (SA). Two hundred and five SA (nmales = 147, nfemales = 58) between 18 and 23 years of age (M = 19.33, SD = 1.13) from eight NCAA division II teams completed a demographic questionnaire, the State Self-Esteem Scale, and the Self-Compassion Scale during the in-season, pre-season, and off-season. A 2 (State Self-Esteem: high, low) x 3 (Time: pre-, in-, off-season) mixed Analysis of Variance (ANOVA) suggested a statistically significant interaction between SSE and time on SC, F (2, 406) = 6.568, p = .002, partial eta squared = .031. The analysis of simple effects suggested that SA with low SSE scored lower on SC during the pre-season (M = 2.89, SD = 0.49) compared to the off-season (M = 3.07, SD = 0.51), p < .003. Additionally, SA with low SSE scored lower on SC during the in-season (M = 2.93, SD = 0.50) compared to the off-season (M = 3.07, SD = 0.51), p < .08. The main effect for SSE was significant suggesting that SA with high SSE (M = 3.55, SD = 0.54) scored higher on SC compared to SA with low SSE (M = 2.97, SD = 0.49), F(1, 203) = 93.46, p < .01. Social support (e.g., teammates) positively affect SC (Jeon, Lee, & Kwon, 2016), which could contribute to increased SC levels among SA with low SSE over time. However, these differences were not significant among SA with high SSE. The finding that SA with high SSE scored higher on SC compared to SA with low SSE supports the previous research (Neff, Pisitsungkagarn, & Hseih, 2008). The results of the current study could benefit coaches and mental performance consultants by increasing SC early in the season for optimal performance.

Funding source: InQuery Grant, University of Indianapolis.

Self-compassion between high and low performers among NCAA division student-athletes

Urska Dobersek, University of Southern Indiana; Abbey Huffine, University of Southern Indiana; Mindy Mayol, University of Indianapolis; Lee Everett, University of Indianapolis

Self-compassion has a strong positive impact on psychological health, including life satisfaction, optimism, positive affect, motivation, mastery goals, and perceived competence (Breines & Chen, 2012; Neff, 2009), which, in turn, can contribute to optimal performance. The purpose of the present study was to investigate self-compassion (SC) between high and low performers over time. Two hundred and ten student-athletes (nmales = 153, nfemales = 57) between 18 and 23 years of age (M = 19.33, SD = 1.13) from eight NCAA division II sports completed a demographic questionnaire and the Self-Compassion Scale – Short Form (Raes, Pommier, Neff, & Van Gucht, 2011). The objective athletic performance was determined by the percentage of wins and losses based on their total number of conference games during the season. A 2 (Performance: high, low) x 3 (Time: pre-, in-, off-season) mixed ANOVA suggested a statistically significant interaction between performance and time on self-kindness, F(2, 416) = 3.046, p = .049, partial eta squared = .014. The analysis of simple effects demonstrated that high performers scored higher on self-kindness subscale during the in-season (M = 3.33, SD = 0.81) compared to the off-season (M = 3.05, SD = 0.77), p = .007. High and low performers did not significantly differ on the overall SC scores and other SC subscales across time. The findings of this study suggest that high performing athletes are warmer and more understanding towards themselves (especially when feeling inadequate, fail, or suffer) during the in-season, compared to the off-season, recognizing that being imperfect and experiencing failures is part of the game.

The results of this study could benefit coaches and mental performance consultants by promoting acceptance and self-kindness to increase athletes' emotional equanimity.

Funding source: InQuery Grant, University of Indianapolis.

A citation network analysis of research on the parent-child relationship in organized youth sport

Travis Dorsch, Matthew Vierimaa, Juliana Plucinik, Utah State University

The review and synthesis of research is an important step in situating a field of knowledge. One under-utilized methodology to address the prominence, configuration, and interconnectedness of empirical research is citation network analysis (Hummon & Doreian, 1989). Citation network analysis is a systematic technique, which affords the synthesis of scholarship in a well-defined content area. In an effort to uncover the structure of citation practices within the sport parenting literature, this systematic review was designed to synthesize research in this area using citation network analysis. Multiple databases were searched using a combination of the following keywords: families, children, adolescents, athletes, parents, fathers, mothers, and sport. A three-step filtering approach (see Jones, 2004; Meade & Richrdson, 1997) was employed to consolidate the article population. This process yielded a final sample of 192 peer-reviewed publications across 73 peer-reviewed outlets since 1968. Descriptive analyses of the sample highlighted a steady increase in publication frequency over the past five decades, with the vast majority of research having been conducted in the US, UK, Canada, and Australia. Athletes participating across 40 unique sports were the focus of these studies, with most targeting athletes aged 11 to 15 and their parents. Nearly 6 in 10 studies employed quantitative methodologies, with the greatest proportion of qualitative work occurring over the past decade. UCI Net and Pajek software were used to identify the most prominent (i.e., widely cited) articles, cohesive subgroups of closely linked articles, and a genealogy of the most influential articles in the sport parenting literature. The use of citation network analysis in the present study was helpful in identifying the most prominent research articles, and in establishing how these articles are interconnected within the cited research. It also proved useful in identifying knowledge gaps in the sport parenting literature, thus highlighting potentially fruitful paths for future empirical research.

Funding source: None.

Trait mindfulness as a moderator of green exercise and attention restoration

Ford Dyke, Jence Rhoads, Tristan Hall, Matthew Miller, Auburn University

Attention Restoration Theory (ART) has been proposed as a potential approach to facilitate recovery from directed attention fatigue (DAF). The theory postulates directed attention is likely to replenish if permitted to 'rest'. One-way to allow directed attention to rest is to promote the use of involuntary attention. Previous research suggests viewing images of natural environments captures involuntary attention while simultaneously limiting the need for directed attention. However, in our failed attempt to replicate findings of previous research, along with shortcomings found within previous research, there remains uncertainty regarding the efficacy of an ART-based intervention. For example, ART-based interventions may be bound by certain conditions. Therefore, the purpose of this research was to investigate potential inter-individual factors that may moderate the relationship between greenspace and directed attention restoration. Specifically, research aimed to investigate the boundary condition of trait mindfulness in relation to the effects of walking while exposed to restorative stimuli (i.e., 'green exercise'). The study examined whether trait mindfulness moderates the relationship between a 10-min bout of green exercise and attentional restoration from DAF. Results suggest that green exercise is inadequate for low or high trait mindful individuals' directed attention restoration or superior attentional capacity and cognitive control. Data suggest that ART is questionable, even when considered within a theoretically-driven boundary condition.

Funding source: n/a.

An assessment of sport officials' perceptions of group cohesion

Rayme Ehle, Indiana University Kokomo; David J. Hancock, Indiana University Kokomo; Kyle F. Paradis, Western University; M. Blair Evans, Pennsylvania State University; Luc J. Martin, Queen's University

Hancock et al. (2017) established that sport officials identify as operating in a team and being members of a group. Group membership was described through examples of the characteristics required for group classification (self-categorization, common fate, mutual benefits, social structure, and quality interactions; Carron & Eys, 2012). Despite demonstrating unique characteristics (i.e., transience/intra-team competition) not typically discussed in sport group dynamics research, the generalizability of group processes across group contexts (Forsyth, 2014) suggests certain constructs (e.g., cohesion) to be critical for officials' individual and group performances. To support further qualitative research on officiating groups, we conducted a descriptive study of officials' responses to a modified cohesion measure and relationships between officiating group cohesion and key demographic constructs. Officials ($N = 106$; $M_{age} =$ 46.3 years; $M_{experience} = 20.4$ years) completed an online, modified Group Environment Questionnaire comprised of four subscales: Attraction to the Group-Task (ATG-T), Attraction to the Group-Social (ATG-S), Group Integration-Task (GI-T), and Group Integration-Social (GI-S). Officials represented basketball ($n = 62$), football ($n = 42$), baseball ($n = 1$), and volleyball ($n = 1$). A series of paired *t*-tests compared responses on the four subscales, demonstrating the following significant differences ($p <$ .05): ATG-T > ATG-S; ATG-T > GI-S; GI-T > ATG-S; GI-T > GI-S). When comparing officiating leaders with non-leaders, independent *t*-tests showed that leaders scored higher on all subscales, although results were not statistically significant. Finally, in relation to sport type, independent *t*-tests demonstrated that football officials scored higher than basketball officials on all subscales, though only ATG-S and GI-S reached statistical significance ($p < .05$). We discuss why officials differed with regard to task and social orientations for cohesion, the link between leadership roles and valuing cohesion, and directions for future research.

Acute aerobic exercise improves emotion regulation: Evidence from the late positive potential

Peter Ehmann, Christopher Brush, Anthony Bocchine, Brandon Alderman, Rutgers University

The event-related potential (ERP) technique has the potential to advance our understanding of neurobiological mechanisms that mediate improved emotion regulation (ER) following exercise. Specifically, the late positive potential (LPP) ERP component is a neural marker of ER that reflects increased attention towards and enhanced processing of emotional content. Reductions in LPP amplitude to aversive stimuli have been observed following ER strategies (e.g., reappraisal), but has not been assessed following exercise. In a within-subjects design, 56 young adults completed a 30-min bout of aerobic exercise or seated rest prior to passively viewing 126 emotional images (42 pleasant, 42 unpleasant, 42 neutral in random order) while electroencephalography (EEG) was recorded. Self-reported valence and arousal measures were recorded pre- and post-condition using the Feeling Scale (FS) and Felt Arousal Scale (FAS). The LPP was quantified as the mean amplitude during 3 time windows following

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stimulus onset (400-700 ms, 700-1000 ms, 1000-1600 ms) to examine intensity and time course of ER. Replicating previous work, valence, $F(1,55) = 5.9$, $p < 0.05$, and arousal, $F(1,55) = 16.2$, $p < 0.05$, increased following exercise relative to seated rest. Consistent with the ERP literature, pleasant and unpleasant images evoked larger LPP amplitudes relative to the neutral images across all time windows and both conditions (all Fs > 28.8, ps < 0.05). In the early time window, a significant Condition x Image Type interaction emerged, $F(1,55) = 5.7$, $p < 0.05$, revealing a significantly reduced LPP amplitude to unpleasant images following exercise (3.5 uV) compared to seated rest (5.0 uV). No significant main effects or interactions emerged for pleasant images. These findings suggest that acute exercise may be an effective ER strategy that downregulates initial reactivity to negative stimuli, as indicated by a reduced LPP amplitude. Future research should examine how physical activity behavior relates to ER, as well as potential moderators (e.g., dose-response) of the relationship.

'Gaelic4girls' for increased physical activity participation - A multi-component, pilot intervention: Study design and protocol

Orlagh Farmer, Wesley O' Brien, University College Cork, Ireland

Background:Recent research demonstrates that girls are less active than boys, and physical activity (PA) interventions targeting this population remain limited. Multi-component sports-based interventions have the potential to increase PA participation levels, basic motor skills, and psychosocial well-being. Few interventions, however, have been conducted for young girls in community sports-based environments, specifically in Ireland. The study aims to report the theory-based design protocol, and assess the effectiveness of a multi-component, community sports-based intervention for increasing girls PA levels, fundamental movement skill (FMS) proficiency, and psychosocial well-being. Methods:A target sample of 241 female only participants, aged 8 to 12 years old, from five sub-urban and rural primary schools in County Cork were recruited. As guided by the Social Ecological, and Self-Determination theoretical frameworks, the Gaelic for Girls intervention was delivered once a week, for 60 minutes, over a 10 week period (March to May 2017) in a rural community sports club setting. Each session comprised of a participatory child component (6 x 10 minute rotatory station-based structure emphasizing fun activities to improve mastery of movement), a coach volunteer component (providing continuous professional development upskilling to coaches) and a parent component (knowledge-based PA support structures). The primary study outcomes were assessed at pre- and post- intervention, using self-report PA questionnaire, and the Test of Gross Motor Development-2 for FMS. Three focus group interviews were also conducted with the child participants, parents and coaches to explore perceptions of the pilot intervention. Data analysis is currently ongoing. Discussion:This pilot study will provide evidence regarding the effectiveness of a multi-component, community sports-based intervention, and may help inform the development of theory-based interventions targeting PA promotion for pre-adolescent girls.

I ride with MS: Motivation, benefits, and quality of life outcomes in bike MS participants with multiple sclerosis

Kimberly Fasczewski, Blair Anderes, Katie Campbell, Hannah Cook, Appalachian State University

Bike MS is a two-day charity bicycle ride where individuals raise money for Multiple Sclerosis (MS). The National MS Society promotes over 100 *Bike MS*events each year and collectively these events have raised over $1billion dollars for MS research since 1980. Little is known about motivation for participation in physical activity (PA) based charity events beyond the assumption that the participants have a relationship to the cause they have chosen to support. Events such as *Bike MS* may be ideal settings to introduce PA to individuals diagnosed with MS, and research supports the use of PA to aid in MS symptom management and disease progression, thus increasing long-term quality of life. The goal of the current research was to explore motives for participation in a *Bike MS* event in seven individuals with MS and three family members who participate in the *Bike MS – Tour to Tanglewood* event, and examine how initial *Bike MS* participation has translated to long-term physical activity behavior. Participants reported important social bonds, raising awareness for the cause, research fundraising, long-term physical benefits, and overall increased quality of life as motives for participation. All participants reported long-term PA participation as a direct result of the *Bike MS* event and none had plans to cease involvement in PA or *Bike MS* in the future. Results support using *Bike MS*as a means to increase long-term PA participation in individuals with MS, resulting in positive quality of life outcomes.

A systematic review of the use and effectiveness of concussion education programs in youth sport

Robyn Feiss, Molly Lutz, Justin Moody, Melissa Pangelinan, Auburn University

Each year an estimated 300,000 youth sport-related concussions are reported. However as many as 50% of concussions may go unreported and the American Medical Society for Sports Medicine estimates the number could be as high as 3.8 million. Concussion education for coaches and parents of youth athletes may influence the reporting and monitoring of concussed athletes. The aim of this review was to determine the current knowledge gaps regarding concussion for parents and coaches of youth athletes, the efficacy of concussion education programs on coach and parent knowledge, and the influence of concussion education programs on health outcomes for athletes. A systematic review was conducted using six databases according to the PRISMA guidelines. A total of 25 articles met inclusion criteria. Parents and coaches are generally able to recognize and identify signs and symptoms of concussion. Knowledge of concussion signs and symptoms further increased following a concussion education program. Providing education for parents and coaches may influence beliefs and attitudes regarding concussion (e.g., seriousness of the injury, necessity of clinical assessment, etc.). Current programs such as the CDC's "Heads Up: Concussion" and USA Football's "Heads Up Football" have been well-received and generally effective at increasing parent and coach knowledge regarding concussion. However, coaches have less knowledge regarding proper concussion management and return to play protocols. Furthermore, providing coaches with concussion education appears to influence health outcomes for athletes (e.g., incidence). Future studies are needed to replicate and extend this research across different sports, as the majority of studies focused on football. Lastly, many coaches were unaware of differences in concussions for adults versus youth athletes (e.g., differences in recovery time or symptoms). Therefore, future research should evaluate concussion knowledge for coaches and parents of youth athletes and how this knowledge may translate into better health outcomes in that population.

Mental and physical health factors influence exercise-induced cortisol responses in college students

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Few studies have quantitatively assessed differences between yoga and traditional exercise programs (e.g., cardio-based exercise programs) and their impact on mental and physical health outcomes over time. To address this knowledge gap, 42 undergraduate students were randomly assigned to participate in either cardio-kickboxing (n = 19) or yoga (n = 22) program for

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one hour a week for 10 weeks. All participants completed testing prior to and following the completion of the intervention. To assess physical health, BMI, body composition, flexibility, muscular strength and endurance, and aerobic capacity were measured. To assess mental health, the DASS-21 and the Student Stress Inventory were completed. To measure exercise-related changes in stress hormone levels, salivary cortisol was obtained before and after the 1-hour exercise sessions on the first and last classes. The exercise-related cortisol response increased over time (last session>first session) for both excise groups. Exercise-related changes in cortisol were significantly related to baseline self-reported mental health (i.e., student stress, general stress, depression, and overall mental health prior to the intervention). Individuals with lower self-reported stress prior to the intervention show an exercise-related increase in cortisol, whereas those who reported higher levels of baseline stress show a decrease in exercise-related cortisol. Similar findings were observed for depression and overall mental health. Exercise-related changes in cortisol were inversely associated with pre-intervention BMI; those with lower BMI exhibited an increase in cortisol while those with high BMI exhibited a decrease in cortisol following exercise. Taken together, these results highlight the relevance of mental and physical health characteristics on cortisol reactivity and the complicated relationships amongst these variables in healthy young adults. These findings will be discussed with respect to implications for future exercise interventions in those at-risk for mental or physical health problems.

Gender differences in division II collegiate athletes' dietary supplement use, sources of information, and motivations to use dietary supplements

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The current study evaluated gender differences in Division II collegiate athletes' dietary supplement use, their motivations for consuming supplements, and their sources of information. Additionally, the Theory of Reasoned Action (TRA) was incorporated into the examination of gender differences in Division II collegiate athletes. The TRA represents the idea that behavioral intention is a function of two determining factors – attitudes and subjective norms. Attitudes about performing a behavior and subjective norms will predict behavioral intentions, which should in turn predict behavior. Participants included 221 Division II collegiate athletes (males = 111, females = 110) from eight universities/colleges. Results indicated the top motivator for male participants to take dietary supplements was to gain muscle while females' main motivation was for energy. The chief source of information and advice regarding dietary supplement use for males came from parents/guardians whereas females received information from coaches. The main analysis was based on the three factors of the TRA: behavioral intentions, attitudes toward behavior, and subjective norms measured by the Survey to Predict Adolescent Athletes' Dietary Supplement Use (SPAADSU; Perko, 1999). Results revealed a significant difference between genders on the subscales of attitude towards behavior ($p < .001$) and subjective norms ($p = .05$) while behavioral intentions trends towards significance ($p = .08$). Males were more likely to agree with these items. Information from the present study may be useful for healthcare professionals, practitioners, and coaches because it will provide a better understanding for the thought processes behind an athlete's use of dietary supplements in Division II collegiate athletics.

Exploring direct and indirect effects of motivational climate among university students in a group fitness setting

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Extensive research has illustrated that compared to a high ego-involving climate, a high caring/task-involving climate can optimize motivation and allows for adaptive behaviors such as greater enjoyment, intrinsic motivation, and well-being (Hogue, Fry, & Fry, 2017; Harwood, Keegan, Smith, & Raine, 2015; Fry & Gano-Overway, 2010; Grant, Wardle, & Steptoe, 2009). Therefore, this study employed an Achievement Goal Perspective Theory and Caring Climate Framework (Nicholls, 1989; Newton, Fry, et al, 2007), which suggest creating a caring/task-involving climate produces the most beneficial motivational responses and behaviors. The purpose of this study was to explore direct and indirect relationships between the motivational climate and motivational responses (i.e., autonomy need satisfaction, enjoyment, and future exercise intentions) in the group fitness context. University students enrolled in group exercise classes (N = 448) were surveyed during the 6th (T1) and 13th (T2) weeks of the semester as part of a larger study. Results revealed that males reported lower T1 enjoyment (M = 4.13, F = 4.43) and perceived the motivational climate to be less task-involving (M = 5.72, F = 6.01) with more emphasis on an ego-involving climate than females (M = 2.78, F = 2.44). A path analysis revealed perceptions of the task-involving climate indirectly predicted enjoyment through autonomy (ab* = .35, $p = .004$). Further, the task-involving climate significantly predicted males' autonomy (b* = .41, p = .0001). Among females, the autoregressive paths from T1 autonomy (b* = .49, $p < .001$), enjoyment (b* = .28, $p = .013$), and future exercise intentions (b* = .28, $p = .001$) were significant, while males' paths were not. This study highlights the importance of examining the indirect effects in motivational climate research, as many factors can contribute to the psychological benefits of a positive environment in exercise settings. Educating group fitness instructors on how to foster a task-involving climate can enhance individuals' feelings of autonomy and enjoyment in exercise.

Diversity in diversity research: A scoping review

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The importance of considering individuals' cultural backgrounds in sport team contexts has recently been expressed within sport psychology research (Schinke et al., 2014; Schinke & Hanrahan, 2009). Despite recognition that cultural diversity may have important implications for group processes and outcomes in sport teams (Schinke et al., 2014), much of the research regarding cultural backgrounds has focused on sport psychology consulting practices with athletes (e.g., Schinke et al., 2012). Furthermore, given that many sports take place in groups and thus require cooperative behavior, it is important to understand how cultural diversity may influence group processes and outcomes in team sport contexts. These relationships have been studied extensively within the field of organizational psychology (Stahl et al., 2010). Generally speaking, there is ambiguity regarding the definition and measurement of cultural diversity. For example, terms like ethnicity, race, and culture are often used interchangeably and concrete definitions of terms are rarely provided (e.g. Harrison et al., 2002). Therefore, a scoping review (Arksey & O'Malley, 2005) was conducted to understand how cultural diversity has been defined and measured, and to identify potential correlates that may be relevant in a sport context. Peer-reviewed research articles ($N = 1150$) were retrieved using keyword searches on five electronic databases (e.g., PsycInfo). In total, 77 articles met the inclusion criteria for the review. Of these articles, only 30 (39%) provided clear definitions of cultural diversity or related terms (e.g., ethnicity, race, nationality). In terms of measurement, Blau's (1977) index was the most common measure of diversity ($n = 34$), followed by the use of dichotomous categories (e.g., heterogeneous vs. homogeneous; $n = 10$), and Teachman's (1980) index ($n = 7$). Team performance/success ($n = 42$) was the most cited correlate of cultural diversity.

Discussion of the results is focused on factors that should be considered when examining cultural diversity in sport teams.

The effects of acute exercise on reward processing during a monetary gambling task

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The beneficial effects of exercise on affective responses and mental health have been well documented and multiple mechanisms have been hypothesized to explain these effects. However, the effects of exercise on reward processing in humans has not been well studied. The reward positivity (RewP) event-related potential (ERP) is thought to directly reflect activity of the midbrain dopamine system, a critical neural system implicated in reward processing. To date, no study has been conducted to examine changes in RewP following acute exercise. Examining the effects of exercise on RewP may help to advance our understanding of the effects of exercise on mental health. The aim of this study was to determine the effects of aerobic exercise on reward processing during a simple gambling task. 42 young adults (20.4 ± 1.4 yrs) completed a single session of moderate-intensity aerobic exercise or seated rest on separate days prior to engaging in a simple gambling task. Results indicated an improvement in affect following exercise compared to the control condition, as indicated by a marginally significant condition x time interaction, $F(1, 41) = 3.6$, $p = .07$, $ES = .16$. Additionally, the expected feedback type main effect was found, $F(1, 41) = 33.7$, $p < .001$, $ES = .53$, indicating that RewP amplitude was larger for gain (win money) trials relative to loss (lose money) trials. Despite improvements in affect following exercise, no condition main effect or condition x feedback type interaction emerged for RewP, $ps > .05$, suggesting that a single bout of aerobic exercise failed to modulate reward processing. Notably, there was a significant relationship between pre-to-post changes in affect and RewP amplitude following exercise, $r = .53$, $p < .05$, such that greater improvements in affect were associated with larger RewP amplitude. This study serves as a preliminary test of acute exercise effects on reward processing and for determining whether the RewP is modifiable through exercise. Future studies are warranted to examine the effects of exercise on reward processing.

Effects of a 6-week classroom-based physical activity intervention on executive functioning and math performance in children

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Emerging research supports the efficacy of classroom-based physical activity (PA) breaks on aspects of executive functioning (EF) and academic performance. Previous studies have manipulated the dose of PA (5, 10, and 20-min) and type of PA, ranging from more traditional forms of aerobic PA to cognitively engaging PA (Schmidt et al., 2015). Cognitively engaging PA requires a high degree of mental effort and, in some cases, has been shown to be superior to traditional forms of PA. The purpose of this study was to investigate the effects of different doses and types of classroom-based PA on EF and academic performance in a single study. Participants (N = 421, Mage = 10.55±1.81, 213 females) performed an EF task (i.e., Flanker task) and a 1-min math test on two occasions separated by either a 6-week teacher-led PA intervention or regular classroom work (controls). The dose of the breaks consisted of 20min of PA performed in the middle of math class, or equally spread out breaks (4 x 5 min or 2 x 10 min). The types of PA were made up of traditional classroom-based PA (e.g., jumping jacks, squats) or cognitively engaging PA (i.e., solved math problems alongside PA). Results showed that EF performance (i.e., accuracy on the incongruent trials) improved in the PA conditions when compared to controls ($p = .02$, $d = 0.36$). Math scores were not different between conditions. However, participants in the PA conditions reported that math was easier following the intervention ($p = .01$, $d = 0.23$) which mediated the change in math performance. Of interest, among participants in the PA conditions, the correlation between perceptions of how easy math was and the change in math performance was weak-moderate ($r = .20$, $p = .003$), whereas this relationship was not evident in the control condition. As data analysis is on-going, the effects of different types and doses of PA will be discussed at the annual meeting. Findings support the efficacy of teacher-led PA breaks on EF and math performance, and suggest these breaks can be broken up into shorter bouts throughout one class period.

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The roles of contextual priors and kinematic information during anticipation: Toward a Bayesian integration model

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It has been suggested that skilled athletes integrate prior situation-specific information (i.e., contextual priors) with emergent environmental information to improve anticipation. However, our understanding of how athletes weigh up the available sources of information to inform their judgements during dynamic and temporally constrained tasks is limited. We present a series of experiments using a video-based soccer task to examine the integration of contextual priors and progressively unfolding kinematic information when anticipating the actions of an oncoming attacker. In one experiment, expert and novice soccer players performed the task with and without prior information about the attacker's action tendencies (dribble = 67%, pass = 33%). We recorded gaze behaviours and ongoing anticipatory judgements during task performance. Early in the trial, when kinematic information from the attacker was less relevant, the provision of contextual priors biased gaze behaviours and anticipatory judgements in experts, but not novices. Toward the end of the action sequence, experts, but not novices, used confirmatory or conflicting kinematic information to update their judgements. These findings align with the Bayesian framework for probabilistic inference which predicts that the reliance on contextual priors and current environmental information is subject to the relative uncertainty associated with available sources of information. To further test this prediction, we carried out two follow-up studies using the same anticipation task. In one, we manipulated the contextual priors by altering the strength of the attacker's action tendencies. In another, we used a temporal occlusion paradigm to manipulate the availability of kinematic information. The reliance on contextual priors increased when the uncertainty associated with evolving kinematic information increased and vice versa. Collectively, our novel findings provide support for a Bayesian integration model of how athletes shape their anticipatory judgements over time in dynamic and temporally constrained situations.

Does level of sport participation impact parent academic involvement, academic self-efficacy, and students' academic outcomes?

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Sport participation is related to greater academic achievement; however, past research suggests that the relationship among these variables is complex (Rees & Sabia, 2010). To better understand the nuanced factors related to sport participation, three variables (differences in parent involvement, academic self-efficacy, and academic achievement) were examined across four levels of sport participation (i.e., non-participation, junior

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varsity, varsity, and varsity captain). Data were drawn from a nationally-representative sample of high school students in the Education Longitudinal Study of 2002. A MANCOVA controlling for gender, race, academic delinquency, and parental education was used to assess group differences. Results indicate differences in parent involvement, self-efficacy, and academic achievement across levels of sport participation (F 7, 8,783 = 14.01, $p < .001$). Specifically, sport participants had more parent involvement and greater academic self-efficacy than non-participating peers, and junior varsity and varsity participants had greater academic achievement than non-participating and varsity captain peers. A multi-group path analysis was then used to examine hypothesized relationships among variables, using level of sport participation as a moderator. The path model was a good fit to the data (χ^2 (2) = 16.219, $p < .001$, RMSEA = .027, CFI = .999, TLI = .982), and indicated that parent involvement is associated with greater academic self-efficacy and academic achievement. These relationships were not moderated by level of sport participation. Collectively, findings suggest that there are differences in academic achievement across levels of sport participation. However, these differences are not due to differing relationships between parent involvement, academic self-efficacy, and academic achievement. Overall, findings show that certain characteristics of varsity captains are associated with parent involvement and academic self-efficacy, but not with academic achievement. Future work should be conducted to examine why these differences exist.

Motivation contagion: Effects of exerciser weight status and perceived motivation on fitness instructors' motivation and beliefs about the exerciser

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Overweight and obese individuals frequently report experiencing weight-based discrimination and stereotypes from health-care professionals, including fitness professionals (Puhl & Heuer, 2009). Within the exercise context, weight-stigmatizing attitudes and perceptions that an individual is extrinsically motivated to exercise can negatively affect fitness professionals' interpersonal styles of communication (supporting or controlling; Ntoumanis et al. 2018). Our goal in the current study was to explore whether fitness professionals' motivation to instruct, perceptions of effective communication style, and beliefs about the client's efficacy to overcome barriers to exercise participation were influenced by their perceptions of their clients' motivation to exercise and body weight. To accomplish this objective, we used a 2 (exerciser motivation: autonomous, controlled) x 2 (exerciser weight: average weight, overweight) between-subjects experimental design. Qualified male and female fitness professionals (N = 134; M_{age} = 28.43 years, SD = 5.95) were presented with an image of a hypothetical new client, a Caucasian, middle-aged male. This image was used across all conditions; however, it was digitally manipulated to reflect the different weight conditions. Each image was paired with statements reflecting the exerciser's motivation to begin exercising (autonomous vs. controlled). Results showed that fitness professionals were more autonomously motivated to instruct, perceived autonomy-supportive behaviors as more effective, and had stronger beliefs regarding the exerciser's efficacy when the exerciser was portrayed as having autonomous motivation, compared to controlled motivation. Fitness professionals reported higher levels of controlled motivation to instruct and perceived controlling behaviors as more effective when presented with the overweight exerciser, compared to the normal weight exerciser. Our findings suggest that perceptions of exercisers' motivation and body weight can influence fitness professionals' interactions with and beliefs about their clients.

Predicting performance in athlete pairs: Unique effects among self-, other-, and collective efficacy

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Self-efficacy is a weaker predictor of performance if factors beyond personal control are partially responsible for personal success. In athlete pairs, for example, each athlete may have beliefs about personal abilities (i.e., self-efficacy), the partner's abilities (i.e., other-efficacy), and their collective abilities (i.e., collective efficacy) as postulated in theory. The current study's purpose was to examine the extent to which both partners' efficacy beliefs predict successive performances in a paired task and, in turn, the extent to which partners' performances predict each partner's efficacy beliefs. Based on previous research, we hypothesized that (a) other- and collective efficacy would emerge as unique predictors of subsequent performance beyond previous performance and self-efficacy, (b) effects from athletes' partners would predict subsequent personal performance, and (c) partner effects would be more salient for one member of the pairs comprised of distinguishable roles. A sample of 74 intact cheerleading pairs performed five trials of a moderately challenging stunt-task while rating self-, other-, and collective efficacy beliefs and subjective performances. Objective measures of paired performances were obtained from digital recordings. Analyses were in line with Feltz, Chow, and Hepler's (2008) Residualized Past Performance-Residualized Self-Efficacy model in conjunction with the Actor-Partner Interdependence Model appropriate for athlete pairs. Inspection of path analyses revealed instances that other- and collective efficacy were unique predictors of subsequent performance beyond previous performance and self-efficacy. Simultaneously, effects from athletes' partners emerged as significant predictors of subsequent performance, with the partner effects more salient for one member of the pair. Effects were also present in the performance to efficacy predictive direction. The results demonstrate how athletes simultaneously process several types of efficacy beliefs, a contribution towards an integrated efficacy theory relative for team athletes.

Selective predictors of competitive state anxiety dimensions during high stakes in elite competition

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Purpose: This present study investigated the possible influence of some competitive state anxiety predictors on the intensity, direction, and frequency dimensions as experienced by elite athletes during high stakes in table tennis competition. *Methods:* Thirty-three (N = 33) purposively sampled elite table tennis players from Ghana completed the modified version of the Competitive State Anxiety Inventory-2, incorporating the direction and frequency of intrusion subscales during breaks within competitive matches. *Results:* Hierarchical multiple regression analyses on intensity dimension revealed that cognitive anxiety was significantly predicted by only the age factor while no predictors emerged for somatic anxiety. Self-confidence was significantly predicted by only competitive experience. For directional dimension, gender and age emerged as significant predictors of cognitive anxiety. However, none of the factors were found to significantly predict somatic anxiety and self-confidence. Regarding frequency dimension, cognitive anxiety was significantly associated with competitive experience and age whereas no predictors emerged for somatic anxiety. Competitive experience factor was also significantly related to self-confidence. *Conclusions:* Findings underscore the need to measure these anxiety dimensions concurrently because they are triggered by different antecedents. Psychological skills interventions should be idiosyncratic based, targeting more self-confidence management

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strategies in alleviating the effect of cognitive anxiety during elite competitive matches where demands are very high.

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General and transgender-specific barriers to moderate-vigorous physical activity among transgender adults

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Transgender compared to cisgender adults experience lower quality of life and higher rates of depression. Engaging in moderate-vigorous physical activity (MVPA) for 150+ minutes/week can improve health however, the majority of transgender adults are not sufficiently active. A need exists to identify general (i.e., common across multiple populations) and population-specific barriers that hinder participation in MVPA. The purpose of this study was twofold: (1) to identify general and transgender-specific barriers experienced by transgender adults and (2) to identify for each barrier, the frequency (occurrence of barrier), limitation (extent barrier limits activity) and self-regulatory efficacy (SRE - confidence to overcome a barrier). Participants included 138 self-identified transgender adults (88 female-to-male and 50 male-to-female) aged 18-66 years (M=31.75 years) from the USA and Canada. Participants completed a 20-minute online survey to assess demographics, MVPA (past 14 days), general and transgender-specific barriers (open-ended), barrier frequency (past 0-14 days), barrier limitation (1-9 scale), and SRE (0-10 scale). Following systematic coding of themes by three trained researchers, 18 general barriers (e.g., inclement weather) and 12 transgender-specific barriers (e.g., social distress to passing) were identified. General barriers identified with high frequency and limitation and low SRE included mental illness (f= 9.17, limit= 7.92, SRE=4.50), and lack of money for participation (freq=6.73, limit=7.67, SRE=3.57). Transgender-specific barriers identified with high frequency and limitation, and low SRE included, lack of sport/classes inclusive to transgender adults (f=6.90, limit=7.07, SRE=3.59) and self-criticism of physical body characteristics (freq=7.83, limit=6.33, SRE=2.83). Findings contribute to new knowledge on problematic general and transgender-specific barriers experienced by transgender adults. Future research should include an examination on whether general and/or transgender-specific barrier frequency, limitation and SRE predict MVPA.

Effects of mental fatigue and incentives on exercise decision-making

Sheereen Harris, Steven R. Bray, McMaster University

Physical activity guidelines recommend adults attain >=150 minutes of MVPA weekly. Although fatigue is a frequently cited barrier to exercise, no studies have investigated whether mental fatigue alters the perceived difficulty of exercise or effort-based decision-making. Monetary incentives have been shown to bias exercise decision-making and to attenuate the effects of mental fatigue on physical performance, but no research has examined the effects of incentives on exercise related decision-making when people are mentally-fatigued. The purpose of this study was to investigate the effects of mental fatigue and incentives on perceptions of exercise difficulty, decision-making, and exercise behaviours. Using a 2 (mental fatigue/no mental fatigue) X 2 (incentive/no incentive) between-groups design, participants (N = 76) completed a 10-minute mental fatigue manipulation and then chose between two exercise options: 20 minutes of continuous moderate-intensity exercise, or 10 minutes of vigorous intensity exercise followed by 10 minutes of very light exercise. Participants in the incentive conditions were offered $2 or $4 for the moderate or vigorous intensity options, respectively. The vigorous-intensity exercise option was rated more difficult than the moderate-intensity option across all groups. Results of a 2x2x2 contingency table showed a significant mental fatigue X incentive X selected intensity interaction. Follow-up tests showed mental fatigue alone had no effect on intensity selection. However, there was a significant effect ($p < .01$) for incentives, where 10/20 in the no mental fatigue/no incentive condition selected the vigorous option, compared to 19/21 in the no mental fatigue/incentive condition. Supplemental analyses also showed mental fatigue led to decreases in self-selected workloads for participants who chose the vigorous-intensity option ($p = .05$). Mental fatigue does not appear to affect effort-based decision making for exercise; however, when mentally-fatigued, people down-regulate energy expenditure when exercising at vigorous intensities.

A prospective study of skill development in elite soccer based on practice and play hours and coach ratings of skills

David Thomas Hendry, University of British Columbia; A. Mark Williams, University of Utah; Nicola, J. Hodges, University of British Columbia

Elite youth Academy soccer players from the UK (~14 yr), were rated for technical, tactical, physical and creative skills by coaches at time 1 (T1). Coach-skill ratings were recorded again ~2.5 yr later (T2) for players that had received a professional-youth contract (~16 yr). Adult-professional success (~19 yr) was determined ~5 yr later (T3). Player estimations of accumulated hours in soccer practice and play during development were also correlated with skill ratings. Players that received a professional contract at T2 were rated higher for technical, tactical and physical skills than those who did not. At T3, only tactical skill differentiated adult-professionals from youth-professionals (technical skill, $p = .06$). Childhood practice was better related to T2 ratings, especially for tactical and creative skills but soccer play was not related to any skills. These data are evaluated with reference to models of talent identification and development.

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Influence of a running training program on exercise self-regulation beliefs

Teri Hepler, Naoko Aminaka, University of Wisconsin-La Crosse

This study examined the influence of a supervised training program on exercise self-regulatory beliefs. Specifically, the purpose of this study was to investigate the influence of a 9-week running training program on exercise self-efficacy beliefs and exercise behavioral regulations of novice runners. Participants (N = 21) were novice runners who were required to complete 3 training runs (2 supervised group runs, 1 solo unsupervised run) of various distances per week. The training program was designed to prepare novice runners to be able to complete a 5K race. Participants were assessed on various psychological and biomechanical measures at 3 time points: baseline prior to initiating the training program (pretest), immediately upon completion of the 9-week training program (posttest), and 3 months after completing the program (follow-up). Self-efficacy was measured by Bandura's 18-item Exercise Self-efficacy Scale, which asks participants to rate their confidence in their ability to exercise regularly in the presence of common barriers (e.g., during bad weather, after facing family problems). Participants' behavioral regulations were assessed by the Behavioral Regulation in Exercise Questionnaire-3 (BREQ-3). In accordance with self-determination theory, the BREQ-3 comprises 6 subscales: amotivation, external regulation, introjected regulation, identified regulation, integrated regulation, and intrinsic regulation. Repeated

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measures ANOVA was used to compare participants' self-efficacy and behavioral regulations across the 3 time periods. Results indicated that self-efficacy significantly increased following the training program and that those beliefs remain elevated 3 months later. In terms of behavioral regulations, there were no significant differences across time on any of the BREQ-3 subscales. Results of this study indicate that a supervised running training program can be an effective tool for enhancing general exercise self-efficacy beliefs, which may in turn promote greater levels of physical activity.

A qualitative study exploring LGBTQ+ experiences with physical activity through a series of focus groups

Shannon Sarah Christine Herrick, Lindsay Duncan, McGill University

LGBTQ+ individuals face an array of unique challenges to physical activity participation, that are related to their diverse minority experiences. Research in this area may be challenged because many potential participants have experienced instances of discrimination, exclusion, and homophobia within physical activity settings. The purpose of this study was to explore the unique challenges involved in conducting research on physical activity within the LGBTQ+ communities. Eight semi-structured focus groups comprised of adult, self-identifying members of LGBTQ+ communities ($N = 42$) were conducted. Participants were encouraged to discuss their experiences with physical activity, with guiding questions such as "How has your minority identity affected your past experiences with physical activity?" All focus groups were audio-recorded, transcribed verbatim, and subject to thematic analysis. Three main themes emerged: (1) complicated intersecting minority identities can uniquely influence experiences with physical activity, (2) preconceived images and notions associated with the word "athlete" make athletics seem like an exclusive, non-accessible context, and (3) macro and micro-aggressions outside of a physical activity context can impact past and current experiences within physical activity. These findings suggest that if these factors are not considered in studies involving LGBTQ+ persons, a homogenous identity may emerge where it does not exist, the typical language used to describe physical activity may alienate participants, and the rich minority context may be ignored.

Funding source: Social Sciences and Humanities Research Council of Canada (SSHRC).

A tripartite efficacy examination of the personal trainer-client relationship

Christopher Hill, Deborah Feltz, Michigan State University

Personal trainers are proxy agents who could help individuals boost their self-efficacy beliefs (SE) about being physically active. Personal trainers develop and instruct fitness programming to help people achieve their fitness goals in a safe and productive manner. Previous literature has noted the role that personal trainers play in interdependent relationships in the physical domain, but research has not yet examined specific relational efficacy beliefs that might explain the development of SE in these fitness relationships. Research in coach-athlete, athlete-athlete, and physical educator-student relationships largely support the tenets of the tripartite efficacy model. However, the personal trainer-client relationship is distinctive from those aforementioned relationships and therefore should be examined surrounding the development of efficacy beliefs via the tripartite model. Also, antecedents and outcomes of the tripartite efficacy model warrant testing in diverse physical activity relationships. Our study examined the tripartite efficacy model, including proposed antecedents and relational outcomes of the model, with clients of personal trainers. Participants (N = 273) were active clients in a personal trainer-client relationship who were asked on a one-time survey, to report their perceptions of other-efficacy (OE), relation-inferred self-efficacy (RISE), SE, perceptions of communication, and perceptions of the relationship. Using path analysis, OE (beta = .30) and RISE (beta = .53) significantly predicted SE, supporting the core of the tripartite efficacy model. Perceptions of trust in communication significantly predicted OE (beta = .55) and RISE (beta = .52). OE significantly predicted the relational outcome of complementarity ($p < .01$). RISE significantly predicted relational outcomes of commitment, complementarity, and closeness ($ps < .01$). Findings support the tripartite efficacy model in predicting SE for personal training. Also, the tripartite efficacy beliefs have ties to relational variables that are central in interpersonal relationships.

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Measuring peer athlete mentoring functions: Development of the Athlete Mentoring Questionnaire (AMQ)

Matt D. Hoffmann, Todd M. Loughead, University of Windsor

Peer athlete mentoring is defined as "a dynamic process in which a more experienced and knowledgeable athlete (i.e., mentor) serves as a trusted role model to another athlete (i.e., protégé), assists him/her in their pursuit of goal achievement and advancement in sport, and/or supports his/her personal growth and development" (Hoffmann et al., 2017, p. 143-144). Despite recent findings highlighting the benefits of being peer mentored as an athlete (e.g., protégé satisfaction; Hoffmann & Loughead, 2016), the investigation of mentoring relationships between athletes remains in its infancy. One explanation for the paucity of research in this area is the absence of a sport-specific measurement tool to assess the mentoring functions provided by athletes serving as peer mentors. Using a multi-phase approach, the general purpose of the present study was to develop a questionnaire to measure peer athlete mentoring functions. In phase 1 the experiences of 14 elite peer mentored athletes were explored through individual interviews. Based on the results of phase 1, phase 2 consisted of three stages related to the development of questionnaire items and the assessment of content validity evidence with six athletes and six expert judges. In phase 3, 377 Canadian National team and varsity athletes who self-identified as having been peer mentored completed an initial 55-item version of the Athlete Mentoring Questionnaire (AMQ) and its factor structure was examined using confirmatory factor analysis, exploratory structural equation modeling (ESEM), and hierarchical ESEM. Phase 3 also showed evidence of strong measurement invariance across competition level (National team vs. varsity), mentoring status (currently mentored vs. mentored in the past), and gender (male vs. female). The final version of the AMQ contains 34 items measuring six mentoring functions: mental guidance, coach relations, task instruction, career assistance, role modeling, and friendship. It is hoped that the development of the AMQ will spur research in the emerging area of peer athlete mentoring.

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Stand up and drive! Using modified ride-on cars with different postures for enhancing mobility and socialization in children with disabilities

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Recent studies have demonstrated that using modified ride-on cars (ROCs) is beneficial for enhancing mobility and social development in children with disabilities. The purpose of this randomized controlled trial with three-group pretest-posttest design is to examine the effects of ROC

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training with 2 different postures on mobility and social function in young children with motor disabilities. 21 infants with disabilities between 1 and 3 years were recruited from the hospitals in Northern Taiwan. All participants received 12-week intervention (120 mins/per session, 2 sessions/per week). The ROC-Sit group (7 participants, mean age: 17.86 months) and ROC-Stand group (7 participants, mean age: 23.93 months) received the ROC training with sitting posture and standing posture, respectively. The control group (7 participants, mean age: 25.29 months) received conventional therapy which also focused on mobility and social training. The Chinese Version of Pediatric Evaluation of Disability Inventory (PEDI-C), and Chinese Version of Parenting Stress Index, Short Form (PSI/SF) were administrated before and after the intervention. One way ANOVA, and a repeated measure ANOVA were used to compare the demographic data and the differences of outcomes among the three groups. There was no significant difference on the demographic data and the pretest scores of mobility, social function and parenting stress. There was a significant time effect on mobility function ($p < .001$), social function ($p < .01$), and PSI ($p = .04$), indicating the three groups all had significant improvements after the 12-week intervention. Although there was no significant interaction effect or group effect on the outcomes, the ROC-Sit group tended to have the greatest improvement in mobility function, and the ROC-Stand group tended to have the greatest improvement in social function and PSI. The control group tended to have the least improvements in all scores. The preliminary results show that using standing posture for independent locomotion may benefit the psychosocial development in young children with disabilities.

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A qualitative investigation of older adults' beliefs about physical activity maintenance and re-engagement

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Background: Physical activity (PA) is a vital aspect of older adults' healthspan, yet maintaining PA remains a challenge. PA maintenance is a process that may include multiple episodes of stable high PA (maintenance), decline (relapse), and re-engagement (recovery) in PA following its adoption. According to the theory of planned behavior (TPB), beliefs are behavior- and population- specific. For example, control beliefs-based constructs (maintenance and recovery self-efficacy) have been found to be positively associated with PA maintenance but not with PA adoption. However, of the studies that have elicited PA beliefs in older adults, few have examined beliefs regarding PA maintenance, and none have examined beliefs regarding PA re-engagement. The purpose of this study was to elicit the salient behavioral, normative, and control beliefs for PA maintenance and control beliefs for PA re-engagement in older adults. Methods: Adults ≥ 60 years old without severe cognitive impairment were recruited from a fitness center, retirement home, and community center in Indiana. In reference to the TPB, physically active older adults ($n = 25$; mean age = 75.88, SD = 5.80) reported via survey their behavioral, normative, and control beliefs for PA maintenance and control beliefs for PA re-engagement after a 1-week period of inactivity. Results: Content analysis revealed that the most salient behavioral beliefs concerned bone and muscle strength (advantage) and taking time away from other activities (disadvantage). The most salient normative beliefs were associated with the members of one's family. Control beliefs for PA maintenance differed from those for PA re-engagement; scheduling was reported as enabling PA maintenance, whereas accessibility to facilities to perform PA and internal motivation were reported as enabling PA re-engagement. Conclusions: This study provides valuable information for the development of new or refinement of existing PA control beliefs-based measures and PA maintenance interventions, which could be more suitable for the older adult population.

Associations among motivational climate, achievement goals, perceived competence, enjoyment, and anxiety within Finnish physical education students

Mikko Huhtiniemi, Timo Jaakkola, University of Jyväskylä, Finland

The purpose of this study was to investigate the relationships among motivational climate, achievement goals, perceived competence, enjoyment, and anxiety of Finnish physical education students. The participants of the study were 1076 Finnish Grade 5 (mean age = 11.27, sd = 0.32) students (554 girls, 522 boys) who completed questionnaires analyzing motivational climate, achievement goals, perceived competence, enjoyment, and anxiety towards physical education. The statistical analyses involved grouping the sample into high and low perceived ability groups based on their responses to the perceived competence scale. Multi-group structural equation modeling (MSEM) indicated that the model fitted the data well: chi^2 (19) = 29.59, p = 0.06; CFI = 0.99; TLI = 0.99; RMSEA =0.032. The high and the low perceived competence groups had several similarities. Task climate was positively, and ego climate negatively, associated with enjoyment. Ego climate was positively linked with anxiety. The MSEM also revealed an indirect positive association from task climate via task orientation to enjoyment. Furthermore, there was a positive association between task orientation and enjoyment, and between ego climate and ego orientation. In the low perceived competence group, there was a negative association between task climate and anxiety. In the high perceived competence group, task orientation was negatively linked to anxiety. Squared multiple correlations showed that motivational climate and achievement goals explained 34% and 32% of variance in enjoyment, and 16% and 18% of variance in anxiety for low and high perceived competence groups respectively. Results of this study support the propositions of achievement goal theory, whereby, motivational climate and task orientation are influential for affective outcomes in physical education. Results also highlight that physical education teachers should implement task-involving elements such as effort, personal improvement, and learning within their lessons in order to enhance enjoyment and avoid anxiety in physical education classes.

Fun, failure, and fulfillment: A case study approach to informal athlete leadership in minor league baseball

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The purpose of this study was to triangulate a single case of informal athlete leadership in minor league baseball (MiLB) during the 2015 season. Teammates and coaches of a Class A MiLB team voted for the highlighted participant as the best athlete leader on the team. The first author conducted eight individual semi-structured interviews with the highlighted participant, two coaches, and five teammates. Using Interpretative Phenomenological Analysis and open-ended prompts based on leadership and athlete literature, the first author learned about the highlighted participant's emergence as leader on a team without formal leadership titles. Findings revealed four main themes: (a) navigating personal on-the-field failure, (b) fulfilling others' expectations, (c) helping teammates manage emotions, and (d) fostering a fun working environment. Findings also indicated one foundational theme, "having a philosophy," that grounded the four main themes. Implications for athlete leadership development and future directions for athlete leadership research are discussed.

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The effects of cognitive effort training on whole body physical exertion and perception of effort

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Performing cognitively-demanding tasks can lead to mental fatigue and subsequent deficits in cardiovascular exercise endurance or maximal voluntary contraction strength as well as increased perceived effort while performing physical tasks. These effects suggest cognitive and physical effort regulation share common determinants and that training in one domain may alter performance and perceived effort in another. The purpose of this study was to explore the effects of cognitive effort training on whole body physical endurance and perceptions of physical effort. Using a between groups design, participants (N = 22) completed a baseline graded exercise test (GXT) on a cycle ergometer and were then randomized to either an experimental or control group. The experimental group performed nine high cognitive effort training tasks (e.g., Incongruent Stroop task) and the control group performed nine low cognitive effort tasks (e.g., Congruent Stroop Task) over three weeks, with each task lasting 10 minutes. Following training, participants completed another GXT. Throughout both GXT protocols, participants reported ratings of perceived exertion (RPE) at 30-second intervals. Results showed no difference in peak power achieved on the GXT from pre- to post-training for either group. Contrary to expectations, the experimental group reported a significant increase in RPE during the GXT from pre- to post-training ($p < 0.05$, $d = 0.88$). Short-term cognitive effort training thus appears to have no benefit for physical performance. However, the cognitive training regimen may have been too intense or too brief to result in beneficial results. RPE results suggest that rather than promoting adaptations to physical performance, high cognitive effort demands of the training may have caused enduring mental fatigue and increased effort perception at equivalent physical workloads. Further research involving longer training intervals and differing doses of cognitive effort should be investigated in future studies.

The effect of messages evoking pleasant or unpleasant feelings from physical education teachers on pre-performance

Tadao Ishikura, Doshisha University, Japan

This study aimed to investigate the effect of messages that evoke students' pleasant or unpleasant feelings from their physical education teachers (PETs) on pre-performance, and whether the students' impressions of their PETs, along with their gender differences, influence the feelings evoked by their messages. We questioned university students (598 males, 535 females) about recollections of their high school's PET and evaluated their favorable impressions and feelings based on the assumption that the teachers provided messages that influenced the responses of the students. Two factors were extracted from the results of an exploratory factor analysis: "messages evoking pleasant feelings scale" and "messages evoking unpleasant feelings scale." Moreover, the students who had a good impression of their PET felt pleasure from the messages that were meant to evoke pleasurable feelings, and did not feel displeasure from the messages meant to evoke unpleasant feelings, as compared to the students who did not have a favorable impression of their PET. Female students felt more displeasure from the messages that evoked unpleasant feelings than did the male students. Consequently, these results suggest that the effect of verbal interaction with PETs on pre-performance affects students' pleasant or unpleasant feelings based on certain parameters, such as the student's degree of pleasant feelings for the PET and their gender differences.

Autonomy enhances movement efficiency

Takehiro Iwatsuki, James Navalta, Gabriele Wulf, University of Nevada

Performer autonomy has been shown to contribute to effective motor performance and learning. Autonomy is therefore one of the three key factors in the OPTIMAL theory of motor learning (Wulf & Lewthwaite, 2016). The purpose of the present study was to examine whether supporting individuals' need for autonomy by giving them choices would increase movement efficiency. Such a finding would be consistent with the OPTIMAL theory prediction that autonomy facilitates the coupling of goals and action. Participants ($N = 32$) first completed a graded exhaustive exercise test to determine VO_2 max. One week later, they were asked to run at a submaximal intensity (65% of VO_2 *max*) for 20 minutes. Participants in a choice group were able to choose 5 of 10 photos as well as the order in which they were shown to them on a computer screen during the run. The photos included 5 city and 5 nature motifs. Control group participants were shown the same 10 photos, in the same order, chosen by their counterparts in the choice group. While VO_2 *max* and maximum heart rate were similar for the choice and control group, throughout the run oxygen consumption and heart rate were lower in the choice group relative to the control group. In 2 (group) x 4 (time: 1-5 min, 6-10 min, 11-15 min, 16-20 min) repeated-measure analyses of variance, the main effects of group were significant for both oxygen consumption and heart rate. Thus, providing autonomy support resulted in enhanced running efficiency. The present findings support the notion that performer autonomy promotes goal-action coupling.

Associations among basic psychological needs, motivational regulations, enjoyment, and anxiety of Finnish physical education students

Timo Jaakkola, Mikko Huhtiniemi, University of Jyväskylä, Finland

The purpose of this study was to analyse associations among basic psychological needs (autonomy, competence, relatedness), motivational regulations (intrinsic, identified, introjected, extrinsic, amotivation), enjoyment, and anxiety of Finnish physical education students. The participants of the study were 1109 Finnish Grade 5 (mean age = 11.27, sd = .32) students (571 girls, 538 boys). Students completed questionnaires analysing psychological needs, motivational regulations, enjoyment, and anxiety towards physical education in their classrooms under supervision of the researchers. Structural equation modelling (SEM) demonstrated that the model had a good fit to the data ($\chi 2$ (11) = 13.33, P = 0.27; CFI = 0.99; TLI = 0.99; RMSEA = 0.01). Results showed direct associations among study variables, whereby, all three basic psychological needs were positively linked with enjoyment. Additionally, intrinsic regulation was positively and amotivation negatively associated with enjoyment. Subsequently, needs for competence and relatedness linked negatively and introjected regulation and amotivation positively with anxiety. The SEM also indicated indirect associations among study variables; all three psychological needs were positively associated with enjoyment via intrinsic regulation, all three psychological needs linked positively with enjoyment and negatively with anxiety via amotivation, and need for competence associated positively with anxiety via introjected regulation. Squared multiple correlations revealed that psychological needs and motivational regulations explained 66% of variance in enjoyment and 33% of variance in anxiety. Results of this study support the self-determination theory indicating that needs satisfaction is important for affective outcomes resulting from motivational process in physical education. Results of this study also reinforce that physical education teachers should ensure that their pedagogical practices include aspects to fulfill students' basic psychological needs.

Grounded theoretical approach in the process of substitution athletes for female professional basketball coaches(I)

Ji-Hye Chung, Mi-Sun Kim, Bo-Ram Lee, Eun Choi, Sookmyung Women's University, South Korea

The purpose of this study was to analyze in depth what problems do coaches have and how they solve them in the process of replacing players and to suggest a theoretical framework for their substitution process by using the grounded theory method. The grounded theory method is a series of categories, concepts or codes are built up which start to explain the phenomena that are emerging from the study. Participants in this study were six basketball coaches in the Woman's Korea Basketball League(WKBL). The collected data were obtained through the following methods: open coding to find relevant categories, axial coding to find links between the categories, and selective coding to find the core categories. First, one hundreds and sixty three concepts, twenty three sub-categories and sixteen top categories were derived through open coding. Second, through axial coding, six paradigm factors such as causal condition, contextual situation, central phenomenon, intervention condition, interaction strategy, and result appeared and the relation between categories was analyzed. Third, the process of using substitute players in the core category was derived and the process of replacing players was presented through the overall story outline through selective coding. In sum, coaches need to be educated in terms of the psychological characteristics of substitute players and their process to become an active team member.

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Exploring the role of trait characteristics underlying variable affective responses to exercise

Leighton Jones, Sheffield Hallam University, UK; Jasmin Hutchinson, Springfield College; Elizabeth Mullin, Springfield College

Positive affective responses to exercise have been linked with longer term adherence. The Dual-Mode Model indicates that affective responses during heavy exercise (between the ventilatory threshold [Tvent] and the respiratory compensation point [RCP]) are subject to inter-individual variability (zone of response variability). This study explored the influence of trait characteristics on affective responses during heavy exercise. Forty-eight participants (21 females; Mage = 30.33+/−7.54 years) were recruited from two sites in England and the USA. Participants completed measures of personality; sensation seeking; preference for, and tolerance of, exercise intensity, prior to a maximal treadmill test. During the test, responses to the Feeling Scale (FS) and the Felt Arousal Scale (FAS) were recorded each minute. Participants' responses during heavy exercise were used to group participants as either Negative Responders or Neutral/Positive Responders. Discriminant Function Analysis revealed a significant weighted linear composite that predicted affective response, $\Lambda = 0.687$, $X2(8) = 15.748$, $p = .046$. When examining the standardized coefficients, Tolerance (.826), Conscientiousness (-.630), and Sensation Seeking (-.586) were notable influences in discriminating between the two groups. Neutral/Positive Responders reported higher scores for Tolerance, and lower scores for Conscientiousness and Sensation Seeking. The combination of eight predictors successfully predicted group membership 73% of the time. Results suggest that researchers and practitioners should seek to account for individual differences when examining affective responses and when designing exercise programs. Through more accurate predictions of how an individual will feel during heavy exercise, we can seek to make the exercise experience more consistently pleasurable.

Consistency of maintaining physical activity guidelines as a predictor of health-related quality of life

Navin Kaushal, Béatrice Bérubé, Louis Bherer, University of Montreal

Background. To date, most research on the relationship between Health-Related Quality of Life (HRQoL) and physical activity (PA) has focused on various clinical populations. While national PA guidelines promote 150 minutes of moderate-to-vigorous PA/week, an investigation on the consistency of maintaining these guidelines has not been explored on healthy adults. Hence, the primary purpose of this study was to investigate whether the consistency of maintaining guidelines affected HRQoL. Methods. Adults (n = 161) were recruited across nine gyms/recreation centres in a metropolitan city. Participants were exercising for 6.2 (SD = 6.78) years and averaged 232 (SD = 116.06) minutes of moderate-vigorous PA per week. Participants completed online surveys at baseline and follow-up after eight weeks. The Godin Leisure-Time Exercise Questionnaire and The Short Form36 were used to measure PA and components of quality of life respectively which included physical health (PH), emotional coping (EC) and energy level (EL). Results. Multivariate analysis of variance that tested consistency of maintaining PA guidelines revealed a significant difference across the guideline groups [Wilk's $\lambda = .844$ $F_{9,377} = 3.01$, $p = 0.002$]. Pairwise comparisons with LSD corrections between PA guideline groups (consistent non-achievers, new achievers, guideline maintainers, failed maintainers) and HRQoL categories revealed maintainers to score higher than all groups in EC ($p < .05$), higher than both non-achiever and failed maintainers in physical health ($p < .05$) and higher than non-achievers in EL ($p < .05$). New achievers scored higher than non-achievers in emotional coping ($p = .046$). Discussion. This is the first study to assess changes in achieving PA guidelines as a predictor of HRQoL. While those maintaining guidelines showed best results across multiple HRQoL domains, new achievers within a span of two months were able to reap some benefits. Long-term analyses could help clarify pattern of new achievers in comparison to other groups.

Funding source: FRQS.

Testing the integrated behavior change model in gym members: A longitudinal study

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Background. The majority of research aiming to predict physical activity (PA) has applied social cognitive models. Although these models have been effective in identifying key correlates and predictors, such approaches are limited as they do not account for post-intention, implicit, and dispositional type constructs. The Integrated Behavior Change (IBC) model incorporates tenets from previous theories found to predict PA and includes pathways relevant to implicit processes. Previous findings have supported predictive validity of the IBC model for nutrition choices and sun safety behaviour, but it has not been tested in PA. The purpose of this study was to test the IBC model in a sample of gym/recreation center attendees. Methods. Participants (N = 161) were a sample of adults randomly selected from nine gym and recreation centres who completed baseline and follow-up questionnaires after eight weeks. Hypotheses of the IBC were tested using structural equation modeling. Prior to analysis, all constructs were converted to standardized residual scores to represent change in constructs over eight weeks. Results. Intention x planning ($\beta = .22$, $p = .004$) and habit ($\beta = .32$, $p < .001$) were found to predict PA directly. Intrinsic reward predicted habit ($\beta = .20$, $p = .025$) and intention x planning ($\beta = .33$, $p = .001$). We also found a significant total indirect effect

of intrinsic reward on behavior ($\beta = .137$, $p = .026$). Finally, consistency was found to predict habit ($\beta = .30$, $p = .023$). The model explained 21% of the variance in behavior. Discussion. This is the first study to test the IBC model in a PA context. Results support previous research adopting dual process models to predicting PA and highlights the importance of non-conscious processes in predicting behaviour change. Future research should extend study duration and assess behavior using objective measures.

Funding source: FRQS.

Gamification in healthcare and physical activity promotion contexts

Winston Kennedy, Oregon State University; Anthony Pellicone, New York University; Samuel Logan, Oregon State University

Gamification is the use of game design elements in non-gaming contexts to motivate and increase user activity and retention (Deterding et al., 2011). Well-designed gamification involves more than a superficial application of awarding points or badges in exchange for arbitrary activities, but rather grounds the reward system to help users understand the importance or meaningfulness of the behavior that interfaces with the game system (Deterding, 2015). Gamification has been used in many domains, ranging across productivity, finance, health, education, sustainability, news and entertainment media with reported success (Seaborn & Fels, 2014). Traditional aspects of gamification include motivational affordances such as badges, leaderboards and points, which may be considered extrinsic motivators (Melker et al., 2017). Recently, gamification use in healthcare has increased due to its potential to promote behavior change, including self-management of chronic illnesses, or physical activity promotion through receiving awards for the number of steps taken in a given time frame (AlMarshedi, Wills & Ranchhod, 2016). An emerging application of gamification in healthcare and physical activity promotion includes using principals of self-determination theory to create game design elements based on competence, autonomy and relatedness to increase intrinsic motivation (Aprico et al., 2012). The purpose of this review is twofold: (1) Provide a review of existing literature on the application of gamification in healthcare and physical activity promotion; and (2) Propose a gamification framework based on self-determination theory to increase intrinsic motivation in healthcare and physical activity promotion contexts. Potential directions for future research will also be discussed.

Are significant others really insignificant? A response surface analysis of subjective norms in predicting physical activity intentions

Jeemin Kim, Mark Eys, Jennifer Robertson-Wilson, Emily Dunn, Kayla Rellinger, Wilfrid Laurier University

The existing literature has consistently shown that subjective norms (SN; i.e., social pressures from significant others) within the Theory of Planned Behavior are a weak predictor of intentions to engage in physical activity (Rhodes & Nigg, 2011). A potential explanation for this weak link may be the inconsistent methods by which SN have been measured (Kim et al., 2017). For example, most previous research in this area did not specifically consider salient normative referents (e.g., parents, spouse). Further, SN were assessed directly, rather than indirectly via the assessment of its sub-components: *normative beliefs* (i.e., perceived pressures) and *motivations to comply* with such norms (Kim et al., 2017). Previous studies that did include both components typically multiplied the normative belief and motivation to comply scores to represent overall SN (e.g., Martin et al., 2007), which do not actually consider the relative contributions of each perception. The current study aimed to address these shortcomings by: (1) eliciting salient normative referents for each participant and (2) using response surface analysis (Shanock et al., 2010) to examine normative beliefs and motivations to comply concurrently in relation to physical activity intentions. The results ($N = 536$, $M_{age} = 22.74$, $SD = 8.08$) based on all normative referents combined revealed that the congruence of normative beliefs and motivations to comply had a U-shaped non-linear relationship with intentions ($p < 0.001$), such that intentions increased as both components increased or decreased together. These results suggest that people with low perceived normative beliefs may still intend to be active by rejecting the low normative beliefs. Further, the results varied across normative referents (e.g., parents, spouse). These results offer an explanation for the weak link between SN and physical activity intentions by suggesting that intentions may be affected by a complex interaction between people's normative beliefs and their motivation to comply with the norms, as well as the source of those perceptions.

Parent personality and child outcomes in youth sport

Michael King, Travis Dorsch, Ryan Dunn, Lauren Prettyman, Utah State University

The majority of American youth participate in organized youth sport during childhood and/or adolescence (SFIA, 2017; USDHHS, 2017). Parents are active and necessary participants in this context, demonstrating a wide range of involvement behaviors. As such, organized youth sport can be an important setting for family interaction. A knowledge gap exists, however, regarding the role of parents' global personality characteristics and sport-related involvement behaviors. The present study was designed to explore the impact of parent personality characteristics on their involvement behaviors, and children's subsequent outcomes in youth sport. Athletes ranging in age from 10 to 17 years ($M = 14.25$; $SD = 2.64$), and their parents completed parallel surveys assessing perceptions of parents' Big-5 personality factors (i.e., openness, conscientiousness, extraversion, agreeableness, and neuroticism), perceived parental involvement (i.e., support and pressure), and children's sport-related outcomes (i.e., enjoyment, competence, and stress). Respondents from the national sample were athletes and their parents from a number of team (i.e., baseball, soccer, lacrosse) and individual (i.e., gymnastics, tennis) sports. Analyses for the present study were performed utilizing an observed variable mediated regression using Hayes' PROCESS SPSS add-in (Hayes, 2013). Results highlight a sequential relationship among parent personality factors, parent involvement, and children's outcomes in sport. The present analysis extends past work by assessing both the direct and indirect impacts of parents' global personality characteristics on salient developmental outcomes for children in organized youth sport. In doing so, it offers researchers and practitioners a potential antecedent to parent involvement in youth sport, as well as an opportunity to view child outcomes through a lens of the family context.

Investigating the possible positive effects of avoidance goals on goal attainment through effort

Keita Kinoshita, University of Ottawa; Eric MacIntosh, University of Ottawa; Shintaro Sato, Montclair State University; Terry Orlick, University of Ottawa

Understanding "what" people want to accomplish and "why" people do what they do is essential for human beings to guide the direction of their behaviors and goal attainment (Ryan & Deci, 2000). Using achievement goal theory (AGT) and self-determination theory (SDT), this study examined the combination of "what" (e.g., mastery and performance avoidance goals) and "why" (e.g., intrinsic and external regulation) on sport participant's perceived goal attainment. Past research has shown avoidance goals are associated with negative outcomes (Lochbaum & Gottardy, 2015). However, we predicted that avoidance goals would positively influence goal attainment via effort when goals are externally

regulated. Based on a sample of sport participants (N = 372), a moderated mediation analysis was used to test whether the level of intrinsic and external regulation moderated the indirect relationships between avoidance goals and goal attainment via effort. A conditional indirect effect of mastery-avoidance goals on goal attainment through effort was not significant at low ($B = -.01$, 95% CI = –.04 to .03), but significant at moderate ($B = .09$, 95% CI = .05 to .15), and high levels of external regulation ($B = .19$, 95% CI = .10 to .30). Similarly, a conditional indirect effect of performance-avoidance goals on perceived goal attainments through effort were non-significant at low ($B = .01$, 95% CI = –.03 to .03), but significant at moderate ($B = .09$, 95% CI = .05 to .13), and high levels of external regulation ($B = .17$, 95% CI = .10 to .26). The results suggest that avoidance goals are not always detrimental. However, increased goal attainment by the combination of avoidance goals and external regulation via effort would be an unhealthy way to improve athletic performance and could negatively affect athletes' well-being (Hall, 2006). Although it may not be ideal, the long-believed negative effects of avoidance goals on performance outcomes are now countered. This paper will discuss the possible positive effects of avoidance goals on goal attainment via effort.

Coaching climate, needs satisfaction, and personal and social responsibility among young soccer participants

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U.S. Youth Soccer is the largest youth sport organization in the United States with over three million participants, making soccer a prime avenue for influencing youth. Research on predictors of children's and early adolescents' positive outcomes can inform coaches how to help youth acquire the benefits of sport at a young age. Self-determination theory (SDT) states that social contexts (e.g., coaching climate) that support one's need for competence, autonomy, and relatedness (i.e., psychological needs) should optimize well-being, such as social development. Our purpose was to examine which dimensions of the coach-created motivational climate are associated with psychological needs satisfaction and, in turn, personal and social responsibility among youth soccer players. The participants, 249 youth soccer players (105 girls, 144 boys; M=10.7 years-old, SD=1.3), completed a survey of study constructs, and we used structural equation modeling to test the hypothesized model based on SDT. Results revealed an acceptable fit to the observed data. Several significant paths emerged: (a) greater perceptions of coach emphasis on cooperative learning were associated with higher perceived competence, autonomy, coach relatedness, and teammate relatedness, (b) greater perceived unequal recognition by the coach was associated with lower perceived coach relatedness, (c) greater perceived competence and coach relatedness were associated with higher reported personal responsibility, (d) greater perceived teammate relatedness was associated with higher reported social responsibility, and (e) perceptions of cooperative learning were positively and indirectly related to reports of both personal and social responsibility. Effect sizes ranged from medium to large (.17-.66). Results suggest that soccer coaches who create opportunities for teammates to learn from each other are likely to optimize young athletes' personal and social responsibility (e.g., work ethic, respecting others), through effects on perceived ability and feelings of connection with coaches and teammates.

Wearable technology to improve physical health of adults with chronic disease conditions: A systematic review and meta-analysis

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Background: Wearable health monitors (e.g., FitBit) have gained attention as viable tools for patient-centered monitoring; however, the extant research focuses heavily on healthy, free-living samples. This review evaluates randomized controlled trials (RCTs) that examined the effectiveness of wearable technology interventions to improve physical health among clinically-diagnosed populations. Search Strategy: Following Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) recommendations, electronic searches of five databases (MEDLINE, PsychINFO, Scopus, Web of Science, PubMed) were conducted. Inclusion/Exclusion Criteria: RCTs where wearable devices were employed for the full intervention duration with chronically ill adults were included; excluded were trials that used devices for part-interventions, medication administering devices, and/or trials with no prospective control group. Data Extraction: 31 studies with 4009 participants were assessed based on PRISMA guidelines, with study quality and RCT risk of bias evaluated with the Cochrane Collaboration Tool. Data Synthesis: Meta-analyses for calculating physical activity (PA) (e.g., steps/day) and selected physical dispersion/summary effects were conducted using raw unstandardized pooled mean differences. Sensitivity analyses based on intervention characteristics and chronic disease condition were examined. Results: Statistically significant increases in PA steps/day (MD = 2638 steps/day [95%CI: 1535, 3740]), MVPA min/week (MD = 53.31 min/week [95%CI: 27.15, 79.47]) and weight reductions (MD = –2.07 kg [95%CI: –3.15, –0.99]) were found in the intervention condition. Sensitivity analysis revealed greater effects for studies that 1) used secondary objective PA measures, 2) provided health-coach support, and 3) had interventions of shorter duration (4-16 weeks). Conclusions: Wearable devices appear to positively contribute to effective chronic disease management. Future research with updated wearable technology (e.g., FitBit, Garmin) will help amplify and refine these findings.

Understanding exercise challenges & solutions for older adults aging with a mobility impairment

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Adults over the age of 65 represented nearly 12% of the world's population in 2013, and are projected to reach 21% by 2050. According to the US Census (2016), 22.5% of adults between 65 and 74 years of age, and 32.6% over the age of 74, report having an ambulatory disability. Many of these individuals developed the mobility impairment earlier in life and are therefore aging *with* an impairment. To understand the challenges this population experiences with everyday activities, we conducted structured interviews with participants who identified as having had a mobility impairment prior to the age of 50 ($N = 57$; 60-79 years of age). We focus here on their exercise engagement, and their challenges and solutions. Interviews were transcribed and a thematic analysis was conducted. Swimming and resistance bands were the most commonly reported modes of exercise. Reported challenges to engaging in exercise included physical exhaustion, lack of stamina, issues with comorbidities (e.g., post-polio syndrome, multiple sclerosis), and difficulty accessing a gym or using gym equipment. Their solutions were evaluated in relation to the Selection, Optimization, and Compensation Model (Baltes & Baltes, 1990), a meta-theory that can be used to understand how older adults age-in-place. Reported solutions to exercise engagement included seeking assistance from others (e.g., physical therapists or specialized personal trainers), as well as modifying their behavior (e.g., pacing themselves or taking frequent breaks). Some participants reported an inability to exercise any longer, despite expressing a desire to exercise and/or find a better way to exercise that satisfies their needs and capabilities. The results provide insights into the nature of the exercise-related challenges experienced by individuals aging with a mobility impairment, as well as solutions that have been effective for them. These findings can be used to design and implement exercise

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interventions for adults aging with mobility impairment to support functional independence and quality of life.

Measurement of 'standard' and 'motivation held constant' self-efficacy in older adults

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Background: Self-efficacy (SE) is defined as the perceived capability to perform a behavior. However, the SE-as-motivation argument holds that standard operationalization of SE for physical activity (PA) may not only reflect perceived capabilities, but also the broader concept of motivation. Thus, assessment using the standard operationalization of SE may provide information for the identification of targets for PA promotion that is misleading. It has been suggested that holding motivation constant when assessing SE should lead to responses that differ from those of standard SE, and associations between SE and motivation that are weaker. Therefore, the purpose of this study was to examine the viability of the SE-as-motivation argument for PA among older adults. Methods: Adults aged ≥ 60 years (mean = 75), without severe cognitive impairment, were recruited from a fitness center, a retirement home, and a community center in Indiana. Participants ($N = 94$) were randomly allocated to one of two SE conditions [1- standard (*I can do . . .*) and 2- motivation-held-constant (*If I really wanted to, I can do . . .*)] using block randomization (block size = 16). A questionnaire was sent to each participant via postal mail. SE and intention were obtained using a 5-point Likert scale. Leisure-time PA was assessed using the Godin Leisure-Time Exercise Questionnaire. Results: ANCOVA, controlling for leisure-time PA and recruitment site, indicated no difference ($F(1,83) = .02$; $p = .89$) in SE responses between assessment conditions (standard SE: mean 3.44, $n = 46$; motivation-held-constant SE: mean = 3.42, $n = 41$). Additionally, the nature of the association between SE and intention (Pearson r [95% CI]) was not different ($Z = .21$; $p = .58$, one-tailed) across the standard (0.53 [0.29, 0.71]) and the motivation-held-constant (0.49 [0.21, 0.69]) conditions. Findings from multiple imputation analysis were similar to those from the complete cases ($n = 87$). Discussion/Conclusion: The current findings do not provide support for the SE-as-motivation argument in the context of PA among older adults.

"A place where I belong:" The experiences of people with disabilities in a community-based dance class at Canada's Royal Winnipeg Ballet School

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Physical therapies for adults living with disability are designed to focus on the immediate physical and psychological needs of the participant. There is limited availability of specialized physical activity (PA) programming that takes the unique needs of this population into consideration through true adaptation of movement and inclusion. The ExplorAbility program was developed at Canada's Royal Winnipeg Ballet School (RWB School) in 2009 and is designed for adults diagnosed with cognitive and/or physical disability. A thirty-week pilot study assessed program outcomes from both quantitative and qualitative perspectives. Here, the qualitative arm of the project explored the psychosocial experiences and outcomes of participation in the program. Eight adults participated in three, 10 week sessions. Social support was examined at three time points over the course of the program using a questionnaire which was developed to facilitate the communication needs of each participant. At the culmination of the program, social and psychological experiences of the participants and caregivers were explored using a guided interview process. Pre and post-test change scores were assessed on the psychometric tool. A thematic analysis was undertaken on interview data. Social isolation scores on the psychometric tool decreased over the course of the program. Participants distinguished between "real" versus "fake" inclusion; they felt that staff at the RWB School exuded a sense of genuine inclusion. Participants who had not previously had the opportunity to engage in public performances enjoyed the opportunity to "take the stage" as performers. The participants felt stronger and more graceful as a result of having the opportunity to participate in the class. Further, the program appears to be convenient and feasible in the context of their everyday lives. Our findings suggest that feelings of social inclusion might influence the desire to participate in dance for people with disabilities in a community based context. Further studies are needed to more thoroughly explore this question.

Using the Response to Challenge Scale (RCS) to measure self-regulation in toddlers during physically active play

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Physical activity (PA) is important for promoting healthy development in childhood, enhancing both motor skills and self-regulation. The Response to Challenge Scale (RCS) measures self-regulation during PA and has produced highly generalizable scores in PA intervention research with school-age children (Lakes, 2012, 2013a&b). The purpose of this study was to evaluate the utility of using the RCS to rate self-regulation in toddlers during play. Methods. Eighty-eight toddlers were video-recorded during a standardized 10-minute play interaction with caregivers. Eleven trained raters blinded to experimental conditions rated each toddler in a fully crossed research design. Raters independently completed the RCS, using 15 items in three domains of self-regulation: cognitive control (e.g., ability to maintain attention), emotion regulation (e.g., frustration tolerance), and motor control. Inter-rater reliability was evaluated using interclass correlation coefficients (ICC's), and scale structure was examined using principal components analysis (PCA). Results. When judged by Cicchetti's (1994) standards, the ICC's were fair to excellent (*ICC*'s = 0.579 - 0.824) for all items except perseverance (*ICC* = 0.317). Item ratings were aggregated across raters to create a single score on each item for each participant. PCA with aggregated scores revealed two components, which collectively explained 77% of the variance: 1) emotional regulation and motor control, and 2) cognitive control. Inter-rater reliability at the level of component scores and internal consistency alphas for subscales derived from these components were excellent (alpha's = .93, .95). Conclusion. This was the first study applying the RCS in toddlers. Subscale inter-rater reliability and internal consistency coefficients were excellent. Motor control and emotion regulation items were strongly correlated, which could reflect a theoretically important linkage between these constructs. Overall, results support further research using the RCS to rate self-regulation in toddlers during play.

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Cognitive and executive function measures used in pediatric exercise research: An analytical review

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There have been an increasing number of physical activity (PA) intervention and exercise studies investigating cognitive or executive function (EF) outcomes in children, but not all have shown significant improvements (Vazou et. al, 2016). Successfully documenting change depends a great

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deal on the measures selected for a particular study. Lakes & Hoyt (2009) illustrated how measurement error contributes to Type I research errors and described the strengths of a mult-method, multi-source measurement approach. The purpose of this study was to summarize and analyze the measurement approaches used in recent pediatric exercise and PA studies. We reviewed PubMed and PsychInfo, searching for keywords: physical activity, exercise interventions, children, cognition, and executive function. We reviewed recent meta-analyses and obtained all of the studies included in those reviews. We created tables summarizing intervention characteristics (e.g., type of exercise or PA, duration of intervention, intervention targets, participant age and gender) and measures, reporting psychometrics and sensitivity to change. Thirty-one intervention studies met inclusion criteria. These studies collectively utilized 52 measures of cognition or EF. Intervention outcomes varied substantially across measures and various domains of cognitive functioning. Reported psychometric properties (e.g., generalizability, reliability, validity, sensitivity to change) of scores obtained using these measures varied widely across studies. Domains shown to be improved after exercise or PA intervention included attention, inhibition, working memory, spatial memory, creativity, and perceptual speed. Conclusion. To advance research investigating the effects of exercise on children's cognition and EF, it is necessary to carefully construct robust measurement protocols. We provide researchers with an analysis of measures used in prior research as a resource to use when selecting measures and with recommendations addressing how to apply these measures in PA research.

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Effects of self-control exertion on mental fatigue and perceived exertion during whole-body exercise

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Exerting cognitive control leads to performance decrements on muscular and cardiovascular endurance tasks or increases ratings of perceived exertion (RPE) when task performance is maintained. RPE can be measured as a gestalt, overall, perception or separate ratings for differential domains such as muscular, respiratory, and mental exertion. The purpose of this study was to investigate physical performance and differential ratings of perceived exertion (dRPE) during a self-paced maximum distance cycling trial (MDT) following a short bout of mentally-fatiguing cognitive activity (suppressing the thought of a white bear; Wegner, 1987). Recreationally-active participants ($N = 16$, $Mage = 20.94$) completed one familiarization session and two testing sessions, each separated by ≥ 72-hours. Control and experimental trials were counterbalanced, with either a 6-minute bout of thought-logging (control) or a 6-minute bout of thought-suppression (experimental) performed prior to each respective MDT. Differential measures of RPE were obtained from three sensory domains (Leg-muscle, Respiration, Mental) at 30-sec intervals during exercise. Thought-suppression resulted in significantly higher ratings of mental fatigue than thought-logging ($p = 0.04$, $\eta p2 = 0.26$). Performance on the MDT was not significantly different between the thought-suppression and control conditions. However, leg-muscle RPE (RPE-L) was significantly higher during the MDT following thought-suppression ($p = 0.05$, $\eta p2 = 0.24$). RPE-R (respiration) and RPE-M (mental) ratings did not differ by condition. Results indicate controlling one's thoughts for brief periods of time may cause increased symptoms of mental fatigue, which can lead to higher than normal ratings of perceived leg muscle exertion during cycling tasks. Results suggest athletes should avoid thought-stopping or thought-controlling activities prior to practicing or competing in endurance events.

Emotion regulation interventions adapted to athletes' emotional performance objectives: A multiple baseline single-subject study of 4 tennis players

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The IZOF model (Individual Zone of Optimal Functioning; Hanin, 1997, 2000) suggests that athletes experience emotions and psychological states that can either help or hinder their performance. Identification of emotion intensity associated to optimal and poor performance and use of emotion regulation strategies to regulate them in the desired direction seems to have an effect on sport performance (e.g.: Robazza, Pellizzari, & Hanin, 2004). However, application of these types of psychological intervention based on IZOF model have been little tested with adolescent athletes until now. The objective of the present research was to implement individual emotion regulation interventions (self-talk or imagery) adapted to athletes' emotional performance objectives, with four tennis players ($n = 4$) aged between 13 to 16 years old based on the IZOF model. The following instruments have been used: a French translation of the list of emotions and physiological states by Robazza, Pellizzari and Hanin (2004), the Borg CR-10 (intensity of emotions and states), the Twenty-Item Toronto Alexithymia Scale, the Emotion Regulation Questionnaire, the Competitive State Anxiety Inventory-2 Revised, the Ottawa Mental Skills Assessment Tool and a subjective assessment of performance. A multiple baseline single-subject AB design was chosen in order to verify the effectiveness of interventions on pre and post competitive emotions and physiological states regulation, on anxiety, mental abilities and performance. Results at Wilcoxon test indicate a significant decrease of physiological states detrimental to performance' intensity measured after the games ($z = -2.09$, $p < .05$) for the group. Furthermore, results show an effect of interventions on mental abilities of every participants. Use of IZOF model combined with application of interventions adapted to the performance goals and emotional need of these athletes have been effective to help them regulate emotions and physiological states.

Exploring long-term behavioural consequences of early specialization in swimming among masters swimmers

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Although "Sport for Life" (2016) literature assumes coherent participation from youth to adulthood sport, surveys of masters swimmers demonstrate disjoint between youth and later competitive swimming in adulthood, with significant delays to rejoin swimming (Daughtrey, Vowles, & Black, 2011). While this could be due to external factors like finances, career, and family obligations, another possibility that has yet to be examined is that early specialization in swimming has deleterious and latent effects on masters participation. The purpose of this mixed-methods investigation was to examine the relationship between youth swimming experiences and adult swimming participation. In Part 1, masters swimmers ($N = 205$; age range= 18-85 yrs; 60% female) completed an online retrospective survey regarding their sport background, degree of early specialization in swimming, time off between youth swimming and masters swimming, and external obligations affecting this time off. Correlations showed a weak positive relationship between early specialization in swimming and time to return to masters swimming ($r = .27$), when controlling for external obligations. In Part 2, 20 survey participants (10 female) were purposefully selected for interviews to further explore how their youth sport experiences influenced their decision to participate in masters swimming. Several participants described needing to take time away from the pool due to

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burnout occurring as adolescents. They attributed their eventual masters participation to positive swimming experiences as young children or an enjoyment of swimming itself, despite negative experiences with youth competition and/or certain coaches. Participants who transitioned directly from youth into masters swimming, despite early specialization, reported strong relationships with coaches and teammates and felt good about their swimming abilities. Findings suggest that early specialization does impact transitions from youth swimming to masters swimming, but other aspects of the youth swimming experience may be of equal or greater importance.

The role of the coach in athlete emotional and motivational development

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In studying adolescent development in out-of-school activities, Larson and Brown (2007) found that program culture and adult leaders are strong influencers of adolescent emotional and motivational development. However, while sport offers multiple and powerful opportunities for these types of development, Larson and Brown's (2007) findings have not been examined in this context. This study was designed to extend Larson and Brown's (2007) conclusions by examining the role of the coach in athlete emotional and motivational development. Specifically, this study was designed to explore the link between coach philosophy and actions, and the congruency between the coach's actions and the athletes' perceptions of coach behavior. Semi-structured interviews were conducted with both a head coach (pre- and post-season) and five players (five times during season) from a high school varsity basketball team. Coach interviews centered around coaching philosophy and emotional and motivational development strategies. Player interviews focused on perceptions of their coach's actions. Results showed that the coach exhibited a high level of intentionality in addressing development across the season. Themes included: being organized, maintaining team culture, building athlete ownership, creating a family dynamic, role acceptance, and providing positive reinforcement. Athletes cited the coach's organization, the ownership he bestowed, and the team culture as keeping them motivated. Furthermore, the athletes cited the creation of close relationships and the coach's focus on role acceptance and recognition as helping them to learn emotional regulation strategies. The high congruence between the coach's approach and the athletes' view of the coach shows support for Larson and Brown's (2007) conclusions. Future research should examine a broader range of coach's influence, to examine whether this impact would be muted by coaches with a more negative affect or less knowledge about psychosocial development.

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The effects of acute exercise on driving performance and executive functions in healthy older adults

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The benefits of exercise on cognitive functioning in older adults are well established (Chang, Labban, Gapin, & Etnier, 2012; Colcombe et al., 2006; Erickson et al., 2011; Leckie et al., 2014). One limitation of the current literature is that researchers have almost exclusively relied on well-controlled laboratory tasks to assess cognition. Moreover, the effects of a single bout of exercise in older adults have received limited attention. The proposed study addresses these limitations by (1) introducing a more ecologically valid, real-life task relevant to the older population (i.e., driving), and (2) assessing the effects of an acute bout of aerobic exercise on driving performance and executive functioning. Seventy-one participants (M_{age} = 66.39 +/− 4.70 years) were randomly allocated to a 20 min cycling at moderate intensity or sitting and watching driving videos. Participants were then tested on their driving performance with three different scenarios assessing variables such as decision making, driving errors, reaction time, and attention. On a subsequent session, all participants performed a submaximal fitness test. This fitness test served as exercise and executive functioning was assessed before and after this exercise by counterbalancing two commonly used measures of executive functions: The Trail Making Test (TMT) and the Stroop test. Non-significant effects of exercise were observed on driving performance across all three scenarios. However, participants had a better performance on the TMT (Cohen's d = 0.25) and Stroop test (Cohen's d = 0.50) after exercise compared to before exercise. These results suggest that current laboratory results in exercise psychology do not transfer to everyday life functioning. These findings will be discussed in terms of challenges associated with the inclusion of more ecologically valid tasks, consideration of the type of cognitive functions assessed, and the importance of including expectation measures. Future research directions to advance the knowledge base in this area will conclude this presentation.

The immediate effect of ventilatory training on heart rate variability, during training and challenge

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Efficiency in performance during stress is a key skill all athletes and military personnel must excel in. One skill that has been identified to reduce stress is the use of battle-breathing (BB) training developed by Lewis et al. 2015. BB is slow paced diaphragmatic breathing that allows a conscious way to elevate parasympathetic activity. BB training can have a positive impact on performance and potential to acts an intervention treatment for stress disorders. The purpose was to investigate the immediate influence BB has on heart rate variability (HRV). To explore the effects breathing techniques have on the balance of parasympathetic and sympathetic influence, and cognitive-motor performance. Twenty young adults with no prior experience in ventilation training were recruited from the University of Maryland, College Park. The study required two visits by the participants, each visit was separated by seven days. Order of the conditions was randomized and counterbalanced. The Snake® game was utilized as the psychomotor task with two levels (Easy vs hard). Each visit participants underwent the easy condition followed by the hard condition. Then the participants underwent either the intervention condition (BB) or the control condition (coloring task) for 3 trials. Afterwards, the participants reattempted the hard condition. Findings for the study revealed an alteration of HRV between the two intervention conditions and a carryover effect after training. The BB group showed an increase in HRV through an elevation of parasympathetic activities compare to the control condition. During the posttest after BB participants maintained elevated parasympathetic activity when performing the task. The results of the study suggested individuals without prior ventilation training could elicit an acute effect of altering the state of their autonomic nervous system. Furthermore, the results support the use of BB as a performance enhancement strategy to reduce stress and as a treatment method for individuals with high anxiety disorders.

The effect of moderate intensity continuous exercise training on high interference memory in young adults

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Physical exercise promotes hippocampal neurogenesis and improves associated memory function. One aspect of memory function that is

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believed to be dependent on hippocampal neurogenesis is high interference memory, whereby newborn cells form distinct memory representations for highly similar items. High intensity interval training has been shown to improve high interference memory in young adults. However, little research has investigated how these specific memory benefits transfer across different exercise intensities. The purpose of the present study was to examine the impact of moderate intensity continuous training on memory in sedentary young adults. Fifty-five participants were randomly assigned to either a moderate intensity aerobic exercise condition or a non-active control condition for nine weeks. The Mnemonic Similarity Task was used to assess high interference memory and general recognition memory at baseline and after the intervention. High interference memory improved following moderate continuous exercise training compared to the control condition ($p < .05$). However, no changes in general recognition memory were observed in either condition ($p > .05$). This selective memory benefit following exercise may be due to the up-regulation of hippocampal neurogenesis; a process that general recognition memory is less dependent on. These findings suggest that moderate continuous exercise is also a suitable intensity to improve high interference memory, providing individuals an alternative to high intensity interval training.

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A qualitative approach to identifying how mental toughness is characterized by high school coaches

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Consistent with positive youth development research and theory (e.g., Lerner et al., 2005,2006), mental toughness is comprised of the reduction of negative behaviors, cognitions, and emotions and the promotion of strength, engagement, competencies, and thriving (Gucciardi et al, 2009a; Jones et al., 2007). To date, the majority of literature on what constitutes mental toughness has been on populations of collegiate, elite or professional athletes. Little research has been conducted on high school athletes, which may differ from the older populations frequently studied. Coaches play a significant role in developing and maintaining athletes' sporting attitude, competence, and performance (Chelladurai, 2007). Thus, the purpose of this project was to qualitatively examine high school coaches' perceptions of how mental toughness is defined for a high school athlete and qualities that might separate a mentally tough from a mentally weak athlete. A total of 15 high school coaches of team sports from southern California participated in semi-structured interviews lasting approximately 40 minutes each. In terms of defining mental toughness, coaches noted it was hard to quantify but explained it is how an individual reacts to adversity and described it as a continual process to achieve. Mentally tough athletes were described as mature, confident, focused, coachable, consistent, having a strong work ethic, growth mindset, emotionally composed, desire to improve, and taking a team approach to helping others. Mentally weak athletes were described as being defensive, showing poor body language, lack of confidence, having a fixed mindset, and emotional unstable. Coaches reported that mental toughness is not always related to successful performance but for distinguishing factors of mental toughness, the role of parents and family dynamics plays a part in mental toughness development. Further research is needed on examining mental toughness development and strategies to improve this characteristic at the high school level.

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Examining the psychometric properties of the MTS in high school athletes

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To date, multiple measures have been developed to assess mental toughness in sport, for example the MTQ48 (Clough, Earle, & Sewell, 2002), SMTQ (Sheard, Golby, van Wersch, 2009), MTI (Gucciardi, Hanton, Gordon, Mallett, & Temby, 2015) and MTS (Madrigal, Hamill, & Gill, 2013). These measures have exhibited evidence of good reliability and for convergent and discriminant validity in adult populations, however, it is unknown whether they are appropriate for younger populations. The current research examined the factor structure, convergent, and discriminant validity, and reliability of the MTS in adolescents. A total of 333 athletes (138 male; 182 female), mean age 15.24 (SD = 1.06) completed an on-line survey in their high school PE classes measuring health behaviors, psychosocial maturity, academic achievement and extracurricular activities, and mental/physical health outcomes. Results of a CFA using the full 11-item scale indicated poor model fit, DF = 44; $\chi 2$=925.92; CMIN/DF = 21.04; CFI=.78, RMSEA=.25 (.24-.27), PCLOSE=.000; TLI=.72, SRMR=.16. Based on modification indices and standardized residual covariances, several items appeared problematic (1, 2, 3). Those items were removed and the model fit improved, DF = 17; $\chi 2$=25.10; CMIN/DF = 1.48; CFI=.98, RMSEA=.04 (.00-.07), PCLOSE=.69; TLI=.99, SRMR=.02. The 8-item MTS showed good reliability (Cronbach's alpha = .96). The MTS demonstrated evidence of convergent validity through significant correlations with self-reliance, self-esteem, and personal responsibility (respectively, r = .16, .30, .15, p <.05). Discriminate validity was established through non-significant relationships between the MTS with shame, social commitment, height, weight, and GPA (p >.05). The revised 8-item MTS may be an appropriate tool to assess mental toughness at the high school level, however further work is needed to determine if semantic changes can be made to the original 3 items of the MTS to better fit the high school athlete.

Self-efficacy and body weight satisfaction predict physical activity and sedentary behaviors in HIV positive adolescents and young adults on art

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Mediating effects of exercise self-efficacy and body image satisfaction on physical activity and sedentary behaviors of children and adults are well known. However, this relationship is relatively unknown for individuals living with HIV and on antiretroviral therapy (ART). While ART leads to significant improvements in health and well-being, the long term effects of living with HIV on exercise efficacy, body image perceptions and physical activity (PA) remain relatively unknown. We report findings on the relationship among self-efficacy, body weight satisfaction, PA and sedentary behaviors in HIV positive adolescents and young adults on ART from a larger study on PA, fitness, cognition and HIV. A total of 250 HIV+ and HIV- adolescents and young adults (138 females) aged 12-23 years (Mean = 17.87, SD = 2.24) participated in the study. The HIV+ group (n = 88) was part of a previous 12-month ART and nutrition intervention study and were being followed after eight years. The HIV-negative group (n =162) was a randomly selected cohort of public high school students from the Gaborone school district in Botswana. Participants' height and

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weight were measured. PA self-efficacy (PASE), daily PA (DPA), vigorous PA (VPA), sedentary behaviors and body weight satisfaction (BWS) were obtained from a self-administered Youth Health Risk Behavior Survey. Controlling for age, gender and body mass index, we used logistic regression models to compare HIV+ and HIV- participants on PASE, DPA, VPA, BWS, and sedentary behaviors. Higher PASE was predictive of DPA, VPA but not associated with sedentary behaviors (TV, computer and video games). Underweight and normal weight participants were more likely to engage in DPA and VPA than overweight and obese participants. No significant differences were found between the HIV+ and HIV- group on all the factors. Incorporating efficacy beliefs and positive body image into PA promotion could be beneficial to people living with HIV/AIDS.

Funding source: University of Botswana.

The relation of physical activity, aerobic fitness and cognitive function in HIV+ adolescents and young adults on art

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Access to antiretroviral therapy (ART) has led to improvement in wellbeing and higher life expectancy for individuals living with HIV. Evidence supports that physical activity (PA) is positively related to cognitive performance. However, knowledge gaps remain on the relationships between PA, fitness, and cognitive function in HIV. The purpose of this study was to examine these relationships in a sample of 88 HIV+ adolescents (n = 88, M=18.65 yrs) from a previous 12-month ART and nutrition intervention study. Participants completed the Youth Health Risk Behavior Survey to assess daily moderate to vigorous (DPA), the Progressive Aerobic Cardiovascular Endurance Run (PACER) to assess fitness, and the Stroop test to measure cognitive performance. The Stroop test required participants to identify the color of a stimulus during three conditions: color dot (color), word in colored ink (word), color name in colored ink (color/word). Response time (RT), errors, and an interference score of color/word-word was calculated as a measure of executive function (EF). Repeated measures ANOVA and regression analyses were used. For RT in all Stroop conditions, performance was not significantly influenced by DPA. However, interference RT was significantly predicted by fitness. More fit individuals demonstrated better EF. For errors, there was a significant interaction of condition by DPA. Errors increased significantly from word to color/word for the DPA groups but not for the no PA group. Results suggest that in HIV+ adolescents on long-term ART, fitness is predictive of better EF, however increased levels of DPA are associated with more errors on a task requiring EF. As the first study exploring these relationships in HIV+ adolescents, these counter-intuitive results are difficult to interpret, but suggest that HIV+ adolescents may benefit more from moderate intensity activities that improve fitness while not challenging the immune system through VPA.

Funding source: University of Botswana.

Expanding our understanding of knowledge and beliefs about chronic pain and exercise among physiotherapists

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Twenty percent of adults experience chronic non-cancer pain. Although exercise is an evidence-based treatment, resulting in better pain management and improved function, most adults struggle to exercise. Physiotherapists are identified as key professionals who can promote exercise via client counselling. Yet, very little is known about psychosocial factors that are predictive of their intention to counsel. The study purpose was to examine whether physiotherapists' chronic pain knowledge, fear avoidance beliefs about exercise, and self-efficacy to counsel predicted their intention to counsel their clients on chronic pain and exercise, after controlling for years of physiotherapy practice. Participants were 64 Canadian physiotherapists who completed an online survey assessing pain knowledge, fear avoidance beliefs, self-efficacy, and intention to counsel. A two-step hierarchical multiple regression predicting intention was conducted to examine the purpose. Step 1 controlled for physiotherapists' years of practice. Step 2 included psychosocial variables that were significantly correlated with intention. These included fear avoidance beliefs ($r = -.35$, $p < .05$) and self-efficacy ($r = .69$, $p < .01$). The overall regression model was significant (R2 adjusted = .46, $p < .001$), with self-efficacy to counsel being the sole significant predictor of intention (beta = .66, $p < .001$). Findings offer novel insight that higher confidence to counsel predicted greater intention to counsel clients on chronic pain and exercise, even after controlling for years of physiotherapy practice. Given these promising findings, future research should examine whether intention predicts actual counselling over time and, if so, whether intention mediates relationships between self-efficacy and counselling. Research should also examine whether counselling by physiotherapists predicts exercise adherence over time among their clients.

The effect of degree of interpersonal synchronization on synchrony-induced pain threshold changes

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Interpersonal synchrony has been shown to affect a wide variety of pro-social outcomes (Chartrand & Lakin, 2013; Morgan et al., 2017). One possible mechanism for this is the finding that acting in synchrony with others results in an elevated pain threshold (Cohen et al., 2010). Pain threshold is understood to be an indicator of endorphins, which are believed to be related to/cause pro social activities. Although previous research has shown that the effect of synchrony on pain threshold is robust, the research paradigm is based on individuals acting in synchrony but does not assess how well synchronized their actions are. The current study assessed the degree of synchrony between actors to see if it was correlated to pain threshold change induced by the activity. Thirty-nine individuals rowed on ergometers in two counterbalanced conditions – solo and synchronized with a partner. Pain threshold was taken immediately prior to and after the activity. Degree of synchrony was assessed using a Microsoft Kinect Sensor V2, which measures the movements of both partners in three-dimensional space at specific joint markers of the body. A repeated measures t-test revealed that there was a significant difference in pre-post pain threshold change between the two conditions (t (38) = -2.16, $p < .05$) whereby the change in pain threshold for the individual condition ($M = -8.46$, $SD = 32.14$) was significantly lower than that in the synchrony condition ($M = 8.41$, $SD = 51.89$). However, the change in pain threshold seen in the synchronized condition was not significantly correlated with any degree of synchrony between the partners. Therefore, it appears that the effect of synchrony on pain threshold is independent of how well synchronized the actors are. This finding could have significant implications for the application of synchrony towards social outcomes.

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The influence of parental support and pressure on youth sport passion

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Vallerand and colleagues (Vallerand et al., 2003) postulated the dualistic model of passion. In this model, if individuals develop passion for an

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activity it is internalized in one of two manners. If an individual develops harmonious passion, the activity is aligned with other aspects of their life and is well-integrated into their identity. Conversely, if obsessive passion develops, the activity takes a disproportionate percentage of an individual's identity and may cause conflict with other life domains. Research has supported this model and shown that, typically, harmonious passion leads to more positive outcomes than obsessive passion. Even though research has supported the dualistic model, relatively few studies have investigated which constructs are related to sport passion, particularly in youth athletes. One construct that may influence the type of passion youth develop is parental feedback. Specifically, whether youth perceive parental feedback as supportive or as increased pressure could influence whether harmonious or obsessive passion develops for sport. Therefore, the purpose of the current study was to investigate the relationship between youth passion and youth perceptions of parental support and pressure. Ninety-five youth completed the passion scale and a survey assessing perceptions of parental support and pressure for both their father and mother, with 11 participants indicating no sport participation outside of summer camps. Analyses of the 84 youth athletes who participated in sport outside of camps indicated a high level of general passion for their sport. Additionally, youth scored high on harmonious passion (M = 5.09), moderate on obsessive passion (M = 3.15), and perceived high levels of support and moderate levels of pressure from both their father and mother. Finally, parental support from both mother and father strongly correlated to harmonious passion while perceived pressure from the father positively correlated to obsessive passion. Discussion will center on general application and future directions.

Funding source: NA.

Does recess quality matter? Differences in physical activity, student engagement, and student perceptions

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Over the past decade, considerable attention has been focused on the implications school-based recess may have on child development. As recess remains a topic of conversation in policy decisions, there is a need to consider the quality of this environment. The purpose of the current study was to examine differences in high and low quality recess periods. Group level data were collected during 61 recess periods across 13 urban schools. Physical activity (PA) data were collected using the Fitbit Flex, a wrist-worn accelerometer, during 57 of the 61 recess periods and included 3,985 students. Engagement in various types of games and play activities was coded using the Activities of Daily Living – Playground Play at 60 of the 61 recess periods and included 4,435 students. Psychological need satisfaction in recess PA surveys were administered to 820 4th and 5th grade students. The Great Recess Framework - Observational Tool (GRF-OT), a tool that measures safety and structure, adult engagement and supervision, student behaviors, and transitions at recess was used to assess the quality of recess. Recess session with a score greater than the sample median were classified as high quality recess session. Data showed that students in a high quality recess were significantly more likely to engage in light PA (37% vs 33%; $p = .039$), significantly more likely to be engaged in playground activities (74% vs 59%; $p < .001$), and reported feeling significantly more safe ($p < .001$) than students in a low quality recess. A trend towards lower levels of sedentary activity in a high quality recess were found when compared to a low quality recess (13% vs 17%; $p = .078$), which was more pronounced in female students (14% vs 19%; $p = .045$). No differences were found in levels of moderate-to-vigorous PA or psychological need satisfaction. Findings from the current study suggest a high quality recess is an important facet to consider in order to facilitate desired outcomes, and should be considered when planning and evaluating school-based recess.

Funding source: Playworks Education Energized.

Examining the relationship between falls self-efficacy and postural sway in community-dwelling older adults

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The most common cause for both fatal and nonfatal injuries in older adults is experiencing a fall. Identifying variables that may help predict a person's likelihood of falling is essential towards informing fall prevention interventions. There are two independent approaches, psychosocial and biophysical, that examine fall predictors and outcomes. Psychosocial approach focuses on mental states, such as fall self-efficacy, a person's confidence in their ability to perform activities of daily living without falling, as a fall predictor. Whereas the biophysical approach focuses on physical performance, e.g. postural sway, generally quantified by deviations from a person's center of pressure while standing in a static posture. Previous research has explored the relationship between fall predictors on fall outcomes but rarely explores the relationship two predictors have on one another and how, together, these predictors influence falls risk. The purpose of this study was to examine the relationship between common fall predictors, fall self-efficacy and postural sway, in community-dwelling aging adults to further understand fall risk assessment. Ambulatory, community-dwelling adults (n = 107, mean age 73.8, + 7.95, female=80) were recruited from senior centers across San Diego County. The Modified Falls Efficacy Scale was used to measure fall self-efficacy and the BTrackS balance assessment system was used to measure postural sway in both an eyes open and eyes closed condition. A moderate negative correlation was found between falls self-efficacy and eyes open postural sway ($r = -.403$, $p < .001$.), indicating that as a person's self-efficacy score increases, their sway decreases. These findings suggest that there could be an underlying relationship, possibly a mediating effect, between these two fall predictors. Exploring this further may lead to a better understanding of falls prediction and inform more accurate prevention interventions. Future research should further examine this relationship with respect to falls as an outcome.

Investigating the role of tonic and phasic locus-coeruleus activation in modulating cognition following acute exercise

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Because the locus-coeruleus norepinephrine system is involved in alertness and attention, the emerging perspective is that activation of this system may underlie enhancements in cognition that occur following the cessation of acute bouts of exercise. To date, however, we have little understanding to what extent activity in the locus-coeruleus is modulated following exercise. To this end, the current study utilized pupillometric measures to assess modulations in both tonic (i.e., baseline) and phasic activation (i.e., task-evoked) of the locus-coeruleus in response to a modified flanker task. Pupillometric assessments were performed in a sample of college-aged young adults prior to and following a single bout of moderate intensity aerobic exercise or an active control condition during two separate, counterbalanced sessions. Analysis of behavioral performance replicated the previous acute exercise literature. However, findings revealed no exercise-induced modulations in either baseline pupil size (as an index of tonic locus-coeruleus activation) or task-evoked pupillary reactivity (as an index of phasic locus-coeruleus activation). These findings suggest that activation of the locus-coeruleus does not appear to be modulated following a bout of

acute exercise. Therefore, the locus-coeruleus norepinephrine system may not underlie the cognitive enhancements observed following exercise. Investigating the neurobiological mechanisms underlying exercise-induced enhancements in cognitive function is essential for determining how best to optimize physically active behaviors to maximize the influence on these mechanisms for cognitive health and function.

Exploration into the barriers and facilitators of exercise adherence behaviours in patients with persistent musculoskeletal pain

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Introduction. Persistent musculoskeletal (PMSK) pain is defined as pain of the axial skeleton that persists longer than three months. Sedentary lifestyles and the aging population have resulted in current prevalence rates being on the rise; osteoarthritis and low back pain being two of the most common. Active treatments, such as exercise prescribed by a physiotherapist, have been found to be an effective course of treatment. However, the majority of patients do not adhere to their prescribed exercise. Understanding the barriers and facilitators of the behaviour would provide crucial insight to aid in the development of a behaviour change intervention. However, research is minimal. This study aimed to explore the factors influencing exercise adherence behaviour from both the perspective of PMSK pain patients and those treating them. Methods. 20 semi-structured in-depth interviews were conducted on patients with PMSK conditions (6 low back pain, 4 fibromyalgia, 3 shoulder, 3 hip, 2 osteoarthritis, 2 knee) and 3 focus groups with health professionals in the UK. Topic guides were informed by past literature about adherence to exercise. Data was analysed using framework analysis. Results to date. The Theoretical Domains Framework was utilized to develop the analysis framework. To date, preliminary themes have been identified. Lack of specification of prescription, pain levels, infrequent appointments and past physiotherapy interventions have been identified as areas impacting adherence levels. Conclusions. The TDF has helped elicit a wide range of potential determinants of adherence. Themes and sub-themes will continue to be analysed and organized. Findings will be used to inform further research and in the development of a behaviour change intervention utilizing the intervention mapping protocol.

Cycling as a means of improving inhibitory control and maintaining brain function and academic performance in 9- to 10-year-old children

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Acute aerobic exercise has demonstrated positive effects on inhibitory control in children. However, regarding academic performance and underlying neural mechanisms during and following acute exercise, the evidence is not well established. The aim of the present investigation was to examine the effects of moderate stationary cycling on academic achievement and event-related potentials (ERPs) during an inhibitory control task in 9- to 10-year-old children. Children (n = 34) completed a standardized math and reading test (WRAT3) and a hybrid no-go/flanker task (assess attentional and motor inhibition) on two separate counterbalanced days (i.e., cycling, seated rest). Math and reading were assessed during cycling and seated rest while task performance and the P3 ERP component were assessed during and after both conditions. Although results revealed no change in math and reading during cycling, greater overall no-go/flanker accuracy was observed during and after cycling compared to seated rest. Additionally, a decrease in P3 amplitude was observed during cycling and after seated rest compared to during seated rest, suggesting greater temporal reductions in P3 amplitude across the rest condition compared to the cycling condition. Collectively, results demonstrate improvements in inhibitory control during and after cycling without decrements in neuroelectrical underpinnings of attention and performance on math and reading tests. Together, acute moderate bouts of cycling may be an effective exercise modality for improving aspects of inhibitory control that facilitate behavior in children. Such findings have implications for promoting acute bouts of aerobic physical activity in the classroom by improving behavior without interfering with academic endeavors.

The effects of colors on gaze behavior in soccer penalties

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To date, a copious amount of research - often embedded in the influential color-in-context-theory by Elliott and Maier (2012) - has shown the presence and importance of color-effects in a wide variety of sport contexts, e.g., for soccer penalties (Greenlees, et al., 2013). However, these studies often focus solely on psychological and outcomes parameters, and neglect to investigate the underlying processes, such as changes in (visual) behavior or (physical) performance. Following the soccer penalty setting of Greenlees et al. (2008), this study aimed at examining the effects of colors on gaze behavior and physical performance. Based on an a priori power analysis sample size was set to 30 participants. Participants performed a rating task while wearing an eye tracking system that measured the duration per fixation, total duration of fixations and the total number of fixations. During this task, participants had to rate 40 pairs of soccer goalkeepers displayed side-by-side in differing colors (red, blue, yellow, green, and grey) individually on five criteria (e.g., aggression, speed). Before and after the rating task, each participant performed two maximum wall-sit tasks against a video opponent, displayed wearing either a red or a blue jersey (order counterbalanced). Before the task, the participants had to report their expected wall-sit performance. Results showed no significant color-effect for gaze behavior, F (4, 116) = 0.65, p = .63, partial eta^2 = .02, and maximum wall-sit performance, $t(29)$ = -1.70, p = .10, Cohen's d = 0.31. Furthermore, no differences were observed for either the expected wall-sit performance or the rated criteria. These findings allude that colors do not appear to influence gaze behavior. In addition, this study (using a different task as Dreiskämper et al., 2013, or Briki et al., 2015) was not able to replicate the effects of colors on physiological performance. These results indicate that more research is required to gain insight into the actual underlining mechanisms of colors-effects.

Differential effects of aging and aerobic fitness on memory

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The present study examined the differential effects of aging and fitness on memory. Ninety-five young adults and eighty-one older adults performed the Mnemonic Similarity Task to assess high-interference memory and general recognition memory. Age-related differences in high-interference memory were observed across the lifespan ($p < 0.001$), with performance progressively worsening from young to old. Age-related differences in general recognition memory were not observed between young and older adults ($p = 0.28$). However, a decline in general recognition memory was observed within older adults after the age of 60 ($p = 0.02$). Furthermore, older adults with higher aerobic fitness had better high-interference

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memory ($p = 0.035$), suggesting that exercise may be an important lifestyle factor influencing this hippocampal-dependent aspect of memory. Overall, these findings suggest different trajectories of decline for high-interference and general recognition memory, with a selective role for physical activity in promoting high-interference memory.

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Shifting the mirror: Meta-perceptions, body image and objectification predict social physique anxiety - And clothing matters

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In addition to increased culpability, recent shifts from cultural practices of sexual objectification point to the importance of reducing appearance-monitoring. To this end, adopting an observer's perspective can disrupt an individual's stream of consciousness, consume attentional resources, impair performance or even lead to mental health disorders. Social physique anxiety (SPA), a known correlate of disordered eating and depression stems from internalizing perceptions including clothing-based- and meta- perceptions. This study examined body image (BI) and objectification as predictors of SPA. Female D1 and D3 collegiate athletes (N = 87) ages 18 to 24 (Mage=19.5+1.41) from fourteen sports categorized as aesthetic, team, team-contact, individual and track and field, completed a battery of surveys including current and ideal BI related to clothing (i.e., daily clothing, midriff, full uniform) and meta- perceptions (i.e., perceived BI dissatisfaction of parents, teammates, coaches), the SPA Scale and the Self-Objectification Questionnaire. BMI was derived from measured height and weight. Perceived BI was greater than ideal BI in all clothing-based and meta-perceptions except MP-teammates. D3 players were older, taller and heavier than D1 athletes. Aesthetic sport athletes had greater SPA than team-contact. Bigger athletes had higher SPA, greater clothing-based, but lower than MP-teammates dissatisfaction. BMI positively correlated with MP-coach, practice and game-day attire, but not with Objectification. SPA positively correlated with all clothing types. BMI (5.7%), BI-practice (23.8%), Objectification (7.4%) and MP-teammates (3.3%) predicted SPA explaining 40% of SPA variance. Teammates may help to buffer SPA. These findings illuminate possible causes and consequences of ubiquitous, unrealistic standards of appearance. To minimize objectification and associated SPA, athletes should be encouraged to shift their appraisals from third- person ("how do I look") to those that are first-person, non-appearance related ("what am I capable of").

A systematic review of acute sports-related concussion assessments

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The clinical and behavioral manifestations of concussion are highly heterogeneous and as such, reliable, objective measurements and protocols are needed to accurately identify and track concussion symptomology. Given the many different assessments currently available to assess concussion, healthcare professionals and researchers face the challenge of choosing the most appropriate assessment to effectively identify relevant concussion symptoms and follow the time course of injury. The aim of this systematic review is to identify the different acute concussion assessments that have been used in a research context and highlight the differences and similarities of the most widely used assessments. The goal is to aid researchers and clinicians in identifying which of these assessments are most appropriate for their population and that evaluate domains of interest. Consistent with the PRISMA guidelines, a systematic search was conducted using five databases. A total of 32 studies met inclusion criteria. Six assessments were used 3 or more times across these studies. A total of 3,829 participants were included between the ages of 9-67 years. Only 479 female participants were included, suggesting that future studies need to address this major discrepancy. The vast majority of studies assessed adults, with 6 or the 32 studies including children (<12 years) and 3 including young children (<10 years). The majority of the common assessments evaluate concentration and visual attention, memory, processing speed, and symptoms scores. However, fewer assessments evaluate differences in movement (e.g., balance, gait, or eye movements). Moreover, differences in the impact of concussion on different cognitive and motor domains must be evaluated across age and sex, as most of these measures have only been evaluated in adult males. Based on this review, future research should aim to validate these assessments across all phases of injury, as well as across different populations and developmental levels.

Comparing exercise class ownership and autonomy support among university group exercise class participants

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Exercise class ownership has been positively associated with physical activity enjoyment, exercise empowerment, as well as caring. task-involving, and autonomy supportive climates, and negatively associated with an ego-involving climate (Moore & Fry, 2014; 2017). Questions have been raised regarding the distinction between class ownership and individuals' basic psychology need for autonomy satisfaction. Therefore, the purpose of this study was to examine the relationships of class ownership and autonomy need satisfaction with each other, plus with engagement with challenge (EwC) and future intentions to exercise. Half-longitudinal data was collected from University exercise class participants (N = 448; 52% female) during week 6 and 13 of semester long exercise classes. Measurement invariance testing was passed supporting the measurement quality of all constructs across gender. Structural equation modeling revealed significant heterogeneity in variances and means across genders. Furthermore, and the focus of this study, the correlational patterns of class ownership and autonomy need satisfaction had no significant correlation with each other at week 6, and a small to moderate correlation at week 13 (Male = .49, Female = .38). At week 6, autonomy need satisfaction was significantly, positively correlated with EwC, whereas only among females was ownership significantly, positively correlated with EwC. By week 13, ownership and autonomy satisfaction were both positively, significantly correlated with EwC. Both were also significantly, positively correlated with future intentions, except among females. Importantly, the magnitude of the correlation between participants' future intentions and ownership was significantly stronger than the correlation with autonomy among females. The lack of a strong correlation between ownership and autonomy, as well as the different correlation patterns provide supporting evidence that these two constructs are distinct and add unique information to the exercise psychology literature regarding exercise class participants' experiences.

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Athletes' self-compassion, emotion regulation, and pre-competition appraisals and emotions

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Self-compassion is associated with adaptive outcomes in sport and can attenuate negative responses (Ferguson et al., 2015; Mosewich et al., 2013). The purpose of this study was to explore self-compassion as a prospective predictor of key variables relevant to psychological

preparation for competition in sport: emotion regulation and pre-competition appraisal, emotions, and stress. Varsity athletes (N = 106; age: M= 20.59 years; SD= 1.67) completed self-compassion, emotion regulation strategies, and ideal pre-competition emotions surveys 4-5 days prior to a competition. Approximately 1 hour prior to the competition, athletes completed additional surveys assessing current appraisals and emotions. Self-compassion is related to use of adaptive emotion regulation strategies, evidenced by significant (all ps<.01) positive relations with acceptance (r= .39), positive refocusing (r= .38), planning (r= .37), positive reappraisal (r= .41), and perspective taking (r= .46) and negative relations with self-blame (r= -.33) and catastrophizing (r= -.49). Self-compassion assessed 4-5 days prior to competition was positively related to challenge appraisal (r= .36) and confidence (r= .50), and negatively related to threat appraisal (r= -.36), somatic anxiety (r= -.33), cognitive anxiety (r= -.36), and stress (r= -.35) immediately prior to competition. Athletes higher in self-compassion reported higher levels of positive (r= .27) and lower levels of negative (r= -.37) pre-competition emotion. Further, athletes higher in self-compassion appraised their levels of positive pre-competition emotion as more facilitative (r= .29), and reported less discrepancy between their actual and ideal levels of negative pre-competition emotion (r= -.21), suggesting an ability to emotionally regulate. Self-compassion predicted unique variance in challenge and threat appraisals, cognitive anxiety, and confidence beyond the assessed emotion regulation strategies. From an applied perspective, there is support for promoting self-compassion in the pursuit of adaptive pre-competition appraisals and emotions.

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What and why young female dancers image

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Although dancers have been found to use imagery and imagery is believed to be a fundamental aspect of dance training (Adair, 1992), adult dancers have been the sample examined, overlooking young dancers' use of imagery. Given young athletes' use of imagery has been found to vary by age and gender (Munroe-Chandler et al., 2007), we cannot assume young dancers' imagery use is identical to that of adults. As such, the present study qualitatively examined *what* and *why* young dancers are imaging. Twenty-three female dancers (Mage = 10.43, SD = 2.19) from various dance styles participated in one of four focus group discussions. Thematic analysis revealed findings similar to those identified in both the adult dance and children's sport domain (i.e., types of imagery). There were findings, however, specific to young female dancers. For instance, feedback imagery, which refers to images of corrects given by teachers and critiquing one's performance, emerged from the young female dancers. Furthermore, fixing and avoiding mistakes were classified as cognitive reasons for engaging in imagery, a finding not reported in previous research with professional adult dancers (Nordin & Cumming, 2005). The present study provides avenues for both theoretical and applied future research.

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Attentional focus manipulations on affective, exertional, and physiological responses to maximal exercise

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Cognitive strategies, such as attentional focus manipulations, have been employed to improve affective responses to exercise, which highlight their potential for bolstering exercise adherence. Directing one's attention away from (dissociation) rather than towards (association) physiological sensations during exercise has been suggested as a way to improve affective responses and make vigorous exercise feel less strenuous. However, the effectiveness of such attentional strategies on altering the subjective experience of exercise at various intensities remains unclear. The aim of this study was to investigate the effects of manipulating attentional focus on affective, exertional, and physiological responses during and after exercise to exhaustion. The attentional manipulations included association (interoceptive awareness), dissociation (self-selected film), and neutral focus manipulations. Using a within-subjects design, 26 young adults (20.4 +/– 1.8 years) completed an initial aerobic fitness test (VO2 peak) to determine maximal aerobic fitness and ventilatory threshold (VT), followed by three experimental conditions performed on separate days. Affective valence and arousal, perceived exertion (RPE), and heart rate (HR) were assessed at various intensities (80% VT, 90% VT, 100% VT, 105% VT) during exercise and immediately, 5-min, and 10-min following exercise. There were no significant main effects or interactions by condition for valence, arousal, perceived exertion, or HR during exercise, $ps > .05$. Following exercise, there was a significant condition x time interaction that approached significance for positive affect, $F(6,20) = 2.4$, $p = .06$, $ES = .42$, indicating lower positive affect for the dissociation condition relative to the association and control conditions. These findings suggest that affective, exertional, and physiological responses to exercise are relatively stable during exercise despite attentional manipulation, and add to existing theoretical models regarding intensity-dependent effects on these psychophysiological variables.

Mental health literacy in university coaches and athletic therapists

Jessica Murphy, Philip Sullivan, Brock University

Evidence shows physical activity can protect against negative mental health (MH), however, recent reports show that competitive athletes, and more specifically student athletes are just as, or more likely to experience MH issues as non-athletes (Breslin, Donnelly, Haughey & Leavey, 2017; Sullivan, Blacker, Murphy & Carney, 2017). Mental health literacy (MHL), the knowledge and attitudes regarding MH that aid in recognition, management and prevention of MH issues, could help maintain positive MH within the athletic community (Breslin et al., 2017). As coaches and athletic therapists interact most with athletes, this study focuses on the MHL of university-level athletic staff. Head coaches and athletic therapists from Canadian universities were contacted via an email with pertinent study information and a link to an online demographics form and MHL Scale (O'Connor & Casey, 2015). Seventy-six participants, 24 females and 50 males (two failed to disclose gender) completed both measures. The average age was 44.16 (11.06); 54 (71%) identified as coaches, 19 (25%) as athletic therapists, and two as "other". Average MHL score was 128.83 (10.18); this is relatively equal to scores seen in university students (M=127.38, SD=12.63) (O'Connor & Casey, 2015) and a general sample from an Australian population (M=127.98, SD=13.92) (White & Casey, 2017). Using a significance level of $p = 0.05$, significant differences in MHL score were detected between: genders, females having higher scores (M=133.75, SD= 8.28) as compared to males (M=126.78, SD=10.35); age groups, those 20-41 having higher scores (M=132.79, SD=8.45) than those 42-64 (M=126.52, SD=10.47); and total years of experience, individuals with 20 years having higher scores (M=131.13, SD=10.78) than those with 21 years' experience (M=126.28, SD=8.94). No significant difference was detected between coaches and therapists. It appears that, within this sample, higher MHL scores exists in: 1) Females; 2) Those 41 years of age and younger; and 3) Coaches/therapists with less years of total experience.

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Efficacy of the Fun For Wellness online intervention to promote well-being actions

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The purpose of this study was to provide an initial evaluation of the efficacy of the Fun For Wellness (FFW) intervention to increase well-being actions in a universal sample. FFW is a new on-line intervention designed to promote growth in well-being by providing capability-enhancing learning opportunities to participants. Capability-enhancing learning opportunities within the FFW environment come in the form of 152 challenges that were designed to promote growth in well-being and require participants to do one or more of the following activities: play an interactive game; watch a vignette performed by professional actors; listen and/or read a mini-lecture narrated by a coach; engage in a self-reflection exercise and/or a chat room. Self-efficacy theory provided the theoretical framework that guided the creation of the 152 challenges. The study design was a secondary data analysis of a large-scale prospective, double-blind, parallel group randomized controlled trial. 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. Participants who were randomly assigned to the FFW group were provided with 30 days of 24 hr access to the intervention. A two-class linear regression model with complier average causal effect estimation was fitted to well-being actions scores at 30- and 60-days. There was evidence that the effect of simply being assigned to the FFW intervention, without considering actual participation in the FFW intervention, had a null effect on each dimension of well-being actions at 30-days and at 60-days. Participants who complied with the FFW intervention, however, had significantly higher well-being actions scores, as compared to potential compliers in the Usual Care group, in the interpersonal dimension at 60-days and the physical dimension at 30-days. Results from this study provide some initial evidence for both the efficacy of, and possible revisions to, the FFW intervention in regard to promoting well-being actions.

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Development and validation of golf positive psychological capital questionnaire

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ABSTRACT Development and Validation of Golf Positive Psychological Capital Questionnaire Na Jung-Eunâ€§Chung Ji-Hye (Sookmyung Women's University) According to the previous study, Positive Psychological Capital (PPC) has a beneficial effect on the performance of golfers (Jeong-Eun Na, Ji-Hye Jeong, Mi-Seon Kim, 2017). However, there has been no tools to measure Golf Positive Psychological Capital. This study aims to develop and validate the GPPCQ(Golf Positive Psychological Capital Questionnaire) scale. Based on the purposive sampling, 202 golf players were asked to respond to 73 preliminary questions, so that total 17 questions about 5 factors were selected, which included 3 questions for self-efficacy, 4 for psychological strategy, 4 for resilience, 3 for optimism, and 3 for hope. Furthermore, in order to validate this current study, the validity analysis was conducted. In the results, this study demonstrated that the convergent validity, the discriminant validity, and the predictive validity were secured. In addition, multivariate analysis and univariate analysis were tested to understand differences in the GPPCQ in accordance with sex and level of golf players by using the GPPCQ scale. According to the results, there were correlations in accordance with sex and level. To conclude, the GPPCQ scale developed by this study was verified as a reliable and valid tool. In the future, it is expected that this tool would be used to improve educational/counseling programs for psychological skills in golf area. Key words: golf, positive psychology capital, Questionnaire

The association among dispositional mindfulness, mental skill, flow and performance

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Dart performance requires a high degree of internal self-control and psychological regulation under critical stress situations. This study was designed to explore the relationships among dispositional mindfulness, mental states, and dart performance. One hundred and twenty-one dart athletes participating in the National Darts Championship, from April 28-30, 2016, were recruited and filled out the questionnaires for dispositional mindfulness, mental skills, and flow experience. Dispositional mindfulness measured by a Mindfulness Attention Awareness Scale were separated into three levels, wherein mental skill and flow were assessed by an Athletic Psychological Skills Scale and Flow Scale in Taiwan, respectively. All the variables were transferred into Z scores on the statistical analysis. The results showed that the high mindfulness group had a better score on the overall flow experience, but no significant differences were found among the other three mindfulness groups in relation to their performances and their overall mental skills. In addition, the high mindfulness group exhibited better scores in "concentration with feedback" of the flow experience as well as "coping with adversity", "peaking under pressure" of mental skills. Athletic Psychological Skills Scale These findings of high mindfulness group had better scores in "coping with adversity" and "peaking under pressure" reflect that individuals with high mindfulness have better self-regulation when faced with competitive challenges or stress situations. However, no differences were found between the other two mindfulness groups in relation to their performances, which is inconsistent with the previous studies. These might have been self-reported by the participants, and so the evidence is not so clearly established, due to their failure to recall their best performances. Future research might consider utilizing objective measurements of performance.

Affect school, Virya yoga, and compassion-focused therapy: A pilot study of an integrative group treatment, depression and anxiety

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The present study investigated the effectiveness of an eight-week integrative group treatment, consisting of Affect school (AS), Compassion-focused therapy (CFT), and Virya yoga in comparison with treatment as usual (TAU), an eight-week cognitive behavioural group treatment. The sample consisted of patients with mild to moderate mixed depression and anxiety ($N = 31$) in a primary healthcare centre. Correlations were investigated between treatment outcomes, and amount of yoga practice between sessions in the intervention group ($n = 14$). Results showed that both treatments were equally effective. Both groups improved significantly on measures of depression and anxiety, with large within-group effect sizes. The intervention also group improved significantly on measures of self-compassion and alexithymia, with large within-group effect sizes. Significant correlations were found between improvement in alexithymia and amount of yoga practice; between increased self-compassion and greater

quality of life, as well as between increased self-compassion and reductions in anxiety symptoms. The present study highlights the practice of yoga as a potential means to improve alexithymia, and provides additional support for working with self-compassion in psychological treatments. Future research may further investigate the long-term effects and moderating variables influencing potential benefits of integrating AS, CFT, and Virya yoga in psychological treatments.

When efficacy and enjoyment collide: Incorporating low-intensity exercise breaks into learning

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Empirical research suggests that incorporating exercise breaks during a university lecture can improve on-task attention and comprehension. However, one of the greatest challenges towards successful implementation of instructional interventions is the misalignment between students' perceptions and the objective efficacy of the instructional interventions. The present study interviewed 102 undergraduate students at McMaster University to assess their perceptions of exercise breaks in the classroom. Overall, students rated low-intensity exercise breaks as more preferable over moderate or high-intensity exercise breaks ($\chi^2(2) = 56.7$, $p < .001$). In addition, students did not favour incorporating exercise breaks into lectures less than 1-hour in duration ($\chi^2(2) = 28.5$, $p < .001$), but highly favoured exercise breaks in lectures greater than 1-hour ($\chi^2(2) = 158.8$, $p < .001$). Incorporating low-intensity exercise breaks into the classroom was viewed as feasible and important for attention and learning by all students regardless of their fitness level or ability to sustain attention during a lecture. Importantly, students who initially did not endorse the use of exercise breaks in the classroom ($\chi^2(2) = 0.3$, p=.889) were more likely to do so after a single exposure to literature emphasizing the benefits of exercise breaks on learning ($\chi^2(2) = 7.8$, p=.02). This research is an important first step towards ensuring instructional interventions are not only effective at promoting learning, but are also well received by students. By incorporating student perspectives, the alignment between efficacy and enjoyment will ultimately lead to optimal implementation, improving academic success and classroom experiences.

Funding source: Social Sciences and Humanities Research Council of Canada.

Performance and learning of a visual-motor tracking task as a function of motivational orientation and motivational climate

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Individuals with a high task orientation exhibit greater intrinsic motivation to participate as well as greater retention of motor skill (e.g., Ferrer-Caja & Weiss, 2000). In addition, studies suggest that individuals participating within motivational climates that foster mastery perform better and exhibit higher intrinsic motivation (e.g., Kavussanu & Roberts, 1996). Little research, however, has examined the simultaneous role of goal orientation and motivational climate on changes in the non-linear structure of motor performance. Abundant regularity in the non-linear structure of motor performance has been associated with degeneracies due to aging and pathologies such as Parkinson's disease (see Stergiou & Decker, 2011). Preliminary findings suggest that greater irregularity in the structure of behavior may lead to better overall learning outcomes (Studenka et al., 2017). The aim of the present study was to document how differing goal orientation profiles (i.e., task vs. ego) and motivational climates (i.e., mastery vs. performance) interact to influence both linear and non-linear changes in motor performance over time. Participants ($n = 71$, Mage =22, SD = 3) performed a visual-motor tracking task in which finger force was used to match a target line on a computer screen. Outcome variables were the root mean squared error (RMSE) and the complexity of the finger force signal (sample entropy). Within the performance climate, greater performance improvement over one day of practice, and over a retention period, was associated with higher task score, $r(36) = -.53$, $p < .01$, $r(36) = -.39$, $p = .01$. Within the mastery climate, greater performance improvement over a retention period was associated with lower ego score, $r(31) = .34$, $p = .05$. Non-linear data highlight an association between higher sample entropy over Day 1 and greater improvement in RMSE over Day 1 for the mastery group, $r(31) = .45$, $p = .01$. These findings underscore the impact of both goal orientation profiles and motivational climates on linear and non-linear changes in motor performance over time.

Group cohesion and relatedness as predictors of self-determined motivation and burnout in adolescent female athletes

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Athlete burnout is a maladaptive sport participation outcome that is influenced by the social context (Udry, Gould, Bridges, & Tuffey, 1997). A salient social contextual feature of youth sport is group cohesion (Eys, Loughead, Bray, & Carron, 2009). Cohesion may predict a well-being marker, such as burnout, through its link with relatedness and self-determined motivation (Blanchard, Amiot, Perreault, Vallerand, & Provencher, 2009). The current study was designed to test a model of these relations, where cohesion predicts relatedness, which in turn predicts self-determined motivation, and in turn burnout. Female youth soccer athletes (N = 276; M age = 14.9 years, SD = 1.3) completed reliable and valid survey measures of task and social cohesion, relatedness, self-determined motivation, and burnout. Separate models were tested in Mplus using task and social cohesion as the observed exogenous variables, respectively. Both models showed good fit. Task (beta = .64) and social (beta = .74) cohesion predicted perceptions of relatedness, indicating that greater cohesion perceptions predicted enhanced feelings of relatedness with teammates. In turn, relatedness positively predicted self-determined motivation (beta = .34; 12% variance explained), which in turn negatively predicted global burnout (beta = - .68; 46% variance explained). The indirect effects from task cohesion to burnout (beta = - .08) and from social cohesion to burnout (beta = - .17) by way of relatedness and self-determined motivation were significant. The results support a conceptual sequence whereby greater team cohesion enhances an athlete's feelings of relatedness, which fosters more self-determined motivation and, in turn, reduces burnout perceptions. Future research is needed to assess support for causality of these links and could explore how contextual factors such as the teammate-created motivational climate contributes to group cohesion and relatedness perceptions within this burnout model. Such work would broaden possible practical recommendations for addressing athlete burnout.

Proposed sources of coaching efficacy: A meta-analysis

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Coaching efficacy refers to the extent to which a coach believes that he or she has the capacity to affect the learning and performance of his or her athletes. The conceptual model of coaching efficacy proposed by Feltz,

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Chase, Moritz, and Sullivan (1999) consisted of three key elements: (1) the proposed sources of coaching efficacy information, including extent of coaching experience/preparation, prior success, perceived skill of athletes and social support; (2) the proposed dimension of coaching efficacy, including character building, game strategy, motivation and technique, and (3) the proposed outcomes of a coach's efficacy beliefs, including coaching behavior, player/team satisfaction, player/team performance and player/team efficacy. The current study was to empirically synthesize findings of studies published since the conceptual model was proposed, with a special focus on relationships between the proposed sources of coaching efficacy and each of the dimensions of coaching efficacy. Results from meta-analysis of 278 effect sizes from 20 published studies suggest that the overall relationship between the sources of coaching efficacy and each dimension of coaching efficacy was positive and small to medium in magnitude, which was statistically significant. All of the relationships between the proposed sources of coaching efficacy and each dimension of coaching efficacy were statistically significant, indicating the magnitude of the relationship was relatively similar within a particular dimension of coaching efficacy. Of a number of potential moderators being tested, coach gender and level coached were found to moderate the overall relationship between the proposed sources of coaching efficacy and each of the dimensions of coaching efficacy. Results from this meta-analysis provided some evidence for both the utility of, and possible revisions to, the conceptual model of coaching efficacy while having a concerns potential implication of publication bias that based on published studies only.

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The effect of an acute bout of physical activity on inhibitory control in individuals with autism spectrum disorder

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In accordance with the increased prevalence of autism spectrum disorder (ASD) over the last two decades within the U.S., interest in improving quality of life for individuals with ASD-related symptomologies has expanded. Recent evidence suggests that deficits in inhibitory control aspects of cognition may underpin some ASD symptoms. Additionally, transient benefits to inhibitory control in neurotypical individuals have been observed following an acute bout of aerobic physical activity, yet the extent to which this is true for individuals with ASD is not well understood. Thus, the aim of this investigation was to examine the effects of an acute bout of moderate intensity aerobic physical activity on task performance indices of inhibitory control in individuals with ASD. Using a within-subjects crossover design, 18 individuals with ASD and 18 neurotypical individuals were assessed for reaction time and response accuracy differences in modified Eriksen flanker performance prior to and 10-minutes following a 20-minute bout of aerobic exercise or seated reading across multiple, counterbalanced, sessions. Individuals with ASD displayed significantly poorer overall response accuracy than neurotypical individuals. They also had slower reaction times at pretest for the rest and exercise conditions. No significant group differences were observed, however, at posttest or from pre- to posttest for either mode of activity. Differences in groups based on response accuracy task performance support previous literature indicating poorer performance in individuals with ASD. Despite these group task performance differences, it remains unclear if, and to what degree, physical activity may influence inhibitory control in individuals diagnosed with ASD. However, the findings of this study do provide evidence for feasibility and insight regarding study design, establishing the framework for future research.

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Impact of surf therapy on self-determination and quality of life for young adults with ASD

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Introduction Adults with Autism Spectrum Disorder (ASD) typically exhibit low levels of self-determination and quality of life. Such deficits are associated with lower rates of employment, independent living and increased risk for depressive and anxiety related disorders (Konrad et al., 2007; Lee et al., 2010; Wehmeyer & Palmer, 2003; Leyfer et al., 2006). Purpose: The purpose of this mixed methods study was to evaluate the effects of surf therapy on self-determination and quality of life and to capture the meaning and value that young adults with ASD ascribe to their experience. Methods Fifteen participants (age 18-26) enrolled in a surf therapy program participated in this study. The Arc's Self-Determination Scale (adult version) and the World Health Organization Quality of Life Field Scale were used to collect measurements before and after the six-week program. In addition to quantitative data, photovoice was utilized as a participant-centered research method and qualitative data was collected through photographs and the meaning participants ascribed to each photograph during a focus group. Data Analysis A paired samples t-test was conducted to compare the measurements (pre/post) of self-determination and quality of life. Qualitative data was collected through artifacts (photographs) and as verbatim transcript which was analyzed using a generic coding process. Results Statistically significant improvements were found for both self-determination ($p < 0.001$) and quality of life ($p = 0.002$). Additionally, four shared themes emerged from the qualitative data: positive psychological impact, socialization and community, changing perspectives of physical activity, and surf therapy as an empowering and uplifting experience. Conclusion Findings from this study support surf therapy as an effective method for improving self-determination and quality of life in young adults with ASD. Furthermore, the results support the exploration of the psychosocial benefits of alternative physical-activity based programs for young adults with ASD.

Funding source: California State University Office of Sponsored Programs.

Social relatedness in CrossFit participants

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CrossFit (CF) has grown at a staggering pace since its emergence in 2005, jumping from 13 to over 7,000 boxes/gyms in the past decade. Despite this increased popularity, there is still a relative lack of research exploring psychosocial antecedents and outcomes of this activity. The goal of this descriptive study ($N = 76$) was to deepen our understanding of CF exercisers' psychological reactions to its various aspects. The items in this 37-item survey were grouped into the following sections: comfort with others, interactions, outside relatedness, cheering, loyalty, behavioral expectancy, and demographics. An overwhelming percentage of respondents (95%) indicated they were likely or extremely likely to continue CF in the near future. The data indicated that overall, CF exercisers felt comfortable around each other during workouts and outside of the gym. Interactions with other CF exercisers were reported

as very positive. Only half of those surveyed indicated they attend CF for social reasons. As for talking during workouts, 50% reported talking always or most of the time and 45% talked sometimes or never. Data indicated that 75% of respondents met up outside of CF workouts and that there was a very high level of outside relatedness overall. Cheering appeared to be very important in CF gyms, with 93% of responses in favor. The numbers differed only slightly between specifically cheering and other forms of encouragement, with 4% disliking encouragement during workouts and 7% disliking cheering. Finally, loyalty to CF in general was high with 86% indicating they would choose CF over other exercise forms. Furthermore, 90% indicated they were loyal to their specific CF gym. Loyalty appears to be to the gym and not to specific groups, as 42% indicated a neutral response to working out with the same group each time. However, a sense of comradery prevailed with 75% feeling obligated to come to workout, and 68% indicating they would be missed if they skipped a workout. Qualitative data relative to these findings and future research directions will also be discussed.

The psychological and physiological effects of completing a half-marathon on homeless individuals

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Background. One of the primary considerations when designing interventions to reduce chronic homelessness is to assist with developing self sufficiency and problem solving skills. Recent research has demonstrated a correlation between positive psychological markers such as hope, and reduction in the number of days spent in a homeless shelter. Interventions that improve positive psychological markers can promote the individual's cognitive coping skills and contribute to improved self-sufficiency. Aerobic exercise is a low cost method of improving positive psychological capital. A significant amount of literature supports the benefits of aerobic exercise on physical and psychological well-being in the general population but little research has been done within the homeless population. Objectives. To assess the psychological and physiological effects of a progressive thirteen-week training program and completion of a half-marathon on homeless individuals. Methods. Two positive psychological traits – hope and self-efficacy – were measured using the Adult Hope (ADH) scale and the General Self Efficacy (GSE) scale in 17 homeless runners with mean age 35.6, +/–7.6 years, who completed a 13-week training program culminating in a half-marathon. Additionally, body mass index, maximal oxygen consumption (VO2 max), percent body fat, and skeletal muscle mass were collected. Measurements were taken two days prior to initiation of the training program and one week following completion of the half-marathon. *Results.* There was a significant change in pre vs. post mean total ADH scale scores (52.1+/–6.2 vs.56.0 +/– 3.9, $p = 0.005$), ADH agency scores, (27.3+/–3.8 vs. 28.8 +/– .02, $p = 0.02$), and VO_2 max (35.1+/–7.9vs. 37.9+/–8.6, $p < 0.0001$)). Conclusion. Homeless individuals who participate in a thirteen-week aerobic exercise program and complete a half-marathon demonstrate an increased capability to develop means to achieve a desired goal (Hope), and an increase in their maximal oxygen consumption.

Moving well-being well: Evidence and background to the development of the MWBW physical literacy intervention for primary school children

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Operationalising physical literacy and generating meaningful, measurable empirical research will determine what physical literacy is and how it works. Recent research suggests that Irish adolescents are not displaying the attributes of physical literacy that would see them adopt purposeful physical pursuits as an integral part of their lifestyle (Belton et al, 2014). The purpose of this study was to build on previous work by assessing the current level of physical literacy in Irish primary school children (5-13 years). Cross-sectional data on Whiteheadian physical literacy constructs (Whitehead, 2010), physical activity levels (using self and proxy reports, and accelerometers), anthropometric characteristics, perception of body figure, well-being, and fundamental movement skill proficiency of 2098 children (53% male, 9.17 ± 2.04 years) were collected. Findings indicate that the majority of children (85%) were not accumulating the minimum 60 minutes of physical activity recommended daily for health, and 82% did not achieve the fundamental movement skill proficiency expected for their age. Self-efficacy, intrinsic motivation, and physical ($p < 0.01$) and relational ($p < 0.05$) wellbeing scores were significantly different between low (0-3 days), moderate (3-5 days) and high (5+ days) active participants. Both active and inactive children had a poor knowledge and understanding of health. Body mass index data showed that 29% of children were classified as overweight or obese. Data showed a need for targeting the low levels of physical activity in children by utilising their positive psychological constructs of physical literacy. In addition, it seems important to pay particular attention to their poor health related activity knowledge and low fundamental movement skill proficiency. The Moving Well-Being Well targeted physical literacy intervention is being developed in accordance with the present study.

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The effects of gender relevant physical activity program on girls' fitness and perceptions of physical activity

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By adolescence, girls and boys begin to have different levels of physical skills and are interested in dissimilar types of physical activity (PA). For example, girls are less likely than boys to participate in vigorous PA and strength training activities (Mota et al., 2005). Compared to boys, girls also have lower self-esteem, have a perceived lower health status, and see themselves as less athletic than boys (Vu et al., 2006). Therefore, the purpose of the current study was to evaluate the effects of a 26-week gender-relevant after school physical activity program on elementary school girls' fitness and perceptions of physical activity. College female student-athletes served as active role models and led physical activity programming twice a week throughout the school year. Two elementary schools with similar demographics were recruited to participate in the study. Schools were randomly assigned into either the control ($N = 34$; $M = 9.06$ yrs) or intervention ($N = 56$; $M = 8.98$ yrs) site. Pre-and post-tests at the beginning and end of the school year were conducted to examine changes in fitness (i.e., FitnessGram testing) and perceptions of PA (i.e., PA enjoyment and self-efficacy). A 2 (test) X 2 (group) ANCOVA revealed a significant interaction ($p < .05$) on the FitnessGram push up test. Follow-up analysis revealed that participants at the intervention school site significantly improved on the number of push-ups completed from the pre- to post-test, while participants at the control school site demonstrated a slight drop. 2 X 2 ANCOVAs on the short-PA enjoyment scale and the PA self-efficacy scale also revealed significant interactions ($p < .05$). The sources of these interactions were significant self-rating improvements from pre-to post test among participants at the intervention school site. Results of the current study suggest that active female role models engaging girls in bi-weekly physical activity programming can increase elementary school girls' fitness, PA perceptions, and PA self-efficacy.

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Funding source: Paso Del Norte Health Foundation and Mountain West Research Consortium.

Effects of exercise on cognition: Preventing decline in older adults

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The prevalence of dementia has been increasing worldwide (Wimo et al., 2017). Currently, there is no cure or prevention for those with dementia or at increased risk for it (Steiner et al., 2017). Sedentariness is a major risk factor for dementia (Bennett, Matthews, & Brayne, 2017). While regular exercise appears to exert a positive effect on cognitive performance amongst older adults (Trigiani & Hamel, 2017) the dose-response relationship between exercise participation and its cognitive benefits remain unclear. The purpose of this study was to further examine the link between exercise participation and cognitive gains in order to further define a dose-response relationship between activity and cognition. Thirty five older adults ($M_{age} = 70.6$ years) were tested using a cross-sectional design. Participants wore physical activity monitors and completed a number of cognitive tasks (Stroop Task, Trail Making Test) to measure interaction. Correlational analysis indicated a significant relationship between exercise participation and cognitive performance scores. Independent t-tests revealed that older adults participating in > 150 minutes of moderate to vigorous activity each week scored higher on cognitive tasks compared to less active peers ($P < .05$). Regular participation in moderate to vigorous exercise may help prevent cognitive decline in older adults. Recommendations for future research to advance dose-response guidelines will be discussed. Evidence-based strategies to increase suitable doses of activity participation for facilitating cognitive gains and preventing cognitive decline in older adults will be outlined

An examination of movement-integrated learning in the college classroom

Michael Rhoads, Metropolitan State University of Denver; Rena Kirkland, Adams State University; Crystal Baker, Colorado Mesa University

Traditional college classrooms often lack active and engaging curricula. Students report high levels of boredom and struggle to pay attention (Larson & Richards, 1991). Physical movement in the classroom is an emerging approach to increase student engagement and attention. Movement-integrated instructional approaches have been used in primary and secondary classrooms (Grieco et al., 2009; Mahar et al., 2006; Stewart et al., 2004; Whitt-Glover et al., 2011). Research suggests physical activity in the classroom helps students focus on learning (Kibbe et al., 2011) and improves academic performance (Raspberry et al., 2011). However, literature on movement-integrated learning in the college classroom is scant. Suzuki (2015) describes four-minute "brain hacks" for increasing engagement in her college classes. A white paper was written at Adams State University, which described the institution's effort to increase exercise and movement in classrooms and administrative meetings. This integration of movement was named "brain boosters" (Crowther et al., 2012). The purpose of our current study was to examine the efficacy of employing movement-integrated learning in college classes. We implemented a quasi-experimental cross-over design. Using an ABAB experimental manipulation, students participated in two traditional activities in phase A, two experimental "brain booster" activities in phase B, and completed eight experience-sampling assessments through Qualtrics using a cell-phone or electronic device. At the end of the semester, students completed a summative survey regarding their overall perceptions of the learning activities. Preliminary evidence supports our hypotheses that movement-integrated learning produces enhanced enjoyment and attention. Further research should replicate and extend these findings using a larger sample size with students of diverse backgrounds and experiences. Additional attention is warranted for developing movement-integrated learning activities that pair well with the content while also examining learning outcomes.

Funding source: None.

The effects of perceptual and cognitive interference during the preparation and execution of the golf swing

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Significant research shows that skilled athletes can accommodate irrelevant thought while executing a highly-rehearsed action. However, few studies have explored how irrelevant thought in preparation affects later performance. Accordingly, this repeated-measures experiment had skilled golfers (N = 24) hit approach shots (60-150 m) while dual-tasks interrupted their preparation or execution. The results showed that golfers largely maintained performance under distraction, but that distance control of the shortest shots deteriorated when preparation was disrupted. Cluster analysis indicated that interference to short-shot preparation elicited a similar number of cognitive mistakes (e.g., poor decision-making) and execution mistakes (e.g., poor timing). The results indicate novel links between off-task thought and motor skill failure. Implications for preparing shots with complex attentional requirements are discussed.

Sport commitment and psychological well-being in Chilean women athletes: Gender issues from the lens of intersectionality

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The proliferation of women in sport has increased the amount and type of research on psychological and social processes in women athletes. However, there remains a lack of academic research conducted from a critical feminist perspective (Roper, 2013). This paper incorporates an intersectional feminist analysis (Hill Collins, 1986) to address cultural, racial, ethnic and social class forms of influence on psychological outcomes of sport involvement for elite Chilean women athletes. Opportunities for full engagement for Chilean women athletes are limited and the pressures of patriarchal society limit women's participation. Three elite women athletes who participated in both individual and team sports participated in in-depth interviews using Grounded Theory. Important themes emerged from this study and centered on the difficulties associated with maintaining psychological well-being while adhering to culturally prescribed and gender-stereotypical demands within the sport and family systems. In addition, gender-specific challenges were prominent in their sport participation and compromised their psychological well-being. Salient aspects of psychological well-being for these athletes revolved around their personal growth and purpose in life which resulted in a desire for self-determination through sport but resulted in a sense of fatigue and resignation to the difficult demands that they faced. The analysis revealed situations of a perceived double standard in sport for Chilean women athletes in that they were expected to balance the traditional female role with the role of committed high-level athlete. As such, traditional gender roles were reinforced through sport. This research contributed to the understanding of the relationship between sport

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commitment and psychological well-being in relation to gender and sheds light on factors that affect the sport participation of women in similar social and cultural contexts.

Parent-child relationships in youth sport: The positive impact of parental perceived responsiveness

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Parent-athlete relationships are seen to be central to athletes' well-being and growth (Knight et al., 2017), however the features of successful relationships remain relatively unknown. The purpose of the current study was to assess the influence of parental perceived responsiveness on young athletes' well-being, perceived competence, and goal accomplishment in sport. Following receipt of ethical approval, 152 French athletes (124 boys, 28 girls) aged between 10 and 14 years (M = 12.04) involved in competitive basketball (n = 69) or rugby (n = 83) participated in the study. Athletes reported three important sport goals for the next three months and responded to self-reported questionnaires measuring their perceived capability to reach their goals, parental perceived responsiveness (PPR), emotions, self-esteem, vitality, life satisfaction, sport anxiety, and social support availability (all alphas >0.75). PPR scores for fathers (M = 4.36) and mothers (M = 4.39) did not significantly differ ($t = 0.93$, $p = 0.35$) and were strongly correlated ($rs = 0.81$, $p < 0.001$). Subsequently, PPR scores for fathers and mothers were averaged into a single PPR variable. Using multiple linear regressions controlling for age, gender, club, and if athletes lived with both parents, PPR was positively related to athletes' positive emotions ($F(9,133) = 4.54$, $p < 0.001$, adj. r-squared=0.18), self-esteem ($F(9,136) = 3.53$, $p < 0.001$, adj. r-squared = 0.13), vitality ($F(9,134) = 7.35$, $p < 0.001$, adj. r-squared = 0.28), life satisfaction ($F(9,137) = 3.34$, $p = 0.001$, adj. r-squared = 0.12), and also general perception of social support availability ($F(9,137) = 3.34$, $p = 0.001$, adj. r-squared = 0.12). PPR was negatively related to athletes' sport anxiety ($F(9,136) = 4.71$, $p < 0.001$, adj. r-squared = 0.19). These results provide unique evidence of the positive influence of parental perceived responsiveness (PPR) such as being validated, understood, and cared for (Reis, 2015) on athletes' well-being in youth sport. A follow up data collection will assess the athletes' goal accomplishment in 2018.

Group-based physical activity for older adults: Functional fitness and physical health outcomes in a randomized controlled trial

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This study involved examining the efficacy of two group-based physical activity interventions, informed by the tenets of self-categorization theory (SCT; Turner, 1985, 1987), in relation to functional fitness and physical health outcomes among older adults. As part of the GrOup-based physical Activity for oLder adults (GOAL) randomized controlled trial (ClinicalTrials.gov #NCT02023632), older adults were randomized to similar age same gender (SASG), similar age mixed gender (SAMG), or 'standard' mixed age mixed gender (MAMG) exercise group programs. Previous research demonstrated that older adults randomized to the two experimental conditions (SAMG, SASG) conditions displayed better exercise adherence when compared to those in the MAMG control condition. The purpose of this study is to examine whether these adherence effects translated to improved functional fitness and physical health outcomes after the 24-week programs. Based on participants who completed baseline health and fitness testing (n = 510; Mage = 71.56 years, SD = 5.22; 73.3% female), results from intent-to-treat mixed ANOVAs indicated significant time by group interactions for lower-body strength ($p < .05$, $d = 0.24$), upper-body strength ($p < .05$, $d = 0.26$), and aerobic fitness ($p < .05$, $d = 0.23$). No effects occurred for measures of older adults' upper-body or lower-body flexibility ($p > .05$). Across all three conditions reductions were observed in older adults' systolic ($p < .001$, $d = 0.57$) and diastolic ($p < .001$, $d = 0.39$) blood pressure, weight ($p < .001$, $d = 0.75$), BMI ($p < .001$, $d = 0.67$), body fat percentage ($p < .01$, $d = 0.25$), as well as improved agility ($p < .001$, $d = 0.64$). However, there were no differences between conditions for these outcomes. The results suggest that the improved adherence in the SCT-informed exercise conditions translated into improvements in some aspects of older adults' functional fitness over 24 weeks, but did not translate into significant improvements in other physical health outcomes when compared to a standard group-based exercise program.

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Does consumption of slow-releasing carbohydrates improve mental performance following exhaustive exercise?

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Sports require a combination of physical and mental endurance, as athletes make split second decisions under stress. Tactical performers within the military face an even greater challenge as military operational training requires sustained endurance, frequently in austere environments. Previous research has shown that mental fatigue impairs endurance performance, but the effect of physical fatigue on mental performance remains unknown. Mental workload can be measured behaviorally through changes in task performance and is related to physiological response within the central and peripheral nervous systems. Researchers have frequently utilized endocrine, cardiovascular, biometric indicators such as electroencephalogram (EEG) spectral analysis and muscle activity to examine the relationship of mental workload and performance. While high energy expenditure warrants nutrition intake during activity, increased weight and bulk discourages many tactical and traditional athletes from carrying adequate calories. Traditional maltodextrin (MAL) solutions contain high glycemic carbohydrates that spike blood glucose. A novel development in carbohydrate supplementation is hydrothermally modified starch (HMS), a slowly digested substance initially developed for treatment of glycogen storage disorders. The purpose of this study is to compare consumption of a hydrothermally modified starch (HMS) to a high glycemic maltodextrin (MAL) sports beverage sports beverage on mental performance and metabolic variables (glucose, lactic acid, cortisol, heart rate variability) in competitive cyclists following an exhaustive cycling bout. Cognitive performance, event related spectral perturbations, heart rate variability, cortisol, blood glucose, and lactic acid were the dependent measures. Overall, results demonstrated differences ($p < .05$) in the dependent measures pre to post exhaustive bout and difference in cognitive performance and changes ERSP in response to HMS supplementation. The results are discussed in light of the supplementation influence on mental and physical fatigue.

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Multidimensional associations of drive for muscularity in adult men

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Introduction: Internalization of the societal promoted ideal physique for men has contributed to a growing number of men developing an unhealthy drive for muscularity (DFM). DFM is the degree to which men want to increase their muscle size, and at high levels is associated with poor physical and mental health, and risky behaviors. Therefore, identifying other key factors (i.e., behavioral, psychological) associated with DFM may help identify those most at risk for negative outcomes. Purpose: To identify multidimensional associations of DFM in adult men. Methods: Seventy-eight men with a mean age of 37.3 years (SD=13.9) completed the following assessments via an Internet survey: DFM, Social Physique Anxiety, Kessler Psychological Distress, Body Areas Satisfaction, Drive for Thinness, Godin Leisure-Time Exercise, frequency of nutritional supplement use, and height and weight. Stepwise regression analysis was used to determine which factors were associated with DFM. Results: The final regression model explained 59% of the variance in DFM ($F = 9.90$, $p < .01$). DFM was associated with social physique anxiety (β=.66, $p < .01$), distress (β=.38, $p = .01$), frequency of supplement use (β=1.94, $p < .01$), and BMI (β=-.55, $p < .01$). Additional variables, including body satisfaction, drive for thinness, leisure-time exercise, and age were not significant and excluded from the final model. Of note, social physique anxiety explained the greatest proportion of variance in DFM (R^2=.33, $p < .01$), followed by frequency of supplement use (R^2=.12, $p < .01$), distress (R^2=.08, $p < .01$), and BMI (R^2=.06, $p < .01$). Conclusions: Results show that BMI has a negative association with DFM, while social physique anxiety, distress, and supplement use have a positive association. Although the direction of causality cannot be made, it appears that adult men with high DFM also frequently take nutritional supplements (likely to increase body mass), and suffer with high distress and social physique anxiety. Future research examining the longitudinal relationship among these factors is needed.

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Examining perceptions of athletic identity and religious orientation between students competing in varsity and intramural athletics

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In attempt to establish personal significance, humans construct multifaceted self-identities, aspects of which vary in saliency over time and across contexts (Stets & Burke, 2000). Research suggests such identities play a prominent role in shaping one's overall self-concept and other important psychosocial processes (Proios, 2017; Griffith & Johnson, 2002). To date, very few studies have compared the identities of athletes participating at different competitive levels. Thus, the purpose of this study was to examine athletic identity and religious orientation of students competing in varsity and intramural athletics. A total of 162 student-athletes (varsity $n = 114$; intramural $n = 48$) actively competing in one of nine sports at a private Christian institution completed a survey consisting of the Athletic Identity Measurement Scale-Plus (Cieslak, 2004) and the Religious Orientation Scale-Revised (Gorsuch & McPherson, 1989). Interestingly, data showed intramural athletes held significantly higher perceptions of athletic identity compared to their varsity counterparts ($t(159) = 5.95$, $p < .01$) with pronounced differences related to the exclusivity dimension of the measure ($t(160) = 6.56$, $p < .01$). Extrinsic religiosity was also positively correlated with athletic identity among varsity athletes ($r = .30$, $p < .01$) and may be the byproduct of a social environment that places greater emphasis on the development of alternative aspects of identity (e.g., religious, academic). Findings hold valuable implications for sport psychologists as strong and exclusive identities have been linked to emotional disturbances in athletes facing unforeseen sport transitions (Brewer, VanRaalte, & Linder, 1993). In line with findings from previous research, elite level athletes may not be the only ones at risk of identity foreclosure (Lamont-Mills & Christensen, 2006). Additional research is needed to better understand the mechanisms driving identity formation among athletes at private Christian institutions and whether they differ from those at other institutions.

Funding source: Azusa Pacific University - Office of Faith Integration.

An examination of the influence of perceived coaching behaviors and self-determined motivation on student-athletes' grit and mental toughness

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Understanding the relationship between coaching behaviors and athlete psychological factors is critical. The aim of this study was to, first, examine the relationships among athletes' self-determined forms of motivation, coaching behaviors, grit, and mental toughness. Second, the study investigated the mediating effect of self-determined motivation between perceived coaching behaviors, grit, and mental toughness. 219 student-athletes from Midwestern universities completed a series of valid and reliable measures. Surveys included demographic information, the behavioral regulation in sport questionnaire, autonomy-supportive coaching questionnaire, controlling coach behaviors scale, short grit scale, the mental toughness index. Bivariate correlational analysis revealed that autonomy-supportive coaching had significant positive relationships with autonomous motivation, grit and mental toughness. Conversely, controlled coaching had significant negative relationships with grit, mental toughness, and autonomous motivation. The relationship between grit and mental toughness was significant but weak ($r = .25$). Path analysis revealed that autonomy-supportive coaching had a significant positive indirect effect on mental toughness through self-determined motivation, but a non-significant effect on grit. Additionally, controlling coaching behavior was not significantly related to mental toughness, but demonstrated a significant negative direct, indirect, and total effect on grit. The specified model accounted for 14.2% of the variance in autonomous motivation and 8.7% of the variance in controlled motivation, while the explained variance in grit was 14.3% and mental toughness was 40.3%. Collectively these results suggest adopting an autonomy-supportive coaching style has the potential to create appropriate motivational climates and allow for mental toughness to thrive. While, controlling coaching styles may detrimentally impact athletes through its negative effect on grit.

Influences of nonverbal behavior on outcome expectations and performance outcomes in a real-world soccer penalty scenario

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Previous research on nonverbal behavior (NVB) in the sport performance setting (Furley, Moll, & Memmert, 2015; Greenlees, Leyland, Thelwell, & Filby, 2008) has shown that NVB might be among the most important factors influencing emotions and outcome expectations. However, research on NVB so far has neglected to conduct studies in non-experimental settings and to measure the behavioral consequences of NVB. Thus, following the call from Baumeister, Vohs, and Funder (2007), it was the aim of the present research to realize a field study (i.e., a real-world soccer penalty scenario) and to not only measure subjective questionnaire variables (i.e., outcome expectations) but also performance variables (i.e., precision and speed of the kicks) as consequences of NVB. Each of $N = 47$ male experienced soccer players took

20 penalties, alternating against one dominant and one submissive goalkeeper, manipulated using instructions from experimental studies. The reactions of the goalkeepers (left vs. right) were randomised and the NVB of the goalkeepers was changed after each participant. Before the shootout, participants filled in a questionnaire on outcome expectations when watching the goalkeepers. During the shootout, precision and speed of each kick was measured using *GoPro Hero2*-cameras. First results show that both goalkeepers were rated stronger when showing dominant NVB compared to submissive NVB. Further, the dominant goalkeeper was perceived stronger than the submissive one. However, the NVB of the goalkeepers did not significantly influence the outcome expectations of the penalty takers. Further analyses will show whether NVB influences objective performance measurements of precision and speed. Our results concerning subjective outcome variables do not confirm previous laboratory research on NVB as we could not find an effect of NVB on outcome expectations. This discrepancy between previous laboratory research and the results of this study show the importance of conducting field studies and of measuring real behavior.

Comparing accelerometry and self-report when measuring changes to sedentary behavior in the workplace

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Sedentary behavior (SB) has been linked to increased incidence of chronic disease. Short-term interventions (<3 months) have indicated that adopting a standing workstation is an effective tool to reduce sedentary behavior in the workplace. However, current literature has yet to establish a standardized measurement of sedentary behavior. We aimed to assess changes to sedentary behavior using and comparing activPAL accelerometers and self-reporting via the Occupational Sitting and Physical Activity Questionnaire (OSPAQ). We hypothesized that adoption of a standing work station (a) would decrease sitting time over a six-month intervention, and (b) would reduce self report (SR) accuracy compared to quantitative measures using an accelerometer. Sedentary office workers (n = 75, 42.7 ±10.8 yrs; BMI 27.3±6.0 kg/m 2; 12 males) were recruited and assigned to a control (Group C), intervention (Group I), or intervention plus education (Group I+E).Group I was given a standing workstation (Varidesk), while Group I+E received the standing workstation with additional information linking SB and chronic disease. Participants completed the OSPAQ after wearing the activPAL for five consecutive workdays at baseline, three and six months. At baseline, there were no differences in activPAL (P=0.33) or self-reported (SR) sitting times (P=0.63) between the three groups. Group C had no differences in activPAL (P=0.43) or SR (P=0.17) sitting time from baseline to six months. Group I reduced sitting with both activPAL (7.3%, P=0.02) and SR (11.7%, P=0.01) at three months. However, at six months, Group I participants increased sitting time again by 3.1% (P<0.05), which negated the initial decrease. However, they continued to SR decreased sitting time (12.6%, P=0.02), indicating they over estimate their reduction in SB. Group I+E had no overall change in activPAL sitting(P=0.31), whereas they SR a reduction at three (11.7%, P<0.05) and six months (11.1%, P<0.05), indicating they also overestimated their reduction in sedentary behavior.

Funding source: MRU.

"This doesn't look too hard": Sources of self-efficacy information on a novel puzzle task

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Studies have found self-efficacy, a person's belief in his/her ability to produced desired effects by his/her actions (Bandura, 1997), to be a key predictor of performance in numerous domains (e.g., Feltz & Magyar, 2006; Judge & Bono, 2001). However, few studies have examined how self-efficacy and the sources of self-efficacy information change over time, and these studies have all utilized a task participants were familiar or experienced with (e.g., Pattinson, Cotterill, & Leyland, 2017; Samson & Stewart, 2014). Therefore, the purpose of this study was to examine how the sources of self-efficacy information were weighed and interpreted in a novel task. Following completion of the informed consent, data were collected from 63 college students on two different sessions, two weeks apart, using the Tower of Hanoi Puzzle (TOHP), a wooden puzzle solving test requiring participants to move wooden pieces from one point to another in a specific order. Participants completed measures of self-efficacy, a demographic questionnaire, and provided qualitative and quantitative data on the sources of self-efficacy information. Participants completed a total of four trials on the TOHP across the two sessions. Results from a one-way ANOVA revealed hierarchical performance self-efficacy (HPSE) significantly changed across the four trials ($F(3,248) = 6.24$, $p < 001.$). Post-hoc tests revealed a significant decrease in HPSE between trials 1 and 2 and trials 1 and 3, but a significant increase between trials 2 and 4. Qualitative results indicated verbal and imaginal experiences were the most prominent sources of participants' self-efficacy information on trial 1, but by trial 4 mastery experiences and verbal information were the most prominent sources. Taken together, it appears that participants over estimated their self-efficacy prior to the first trial due to the novelty of the task, but then self-efficacy began to increase after the second trial. Findings from this study can be used by practitioners to better assist individuals when learning new tasks.

Coaching behaviors and athlete motivation: A test of psychological safety

Charity Simmons, Jordan Blazo, Mitzi Desselles, Hudson Taylor, Barton Crum, Louisiana Tech University

Research on athlete motivation and coach behaviors is abundant in sport psychology literatures. Researchers have previously found that five coaching behaviors (i.e. autocratic, democratic, social support, positive feedback, training and instruction) significantly relate to athlete self-determined motivation (Amorose & Horn, 2000; Hollembeak & Amorose, 2005). Apart from sport coaches, many athletes spend large amounts of time training with a strength and conditioning coach. Given the role that strength coaches play in an athlete's training, it is worthwhile to examine their behaviors and resultant athlete motivation. Importantly, athlete perceptions of psychological safety may alter this underlying relationship. Psychological safety is the belief held by an individual that he or she is accepted and respected among peers in work and team settings, allowing for interpersonal risk taking (Edmondson, 1999). Therefore, we hypothesized that similar to previous research, strength coach behaviors would be significantly related to athletes' self-determined motivation and that these associations would be moderated by psychological safety. Specifically, we hypothesized that self-determined motivation would be enhanced by psychological safety. Division I athletes ($N = 138$) voluntarily completed assessments on study variables. Participants included 55 females and 83 males (M_{age}= 20.22 ±1.37 yrs.). Moderated regression analyses indicated significant interactions where psychological safety moderated the relationship between democratic behaviors and intrinsic motivation, $b = 1.65$, $t(134) = 2.04$, $p < .05$, and identified motivation, $b = .69$, $t(134) = 2.57$, $p < .05$. Democratic behaviors of strength coaches were positively associated with both intrinsic and identified forms of self-determined motivation in a context of higher psychological safety. Collectively, these findings suggest that psychological safety may play an important, yet understudied, role in the relationship between coaching behaviors and athlete motivation.

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Exploring emotions as proximal predictors of physical activity and sedentary behavior in college students

Kelly Simonton, Alex Garn, Louisiana State University

Objective: To test a model of physical activity (PA) and sedentary (SED) behavior in university students using the Control-Value Theory of Achievement Emotions (CVTAE; Pekrun, 2006). Method: Students from a large Southeastern University (N = 345; M age= 19.63, SD= 1.87; 66.7% female; 75% Caucasian) in the USA completed well-established surveys regarding control and value beliefs, emotions (i.e., enjoyment, boredom, anxiety), and PA and SED behavior. Validity and reliability estimates were tested using coefficient alpha (α) estimates and confirmatory factor analysis (CFA). Structural equation modeling (SEM) was used to analyze data fit and structural relationships. Results: All constructs were reliable (α > .70) and CFA results supported construct validity. SEM revealed an acceptable fit of the data, $\chi 2(452)= 1160.095$; CFI= .909; TLI= .900; RMSEA= .067. Control beliefs predicted enjoyment (β= .728, p < .001; R2= .60), boredom (β= -.543, p < .001; R2= .42), and anxiety (β= -.591, p < .001; R2= .42) while value beliefs predicted boredom (β= -.200, p < .001; R2= .42). Enjoyment predicted PA (β= .267, p < .001, R2= .10) and SED (β= -.182, p < .05, R2= .03). Enjoyment also facilitated indirect relations between control beliefs and PA (β= .194, 95% CI= .115 to .283) and SED (β= -.132, 95% CI = –.250 to -.003). Conclusion: Discrete emotions are key motivational constructs that facilitate or inhibit human behavior, yet they are rarely used to understand PA or SED motivation and behavior in exercise psychology research. Based on the findings of this study, CVTAE appears to be a promising framework to investigate PA behavior, highlighting the important associations between enjoyment and PA. Enjoyment is an important PA determinant, however, most research chronicling this link is atheoretical. Further investigation of CVTAE as a potential intervention framework for increased PA is warranted. Variance attributed to SED was minimal; a more diverse set of emotions may contribute to SED and should be considered in future research.

The effect of acute exercise on neural activation and memory performance

Alexis B. Slutsky, Aiko Ueno, Sudharani Arunachalam, Jennifer L Etnier, University of North Carolina at Greensboro

Acute exercise benefits memory performance, however we have a limited understanding as to mechanisms underlying these effects. Incorporating neuroimaging measures, specifically functional magnetic resonance imaging (fMRI), may advance this understanding. We used fMRI to investigate the effects of exercise on neural activation (NA) during memory performance. Participants were randomized to exercise (n = 7, M=23.3±4.34) or control (n = 8, M=22.3±1.25) before completing the Rey Auditory Verbal Learning Task (RAVLT) with fMRI. The exercise group cycled for 20-min at moderate intensity and the control group sat on the bike for 20-min. Memory outcomes from the RAVLT included: Trial 1 (short-term memory [STM]); Trials 2-5 (learning); Trial 7 (delayed recall); Trial 8 (24hr-recall). The fMRI design included 30s blocks obtained during rest, encoding, and recall for each outcome. NA in regions of interest was converted to % change from rest. Spearman correlations assessed the relation of NA and memory outcomes at concurrent time points. Effect sizes for memory were calculated. Exercise resulted in a moderate benefit to STM (*g*=.52) and a small benefit to learning (*g*=.45) and delayed recall (*g*=.22), but no benefit to 24hr-recall (*g*=.02). During STM recall, angular gyrus NA was related to STM for exercise (ρ=.95, *p*=.00), but not for control. During learning encoding, left inferior frontal gyrus NA was related to learning for exercise (ρ=.857, *p*=.01) and left thalamus NA was related to learning for both groups (ρ=-.714, *p*=.01; ρ=-.893, *p*=.00). During 24hr-Recall, left inferior frontal gyrus NA was related to 24hr-recall for both groups (ρ=-.812, *p*=.05; ρ=.771, *p*=.03) and left thalamus NA was associated with 24hr-Recall for control (ρ=.831, *p*=.01). This is the first study to investigate the effects of acute exercise on memory with fMRI. Findings suggest that changes in NA in known memory regions are associated with memory performance and may help explain benefits of exercise on memory, but the differing signs of some relationships suggests the need for more investigation.

Gender differences in college students' perceptions of motivational class climates, ownership, enjoyment, and empowerment in exercise

Valerie Smith, E. Whitney G. Moore, Wayne State University

Finding a way to foster and maintain an active lifestyle can help individuals' health. Research grounded in Achievement Goal Perspective Theory and Caring Framework has shown individuals in a high caring, task-involving, and low ego-involving climate report more positive responses, such as increased enjoyment, effort, and interest in future participation (Brown & Fry, 2013). Recently, cross-sectional research has shown ownership and empowerment significantly relate to these climates and enjoyment (Moore & Fry, 2014; 2017). Therefore, this study examined the relationships of these constructs over time. As part of a larger study, University exercise class participants (N = 448) were surveyed at weeks 6 (T1) and 13 (T2) on their perceptions of the class climate (T1 only), ownership, enjoyment, and exercise empowerment. Overall students reported high caring climate, moderate ownership, empowerment, and enjoyment. At T1, compared to females, males reported significantly lower class enjoyment, as well as lower task-involving and higher ego-involving climates. Males' T1 responses on task-involving climate, class enjoyment, ownership, and exercise empowerment varied more than females. However, males' variances for T2 class ownership and exercise empowerment were significantly lower compared to females. Significant gender differences were also found among many of the within time correlations. Finally, caring climate was the only significant predictor in the modeling, predicting T2 class ownership (Beta = .24). The lack of significant predictive relationships in this sample and the differences across sex support that more research in the exercise context is needed. The class types male: female ratio varied. It is recommended future research explore class type as a confounder as some exercise class types may have structures and/or contexts (e.g., yoga vs. sport) that align more easily with promoting higher task-, lower ego-involving climate. Examining whether it is the exercise type, male:female ratio, or both that affects motivational climate development and perceptions.

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Using ecological theory to predict sedentary behavior in inner-city middle school aged children

Erin E. Snapp, Jeffrey J. Martin, E. Whitney G. Moore, Nate McCaughtry, Wayne State University

Sedentary time is predictive of increased health problems throughout the lifespan. Social cognitive theory components, such as barrier self-efficacy (BSE), have been used to predict engagement in physical activity (PA) in at-risk children, yet have accounted for little variance (Martin & McCaughtry, 2008). Similar methods have been used to evaluate sedentary behavior (SB). This exploratory study included examined the ability of environmental factors such as neighborhood barriers (NB) and neighborhood facilitators (NF), social factors (i.e., parent, friend, and sibling social support (PSS, FSS, SSS) and individual factors (i.e., enjoyment of PA (ENJ), and time spent outside (TO) to predict SB. Data was collected from 460 inner-city middle school aged children (M=12.14) and was evaluated

using two group (i.e., gender) structural equation modeling. The model had acceptable fit and met criteria for weak invariance, partial strong invariance, and homogeneity of variance and covariances. Mean latent differences were found: females had significantly more SB (.375), and significantly less TO (.522), BSE (.358), ENJ (.382), sibling SS (.313), and friend SS (.337) compared to males. The predictive ability of each SB antecedent construct was examined. The overall final model was significant and included TO ($\beta = .198$, $p = .028$), FSS ($\beta = .335$, $p < .001$), and NF ($\beta = .251$, $p = .019$) as significantly predictive paths that accounted for 28% of SB (Chi-square(721) = 1078.996; CFI = 0.913; TLI = 0.909; SRMR = 0.067; RMSEA[CI] = 0.046[0.041, 0.052]). Results suggest that spending time outside, having friends to play with, and having a more PA friendly neighborhood are important predictors of child SB. Longitudinal research is needed to better understand the impact of psychosocial and environmental factors on SB.

Obesity and cardiovascular fitness are associated with executive function in young adults

Tai-Fen Song, Feng-Tzu Chen, Chien-Heng Chu, Yu-Kai Chang, National Taiwan Sport University, Taiwan

Obesity is associated with the aberrant functioning of neural circuitry and cognitive functions. It is speculated that the status of cardiovascular fitness may be capable of ameliorating these obesity related negative outcomes, because cardiovascular fitness has been positively linked to improved cognition. This study aims to investigate the difference of executive functions between a young population suffering from obesity and a normal population. Eighty healthy college students were recruited, forty being within the normal body mass index (BMI), ages ranged between 18.5 and 24, and the other forty were obese (BMI > 27). Then, sixty participants meeting the requisite criteria (maximal oxygen uptake, VO2max) based upon their cardiovascular fitness test, were assessed by using YMCA standard protocol. All participants were categorized into four groups: OH group (n = 15, i.e. those that were obese, but with high cardiovascular fitness); OL group (n = 15, i.e. those that were obese and with low cardiovascular fitness); NH group (n = 15, i.e. those that were normal-weight and with high cardiovascular fitness); and NL group (n = 15, i.e. those that were normal-weight but with low cardiovascular fitness). A Stroop Test was used as an assessment of the inhibition aspect of these test subjects' executive functions, which was comprised of neutral and incongruent conditions. The results revealed that the OL group demonstrated the worst Stroop Test performance, relative to those of the other three groups, regardless of the Stroop Test congruency. Additionally, the OH group exhibited a longer response time relative to that of the NH group, for the neutral and incongruent conditions. These findings suggest that obesity has a negative impact on cognition. The beneficial effects from having a high fitness status could therefore be extended to assessing the cognitive function deficiencies of young adults with obese status.

Investigating collegiate student-athlete well-being: A qualitative study

Brian Souza, Framingham State University; David Schary, Winthrop University

The study explored factors influencing collegiate student-athlete well-being. Forty-four athletes ($n = 29$ women, 15 = men) from a NCAA Division I university participated in semi-structured focus groups designed to gather data about factors that enhance or inhibit student-athlete well-being. The data were analyzed using Lundqvist's Integrated Model of Well-Being in Sports (M-WBS), which allowed an assessment of the participants' hedonic (i.e., psychological and social) and eudaimonic (i.e., subjective) well-being at both the global (i.e., student) and sport (i.e., athlete) levels. The student-athletes experienced most of the well-being domains proposed by the M-WBS at both levels. We found evidence for a potentially new form of sport-specific social well-being related to resource allocation within athletic departments where a perceived inequality of resources among athletic programs negatively influenced student-athlete well-being. In addition, we suggest another new form of well-being, physical well-being, exists which encompasses the four subdomains of rest-recovery, injury, nutrition-diet, and fitness-exercise. This highlights the intricate connection between mind and body. Student-athlete's dual identities as students and athletes often interacted to reinforce or hinder aspects of well-being. For example, the responsibilities of playing collegiate sports often inhibited extracurricular opportunities to expand psychological and social well-being as a student, such as attending campus events or guest lectures. Administrators, coaches, professors, and researchers can use the study's findings to help maximize the well-being of collegiate student-athletes.

Self-control, social support, and burnout among collegiate athletes: A prospective analysis

Jessie N. Stapleton, Missouri Baptist University; Molly V. Josephs, Southern Illinois University Edwardsville; Paul D. Saville, Azusa Pacific University

Self-control and social support have each been shown to be inversely related to stress, anxiety, and depression among college students (DeFreese & Smith, 2013; Park, Edmonson, & Lee, 2012). More specifically, social support has been shown to be negatively related to athletic burnout among collegiate athletes. According to a recent review, the relationships between self-control, social support, and stress have yet to be adequately evaluated (Pilcher & Bryant, 2016). As such, the purpose of the current study is to evaluate the utility of self-control and social support for predicting athletic burnout among collegiate athletes over the course of an academic year. A sample of 212 National Association of Intercollegiate Athletics athletes (Mage = 20.54 ± 1.20) completed an online questionnaire during consecutive semesters in an academic year. Multiple regression was used to evaluate self-control and social support, reported in the fall semester, as predictors of athletic burnout in the subsequent spring semester. The regression model yielded significant results ($R^2 = .14$, $F = 12.79$, $p < .01$), whereby self-control (beta = –.26, $p < .01$) and social support (beta = –.25, $p < .01$) both significantly predicted athletic burnout among collegiate athletes. Results indicate athletes who reported lower levels of self-control and social support experienced more athletic burnout than athletes who reported higher levels self-control and social support. These findings provide athletic staff with two modifiable variables, self-control and social support, that could potentially buffer the effects of athletic burnout among collegiate athletes.

Hold your strength! The influence of motivation, attention and emotion on self-control performance

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In sport and exercise contexts, it is highly important to control one's impulses and behavioural tendencies to meet specific goals. However, such self-control acts do not always successfully work (Englert, 2016). One of the most prominent self-control models is the strength model of self-control (Baumeister, 2002), while an alternative explanation for self-control lapses derives from the process model of self-control (Inzlicht, Schmeichel, & Macrae, 2014). Some argue that self-control failures are due to shifts in attention, motivation, and emotion following a primary self-control task. Thus far, this model has not undergone rigorous empirical testing. The purpose of this study was to investigate the role of attention,

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motivation and emotion as psychological mediators involved in the relationship between self-control and physical endurance performance ($N = 70$). Self-control was manipulated via a transcription task (Bertrams, Englert, & Dickhäuser, 2010). The non-depletion group ($n = 34$) had to transcribe a text conventionally, whereas the depletion group ($n = 36$) also had to omit the letters 'e' and 'n', which requires self-control to overcome writing habits. Before and after the self-control manipulation, participants performed an isometric biceps-contraction endurance task. This task required the participants to hold for as long as possible at least 60% of their maximum strength, which was displayed as visual feedback on a computer screen. Changes in motivation (Hutchinson et al., 2011; Ryan, 1982) and emotion (Positive and Negative Affect Scale; Watson, Clark, & Tellegen, 1988) were assessed via self-report questionnaires before and after the isometric contraction. Changes in attention (attentional shifts) were assessed with an eye-tracking device via the percentage of viewing time to relevant (visual-feedback screen) or irrelevant (second distracting-picture screen) stimuli. Preliminary analyses indicate self-control has a significant direct effect on physical performance through changes in motivation, emotion, and attention.

Mental practice and psychological health in stroke patients: A systematic review

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Background. Motor impairments after stroke can lead to limitations in functional performance (López-Espuela et al., 2016) and mental health (Kutlubaev & Hacket, 2014). Previous systematic reviews and meta-analyses have mainly assessed randomized clinical trials (RCTs) of mental practice interventions (MPI) among stroke patients, focusing on physical outcomes (e.g., Guerra, Lucchetti, & Lucchetti, 2017). We aim to investigate the effectiveness of MPI on mental health outcomes such as quality of life (QOL). Methods. We performed a systematic review of RCTs according to PRISMA guidelines. 16.125 records were identified through PubMed, Web of Science, Science Direct, and Cochrane resulting in 8.573 documents after duplicates were removed. 62 were full-text screened. Results. 3 studies met the eligibility criteria. MPI showed positive effects on the physical functioning domain of QOL ($p > .001$) compared to conventional physical therapy and on stroke-specific QOL ($p > .05$) when compared to a control condition. MPI showed no significant effect on fall-related self-efficacy when compared to a control condition ($p = .67$). Discussion. The included RCTs showed promising results for the effectiveness of MPI on mental health such as QOL. Further research is needed to investigate and improve MPI with regard to mental health. References. Guerra, Z.F., Lucchetti, A.L.G. & Lucchetti, G. (2017). Motor imagery training after stroke: a systematic review and meta-analysis of randomized controlled trials. Journal of Neurologic Physical Therapy, 41 (4), 205-214. Kutlubaev, M.A. & Hackett, M.L. (2014). Part II: predictors of depression after stroke and impact of depression on stroke outcome: an updated systematic review of observational studies. International Journal of Stroke, 9(8), 1026-1036. López-Espuela, F. et al. (2016). Functional status and disability after acute stroke: a longitudinal study. American Journal of Critical Care, 25(2), 144-151.

Differences in character strengths use and associations with optimal functioning across contexts

Cheryl Stuntz, St. Lawrence University

In 2004, Peterson and Seligman identified a group of character strengths that are fairly universal, morally-valued, and stable positive traits. Across a broad variety of studies, using character strengths is associated with optimal functioning, psychological fulfillment, and well-being in general. Measurement of these variables has occurred at a general level. However, Peterson and Seligman (2004) assumed that (a) character strength use may vary across specific contexts and situations and (b) some strengths may be more applicable across a broad variety of situations and will appear more trait-like, while other strengths will be used less frequently in some specific situations and will appear more state-like. However, little research has examined whether these assumptions are true. The current study (a) examined whether character strengths use differs across general as well as specific eating, exercising, and work contexts, (b) determined how trait-like and state-like strengths are, and (c) assessed if the relationships between strengths use and optimal functioning in eating, exercise, and work contexts were similar. Participants ($N = 270$) completed questionnaires assessing character strengths use in various contexts as well as psychological need satisfaction, job satisfaction, and eating and exercise behaviors. Results showed that strengths use did vary by context, with participants commonly using strengths more in general (no context suggested) and at work than while exercising and while eating. Most strengths demonstrated both trait-like and state-like qualities, with about half of the variance due to between-person and about half due to within-person variability, except for the trait-like strength of religiousness. Finally, across eating, exercising, and work contexts, a set of all (or almost all) strengths related to satisfaction of the psychological needs of competence, autonomy, and relatedness. Although there are differences in how applicable strengths are across domains, using character strengths appears advantageous in each of these contexts.

Perceived social support predicts competition appraisals and performance satisfaction among varsity athletes: Organizational stressors as moderators

Katherine Tamminen, University of Toronto; Catherine Sabiston, University of Toronto; Peter Crocker, The University of British Columbia

Athletes report a number of organizational stressors in sport including training demands, high performance expectations, and challenges in interpersonal relationships. These stressors may negatively impact athletes' perceptions of the support they have to help manage stress, and they may also impact appraisals of competitive stressors and in turn influence performance outcomes. The purpose of this study was to prospectively examine the associations between athletes' perceptions of available social support, competitive stressors, and performance satisfaction, as well as to examine the impact of organizational stressors on these relationships. Varsity team sport athletes ($n = 84$, 55% females) completed measures of perceived social support, organizational stressors, competitive appraisals, and performance satisfaction. Perceived support was a positive predictor of athlete's satisfaction with their performance, and the indirect effect through secondary appraisals was significant: athletes who perceived greater support also reported greater resources to deal with the upcoming competition, and subsequently reported greater performance satisfaction. Two organizational stressors (team and culture, and coaching) moderated an effect of esteem support on secondary appraisal, albeit in opposite directions. Athletes who perceived fewer coaching demands reported a stronger association between perceived support and secondary appraisals, while perceptions of higher team and culture demands showed a stronger association between perceived support and competition appraisals. These divergent results suggest that coaching organizational stressors may worsen the relationship between perceptions of support and appraisals of competitive stressors; however, team and culture organizational stressors may reflect perceptions of high standards for performance and may not necessarily be viewed as negatively impacting perceived support availability among athletes.

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Experiences of peers and peer-mentors during a peer-mentor physical activity program for college students with autism spectrum disorder

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Introduction: Regular physical activity is important for optimal physical and mental health. Individuals with ASD experience poor motor skills and typically lead sedentary lifestyles, thus it is critical to develop strategies to promote engagement in regular physical activity.Purpose: To explore the experience of a peer-mentor physical activity program for college students with ASD from the perspective of college students with ASD and Peer Mentors (PMs).Methods: College students with ASD ($n = 28$), participating in a 10-week peer-mentored physical activity program called Into Fitness Together (IFiT). Kinesiology majors who completed upper division courses were paired with participants as PMs. Upon the completion of IFiT individual interviews, following an interview protocol, were conducted with participants. PMs participated in a focus group that was audiotaped and observed by note-takers. Verbatim transcription and notes were analyzed using a generic coding process. Data were coded, similar codes were grouped into categories and themes were generated. Data from participants and PMs were analyzed separately.Results: College students with ASD shared common experiences during IFiT and four themes emerged: 1) social opportunities and fun, 2) time-management, 3) health benefits, and 4) learning exercise techniques. Ongoing opportunities for social interactions and feelings of increased health motivated many of the participants to engage in regular physical activity. Shared experiences of PMs included: 1) self-recognized growth in empathy, 2) professional skills and independence, 3) overcoming challenges. Peer mentors reported their learned ability to recognize that the experience of a situation for their partner was different than their own.Conclusions: College students with ASD reported positive experiences and reaped the benefits of regular physical activity, many reporting they would stay active after completing the program. Peer Mentors gained skills that will be useful as they transition into the workforce and provide services to all members of the community.

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Ahead of the game: Results of a sports-based mental health program for adolescent males

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Childhood psychological disorders are recognised as one of the most prominent contributors to the global burden of disease among young people, with the onset of half of all psychological disorders occurring before the age of 14 years. There is a recognised need for targeted community-wide mental health strategies and interventions aimed specifically at prevention and early intervention in promoting mental health. However, adolescent males hold particularly negative attitudes toward mental health services which are detrimental to effective prevention and early intervention initiatives. One potentially motivating and engaging way of reaching adolescent males through community-wide initiatives are community sports. This presentation will report on the preliminary findings of the Ahead of the Game controlled trial. Ahead of the Game is a multi-component, community-sport based program targeting prevention, promotion and early intervention for mental health among adolescent males. The effectiveness of the Ahead of the Game program was tested using a quasi-experimental, community-matched control design. In total, 484 adolescent males aged 13-18 years (M age = 14.59 years, SD = 1.35) participated in the Ahead of the Game program ($n = 228$) or as a matched control ($n = 256$). Results show that the Ahead of the Game program led to benefits that are likely to underpin the prevention of mental health problems and promote wellbeing, including greater mental health literacy, greater intentions to seek help from professional sources, and greater wellbeing. Further, the Ahead of the Game program led to benefits to sports-related outcomes such as greater levels of perceived autonomy support, greater levels of engagement, and less burnout. The design and implementation of community sport-based programs can be effective in the prevention and early intervention of mental health problems among adolescent males. Sustainable and effective implementation strategies may be the most important variables in meaningful change at a community level.

Funding source: Movember Foundation.

Investigating birthplace effects in US collegiate and professional men's basketball

Matthew Vierimaa, Utah State University; David John Hancock, Indiana University Kokomo; Ross Budziszewski, Utah State University

Past research has highlighted that contextual factors, such as the population of one's birthplace, can influence the likelihood of attaining sport success. Studies across several professional sport leagues in the US (including basketball) have found an over-representation of elite athletes from cities of less than 500,000 inhabitants, and an under-representation from cities of larger than 500,000 inhabitants (e.g., Côté et al., 2006). To better understand the birthplace effect, the role of population density has also been considered, with varied results across sports and countries (Farah et al., 2017; Hancock et al., 2017; Rossing et al., 2016; 2017). By analyzing city size and population density, the purpose of the present study was to investigate birthplace effects in US men's basketball at both the collegiate (Division I) and professional levels. Birthplace data for 4,030 NCAA and 382 NBA athletes were collected from team websites. US census data were used to compare participants across several city size and population density categories. Odds ratio analyses revealed similar trends among city size and population density at the collegiate and professional levels. Relative to the general US population, athletes from moderately-sized cities were over-represented, most notably from cities between 250,000-499,999 inhabitants (NCAA OR = 1.89, 95% CI = 1.72, 2.09; NBA OR = 2.90, 95% CI = 2.20, 3.81). NCAA athletes were most likely from cities with densities between 2,500 and 4,999 pop./km2 (OR = 1.31, 95% CI = 1.23, 1.40). NBA athletes were most likely from densely populated cities (>5,000 pop./km2; OR = 1.64, 95% CI = 1.34, 2.01). In contrast to the previous study of NBA players (Côté et al., 2006), the birthplace effect in professional basketball seems to have shifted to favor larger cities. By studying several levels of competition while considering both city size and population density, the present study helps to advance our understanding of the role of contextual factors in the development of sport expertise.

Exploring the relationship between parent and child physical activity during a family-based fitness intervention

Danielle Wadsworth, Shelby Foote, Alexandria Venezia, Auburn University

This study examined the effects of parental influence on their child's physical activity levels. Participants consisted of 8 families; parents (n = 9) who identified as sedentary and children (n = 10) who were considered

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obese (> 93rd percentile). Families were asked to come once weekly for a 60-90 minute session involving separate but concurrently running exercise sessions for children and adults, parental health education, and family group session for 10 weeks. Linear mixed-effects models were used to predict daily physical activity over time and child physical activity as a function of parent physical activity on a day-to-day basis. Physical activity for all participants did not change significantly ($p > .05$) over the course of the intervention. Parents were getting on average 2825.18(±1282.77) fewer *moves* than their children on a daily basis. When examining the relationship between mothers' physical activity and their children's activity, our results indicated that for every 1,000 *moves* a mother achieved above her average, her child achieved an additional 191.8(±57.3) *moves* per day ($p = .001$). Encouraging parents to take a more active role in engaging in physical activity with their children may have a positive impact on their child's daily physical activity engagement.

Funding source: None.

Exploring early sport specialization: Associations with athlete burnout

Shelby Waldron, J.D. DeFreese, Brian Pietrosimone, Johna Register-Mihalik, Nikki Barczak, University of North Carolina at Chapel Hill

Despite an increasing number of cautionary position statements regarding early sport specialization (Wiersma, 2000), there is limited extant research on its posited psychosocial risks including athlete burnout. Thus, the purpose of this study was to examine the associations of sport specialization and American high school athlete burnout perceptions as well as theoretically-specified burnout antecedents (i.e. perceived sport stress and amotivation). We hypothesized that early sport specialization would be associated with higher levels of retrospective burnout and targeted antecedents. Using a retrospective design, college-aged individuals (N = 243; Mage = 19.83 years) completed self-report assessments of study variables relative to American high school sport experiences via an online survey. Based on their age of specialization (quitting other sports to focus on one sport), participants were classified as an early specializer (≤ 12; n = 67), late specializer (> 12; n = 91), or sampler (not specialized; n = 85). ANOVA results supported study hypotheses, with early specializers (M = 2.63) reporting higher levels of global burnout than both late specializers (M = 2.36) and samplers (M = 2.28; $F = 4.51$, $p < .05$). Results were similar for all burnout dimensions with the exception of reduced accomplishment, which did not differ across groups. Furthermore, early specializers reported higher levels of amotivation, but not perceived sport stress (antecedents of burnout), when compared to both late specializers and samplers, $F = 3.55$, $p < .05$. Findings corroborate prominent position statements regarding endorsement of higher levels of burnout and maladaptive motivation by early sport specializers. However, the association between specialization and sport stress should be probed further due to the well-established stress-burnout relationship. Results support future prospective burnout research to examine potential temporal effects among study variables and inform the development of interventions designed to positively impact the psychological experience of youth athletes.

Why specialize? Impact of athletes' reasons for specializing on psychological outcomes

Shelby Waldron, J.D. DeFreese, Brian Pietrosimone, Johna Register-Mihalik, Nikki Barczak, University of North Carolina at Chapel Hill

Little is known regarding whether reasons to specialize in one sport are associated with participants' psychosocial outcomes, such as burnout and stress (Russell, 2015). Previous pilot work suggests that the specialization decision may not be inherently maladaptive, but rather dependent on athletes' patterns of sport commitment and motivation. Accordingly, the current study examined associations among athletes' reasons for specialization, specialization age, and targeted psychological outcomes. Early specialization was hypothesized to be associated with maladaptive reasons for specialization, and subsequently, maladaptive psychological outcomes including burnout and stress. College-aged individuals ($N = 158$; $M_{age} = 19.99$ years) completed retrospective, self-report assessments of study variables via an online survey. Participants were classified into groups based on their age of specialization (i.e. quitting all other sports to focus on one sport), with an early (≤ 12; $n = 67$) and late (> 12; $n = 91$) specialization group. Chi-squared results partially supported study hypotheses, as late specializers reported more autonomy in the decision process, versus early specializers, $X(2) = 4.78$, $p < .05$. Moreover, athletes who cited external sources of influence (e.g. parents) reported maladaptive psychological outcomes, such as higher burnout ($t(156) = -2.87$, $p < .01$) and sport stress ($t(156) = -2.24$, $p < .05$). However, early specialization was associated with both adaptive (i.e. "personal enjoyment" and "feelings of competency") and maladaptive (i.e. "parent/coach pressure" and "high investment") reasons for specialization. Athletes who reported adaptive reasons (i.e. "to achieve athletic excellence") also reported adaptive psychological outcomes, such as lower levels of reduced accomplishment ($t(156) = 2.70$, $p < .01$) and higher intrinsic motivation ($t(156) = -2.24$, $p < .05$). Findings suggest that in addition to specialization age, athletes' reasons for specialization may impact their psychological outcomes. Findings merit continued empirical scrutiny.

The relationship between social skills and social anxiety in Chinese student athletes: The mediating effect of cognitive disorders

Ye Wang, Florida State University

Social anxiety refers to the intense anxiety, the reaction to tension and fear, and avoidance behavior in interpersonal situations. Social skills refers to learned behaviors that are accepted by the society, which can help people to communicate with others effectively. It is very important to study the relationship between social anxiety and social skills in student athletes because: 1. There is an increasing tendency of social issues among student athletes, 2. Monitoring social anxiety and social skills are essential for the mental health of student athletes 3. The study will benefit both theory and practice in sport psychology. Cognitive disorders cause people to have negative attitudes towards themselves, the surroundings and their future. It causes depressive symptoms. Thus, in some situations, to reduce social anxiety, we should change the negative thoughts and cognition instead of improving social skills only, as both the thoughts and the skills play a role in anxiety. We used questionnaire method, and selected 372 Chinese student athletes. We used the Social Anxiety Inventory for Chinese College Students, the Chinese University Students Social Skill Inventory and the Dysfunctional Attitudes Scale as the research tools. We used SPSS to analyze the features of social anxiety, social skills and cognitive disorders as well as the mediating effect in the relationship between social anxiety and social skills. The conclusions are as follows: (1) Social skills have a negative correlation with social anxiety. The lower social skills are, the higher social anxiety is.(2) Social skills have a negative correlation with cognitive disorders. The better social skills are, the lower cognitive disorders are.(3) Cognitive disorders have a positive correlation with social anxiety. The higher cognitive disorders are, the higher the social anxiety is.(4) Social skills influence social anxiety through cognitive disorders. The cognitive disorders act as a mediator in the relationship between social skills and social anxiety.

Examining the overall wellness of college student-athletes

Shane Warehime, Danae Dinkel, University of Nebraska at Omaha

College student-athletes (SAs) have a unique set of college experiences. They may also have distinct characteristics that impact how they view and

experience the world. Subsequently, it is likely that there is some downstream effect on SAs' overall wellness. Wellness is an increasingly relevant construct because it displays a broad, comprehensive understanding of individuals and groups. It has become a point of emphasis in academic institutions for improving student development. Thus, the present study examined the overall wellness of SAs in comparison to college students that are not student-athletes (non-SAs). Participants (n = 127) were full-time college students between the ages of 19-24 from a mid-sized, NCAA Division I university in the Midwest. Fifty-four SAs and 73 non-SAs participated. Overall wellness was assessed using the Five-Factor Wellness Inventory, a 91-item survey. The Five-Factor Wellness Inventory calculated one overall wellness score based on values from nine subscales: five wellness factors (coping self, creative self, social self, physical self, and essential self), three contexts (local, institutional, and global), and one life satisfaction measure. An independent samples t-test was conducted to compare mean scores between groups. SAs displayed significantly higher levels of overall wellness than non-SAs ($p < 0.01$). SAs also displayed significantly higher levels in wellness sub-scales of the physical self ($p < 0.001$) which includes exercise and nutrition; the essential self ($p < 0.05$) which includes spirituality, gender identity, cultural identity and self-care; and life satisfaction ($p < 0.01$) which is a single, Likert-type inquiry about the extent to which one is satisfied with their life. No significant differences were found in the remaining six sub-scale measures. These results suggest the unique experiences and/or characteristics of SAs may boost specific areas of wellness that are enough to improve the overall wellness of SAs. Future efforts may expand on this study by examining the effect of specific demographic variables on wellness in SAs.

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When a team suddenly falls apart: Comparing athletes', coaches', and sport psychologists' perceptions of causes of collective team collapse

Vivian Vanessa Wergin, Jürgen Beckmann, Technische Universität München, Germany

Collective team collapse occurs when multiple players of a sport team experience a sudden underperformance within a game (Cotterill, 2012). While a previous study investigated athletes' perception of causes of collective team collapse, the goal of this qualitative study was to explore differences in perceptions of these causes between athletes, coaches, and sport psychologists of various professional German sport teams. Semi-structured interviews were conducted to investigate seven coaches' and four sport psychologists' perceptions of causes of collective team collapse and to compare them to athletes' perceptions. Abductive reasoning was used to apply a process model, developed in the previous study with athletes, to the data collected in this study. Thematic analysis revealed that athletes, coaches, and sport psychologists found collective team collapse to be an existing and relevant phenomenon in team sports. While perceived antecedents and critical events causing team collapse were mostly identical between the three participant groups, coaches and sport psychologists differed from athletes in their perception of emotional, cognitive, and behavioral outcomes of team collapse. Coaches tended to see behavioral factors, such as immobility, the blaming of other players, or even negative coaching behavior, as critical factors maintaining team collapse. Sport psychologists reported cognitive factors, such as individualization or a lack of accountability between the players, to maintain team collapse. Furthermore, sport psychologists showed less emotional attachment to team collapse events than athletes and coaches when discussing the phenomenon. In accordance with these results, the process model of collective team collapse is expanded by a few dimensions and further adaptions of the temporal cascade of causes of team collapse are discussed. The expanded model is supposed to help future research to better connect to practice and to support athletes, coaches, and sport psychologists in dealing with collective sport team collapse.

An investigation of Canadian university sport coaches' awareness and use of motivational interviewing

Colin M Wierts, University of British Columbia; Philip M Wilson, Brock University; Diane E Mack, Brock University

Motivational Interviewing (MI; Miller & Rollnick, 2013) is an evidence-based approach for leading behaviour change conversations, and has been recommended for sport coaches to use with athletes (Miller & Rollnick, 2013). However, research in sport pertaining to MI is scarce. To address this gap in the literature, the main aim of this study was to investigate Canadian university sport coaches' awareness and use of MI. Coaches (N = 152; nmale = 114) completed items measuring demographic variables (e.g., age), coaching history, plus questions adapted from Spence et al. (2002) assessing their awareness and use of MI. Using a non-experimental cross-sectional research design, coaches provided responses to a survey on a single occasion using an encrypted website. Most coaches were certified (93.00%), either by the National Coaching Certification Program (NCCP; 41.40%), or by another organization (52.00%). Coaches possessed, on average, 2.95 (SD = 2.14) certifications pertinent to their sport. Less than one-third of the coaches reported being aware of MI (27.00%) or using MI (29.80%) in their coaching practice. There were no significant differences between male and female coaches regarding MI awareness (chi^2 = 0.96, df = 1, p = 0.33, phi = 0.08) and use (chi^2 = 0.24, df = 1, p = 0.63, phi = 0.63). Coaches with alternative certification to NCCP reported more awareness of MI (chi^2 = 4.77, df = 1, p < .05, phi = -0.18), however differences between coaches certified by the NCCP or another organization were not significant for use of MI (chi^2 = 2.87, df = 1, p = 0.09, phi =-0.15). Coaches with a higher number of coaching certifications were more likely to report they were aware of MI (chi^2 = 5.59, df = 1, p = 0.02), and use MI (chi^2 = 6.26, df = 1, p = 0.01) in their coaching practice. Overall, the findings in this study demonstrate that MI does hold relevance with sport coaches regarding both awareness and use within sport suggesting further research addressing the utility and applicability of MI for sport coaches is justifiable.

Funding source: Ontario Graduate Scholarship.

Knowledge of motivational interviewing among certified coaches in Canadian university sport

Colin M Wierts, University of British Columbia; Philip M Wilson, Brock University; Diane E Mack, Brock University

Motivational interviewing (MI) is a popular, empirically based technique to guide professional communication for behaviour change (Miller & Rollnick, 2013), yet MI research in sport is scarce. The aim of this study was to assess basic MI knowledge held by certified sport coaches affiliated with a university-based sport team in Canada. Male (n = 107; Mage = 44.46±11.02 years; 80.40% head coaches) and female (n = 35; Mage = 41.23±11.23 years; 74.30% head coaches) sport coaches responded to a cross-sectional survey using a non-experimental research design via an encrypted website. The survey included sections assessing participant demographics, coaching history, certification status, and MI knowledge measured using 6 items modified from the Motivational Interviewing Treatment Integrity coding manual. On average, coaches in this sample reported 10.29±7.89 years of coaching university sport. Correct responses to the MI knowledge items were above the theoretical mid-point for both male (M = 77.93%±16.55%) and female (M = 80.00%±15.06%) university sport coaches. MI knowledge did not differ as a function of the coaches' sex (t (140) = -0.85, p = 0.40, d= 0.17) and was uncorrelated with coaches'

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age, years of coaching university-level sport, and number of coaching certifications held (r's ranged from -0.01 to -0.06, p's > .10). Overall, the results of this study indicate that university-level sport coaches in Canada hold a high degree of knowledge pertaining to basic MI skills and concepts, which seem independent of select demographic or coaching certification history. Further investigation pertaining to where and how university sport coaches obtain MI knowledge seems warranted given the potential utility of this professional communication technique for sport personnel.

Funding source: Ontario Graduate Scholarship.

Maintenance of parental outcomes following a home-based physical activity intervention for families of youth with and without Prader Willi Syndrome

Kathleen S. Wilson, Daniela A. Rubin, California State University, Fullerton

Parents play a key role in the success of physical activity (PA) interventions that target youth (Dellert & Johnson, 2012). However, changes in parent outcomes are understudied. This study explored the changes in parent self-efficacy (SE) to provide PA opportunities for their child and parental PA influences after six months following the implementation of a parent-led home-based PA intervention. Parents (N = 103; 88.3% female) and their child with Prader-Willi Syndrome (PWS; n = 41; Age: M = 10.8 y, SD = 2.5) or child with obesity but without PWS (n = 62; Age: M = 9.7 y, SD = 1.1) participated in a 24-week home-based PA intervention. The Active Play at Home intervention included a curriculum of playground and inter-active video games for families to play together four days a week (Rubin et al., 2014). This study used data following the implementation of the intervention for both the intervention group and the wait-list control group. Measures were assessed at baseline (prior to; n = 93), post (immediately following; n = 77) and follow-up (six months after; n = 61) and included questionnaires for parent SE and parental influences: collaborative (offer to be active together), positive (encourage), and negative (order). Generalized estimating equations were used to evaluate changes in each parent outcome with visit (baseline, post, and follow-up), and child group (with/without PWS) serving as independent variables. All four models showed a significant time effect ($p < .01$). Parent SE decreased from baseline (M = 90.2, SE = 1.0) to post assessment (M = 87.9, SE = 1.1, p = .001) and remained lower at follow-up (M = 84.7, SE = 1.6; p = 1.0). Parental influences showed an increase immediately following the intervention (at post) but the values returned to the baseline level at follow-up for all three types ($p < .01$). The changes in parental influences were not maintained over the long term and parent SE decreased post intervention. These results illustrate the need for future research to include plans for maintaining parental behaviors after a PA intervention.

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Gatekeepers' experiences of hiring a sport psychologist: A phenomenological study

Toby H Woolway, Chris G Harwood, Loughborough University, UK

Within applied sport psychology, the process of gaining entry to practice, specifically the employment interview, has been sparsely researched relative to the other stages of practice (i.e., assessment, programme implementation, and termination and continuation stages; Poczwardowski, Sherman, & Henschen, 1998; Visek, Harris, & Blom, 2009). In addition, past research examining the likelihood of gatekeepers and consumers to seek the services of an applied sport psychologist has paid little attention to the interpersonal phenomenon of the employment interview (Wilson, Gilbert, Gilbert, & Sailor, 2009; Woolway & Harwood, 2015). Understanding this employment tool can provide useful information regarding required skills, behaviours, and processes to navigate through this stage of consultancy. This presentation will describe a study which aimed to understand the experiences of gatekeepers to practice within elite sport in the United Kingdom, who had been directly involved in the hiring of applied sport psychology practitioners. The presented study utilised semi-structured interviews with seven participants, and performed analysis using an interpretive phenomenological approach. The analysis indicate that four essences acted to influence the gatekeepers' experiences: (a) consultant affability, (b) consultant confidence versus arrogance, (c) consultant collaboration, and (d) presentation of consultant competency. Depending on the interviewee, these essences may serve to strengthen or inhibit the practitioners' entry to practice. The findings highlighted the importance of developing interpersonal skills, employment interview technique, and self-promotion skills in applied sport psychology practitioners.

Parents' perfectionism, parenting styles, and views of sport specialization

Emily Wright, Michigan State University; Melissa Chase, Miami University; Robin Vealey, Miami University; Thelma Horn, Miami University

The purpose of this study was to investigate parents' perceptions of sport specialization within the samplings years of Côté's Developmental Model of Sport Participation (Côté, 1999). More specifically, this study explored how parents' perceptions of their perfectionism and parenting styles were related to views of sport specialization in youth sport. Participants were 203 parents ($M = 42.87$, $SD = 5.44$) of youth athletes from the Midwest. Youth athletes ($M = 9.85$, $SD = 1.78$) were sons or daughters, between the ages of 6 and 12 years old, participating in ice hockey, figure skating, or swimming. Parents completed measures of perfectionism (self-oriented, socially prescribed, and other oriented), parenting styles (authoritarian, permissive, and authoritative), and views of sport specialization through in-person questionnaires at the beginning of their child's sport season. A cluster analysis identified four distinct parenting groups based on overall perfectionism and parenting style profiles named: Cluster 1: High permissive, high socially prescribed, low in all others, Cluster 2: Moderate permissive, low in all others, Cluster 3: High authoritarian, high in all perfectionism, and Cluster 4: High authoritative, moderate self-oriented, low in all others. Findings revealed a significant cluster group main effect, indicating the four cluster groups differed significantly on two of the four specialization subscales. Following this, a univariate Pearson correlation indicated significant positive and negative associations between parent perfectionism, parenting styles, and views of sport specialization. Results suggest parenting styles and levels of perfectionism are linked to parent views of sport specialization. This information is important, as we know that while parents serve as the primary support systems for their children, they can also apply a great deal of pressure in the interest of achieving excellence and success through sport specialization. Therefore, this study was able to provide initial evidence of parent influence on their child's youth sport specialization.

Relationship among mindfulness, mental skills and mental toughness in martial arts athletes

Chih-Han Wu, Jui-Ti Nien, Tai-Sheng Chen, Chen-Shuo Liu, Yu-Kai Chang, National Taiwan Sport University, Taiwan

Numerous studies have shown that dispositional mindfulness is positively associated with many mental states related to sports performance, including mental skills and mental toughness. However, the previous studies have mostly explored closed-skills sport, rather than open-skills sport. The purpose of this study was to explore the relationship between dispositional mindfulness, mental skills and mental toughness among different types of martial arts that involved both closed-skills and open-skill characters.

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Ninety-three college athletes with excellent sport level including Tae-Kwon-Do, Judo, Wushu and Archery athletes were recruited. The dispositional mindfulness, mental states, and mental toughness were measured by a Mindfulness Attention Awareness Scale, an Athletic Psychological Skills Scale, and a Traits of Mental Toughness Inventory for the Sports Scale. A Pearson's correlation was calculated for the association among the dispositional mindfulness, mental skills and mental toughness. The results showed that dispositional mindfulness is positively associated with peaking under pressure and coping with adversity, exhibiting confidence, maintaining concentration, enhancing coachability, elevating motivation and sharpening overall mental skills in relation to an Athletic Psychological Skills Scale. The correlation also showed that dispositional mindfulness is positively associated with positive effort, resisting pressure and increasing overall mental toughness, as indicated by a Trait of Mental Toughness Inventory for the Sports Scale. This study provided a positive correlation between mindfulness and the two examined mental abilities. Given that mental skills and mental toughness have always been key factors in the best athletes, it may be suggested that mindfulness training for athletes be used in order to enhance their mindfulness abilities. Further expectations are that this will enhance their overall performances.

Does physical activity moderate the associations between body mass index and self-perceptions in adolescent and young adult cancer survivors?

Amanda Wurz, Jennifer Brunet, University of Ottawa

Adolescents and young adults diagnosed with cancer (AYAs) may have poor physical self-perceptions due to adverse body composition changes during and after treatment, which can impair their global self-perceptions. Physical activity (PA) may help AYAs improve their body composition. As well, PA may attenuate the negative effect body composition has on physical and global self-perceptions. Therefore, we sought to (1) examine the associations between body composition (using body mass index [BMI] as a proxy) and measures of physical (i.e., strength, endurance, body fat, appearance, physical self-worth [PSW]) and global self-perceptions (i.e., global self-worth [GSW]), and (2) test if PA moderates these associations. Eighty-five AYAs (M_{age}=32.4±4.9 years) completed a survey online. Data were analyzed using multiple hierarchical linear regression analysis; separate models were tested for each self-perception. After adjusting for age, sex, and time since diagnosis in Step 1, BMI, PA, and the interaction term between BMI and PA accounted for a significant amount of variance in three of the five physical self-perceptions, namely endurance, body fat, and PSW (Step 2: R^2=.20-.41, $ps \leq .001$). PA was positively associated with endurance perceptions (β=.40, $p < .001$), and BMI was negatively associated with body fat perceptions (β=-.65, $p < .001$) and PSW (β=-.59, $p < .001$). PA did not moderate the associations between BMI and self-perceptions. Although, our results suggest higher BMIs and lower PA levels may explain why AYAs have poorer physical self-perceptions, they do not provide evidence that PA buffers the effect of BMI on self-perceptions. Drawing on the Exercise and Self-Esteem Model, whether PA moderates the association between BMI and self-perceptions in AYAs may be contingent on the degree to which PA results in physical changes (e.g., improved fitness, reduced weight). It is important to examine if this is the case using longitudinal study designs.

Exercise and physical self-esteem: A meta-analysis of recent research

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Physical self-esteem is associated to the self-evaluation of individual's physical appearance and physical competencies. Previous studies show it is an important index to predicate the psychological benefits after exercise or physical activity. However, the reported correlation between exercise and physical self-esteem was inconsistent with range from 0 to 0.8 from recent literature in China. Therefore, the current study utilized a meta-analysis to analyze the relevant research published in China from 2008 and 2017 in order to determine the relationship between exercise (or physical activity) and physical self-esteem. 47 original studies with total samples of 16,836 met the inclusion criteria. The correlation coefficients(Pearson r) between exercise including time, frequency, & intensity and physical self-esteem including its subscales (i.e., physical self-worth, sports competence, attractive body, etc.)were collected as original effect sizes for further analyses. Comprehensive Meta-Analysis (CMA) 2.0 software was used in this study. The homogeneity test revealed Q values were greater than a critical value of χ^2. Thus, random effects model was adopted for meta-analysis. The results indicated: (1) a positive correlation between exercise and physical self-esteem (r = .230), (2) a positive correlation between exercise time (r = .327), intensity (r = .278), or frequency (r = .344) and physical self-esteem, and (3) significant moderator effects of types of exercise ($Z = 3.511$), age groups of participants ($Z = 4.405$), and research designs ($Z = 3.096$). In summary, the positive correlation between physical activities and physical self-esteem had a stable effect size although exercise types, participant groups, and research designs produced a moderating effect.

Individual and climate perceptions in Finnish youth team sport athletes: A prospective and retrospective study

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Sports programs possess the capacity to enhance children's physical health and psychological well-being. Sports programs also play an important role in training youth for elite athletics. Due to the importance of understanding sports participation patterns, this study aimed to investigate prospectively and retrospectively individual and climate perceptions of Finnish athletes. We specifically examined differences in motivational variables among competitive levels (elite, national, regional, and city). The sample consisted of young athletes (N = 841) who played soccer, ice hockey, or basketball in elite and sub-elite leagues and was born in 1995. The prospective data collection occurred in 2010/2011 (participants were teenagers), and the retrospective in 2014 (participants were young adults). The participants answered questionnaires measuring climate and interpersonal motivation variables related to their sports participation. Participants also answered questions concerning some demographic characteristics. Prospectively, the athletes that rose to the elite level (n = 77) indicated significantly ($p < .05$) higher differences in perceptions of a task climate, autonomous motivation, perceptions of athletic ability, and enjoyment and a lower level of amotivation compared to the other groupings. The meaningfulness of the differences based on Hedges' *g* values ranged from small to moderate. Retrospectively, elite athletes indicated significantly ($p < .05$) higher perception of social relatedness and a task climate over their sporting career compared to the other groupings. Hedges' g values ranged from moderate to large in meaningfulness. The results revealed that individual and climate perceptions among elite and sub-elite athletes differ considerably and meaningfully. Therefore, we recommend implementing sports programs for young athletes focused on the positive aspects surrounding elite athlete perceptions.

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Nudging beyond the default: Prompting exercisers to increase pleasure and enjoyment increases experienced and remembered pleasure and enjoyment

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The pleasure and displeasure that people feel during exercise predicts future exercise behavior. Researchers have argued that the pleasure experienced during exercise should be maximized to promote exercise behavior. However, little is known about the default pleasure and displeasure that people experience during self-selected exercise intensities and whether that default level can be enhanced with simple prompts. The purpose of this study was to determine if people maximize their pleasure during self-selected exercise by default, or if prompts to maximize pleasure and enjoyment could enhance the affective experience. Thirty-five participants (mean age: 31 ± 10 years; 23 women) completed two 10-min bouts of cycling at a self-selected intensity under two randomly ordered conditions. In the prompt condition, participants were prompted every 2 min to maximize their pleasure and enjoyment, while those in the control condition were not. In-task ratings of affective valence and perceived exertion were assessed using the Feeling Scale (Hardy & Rejeski, 1989) and the Rating of Perceived Exertion (RPE) scale (Borg, 1998) respectively; heart rate (HR) was continuously monitored. Enjoyment and remembered pleasure were assessed postexercise. Participants experienced more pleasure during the prompt condition ($d = .35$, $p = .042$). The prompt condition elicited greater enjoyment ($d = .43$, $p = .020$) and greater remembered pleasure ($d = .77$, $p = .010$). A significant time by condition interaction (partial eta^2 = .07, $p = .037$) indicated that the prompt condition elicited increasing pleasure, while the control condition elicited decreasing pleasure. HR and RPE were not significantly different between conditions. These data indicate that (a) prompting participants to maximize pleasure and enjoyment may represent a simple intervention that can enhance the affective experience of exercise, and (b) these affective enhancements occur independently of changes in HR or RPE. Future research should determine the impact of "pleasure prompting" on continued exercise adherence.

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