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- 1997 Robert Singer
- 1992 Rainer Martens
- 1991 Alfred Hubbard
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Keynote Speakers

Human Kinetics Lecture

Beyond Born vs. Made: A Multifactorial Perspective on Expertise

Zach Hambrick, Michigan State University

The question of what underlies expertise in sports (and other domains) has been a topic of vigorous scientific debate for well over a century. In recent years, the view that expertise primarily, if not entirely, reflects acquired characteristics (“nurture” rather than “nature”) has gained popularity. Most notably, K. Anders Ericsson and colleagues have claimed that individual differences in domain-relevant performance can largely be explained by deliberate practice, with little (or no) direct role for innate characteristics. In this talk, I will review evidence concerning this claim from my own and other researchers’ labs. I will then discuss the role of a broad range of factors in explaining individual differences in expertise. I will conclude with directions for future research that takes a multifactorial perspective on expertise and moves beyond anachronistic nature vs. nurture debate.

Keynote Speaker: Motor Development

Motor Development and Hands-On Learning Early in Life

Amy Needham, Vanderbilt University

Even prior to birth, fetuses move their arms, hands, and fingers and can learn from the consequences of these actions. As the developing organism is born and gains more control over the movement of their upper extremities, there is much to learn from moving. These movements offer opportunities to observe and learn about their own bodies and about things in the environment that they might interact with and explore. I will describe research from my lab and others documenting what infants learn from their own actions and what the consequences of this early learning might be. As infants become more effective at controlling their movements, they transition into independent reaching and open up a whole new world of agentic action on objects. As they become capable of using hand-held objects in instrumental ways (usually around the beginning of the second year of life), they start to learn how to use tools to create changes in their environment. For children following atypical pathways of development, their trajectory can veer away from the typical in many ways. Infants with Down syndrome (DS) tend to explore objects less actively, which could result in fewer learning opportunities and less knowledge about the world around them. I will present data from our studies comparing the behaviors of typically developing infants and young children and those with DS, highlighting similarities and differences. Motor behaviors as important contributors to developmental cascades will be discussed.

Keynote Speaker: Motor Learning and Control

Task Constraints and the Dynamics of Coordination, Control, and Skill

Karl M. Newell, University of Georgia

The talk will address the relation between task constraints and the dynamics of movement coordination, control, and skill from the theoretical perspectives of ecological psychology, perception/action, and the related domain of coordination dynamics. The growing emphasis on the role of task constraints to action has enhanced an appreciation of the more general influences of the task in theorizing about motor learning, control, and development. The dynamical framework has brought considerable coherence to the issues of change over time in motor learning and development through the common problem of the time scales of change both in learning/performance curves and the typically longer time frame of the stages of learning. The influence of task constraints on learning and performance are assessed in terms of the stability characteristics of the dynamics that emerge. The confluence of constraints includes those arising from the intrinsic dynamics of the learner and the prior perception/action experiences of the individual. The general postulation is that interaction of the individual, environment, and task in practice leads to individual pathways of progressive qualitative and quantitative change in both the movement pattern and the performance outcome that shapes what we interpret as coordination, control, and skill. A key element of this approach is having a common dynamical framework and language from which to describe both the goals of tasks and the properties of movement within the context of action.

Keynote Speaker: Sport and Exercise Psychology

Why Teams Work: The Psychology of Interdependence

Susan Fiske, Princeton University

Teams can overcome prejudice and discrimination. When people need each other, they go beyond superficial stereotypes. That is, when people work together toward a shared goal, they must pay close attention to each other – if they want to succeed, they must coordinate. We show that people specifically try to understand teammates’ unexpected features. This way, they individuate each other and overcome stereotypes. Sports can help heal the divides in our polarized societies.

Senior Lecturers

Motor Development

All That is Gold Does Not Glitter; Not all Those Who Wander are Lost . . .

Nancy Getchell, University of Delaware

What is the best way for young academics to visualize their career path in Motor Development? The reward system in academia often seems prescriptive: Write a grant proposal, rewrite a grant proposal, get a grant, write up a manuscript, rewrite a manuscript, publish manuscript . . . and then repeat until you are promoted and tenured. While this may appear to be the golden pathway to success, it is not equally available (or even advisable) at all educational institutions. I offer my academic history as an alternative, more meandering means to the same ultimate end, promoting a better understanding of the development of motor coordination and control. As a graduate student at Wisconsin, I imagined my career would lead me to a similarly well-resourced university. Instead, I learned to make my way through unexpected challenges, workload changes, and priority shifts (all the while, attending and presenting at 25 NASPSPA conferences). Based on my experiences, I provide five suggestions for a successful career as a Motor Development researcher: 1) Think big thoughts, 2) Network, 3) Roll with the punches, 4) No opportunity is too small, and 5) Give back to the
Motor Learning and Control
Consolidating a 30-Year Journey
David L. Wright, Texas A&M University

Consolidation is critical to human memory, directing the transformation of new knowledge from an initial fragile state to a more stable one. The importance of this process is underscored by its recent designation as one of four pillars of learning (Daheane, 2020). For motor skill acquisition, the behavioral manifestation of successful consolidation is preservation of a motor skill, even in the face of interference, or a gain in skilled performance across significant time periods despite no additional motor practice. A brief review of my early behavioral and more recent neuropsychological efforts to understand motor sequence learning will highlight a rich array of ways in which post-practice consolidation can be modified in order to optimize learning.

Sport and Exercise Psychology
Reflections on a Scholarly Career in Sport and Exercise Psychology
Thelma S. Horn, Miami University

In any academic field of study, evolution occurs across the decades in the things that we, as researchers, study as well as the way in which we study them. It is occasionally of value to examine such changes in order to situate what is currently known within the context of our journey to get to this point. This presentation will utilize a personal scholarly journey to illustrate changing theoretical perspectives and varied research approaches. Primary focus will be on the socio-environmental and developmental factors that affect individuals’ participation in, and enjoyment of, sport and physical activity. As befits a senior lecture perspective, this career overview concludes with a summary of lessons learned and steps not taken or taken on the road to scholarly fulfillment.

The NASPSPA Outstanding Student Paper Award Recipients

Motor Development
Soccer Skill Performance and Retention Following an 8-Week Adapted Soccer Intervention in Adults with Disabilities
Danielle Carabello; Emily Munn; Claire Tielke; Tessa Evans; Melissa Pangelinan, Auburn University

Despite an increase in the number of individuals with intellectual and developmental disabilities (IDD) participating in Special Olympics Unified Soccer programs, few studies have examined the development of fundamental soccer skills needed for participation. To address this knowledge gap, the current study evaluated the efficacy of an 8-week (2 sessions/week; 60-minutes/session) adapted soccer intervention on soccer skill performance and retention in 37 adults (22 males, 15 females) with developmental disabilities (i.e., autism spectrum disorder, Down syndrome, and intellectual disability) ages 17–64 years. Pre- and post-testing consisted of the “Everyone can!” assessment of soccer skills (i.e., dribbling, trapping, throw-ins, kicking a stationary ball, kicking a moving ball, and a composite score for all skills). For each session of the intervention, participants rotated through stations in small groups of 4–6 participants (based on age and behavioral needs) in which they practiced different soccer skills with weekly progressions and adaptations. Repeated measures analysis of variance revealed significant improvements from pre-test to post-test for dribbling, trapping, throw-ins, and kicking a stationary ball. In addition to these time main effects, level of function was positively associated with performance of all skills. A subsample of participants (n = 29) completed a 1-month follow-up test. Significant improvements from pre-test to post-test and pre-test to retention were observed for all skills. Modest offline gains (i.e., post-test < follow-up) were also observed for kicking a moving ball and the composite score of all skills. For this subsample, the level of function was positively related to performance of kicking a stationary ball and kicking a moving ball. Thus, short-term, adapted soccer programs that include a variety of practice stations with appropriate adaptations for varying levels of function and adaptations to challenge participants enable adults with IDD to gain the necessary soccer skills for game play and eventual competition.

Motor Learning and Control
Self-Controlled Learning: Making a Yoked Group Explicitly Aware of Being Denied Choice
Laura St. Germain, McMaster University; Allison Williams, McMaster University; Andrew Poskas, McMaster University; Noura Balboa, McMaster University; Olena Leshchyshen, McMaster University; Keith R. Lohse, University of Utah; Michael J. Carter, McMaster University

Research has revealed that skill retention is enhanced when learners exercise choice over an aspect of their practice environment (e.g., observation schedule) compared to being denied this same choice opportunity. This self-controlled learning advantage is often attributed to motivational influences, in particular autonomy-support (Wulf & Lewthwaite 2016). However, recent work has not found reliable differences in perceptions of autonomy between self-controlled and no-choice (i.e., yoked) groups (e.g., Barros et al. 2019; Carter & Ste-Marie 2017). One reason for this may be that participants in no-choice groups are told that they will experience a predetermined schedule during practice. That is, they are unaware that they have been denied some choice opportunity and that their “predetermined” schedule was actually self-selected by a self-controlled participant. Here, we addressed this methodological limitation to investigate whether explicit awareness of being denied choice during practice decreases perceptions of autonomy and learning of a 3 x 6 x 3 second cup stacking task. A self-controlled (SC) group had choice over their video demonstration schedule (YES/NO) and video speed (SLOW/REAL-TIME). Participants in the traditional yoked (TY) and explicit yoked (EY) groups were matched to the observation schedule (frequency and speed) of a SC counterpart. The TY group was told they would receive a predetermined schedule. The EY group was told they would receive the observation schedule created by another participant in the experiment. All groups decreased their stacking time (s) from pre-test to the 24-h retention test. The SC group (M = 10.0, 90% CI [9.76, 10.3]) had the fastest stacking time in retention, followed by the EY group (M = 10.3, 90% CI [9.98, 10.6]), and the TY group (M = 10.5, 90% CI [10.2, 10.9]). The resulting standardized mean difference was d = -.23 for the SC and TY groups and d = -.08 for the EY and TY groups. In line with recent work, these data challenge the notion that self-controlled practice conditions are in fact autonomy-supportive. Funding source: Natural Sciences and Engineering Research Council of Canada.
Sport and Exercise Psychology

The Face of Affect and Exertion: Automated Facial Action Analysis to Decode the Flow of Experience During Exercise

Sinika Timme, University of Potsdam

Increasing evidence suggests affective experience during exercise influences future exercise behavior. The analysis of the affective responses to exercise has so far relied on self-reports and statistical analyses based on aggregated individual data (e.g., repeated-measures ANOVA). The present study tested an alternative approach: Utilizing machine-learning powered automated facial action analysis, continuous facial variations were recorded and classified into facial action metrics. The resulting longitudinal data were analyzed with multilevel regression analysis, considering the variability of individual trajectories. One hundred thirty-two individuals (M = 21.58 years, SD = 2.93; 53 women) followed an incremental cycle ergometer protocol until volitional exhaustion, while their faces were video-recorded. Thirty-four facial landmarks were continuously monitored and an algorithm (iMotions Affdex) applied a set of rules based on psychological theories and statistical procedures. In addition, affective valence (Feeling Scale) and perceived exertion (RPE) were verbally reported every two minutes. The intraclass correlation showed that 33% of the variance in affective valence was due to inter-individual variability. Observed facial actions were indicative of reported feelings. Jaw drop was uniquely associated with RPE (β = 0.02, p < .01), whereas nose wrinkle was uniquely associated with affective valence (β = -0.09, p < .01). Mouth open was associated with both RPE (β = 0.03, p < .01) and affective valence (β = -0.02, p < .01). These findings underline the importance of considering individual differences in exercise response trajectories and demonstrate that reported feeling states covary with unique facial actions that occur during exercise. Taken together, this study provides evidence and further statistical approaches to support future research endeavors to examine exercise-affect by recording facial actions, which also entails practical implications by providing observable facial variations to monitor the affective state of exercisers without interrupting the person’s experience.
Symposia

Motor Development Symposium

Using Process- and Product-Oriented Measures of Motor Competence Across the Lifespan

Symposium organizer: Kara K. Palmer, University of Michigan
Symposium discussant: Samuel W. Logan, Oregon State University

Process- and Product-Oriented Measures of Motor Competence: A Lifespan Approach

Kara K. Palmer, University of Michigan

Motor competence (MC) is important and relates to health and physical activity across the lifespan. The importance of MC predicates the need for valid and reliable measures of motor skills and abilities in all ages. Currently, there are two common orientations to measuring MC: process-orientation measures that examine how a movement is performed, or product-orientation measures that examine the outcome of the movement. Most research efforts utilize MC measures with a single orientation (i.e., process or product), but emerging literature supports that data from process- and product-orientation measures are only weakly to moderately related. Hence, process- and product-oriented measures appear to yield unique data about MC. There is a need for research to use both process- and product-oriented measure of MC and compare how data gained from both measures relate in a variety of contexts and populations. The purpose of this symposium is to examine ongoing research efforts that simultaneously use both process- and product-oriented measures of MC across the lifespan and to provide an example of a measure that includes both orientations and can be used in all ages. Presentation 1 compares two normed and validated process- and product-oriented measures of MC in elementary-aged children. Presentation 2 examines MC of cadets using developmental sequencing and a process battery. Presentation 3 reports on the associations among a supine-to-stand task, MC, and health-related fitness in older women. The final presentation provides an example of an assessment that combines process and product orientations and could be used across the lifespan. The session will conclude with an overall discussion of measurement approaches and implications for researchers who use these measures.

Comparison of Product- and Process-Oriented Measurements of Children’s Motor Competence

An De Meester, University of South Carolina; Eline Coppens, Ghent University

Objective: This study explored potential differences in children’s motor competence (MC) scores based on the measurement type (i.e., process-oriented vs. process-oriented). Methods: MC was measured in a sample of 175 nine- and ten-year-olds ($M_{age} = 10.22 \text{ yrs, } SD = .50$) with a process-oriented (i.e., TGMD-2) and a product-oriented test battery (i.e., KTK). Children with a norm-based (i.e., age- and sex-adjusted) percentile score lower than 16 were categorized as having a low MC (i.e., standardized TGMD-2 score < 15; KTK motor quotient < 86), children with a norm-based percentile score between 17 and 84 were categorized as having an average MC (i.e., $15 \leq$ standardized TGMD-2 score $\leq 25$; $86 \leq$ KTK motor quotient $\leq 115$), and children with a norm-based percentile score higher than 85 were categorized as having a high MC (i.e., standardized TGMD-2 score $> 25$; KTK motor quotient $> 115$). Correlations were used to examine the association between children’s process- and product-scores (i.e., variable-centered approach) and chi-square analyses were used to examine whether the classification of MC levels (i.e., low, average, high) based on process-scores were similar to those based on product-scores (i.e., person-centered approach). Results: Process- and product-scores of MC were positively correlated ($r = .45, p < .001$). Based on process-oriented scores 25% of children were considered to have a low MC, 74% an average and less than 1% a high MC. Based on product-scores 12% had a low MC, 67% on average and 21% a high MC. Most children (61%) were classified into the same competence category whether process-or product-scores were used but 34% had a lower (and 5% a higher) competence label based on the process-oriented categorization compared to the product-oriented categorization ($\chi^2 [4] = 17.54, p = .002$). Conclusion: Although the results confirm the previously established moderate correlations between process-and product-scores, it must be taken into account that the type of MC measurement could impact whether children are considered to have a low, average, or high MC, respectively.

Comparison of Product- and Process-Oriented Measures of Motor Competences in a Military College Cadet Population

Ryan S. Sacko, The Citadel; David F. Stodden, University of South Carolina; Amy F. Hand, University of South Carolina; Kyle Silvey, University of South Carolina; Bryan Terlizzi, University of South Carolina; Cade Abrams, University of South Carolina; Hannah Thompson, The Citadel; Giovanna Leone, The Citadel, Charleston, South Carolina

Objective: Motor competence is an established prerequisite for physical activity (PA) participation that should be well developed upon graduation from high school. Research has begun to provide evidence of the relationship between product- and process-oriented motor skill assessments in young children and adolescents; however, scant evidence exists relating these measures in adult populations. Thus, the purpose of this study is to examine associations between product- and process-oriented motor competence assessments in a population of young adults. Methods: Participants included cadets ($N = 258$; $M_{age} = 18.2 \pm 5.6$ months), from a military college in the southeastern US. Standing long jump (SLJ), hopping, kicking, and throwing were assessed using process-oriented developmental sequences (sum of components, averaged across 3 trials) and product-oriented (SLJ distance, hop, kick, and throw speed) assessments. Participants were asked to participate with maximal effort. Means and standard deviations were calculated for outcome variables. Spearman’s Rho correlations were calculated to determine the strength of association between process and product scores [correlations; low ($r = 0.10–0.29$), moderate ($r = 0.30–0.49$) and high ($r \geq 0.50$)]. Results: Product and process (mean $\pm$ SD: mean $\pm$ SD) for each skill were as follows: SLJ ($202.0 \pm 30.5$ cm: $168.8 \pm 2.7$), hop ($3.5 \pm 0.8$ m/s: $6.2 \pm 0.8$), throw ($56.1 \pm 12.1$ mph: $88.8 \pm 1.3$), kick ($44.1 \pm 7.6$ mph: $12.3 \pm 2.4$). Correlations ranged from weak to strong ($0.1$ to $0.85$). Process for the SLJ throw, and kick were all significantly associated with their corresponding product scores. The SLJ process scores had the highest correlations to their respective product scores. Conclusion: Understanding differences in process- and product-assessment outcomes is important from a motor competence and PA participation perspective. These data provide evidence that strong associations between product- and process-oriented motor competence assessments is lacking. Continued work to remove ceiling effects from motor competence assessments used in populations of young adults is needed.
Exercising to the Relationship Between Supine-to-Stand, Motor Competence, and Health-Related Fitness in Middle-Aged Women Ages 45-65 Years

Danielle Nesbitt, Fayetteville State University; Cheryl Der Ananian, Arizona State University; David F. Stodden, University of South Carolina; Jesse Vezina, Arizona State University; Alberto Florez-Pregonero, Pontificia Universidad Javeriana; Barbara Ainsworth, Arizona State University

Objective: The purpose of this study was to examine the associations among STS time with measures of motor competence (hop, kick and throwing speeds, and standing long jump distance) and health-related fitness (curl-ups, pushups, and Submaximal Graded Treadmill Test (SGTT)) in a sample of middle-aged women. Methods: Participants included a convenience sample of sixty-four women between the ages of 46–65 years (M = 56.6, SD = 5.3). Participants performed five trials of the STS task, throwing, kicking, and standing long jump. Hopping was assessed using two trials of hopping on each leg. Maximum throwing and kicking speed (m/s) were calculated using a radar gun (Stalker, Inc). Maximum standing long jump distance was assessed as a percentage of the participant’s height. STS time was calculated from the first initial movement to the point where the participant was fully erect. Both STS time and average hop speed (minimum of three consecutive hops) using Dartfish Video Analysis Software (Version 7.0). Results: Data were analyzed using Pearson’s correlation with an alpha of <0.05 to determine significance. Results demonstrated a moderately high inverse correlation (r = -0.67, p < 0.01) between STS time and the minutes completed in the SGTT and moderate to high inverse correlations to the number of completed curl-ups and push-ups (r = -0.39 to -0.52, p < 0.01). Data also revealed a moderately high correlation (r = -0.67, p < 0.01) between STS time and standing long jump distance. The results also showed a moderate correlation (r = -0.32, p < 0.01) between STS time and kicking speed and a moderately high correlation (r = 0.63 to 0.73, p < 0.01) between STS time and hop speed (dominant and non-dominant leg). There were no significant correlations between STS time and the overhand throw (p > 0.05). Conclusion: Findings provide evidence indicating STS may be an important assessment of functional motor competence, specifically for locomotor skills and aspects of health-related fitness in middle-aged women.

Towards a Lifespan Approach for the Assessment of Motor Competence

Ryan M. Hulteen, University of British Columbia; An De Meester, University of South Carolina; Ryan S. Sacko, The Citadel, Charleston, South Carolina; David F. Stodden, University of South Carolina

Introduction: The development and maintenance of motor competence is posited to be important across the lifespan. Evidence from child and adolescent populations demonstrates the role motor competence has in supporting and maintaining various health outcomes. However, there is a distinct paucity of studies that have assessed motor competence in adult and older adult populations. Studies that exist in older adult populations have disproportionately concentrated on functional capabilities, as opposed to competence in specific skills (e.g., kicking and throwing). Consequently, we do not have adequate data to map the trajectories of movement skill competence across the lifespan or an understanding of the implications of changing skill levels on the progression and/or deterioration of salient health behaviors (e.g., physical activity) and subsequent health outcomes (e.g., physical fitness and quality of life). To better understand the importance of motor competence across the lifespan, we need an easy to administer assessment that remains relevant across age and culture. Discussion: A proposed assessment for tracking motor competence across the lifespan is a combination throwing and catching assessment. The benefits of using this assessment is its capability to provide both process- and product-oriented scores, it can be functionally adapted to cater to differing developmental levels, it assesses skills which are not culturally exclusive, and this assessment inherently requires users to incorporate principles of motor behavior. While this assessment is focused on object control skills, similar assessments can (e.g., locomotor) or have been (e.g., functional) created. Continued testing and use of these assessments would provide an opportunity for tracking across various age groups and cultures, allowing for a unified global understanding of motor competence. From a larger public health perspective, such assessments will be vital to help keep pace with related fields (e.g., physical activity/public health) as it relates to global surveillance efforts.
Sport and Exercise Psychology

Symposium 1

The Psychology of Concussion in College Sport: Understanding Psychosocial Factors Impacting Athletes, Coaches, and Sports Medicine Professionals

Symposium organizer: J. D. DeFreese, University of North Carolina at Chapel Hill
Symposium discussant: J. D. DeFreese, University of North Carolina at Chapel Hill

Symposium Overview

J. D. DeFreese, University of North Carolina at Chapel Hill; Melissa Kay, University of Southern Mississippi; Zack Kerr, University of North Carolina at Chapel Hill; Emily Kroshus, University of Washington; Johna Register-Mihalik, University of North Carolina at Chapel Hill

Sport-related concussion represents a prominent public health concern with important implications for current and former athlete health. Research on the mechanisms, diagnosis, and care of this injury demonstrates important avenues for improving sport safety. Yet, implementation of care depends on athlete, coach, and sports medicine professional behaviors. Psychosocial factors impact such behaviors is critical for developing policies, practices, and interventions that lead to optimal recognition, treatment, and long-term outcomes of sport-related concussion. In an effort to expand the extant knowledge base and address key psychosocial-driven questions, four conceptually innovative studies will be presented that meaningfully enhance understanding of sport-related concussion within sport and exercise psychology. To open the symposium, a definition of concussion, extant theory, and evidence informing all studies will be overviewed. Study 1 will address how college athletes’ perceptions of care and organizational support influence their concussion care-seeking behaviors, key aspects of injury recognition, and treatment outcomes. Study 2 will examine how concussion-symptom malingering, a concern of college coaches that limits their engagement in promoting concussion care seeking, is associated with athlete depression—eliciting a novel intersection of sport culture and athlete mental health. Study 3 will examine perceived barriers to effective athletic trainer decision-making behaviors regarding prospective concussive injuries, a key synergy between sport psychology and sports medicine. Study 4 will showcase how psychosocial variables within larger surveillance studies, specifically former college athletes’ relationship statuses, are associated with their health-related quality of life after sport. Finally, a discussant will offer a critique and facilitate group discussion of future directions. Cumulatively, this symposium will enhance knowledge of psychosocial factors associated with concussion in college sport by showcasing efforts of a diverse panel of scholars.

 Associations between perceived concussion care, organizational support, and concussion care-seeking outcomes in collegiate student-athletes

Johna Register-Mihalik, University of North Carolina at Chapel Hill; Kenneth L. Cameron, Keller Army Hospital; Paula Gildner, University of North Carolina at Chapel Hill; Karen Y. Peck, Keller Army Hospital; Megan N. Houston, Keller Army Hospital; Steven J. Svoboda, Keller Army Hospital; Melissa Kay, University of North Carolina at Chapel Hill; Zack Kerr, University of North Carolina at Chapel Hill; Christine E. Callahan, University of North Carolina at Chapel Hill; Steve W. Marshall, University of North Carolina at Chapel Hill

Over 50% of concussions among high school and college student-athletes go unreported (Kerr, 2016). Understanding student-athletes’ concussion care-seeking behaviors is critical to improve concussion identification and care. Perceived organizational factors such as concussion care and support likely play a role in these decisions and behaviors. This analysis aimed to examine associations between perceived organizational concussion care and support and concussion care-seeking behaviors in collegiate student-athletes. We hypothesized that more positive care and support perceptions would be associated with more positive care-seeking behaviors. A convenience sample of first-year collegiate student-athletes (n = 389, M_age = 18.3 ± 0.8 years, 33.2% female, 28.6% with a concussion history) from two institutions completed a pre-validated survey (Register-Mihalik, 2019) assessing demographics and general concussion perceptions. Negative binomial regression controlling for concussion history and institution was utilized to assess relationships between perceived organizational care and support and care-seeking outcomes: participating with symptoms (negative behavior) and disclosing concussion symptoms (positive behavior). More positive organizational concussion care and support perceptions were associated with a 32% reduction in participating with symptoms [Care Prevalence Ratio (PR): 0.68; 95% CI: 0.48, 0.95 and Support PR: 0.68; 95% CI: 0.50, 0.90]. Neither factor was associated with ever disclosing possible symptoms to someone in authority [Care PR: 0.96; 95% CI: 0.65, 1.43 and Support PR: 0.91; 95% CI: 0.68, 1.22]. These findings suggest perceived organizational care and support are associated with symptom disclosure. However, better perceived care and support may be associated with a lower prevalence of participating in activity with concussion symptoms. These findings can inform organizational and educational interventions targeting improved concussion identification and care.

Association Between Depression and Concussion-Related Malingering Among Collegiate Athletes

Emily Kroshus, University of Washington; Sara Chrisman, University of Washington; Jeffrey Milroy, University of North Carolina at Greensboro; David Wyrick, University of North Carolina at Greensboro

Some coaches believe athletes pretend to be injured with concussion. This belief has been used to justify not communicating with athletes about concussion reporting, even though no evidence exists to support concussion malingering. Prior research has found the opposite behavior occurs frequently: up to 50% of athletes with concussion choose not to report symptoms. It is possible that athletes with depression might be experiencing symptoms that cause participation ambivalence. However, they may feel trapped by external pressures. Concussion may provide a less stigmatized escape from this dilemma. This study elicited whether athletes had feigned concussion or exaggerated concussive symptoms, and their reasons for doing so. We also examined the relationship between depressive symptoms and such malingering. Athletes completed a web-based survey (n = 1458). Six percent reported ever having feigned (n = 94), 2% (n = 36) exaggerated symptoms of a diagnosed concussion, and 8% (n = 121) engaged in either behavior. Results of multivariable logistic regression (i.e., controlling for year in school, gender, concussion history, and athletic identity) found that a one-point increase in PHQ-9 scores was associated with 6% greater odds of ever malingering (OR = 1.06, 95% CI = 1.03-1.10). 12.9% of athletes with elevated PHQ-9 scores (≥10) engaged in malingering compared to 6.7% of athletes below this cut-off (χ²(1) = 11, p = 0.001). Frequent reasons for feigning or exaggerating symptoms included: (a) wanting more time to devote to non-sport activities and (b) being worried about sustaining another concussion. In sum, it is clearly more common for an athlete to hide than exaggerate symptoms. Coach messaging should emphasize the rarity of malingering relative to concussion underreporting, and the potentially catastrophic nature of the latter behavior. Broadly, results further underscore the importance of mental health screening and care in...
collegiate sport environments, of reducing stigma related to mental health help seeking, and of normalizing sport transitions.

Concussion-Related Decision-Making: Barriers to Optimal Healthcare Delivery

Melissa C. Kay, University of Southern Mississippi; J. D. DeFreese, University of North Carolina at Chapel Hill; Zachary Y. Kerr, University of North Carolina at Chapel Hill; Kristen L. Kucera, University of North Carolina at Chapel Hill; Meredith A. Petschauer, University of North Carolina at Chapel Hill; Johna Register-Mihalik, University of North Carolina at Chapel Hill

Removing concussed individuals from participation is one of the most scrutinized decisions healthcare providers (HCP) can make. Recent research and media evidence show stakeholder dissatisfaction with athletic trainers (ATs) in removing concussed athletes from play and athletes continuing to participate while concussed. The current study purpose was to identify psychosocial barriers that impact decisions to remove concussed athletes from play. ATs (n = 1,029; M_{age} = 26.0 ± 3.7 years old) completed a validated survey with qualitative and quantitative variables as part of a larger study. A qualitative survey variable regarding concussion-related decision-making barriers was used for this study. Responses were coded using an a priori codebook and a progressive consensual qualitative research tradition. Overall, 598 ATs (85.8%; missing = 350) reported barriers to concussion-related decision-making. The four primary barriers were interactions with school personnel (n = 132), decision-making confidence (n = 119), athlete-based factors (n = 96), and parent interactions (n = 71). Participants described coaches as a primary source of conflict for school personnel through significant pressure, push-back, and questioning of medical authority. Decision-making confidence described the lack of objective diagnostic testing and reliance on self-report of symptoms. Athlete-based factors included not knowing the athlete and concerns about athlete honesty. Lastly, parent interactions highlighted the frustration of “doctor shopping” (finding a doctor to clear), pressure, and confrontation. Participants also discussed the need for standardized communication with other healthcare providers to ensure continuity of care. Our findings indicate barriers exist with multiple stakeholders (i.e., coaches, athletes, parents, and other HCP), regarding communication in particular. Decision-making confidence can be improved by prioritizing communication and collaboration with a multidisciplinary healthcare team.

Psychosocial Factors and Concussion in Former Collegiate Athletes: Relationship Status, Concussion History, and Health-Related Quality of Life

J. D. DeFreese, University of North Carolina at Chapel Hill; Samuel R. Walton, University of North Carolina at Chapel Hill; Zachary Y. Kerr, University of North Carolina at Chapel Hill; Benjamin L. Brett, Medical College of Wisconsin; Avinash Chandran, Datalsy Center for Sports Injury Research; Michael M. McCrea, Medical College of Wisconsin; Kevin M. Guskiwicz, University of North Carolina at Chapel Hill

The long-term health-related quality of life (HRQOL) of former collegiate athletes (FCAs) is an important public health concern, with mental health and physical functioning representing vital markers of health and well-being. Further, growing empirical evidence suggests psychosocial factors have a fundamental influence on the HRQOL of FCAs, particularly in their dynamic interactions with other important factors. While concussion history and demographic characteristics have been previously shown to influence HRQOL, relationship status also represents an important psychosocial factor for understanding the HRQOL of FCAs. The purpose of this study was to examine the association of relationship status with mental and physical markers of HRQOL in a sample of FCAs when age, collegiate concussion history, and sport type (football vs. non-football) were considered (i.e., included as factors within statistical models). We hypothesized that, after accounting for covariates, being married or living with a romantic partner would be associated with higher levels of self-reported mental and physical functioning for FCAs. Participants (n = 259; M_{age} = 35.3 ± 2.6 years) completed psychometrically validated, self-report assessments of HRQOL (i.e., VR-36). The majority (n = 222; 86%) of FCAs sampled endorsed being married or living with a romantic partner as opposed to being single, divorced/separated, or widowed (n = 37; 14%). Group difference analyses revealed FCAs with a partner exhibited significantly higher mental (M_{diff} = 4.97, p = 0.037), but not physical (M_{diff} = 1.82, p = 0.162) functioning scores. Regression analyses further showcased relationship status as a positive contributor to mental (β = 0.15, p = 0.016) but not physical (β = -0.10, p = 0.114) functioning after adjusting for covariates. Study results support a positive link between FCA relationship status and mental functioning markers of HRQOL. Results inform future prospective research efforts on the lifespan HRQOL of FCAs using specific markers of relationship quality (e.g., social support, relational conflict).

Symposium 2

Promoting Physical Activity to Enhance Hot and Cool Executive Functions and Motor Skills-Implications for Children With and Without Disabilities

Symposium organizers: Kimberley Lakes, University of California, Riverside; Spyridoula Vazou, Iowa State University

Symposium Overview

Kimberley Lakes, University of California, Riverside; Spyridoula Vazou, Iowa State University

In the last decade, across diverse disciplines, there has been a rapidly growing recognition of the positive effects of physical activity (PA) and sport engagement on interconnected domains of child development. Increasing literature has emerged investigating the importance of considering the qualitative characteristics of PA interventions and sports as well as considering the role of motor competence in the exercise-cognition interplay. In light of these developments, this symposium will present new data on the benefits of organized PA in early childhood and novel interventions aimed to enrich the PA environment by jointly targeting motor, cognitive, and social-emotional skills in children with and without disabilities. The 1st presentation by Ross Neville will explore the extent to which the associations between developmental delays in the first year of life and social-emotional and behavioral outcomes in preschool children may be attenuated by participation in organized sports. The 2nd presentation by Ali Brian will describe the effects of the Successful Kinesthetic Instruction for Preschoolers (SKIP) intervention on both motor and executive function (EF) skills in preschoolers with and without disabilities. The 3rd presentation by Spyridoula Vazou will describe a rhythmic PA intervention and its effects on motor and EF skills in typically developing children. Highlighting the importance of sustaining these positive benefits throughout childhood (and beyond), the 4th presentation by Kimberley Lakes will describe how technological tools can be developed and applied to promote and sustain interventions targeting hot and cool EFs and PA in children, particularly among children with executive dysfunction who are likely to benefit the most from support in maintaining healthy behaviors. Collectively, this symposium will provide a better understanding of the value and the content of
The Association Between Developmental Delays and the Onset of Behavioral Difficulties in Preschool Boys is Attenuated by Engagement in Organized Sport
Ross Neville, University College Dublin; Kimberley Lakes, University of California, Riverside

Objective: This study explores the extent to which the associations between developmental delays in the first year of life and social-emotional and behavioral outcomes in preschool children are moderated by participation in organized sport. Methods: Data were derived from a longitudinal infant cohort study of n = 11,194 children, entitled Growing Up in Ireland project. Parents reported on child development (Ages and Stages Questionnaire) at age 1 year, psychosocial characteristics (Strengths and Difficulties Questionnaire) at ages 3 and 5 years, and regularity of engagement in organized sport at age 5 years. Data were analyzed using linear mixed models. Results: At age 1 year, approximately 15% of the cohort (n = 1,654) was classified as developmentally delayed. These children exhibited more behavioral difficulties (0.53 ± 0.25; mean difference, ±99% confidence limits) (p < 0.0001) and fewer prosocial behaviors (-0.53 ± 0.10) (p < 0.0001) at age 3 years. For boys in this group, engagement in sport was associated with a significant decrease in behavioral difficulties between ages 3 and 5 years (-0.44 ± 0.39) (p = 0.3). Lack of engagement in sport was associated with a positive increase (0.26 ± 0.43) (p = 0.23), which meant that the relative effect of sport on behavioral difficulties for developmentally delayed boys was of a substantial magnitude (0.70 ± 0.59) (p = 0.2). Participation in sport was not associated with a meaningful change in behavioral difficulties for girls, or in prosocial behaviors for boys or girls. Implications: Regular participation in sport in the preschool years could attenuate some of the behavioral difficulties associated with male development in the early years, particularly for boys with early developmental delays. Lack of opportunities for engaging in sport could negatively affect boys’ behavioral regulation in the preschool period.

The Effects of a Universally-Designed Intervention on Locomotor and Executive Functioning Skills of Rural Preschoolers With and Without Disabilities
Ali Brian, University of South Carolina; Angela Starrett, University of South Carolina; Taanton Miedema, University of South Carolina; Adam Pennell, Pepperdine University

Background: Children with disabilities are often educated alongside peers without disabilities, requiring universally-designed curricular strategies. Many children, regardless of possessing a documented disability or not, are at-risk for delays with gross motor skills. Executive functioning (EF; e.g., working memory and cognitive flexibility) and locomotor motor skills (LOC) support school readiness. As there is a recursive relationship among EF and LOC, both should be improved via intervention. However, the effects of a universally-designed Successful Kinesthetic Instruction for Preschoolers (SKIP) intervention on both LOC and EF is unknown. The purpose of this study was to examine the effects of the universally-designed SKIP intervention on the EF and locomotor skills of rural preschool-aged children with and without disabilities. Methods: Preschoolers (N = 107) were randomly assigned to either the SKIP group (N = 51; M_{age} = 5.31 years, SD = 0.82 years, female = 26) or the control group (N = 56; M_{age} = 5.01 years, SD = 0.78 years, female = 25). Children completed the Head, Toes, Knees, and Shoulders Test (HTKS) and the locomotor subscale of the Test of Gross Motor Development-3 prior to and after the nine-week SKIP intervention. Results: After nine-weeks, control group change scores included LOC (M = 3.23, SD = 7.21) and HTKS (M = 3.98, SD = 5.38), compared to SKIP groups scores of LOC (M = 10.94, SD = 5.38) and HTKS (M = 6.51, SD = 9.70). Path analysis results showed excellent model fit (RMSEA = 0.024, CFI = 0.995, SRMR = 0.048). There was a significant direct effect of SKIP on LOC (b = 7.83, 95% CI [5.28, 10.34]) and on the change in EF (b = 3.90, 95% CI [0.13, 7.68]) from SKIP. Sex, age and disability status were used as covariates but none were significant. Conclusions: Children who completed the SKIP intervention showed significantly higher LOC and EF than control children regardless of classroom placement. Results showed no differential effects for age, sex, or disability status.

Rhythmic Physical Activity Intervention: Exploring Feasibility and Effectiveness in Improving Motor Skills and Executive Functions in Children
Spyridoula Vazou, Iowa State University; Brenna Kiesel, Iowa State University; Kimberley Lakes, University of California, Riverside; Ann Smiley, Iowa State University

Background: The need to consider how specific characteristics of physical activity (PA) influence motor and cognitive skills has been highlighted in recent literature. The purpose of this pilot study was to examine the feasibility and effectiveness of a theoretically derived rhythmic PA intervention, compared to a standard physical education (PE) program. Methods: Twenty-two children (M_{age} = 7.64 ± 1.46; Males = 11, Females = 11) were enrolled in the rhythmic PA program (intervention) and 17 children (M_{age} = 7.76 ± 1.64; Males = 10, Females = 7) in the PE program (control), both meeting for 30 minutes, twice per week, for 7 weeks. A battery of tests including the Rhythmic Beat Competence, Movement ABC-2 (Motor Skills), Flanker (Executive Functions), and parent ratings of Attention and Behavioral Control (SWAN) were collected before and after the intervention in both groups. Data on affect, concentration, cognitive engagement, perceived exertion, and PA levels were collected at every lesson in both groups. The rhythmic PA program incorporated varied ways of moving to the beat of music and creating rhythmic routines. The PE program focused on fundamental motor skills with no additional emphasis on rhythm. Results: Repeated MANOVAs showed no significant group interactions, but there was a significant improvement over time in both groups in specific executive functions (Flanker task accuracy and response time) and motor skills (balance). Effect sizes for Attention, Behavioral Control, and Rhythmic Competence were small-to-medium for the rhythmic intervention group and negative small-to-medium for the PE program. Students in both programs perceived the activities to be fun and both cognitively and physically challenging. Differences in accelerometer-assessed moderate-to-vigorous levels of PA were non-significant. Discussion: Our results demonstrate the feasibility and acceptability of a rhythmic PA program among elementary school children and suggested potential positive effects on motor and executive function skills, but gains observed did not seem to substantially differ from benefits of the PE program.

Coolcraig: A Technological Intervention to Promote Self-Regulation and Physical Activity in Children with Executive Dysfunction
Kimberley Lakes, University of California, Riverside; Franceli Cibrian, University of California, Irvine; Sabrina Schuck, University of California, Irvine; Gillian Hayes, University of California, Irvine

Introduction: Promoting self-regulation (SR), executive function (EF), and physical activity (PA) is especially critical for children with...
neurodevelopmental disabilities. Diverse PA interventions are associated with behavioral, cognitive, and motor improvements, but little is known about how to maintain gains over time. Wearable computing and the Internet of Things provide innovative mechanisms for delivering long-term intervention, sustaining healthy behaviors, and maintaining clinical adherence. Methods: This study was designed to develop CoolCraig, a wearable and connected system that combines an Apple Watch 5, mobile phone app, and secure web portal. The first aim was to engage children and caregivers in design sessions and collect data to inform development. Children (n = 24; diagnosed primarily with ADHD) and caregivers (n = 13; parents and educators) participated in design sessions, interviews, and focus groups. Our second aim was to conduct a pilot clinical trial in 20 children (ages 10–15) to test the feasibility and acceptability of the CoolCraig system. The design included a novelty wash-out phase (i.e., wearing Apple Watches without intervention) followed by an intervention phase (i.e., CoolCraig), with collection of PA, SR, EF, sleep, and behavior data across both phases. Results: Participants expressed interest in using a technological system to manage their behavior and learn more about how PA impacts their experiences and behavioral responses. Children were engaged in the design process, providing sketches for the app and feedback on data collection, intervention delivery, and privacy. The Apple Watch 5 yields high quality data on PA, sleep, and heart rate that, when combined with daily ratings of SR and EF, provides insight into relationships between these constructs. Children and caregivers viewed feedback on these patterns as both educational and meaningful. Conclusion: Our research illustrates how technological tools can be applied to sustain healthy behaviors over the long-term and enable children to engage in managing their health behaviors.
Free Communications: Verbal and Posters

Motor Development

Otteroo Aquatic Experience Accelerates Motor Development During the First 18 Months of Life

David I. Anderson, San Francisco State University; Minxuan He, University of Maryland

The rate of motor skill acquisition during infancy is particularly sensitive to experience. Variations in child rearing can lead to large disparities in the attainment ages for specific motor milestones, which in turn can lead to large disparities in psychological development. The current study focused on an under-investigated aspect of early motor experience – the influence of aquatic experience on motor development. The main purpose was to determine if use of an infant neck floatation device (an Otteroo) is associated with earlier acquisition of specific motor skills during the first 18 months of life. Because the Otteroo allows infants to express or practice movements that would be much more difficult on land, we expected greater use to predict earlier skill onsets. Parents of 46 infants (20 girls) between 12 and 18 months of age answered a retrospective survey on their child’s Otteroo use and the age onsets for various motor and communicative skills. The average total Otteroo use in the sample was 154.29 minutes. Infants acquired the skills within typical ranges reported in the literature. A general linear regression model, which controlled for infant age and sex, revealed that total duration of Otteroo use was significantly or marginally significantly correlated with onset ages for 10 motor skills (r value range = -.18 to -.30). The highest correlations were between Otteroo experience and hands-and-knees crawling, transition from supine to prone posture, pincer grip, and cruising. Interestingly, Otteroo use correlated strongly with four items that assessed infants’ ability to follow the parents’ referential gestural communication, an important indicator of spatial cognitive development (r value range = -.24 to -.32). The potential therapeutic value of these intriguing findings for young children with disabilities that impede motor development warrants further research to confirm whether Otteroo use accelerates motor and psychological development.

User and Caregiver Acceptability of a Novel Pediatric Mobility Training Combining Socially Assistive Robots and Body Weight Support Technology

Amanda J. Arnold, University of California Riverside; Jylia Mestas, University of California Riverside; Niki Fujimoto, University of California Riverside; Jared Cristobal, University of California Riverside; James C. Galloway, University of Delaware; Herbert G. Tanner, University of Delaware; Elena Kokkoni, University of California Riverside

Acceptability of a new mobility intervention program, especially when this involves the use of technology, is essential for keeping up with the program and reducing the chance of technology abandonment. One such program is the Grounded Early Adaptive Rehabilitation (GEAR) system. GEAR is a learning environment featuring socially assistive robots (SARs) and a body weight support system (BWSS) designed for early mobility intervention. This work reports on both child and parent acceptability of GEAR. Five pre-walking infants (one with Down Syndrome) were engaged in various motor tasks while interacting with the SARs, with and without BWSS assistance, over eight 1-hr sessions. Parents attended the sessions and intervened if needed (e.g., when infant cried or was tired). User acceptability was assessed based on the infant’s facial expressions, annotated in 10-s intervals from the videos (Positive: smiling, Neutral: no expression, Negative: frowning/crying, Obstructed: face not visible). Parent acceptability was assessed via a perception questionnaire on their infants’ experience with the SARs and BWSS. Infants mostly displayed a neutral expression (84%) and rarely a positive (3%) or negative (<1%) expression. The majority of parents reported that their infant: (a) had fun interacting with the SARs (80%), (b) was comfortable using the BWSS (80%), and (c) was motivated by the SARs into moving in the environment (60%). All parents reported that the wheeled SAR seemed to connect more effectively with the infant than the humanoid SAR. Users (infants and parents) support the application of the GEAR system as an early mobility program. Although neutral affect may seem counter to a positive experience, it actually allows for attention and integration of information related to a task to facilitate learning, which aligns with the goal of the GEAR protocol (i.e., to continuously engage infants in complex perceptual-motor tasks). The findings on parent acceptance of SARs used by infants extend on recent findings with older children which supports SAR acceptance throughout childhood.

Combining the Use of Socially Assistive Robots and Body Weight Support Technology to Encourage Infants’ Participation in Complex Motor Tasks

Amanda J. Arnold, University of California Riverside; Jylia Mestas, University of California Riverside; Niki Fujimoto, University of California Riverside; Jared Cristobal, University of California Riverside; James C. Galloway, University of Delaware; Herbert G. Tanner, University of Delaware; Elena Kokkoni, University of California Riverside

Use of technology can support functional mobility and participation in children with mobility issues. The Grounded Early Adaptive Rehabilitation (GEAR) system is an enriched setup equipped with socially assistive robots (SARs) and a physically assistive body weight support system (BWSS), designed to address immobility. SARs and BWSSs are currently used in very limited ways: SARs interact with children to elicit simple motor responses and BWSSs assist children with a single skill (i.e., walking). The goal was to assess if SARs + BWSS would motivate pre-walking infants to perform complex motor tasks. Five infants (one with Down syndrome) performed various motor tasks including the Platform Ascending Task (PAT) and Staircase Ascending Task (SAT) over eight 1-hr sessions. In PAT, the SAR motivated the infants by ascending the platform with them. In SAT, the SAR motivated the infants to approach it while moving and flashing lights on the top of the staircase. Participants performed each task twice: with and without the assistance from the BWSS. Videos from both tasks were analyzed for task completion (full, partial, no ascent) and child-SAR interaction (follow/move toward the robot, not follow). Overall, infants completed 83% and 98% of PAT and SAT trials respectively. They followed/moved toward the robot in all of these trials. There were trials in which infants partially ascended (PAT: 16%; SAT: 1%) and did not follow the robot. Infants failed to ascend in 1% of PAT and SAT trials. Finally, in total, infants completed more trials without BWSS (94%) than with BWSS (86%) assistance. Nesting infants’ mobility within a socially and physically enriched environment is known to have an impact on the coupled motor-perceptual-cognitive-social development. SARs and BWSSs can be used to motivate and assist pre-walking infants in performing complex motor tasks in an enriched setup. Further kinematic analyses will give an insight on the impact of...
BWSS assistance on motor performance beyond task completion success rate (e.g., postural control and interlimb coordination during ascent).

**Coordination Dynamics of Hopping on a Mini-Trampoline in Adults and Children**

Matthew Beerse, University of Dayton; Jianhua Wu, Georgia State University

Mini-trampolines have been used with children as an intervention, but the motor behavior children adopt on this soft, elastic surface is unknown. Identifying the coordinative structures and their stability for hopping on a mini-trampoline is important for recommending future interventions and suitably applying them to children with motor dysfunctions. This study aimed to assess whether typically developing children show similar biomechanical and coordination patterns as adults while hopping on a mini-trampoline. Data were collected from 15 adults (8M/7F, 23.4 (1.4) years), and 14 children (5M/9F, 9.6 (1.6) years). Participants hopped on two feet to a metronome cue. Participants hopped on a stiff surface for two 10-second trials at their preferred frequency (adults: 2.2 Hz, children: 2.3 Hz). Then, participants hopped on a mini-trampoline at 1.5 Hz for two 30-second trials. A Vicon motion capture system tracked positions of body segments while hopping on both surfaces. An AMTI force plate measured vertical ground reaction force while hopping on a stiff surface. We calculated whole-body vertical stiffness and stance/flight time. We tracked the angles of the foot, shank, thigh, and pelvis and calculated the continuous relative phase of the foot-shank, shank-thigh, and thigh-pelvis. Only children increased whole-body vertical stiffness from a stiff surface to a mini-trampoline, due to an inability to dampen peak vertical force. Both groups conserved the coordinative structure on a mini-trampoline, but distinctly modulated stance/flight time. Children hopped with an adult-like coordinative structure, with the exception of greater out-of-phase motion of the shank-thigh and thigh-pelvis. Children hopped with a less consistent coordination pattern compared to adults. Our results suggest children aged 7–12 years might be developing control strategies for preferred whole-body vertical stiffness. However, children have formed a stable coordinative structure for a spring-mass model, suggesting hopping interventions might have translational benefits to other movements such as running.

**Kinematic Coordination of Gait at Different Walking Speeds in Children With and Without Down Syndrome**

Matthew Beerse, University of Dayton; Gena Henderson, Georgia State University; Jianhua Wu, Georgia State University

The intersegmental coordination pattern of the legs during walking can be defined by a covariance plane of the foot, shank, and thigh segments. Planar covariation emerges rapidly following onset of walking in typically developing (TD) children, but fine-tuning can continue through age 12 years. In contrast, children with Down syndrome (DS) often show delayed onset of walking and poorer gait patterns than their TD peers. It is unknown the extent to which intersegmental coordination differ between children with DS and their TD peers. This study aimed to compare the intersegmental coordination pattern between children with and without DS at different walking speeds. Data were collected from 13 children with DS (11M/2F, 9.12 (1.4) years) and 13 age- and sex-matched TD children. Participants walked overground at their normal speed and fast speed (as fast as they could without running). A Vicon motion capture system tracked positions of body segments. We calculated the elevation angles of the foot, shank, and thigh and conducted a Principal Component (PC) analysis to evaluate the covariation plane. We also conducted a correlation analysis on age and percent variance explained by each PC. At the fast speed, children with DS increased percent variance of the first PC and decreased percent variance of the second PC, which are characteristic of a more mature coordination pattern. In addition, both groups increased their third PC, suggesting improved foot-shank coordination. Further, children with DS demonstrated a positive correlation between age and percent variance of the first PC, and a negative correlation between age and percent variance of the second PC. Our results suggest that children with DS are fine-tuning their gait pattern during 7–11 years of age, perhaps more so than their TD peers. Further, requiring children with DS to walk at a faster speed shifted their coordination pattern to be more mature. Therefore, preadolescence might be an ideal time for children with DS to receive gait intervention with challenging speeds and improve their walking ability.

**Promoting Early Years Physical Literacy Through Summer Success: SKIPing to Motor Competence with Disadvantaged Preschoolers**

Dimetri Brandon, The Ohio State University; Ruri Famelia, The Ohio State University; Jacqueline Goodway, The Ohio State University; Kielley Stroupe, The Ohio State University; Yang-Ju Chen, The Ohio State University; Terraco Johnson, The Ohio State University; Ali Brian, University of South Carolina; Laura Justice, The Ohio State University

Many children from disadvantaged environments enter kindergarten (K) without prerequisite skills to be successful in school, setting them on a negative educational trajectory. Often children have been raised in low income homes with no access to organized childcare and sports, and often lack important school readiness skills including fundamental motor skills (FMS) that are part of physical literacy. In response, an innovative month-long summer program called Summer Success (SS) was developed to promote a variety of school readiness skills, including FMS for disadvantaged preschoolers. To improve physical literacy, the SKIP FMS intervention was incorporated into SS. This study investigated if a 4-wk SS-SKIP motor skill intervention delivered as part of SS could improve the OC skills of disadvantaged preschoolers, and compared these data to existing data from a longer T-SKIP program. Methods: Participants (N = 21) were low-income preschoolers who had no prior preschool experience and were going to K in the Fall. Comparison participants were 122 disadvantaged preschoolers who had previously received a 6-wk T-SKIP program. Children in SS-SKIP were pre-and post tested on the OC subscale of the TGM2 (percentile < 25% = developmentally delayed [DD]). Children received SS-SKIP 3/week for 30 mins for 4 weeks. Results: Prior to SS-SKIP, 71.4% of children were DD in locomotor skills and 66.7% in OC skills. Following SS-SKIP, only 38.9% were DD in locomotor skills and 44.4% in OC skills. A MANOVA with repeated measures on locomotor and OC standard scores revealed a significant time effect (p = < .001, ES = .52). Follow-up analysis showed both locomotor (p < .001, ES = .52) and OC (p = < .05, ES = .25) skills improved from pre-to posttest supporting the effect of SS-SKIP. When comparing the shorter SS-SKIP to the longer T-SKIP, a summary independent sample t-test revealed no differences at the pretest but T-SKIP children were significantly better than SS-SKIP children at the posttest (p < .001), suggesting the higher dose was more effective. Implications for policy and practice are discussed.

**Construct Validity of the English Version of the Perceived Motor Competence Questionnaire in Childhood (PMC-C)**

Swantje Brandt, University of Muenster; Till Utesch, University of Muenster; Dennis Dreiskaemper, University of Muenster; Farid Bardid, University of Strathclyde

Objectives: Perceived motor competence is an important part of the physical self-concept. Whilst there are various questionnaires measuring physical self-concept and its sub-components in children and adolescents,
few have focused on assessing self-perception of motor skills. To this end, the Perceived Motor Competence Questionnaire in Childhood (PMC-C; Dreiskaemper, Utesch & Tietjens, 2018) was developed to measure children’s perception of different locomotor and object control skills; the instrument has been validated in German. The present study aimed to investigate the construct validity of the English version of the questionnaire. Methods: A total of 324 children aged 8–12 years (M = 10.17, SD = 1.16) from Scotland (UK) took part in the study and completed the 24-item questionnaire, which uses a 4-point Likert scale. The PMC-C covers 4 locomotor skills (hop, jump, run, and skip) and 4 object control skills (bounce, catch, kick, and throw) with 3 items per skill. Internal consistency was examined using polychoric alphas or omegas. The latent structure of the original PMC-C was tested using confirmatory factor analysis (CFA). Results: The results showed good internal consistency for locomotor skills (.78–.88) and object control skills (.73–.89), and ordered thresholds for all items. Furthermore, the CFA revealed a good model fit for the assumed structure of the original PMC-C (χ²(243) = 501.1, p < .001, TLI = .985, CFI = .987, RMSEA = .061). Conclusion: The study provides evidence for the construct validity of the English version of the PMC-C. This questionnaire is thus considered an appropriate tool to assess children’s self-perception of motor skills.

Functional Movement Proficiency Declines From 7th to 8th Grade

Regan Bristol; Brittney Herrick; Cheryl Coker, Plymouth State University

Recent studies have shown that functional movement proficiency in adolescents is poor, with males typically being found to score lower than females within the Functional Movement Screen (FMS). Poor functional movement predisposes individuals to injury and could result in the adoption of sub-optimal movement patterns (Cook, 2010). The purpose of the current study was to examine changes in FMS scores in a cohort of middle school students from 7th to 8th grade. Given the decline in the engagement of physical activity in this population, it was expected that FMS scores would decrease. Extant FMS data of 44 middle school students (Males = 28; Females = 16) acquired during physical education in the fall of their 7th grade and again in their 8th grade were analyzed. The FMS rates seven individual movements according to the quality of their performance. A score of 3 indicates the movement was performed as directed (functional). A score of 2 is assigned when a movement pattern is performed with a compensation (acceptable), and a score of 1 is given when an individual cannot perform the movement, even with a compensation (dysfunctional). In addition to scores of 1, a total FMS score of 14 or less and/or any asymmetry with a movement pattern are indicative of the use of sub-optimal movement strategies. Results showed a significant decline in overall FMS score from the 7th to the 8th grade. The average score decreased from a mean of 14.80 (SD 3.04) to a mean of 13.52 (SD 2.28) with 40.91% of participants scoring a 14 or below in the 7th grade increasing to 63.64% in the 8th grade. Furthermore, there was a 6.13% increase in asymmetries and a 9.09% increase in dysfunctional movement patterns (scores of 1). No statistically significant difference was found between males and females. Results are concerning given the foundational role functional movement plays in movement competency. Methods for resolving these dysfunctions are therefore necessary to better position young adolescents for a healthy future.

The Effects of Tummy Time on Infant Obesity

Gabriela Carey-Zuniga; Raquel Castillo; Joao Barros; Do Kyeong Lee, California State University Fullerton

Despite ample evidence of the importance of physical activity in motor and cognitive proficiency and weight gain of healthy infants, little is known about the type and amount of physical activity needed for infant development. Pediatricians recommend “tummy time” (TT) (placing a baby on his or her stomach while awake) as a physical activity for infants <6-month old). TT activity moderates rapid weight gain, advances growth of motor skills, and increases the level of physical activity later in young childhood. Given the benefits of TT activity, the daily time commitment needed to see those benefits is unclear. Additionally, insufficient TT has not been reviewed as a risk factor of obesity in infancy. The purpose of the present study was to examine the short-and long-term effects of TT practice on healthy weight gain during the 1st year of life. Healthy infants (0 to 16-week old) were randomly assigned to one of 4 groups (0, 30-, 60-, or 60+ minutes/day) and participated in a prescribed daily TT practice until the time at which the infant could independently transition in and out of sitting. Parents were encouraged to achieve the maximal minutes prescribed for their group. The requested dosage is an accumulation of minutes of TT throughout the day. Parents’ log of infant’ TT activity and body composition were monitored at parents’ home bi-weekly during the intervention and bi-monthly until 12 months of age. The weight-for-length z-scores were calculated from weight and length measures using World Health Organization growth standards. The pilot study has 23 infants (13 F; 10 M, 9.045 weeks starting age), the mean cumulative time that infants spent in TT was 34 minutes (range 0–306 min). The mean daily frequency in TT was 3.3 times (range 1–6.5 times), with a total of 122.1 days duration per participant (range 32–184 days). We expect that with longer durations of TT, healthy weight gain will be achieved in infants. The study will result in guidelines for daily TT (e.g., duration and frequency) in infants to reduce the risk factors of early-onset obesity.

Investigating the Underlying Mechanisms Influencing Physical Activity on Elementary School Playground

Yung-Ju Chen, Ohio State University; Jacqueline Goodway, Ohio State University; Dimetrius Brandon, Ohio State University; Alexandria Comito, Ohio State University; Aylah Khan, Metro Early College High School; Ruki Famlia, Ohio State University; Jerraco Johnson, Ohio State University

The WHO has identified childhood physical inactivity as a major public health concern. Schools and specifically physical activity (PA) at recess have been recognized as a central means to increase health-enhancing PA during the school day. This study investigated the underlying mechanisms that influence elementary school students’ PA at recess. Fifty-two 3rd graders (28 boys, 24 girls) from two elementary schools in the Midwestern U.S. participated in the study. The students were measured on their fundamental motor skill competence (FMSC), perceived motor competence (PMC), and playground social group size and behavior using TGMD-2, Harter’s subscale of perceived athletic competence, and the System for Observing Children’s Activity and Relationships during Play (SOCARP). Five-day school accelerometry measured school day/recess PA. Descriptive analysis, Pearson correlations, regressions, and MANOVAs were conducted. Students spent 10.55% of their school day in MVPA and 80.12% in sedentary behavior. At recess, they spent 42.88% in MVPA and 39.42% in sedentary behavior. Gender, time in sports, and weight were significantly correlated with students’ MVPA. Girls spent more time in sedentary behavior both during the school day (p < .001) and at recess (p < .001) than boys. Boys, on the other hand, spent more school day time in VPA (p < .01) and MVPA (p < .001) than girls. At recess, boys spent more time in MPA (p < .05), VPA (p < .001), and MVPA (p < .001). Students who spent more time in sports activities on the playground were more likely to engage in higher VPA at recess (p < .05). Both students’ BMI and weight were positively correlated to their LPA (p = .05) at recess. Regression analyses showed that two specific types of social interactions on the playground predicted students’ recess PA. Students who ignored negative
social interactions engaged in higher VPA at recess \( (p < .05) \). Students who demonstrated more positive and physical social interactions participated in less MVPA \( (p < .05) \) and more LPA at recess \( (p < .05) \). Students’ age positively predicted students’ engagement in MPA at recess \( (p < .05) \). Discussions and implications of the study will be discussed.

Establishing the Relation Between the Fundamental Locomotion Skills and Competitive Badminton

Pei-Pei Cho, National Taiwan Sport University; Yeou-Teh Liu, National Taiwan Normal University; Karl M. Newell, University of Georgia

A long-standing proposition in several emphases of the movement domain is that an individual’s degree of competency in the fundamental movement skills relates positively to the level of sport development. However, there have been few empirical studies on this relation between the fundamental movement skills and sport skills. The purpose of this study was to examine the relation between the fundamental skills of locomotion and those of competitive badminton. Eight foot-patterns of walking, running, jumping, skipping, hopping, leaping, galloping, and sliding in eight movement directions were recorded on 6 players from the semi-finals and final U11 badminton games. Pattern by direction repeated measure ANOVA was performed on the six players. There were a total of 1373 rallies observed in the six sets with 1437 recordings of foot patterns from 549 rallies. The ANOVA showed significant main effects of pattern and direction as well as a pattern by direction interaction. Post hoc comparisons revealed that hopping and leaping were used significantly less than all the other patterns and moving in the mid-court toward left and right were also significantly less than all the other directions. For the interaction effect, there were significant associations for running and forward direction, sliding and backward direction, hopping in the left forward and right backward directions, and leaping in the left forward and left backward directions. These results support the interpretation that the foot patterns used in competitive badminton games can be identified with the foot patterns of fundamental locomotion skills. Sport performance development may benefit from an early and focused involvement of the fundamental movement skills for children.

Object Transportation in Crawling Infants

Laura Claxton, Purdue University; Amanda Arnold, University of California Riverside; Maria Stiens, Purdue University; Alyssa DeJoan, Purdue University

Carrying objects leads to fewer falls in newly walking infants suggesting an increase in stability \( (p < .05) \). Given that crawlers also frequently carry objects through their environment and rarely fall during these object carriage bouts \( (p < .05) \), an open question remains if carrying objects is beneficial to crawling. Therefore, we investigated whether transporting a toy while crawling leads to an increase in stability such that crawlers will be able to spend more time in motion. Thirty-nine 13-month-old infant and caregiver pairs (24 girls, \( M = 13 \) months, 3 weeks, Range = 13.0–13.4) participated in a 20-minute free-play session in a room filled with various toys. Trained coders used Datavyu to identify crawling bouts (consisting of at least four forward continuous hand or knee movements) during the middle 10 minutes of the free-play session. For each crawling bout, coders also recorded if the infant was carrying a toy. Although the majority of the infants both crawled and walked, we only focused on time points when the infants were crawling for the following analysis \( (N = 27 \) infants). From the crawling bouts, proportion of time spent in motion with and without a toy was calculated. Infants spent more time in motion when crawling without a toy \( (M = 0.68, SE = 0.08) \) as compared to when crawling with a toy \( (M = 0.32, SE = 0.08) \), paired-samples \( t(26) = -2.21, p = .036 \). These findings suggest that while object carriage during crawling may reduce the number of falls \( (p < .05) \), carrying a toy does not lead to additional stability benefits, such as increased time spent in motion. Additional insights regarding the potential stability benefits during object carriage should be further investigated by assessing other aspects of stability, such as gait characteristics, to see if those measures are impacted by carrying objects during crawling bouts.

Visual Pedagogical Support for the TGMD-3: Face Validity of Sequential Pictures Animation Illustrating the Skills Performance Criteria in an App

Fernando Copetti; Nadia Cristina Valentini; Andréa C Deslandes, Universidade Federal do Rio de Janeiro

Animations are dynamic demonstrations that make visual information more attractive, facilitating children’s understanding of the motor tasks. Aim: To develop and investigate the face validity of sequential pictures illustrating the TGMD-3 skills performance criteria, animate the sequence, and insert it in an App to be used as pedagogical visual support to assess children. Method: Motor Skills Sequential Pictures (MSSP), representing the skill performance criteria and their adequacy, were assessed by 23 experts and 52 undergraduate students (teachers and youth-sports experts) to see if those measures are impacted by carrying objects during crawling bouts.
objects). Children (N=66), 3 to 10 years old (48 neurotypicals, and 18 with Autism Spectrum Disorder – ASD) were assessed. The movement sequence of each skill was developed using a video database of children who completed the TGMD-3 and the TGMD-3 manual. Children’s characters were created, taking into consideration sex and ethnicity. Each skill sequence contains five to six representations of the performance criteria. Experts and undergraduate students assessed the adequacy of the MSSP. Children were requested to identify and perform the skills, and if they were not able, verbal support was provided. Results: Agreement among experts was high for 11 skills (95%), with the exception of gallop (representatives 78.3%; adequacy 69.6%) and dribble (representatives 95.7%; adequacy 82.6%) the MSSP was adjusted. Undergraduate students also showed high levels of agreement for all skills (94.15–100%). Regarding children’s results, young children (3–4 years old) had more difficulties in the identification of skills, specifically the gallop and skip, compared to older children (5 to 10 years old). The children with ASD group demonstrate difficulty in identifying the skills in all age groups. All children more easily recognized ball skills. After face validity by experts and target population was achieved, the MSSP was animated an inserted in an App. The MSSP proved useful as visual pedagogical support to facilitate understanding and identification of motor skills and motor performance criteria. Funding source: CAPES and CNPq.

The Relationship Between Children’s Actual and Perceived Motor Competence: A Person-Centered Approach Based on Multiple Measurement Instruments

Eline Coppens, Universiteit Gent; An De Meester, University of South Carolina; Eva D’Hondt, Vrije Universiteit Brussel; Matthieu Lenoir, Universiteit Gent

Objective: To investigate 1) whether different profiles reflect children’s levels of actual and perceived motor competence (AMC; PMC) using a person-centered approach, and 2) whether the same profiles could be identified based on different assessments of both constructs (i.e., AMC: process & product measurement; PMC: specific skill & general athletic competence). Methods: Four hundred and forty 9- to 14-year-old children’s (53.9% boys; 46.1% girls) AMC was measured using the process-oriented Test of Gross Motor Development-2 (TGMD-2) and the product-oriented Körperkoordinatentest für Kinder (KTK). The Physical Self-Confidence Scale (PSCS; perceived competence in 15 motor skills) and the athletic competence subscale of the Self-Perception Profile for Children (SPCC, perceived athletic competence) were used to measure PMC. Two separate cluster analyses (CA) were conducted to identify different profiles. The first CA (CA1) combined two optimally aligned instruments of AMC and PMC: the TGMD-2 and PSCS. The second CA (CA2) combined two mediocly aligned instruments: the KTK and SPCC.

Results: In both analyses, the five-cluster solution was found to be the best fit for the data (CA1: Cohen’s Kappa (κ) = .67, R² (AMC) = .76%, R² (PMC) = .64%, CA2: κ = .83, R² (AMC) = .65%, R² (PMC) = .78%). In both five-cluster solutions two groups were characterized by similar, relatively high or low levels of both AMC and PMC (i.e., low-low & high-high). In addition, two groups were characterized by divergent levels of AMC and PMC (i.e., low-high & high-low). The fifth group was different in both cluster solutions. Where CA1 revealed an additional low-high profile, CA2 revealed an extra high-high profile. Conclusion: It can be concluded that the choice of measurement impacts the relationship between AMC and PMC. Therefore, future research should explore whether associations will be stronger when the used AMC instrument aligns with the PMC measurement. In addition, these findings show that both the type of measuring instrument and the alignment between AMC and PMC have an influence on the results. Funding source: Flemish Government by means of the Policy Research Centre on Sports.

Exploring the Relationships Between Motor and Cognitive Function as We Age: A Cross-Sectional Pilot Study

Rhiannon. L. Cowan; Anupriya Pathania; Mindie Clark; Kevin Dufl; Keith. R. Lohse, University of Utah

Declines in motor function come from neurological and musculoskeletal changes as we age, such as decreased efficiency in force production. Recent evidence suggests that these motor changes may be related to cognitive changes beyond the effects of age, as lower grip forces have been associated with increased risk of Alzheimer’s disease, and physical frailty is a marker of future cognitive impairment. To add to this literature, we conducted a pilot study collecting demographics, cognitive function, motor function, and self-reported physical activity in a sample of healthy young adults (n = 20; age <35 y) and healthy older adults (n = 20; age >65 y). Following cognitive assessment by the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS), participants completed a grip-force task: gripping a force-transducer in their dominant hand for three 4-s maximum force trials while surface electromyography (EMG; Biopac) was recorded from the extensor and flexor muscles in the forearm. EMG data were filtered and root-mean-square rectified, then normalized to an identically processed resting baseline. Consistent with previous research, older adults produced lower grip forces (p <.001), and men generally produced higher forces (p <.001). Notably, although older adults tended to produce lower forces, they had greater normalized activation of the flexors and extensors (p <.01). Importantly, when explaining RBANS average scores, there was a gender by grip-force interaction (p = .013), such that for women, greater grip forces were associated with higher cognitive scores (p = .026). For men, this relationship was negative, but not significant (p = .17). When restricting our sample to older adults and controlling for sex, the relationship between grip force and RBANS scores was positive but not statistically significant (p >.05). These findings replicate past work on age-related differences in cognition and motor function considered separately, and provide informative estimates for future work exploring the relationships between cognition and motor behavior as we age.

The Impact of Different Types of Feedback on Children’s Persistence After Experiencing Success and Failure in Locomotor and Object Control Tasks

An De Meester, University of South Carolina; Jullie Galle, Ghent University; Bart Soenens, Ghent University; Leen Haerens, Ghent University

Objectives: To examine the impact of various types of feedback on children’s perseverance in motor tasks after experiencing success and failure, respectively. Methods: A total of 176 children (44.3% boys, 55.7% girls, 9–13 yrs) participated in this experimental study. Each of the participants was randomly assigned to one of three experimental conditions. All children successfully completed two easy locomotor and two easy object control tasks after which they received positive feedback: children in the first condition received person-oriented positive feedback (i.e., PoPF: “Well done, you’re very talented.”), children in the second condition received task-oriented positive feedback (i.e., ToPF: “Well done, you tried really hard and I appreciate your effort.”), and children in the third condition received neutral positive feedback (i.e., NPF: “Well done.”). In the second part of the experiment, all children – as intended – failed to successfully complete a set of very hard locomotor and object control tasks (two of each), after which they were all given the same, negative feedback (i.e., “That was not good at all, it was a whole lot worse than other children your age.”). All children were then offered a free-choice paradigm (i.e., participation: yes-no, challenge: easy-difficult, duration: 0–3min) to measure their perseverance. ANOVAs were used to examine differences in perseverance among the three conditions. Results: Children who initially
received ToPF persevered significantly longer after experiencing failure ($M = 138.23 \pm SD = 67.49$) than children who received PoPF ($M = 104.87 \pm SD = 69.53$) or NPF ($M = 92.56 \pm SD = 70.27$; $F = 6.83, p < .01$). They also chose significantly harder tasks to practice ($M = 1.72$ on a 0–2 scale, $SD = .61$) than children in the control group (NPF, $M = 1.36$, $SD = .85$; $F = 3.48, p < .05$). Conclusions: This study has important implications for physical education teachers and youth sports coaches: applying task-oriented (rather than person-oriented) positive feedback may increase students’ and athletes’ perseverance after experiencing failure.

### Quantity and Variability of Infant Leg Movement During a Socially Assistive Robot Reinforced Contingent Learning Paradigm

Wei Yang Deng, University of Southern California; Marcelo Rosales, University of Southern California; Barbara Sargent, University of Southern California; José Carlos Pulido, Universidad Carlos III de Madrid; Maja Matarić, University of Southern California; Beth Smith, University of Southern California

Background: Movement acceleration is a critical parameter in motor control, and infants born preterm show slower and less variable acceleration patterns than infants with typical development. However, it is still unknown how infants learn to control the acceleration of their movements. Our objective is to determine whether infant learners (L), compared to non-learners (NL), show different quantity and/or variability of leg movement in a contingent learning paradigm. Methods: Nine infants (7–9 months old) with typical development participated in the study. Their movements were monitored by tri-axial accelerometers attached to each limb for a 2-minute baseline, 8-minute contingency, and 2-minute extinction period. Infants received reinforcement from the robot when their right leg total peak accelerations were between $9–20$ m/s$^2$ during the contingency period. Infants whose leg movement frequency within the acceleration band during the contingency period was 1.5 times greater than baseline were identified as learners. Quantity (1. general movement quantity; 2. proportion of movements within acceleration band compared to general movement quantity (Prop)) and variability of acceleration (1. nonlinear variability; sample entropy (SampEn); 2. linear variability; interquartile range (IQR)) of their leg movements during the contingency session were normalized to their baseline. Peak performance was compared between learners and non-learners using Mann-Whitney tests. Results: Six infants were identified as learners and three as non-learners. Compared to non-learners, learners demonstrated a higher quantity of general movement (median: L: 2.2; NL: 0.6, $p = .04$) and higher Prop (median: L: 3.3; NL: 0.6, $p = .02$). Learners also had higher non-linear variability (SampEn median: L: 4.2; NL: 1.1, $p = .048$) and linear variability (IQR median: L: 2.5; NL: 1.0, $p = .03$) of leg acceleration than non-learners during the contingency period. Conclusion: The results indicated that both quantity and variability of movement may influence the learning process of adjusting leg acceleration control during infancy. Funding source: NSF.

### Self-Perception in Primary School Children: Is it Fitness- or Competence-Based? – An Approach Applying the I/E-Model

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

In research on motor development in childhood, the physical self-perception is found to be an important predictor for physical activity (e.g., Robetson et al., 2015). Often, a competence-based approach to measuring self-perception is used in childhood (i.e., locomotion and object-control, Dreiskaemper et al., 2018). However, the physical self-concept as a sub-domain of the non-academic self-concept is considered to be structured in different domains of physical fitness (e.g., endurance, Marsh & Redmayne, 1994). It is neither sufficiently investigated on which domains children base their physical self-perception (fitness or competence), nor if these two different parts of motor development can be identified as being independent sub-domains. Therefore, the aim of this study was twofold: First, identifying which self-perception domains are more strongly related to the self-perception of general sportiness in different age-groups in childhood. Second, to test an I/E model on the objective measured values on fitness and motor competence and fitness- and competence-based self-concept domains in childhood. In a longitudinal design with three cohorts, 387 children from first to fourth grade took part ($M_{age} = 7.84$, $SD = 0.98$). Fitness was measured with 20m run (speed) and Pacer test (endurance), motor competence was measured by a short version of TGMD-3 (Ulrich, 2019). Physical self-concept was measured by PSC-C and PMC-C (sum: 45 items, 4-point-Likert-scale). Results show stronger correlation between general sportiness with fitness domains ($b = .43/.23$) than with competence domains ($b = .02/.11$). The I/E-model shows positive relations between self-concept domains and related domains, but no assimilation or contrast effects between them. The results underline the necessity to investigate the development of physical self-concept in childhood in a more differentiated way considering fitness and competence domains.

### Effect of Body Position and External Load on Knee Joint Kinematics During the Pendulum Test in Typically Developing Children

Diego Ferreira; Gena Henderson; Jianhua Wu, Georgia State University

The Wartenberg pendulum test has been used to measure the passive motion of the knee in different populations. However, there has been some inconsistency in the administration of the test between studies. Some studies have used an upright position, others lay supine, and others use a reclined position. In a previous study, we found that body position did not alter the passive motion of the lower leg in healthy young adults; however, including an external ankle load significantly increased passive motion of the lower leg. Therefore, the purpose of this study was to determine if body position and ankle loading influences the performance of the pendulum test in typically developing children. Three body positions were included: sitting upright, sitting reclined at a 45-degree angle, and lying supine. Three loading conditions were included: without load (NL), an ankle load equaling to 3% of body mass (AL3), and 6% of body mass (AL6). This resulted in a total of 9 test conditions presented in a random order. 15 children (8M/7F, 9.74 ± 2.25 years) performed 5 trials for each condition. A motion capture system was used to collect kinematic data of the knee joint. Calculated variables included: range of motion (ROM) of the knee in the sagittal plane in the first swing excursion, number of swing cycles, and a relaxation index (RI). Two-way (3 position x 3 load) ANOVAs with repeated measures were conducted on each variable. Post-hoc pair-wise comparisons with Bonferroni adjustments were conducted when necessary. Our results demonstrated that body position did not significantly affect the knee ROM, number of swing cycles, and RI. However, all the variables increased from the NL to AL3 to AL6 conditions. Our results suggest that although different body positions may induce different muscle length of the quadriceps, they may not result in different knee kinematics and stiffness property. In contrast, the increased moment of inertia due to ankle load allowed greater passive motion to occur during this test.

### Middle-Aged and Older Adults Have Similar Motor Imagery Abilities

Chadwick Fuchs; Priscila Tamplain, University of Texas at Arlington

Motor imagery (MI) refers to the imagination of a motor task without actual movement execution. Previous research has shown a significant difference between accuracy and vividness of MI in children with motor deficits (Fuchs & Caçola, 2018) and in children and young adults. Here, we...
investigated differences in MI accuracy and vividness between middle-aged adults (40–64 years of age) and older adults (65 and older years of age) while using young adults (18–25 years of age) as a control group. To that end, we used the Florida Praxis Imagery Questionnaire to measure MI accuracy and the Movement Imagery Questionnaire for children and Movement Imagery Questionnaire-3rd edition to measure MI vividness. Pilot results indicated a similar trend for MI accuracy in middle-aged and older adults when compared to young adults with the lowest scores in the kinesthetic subscale followed by object, position and the action subscale having the highest score. Additionally, middle-aged and older adults reported greater difficulty in MI vividness when compared to young adults. These findings describe that an individual’s MI vividness becomes lower as they progress from young adulthood into middle-age and older adulthood, while their MI accuracy remains similar. These results help further our understanding of these components of MI which provide valuable insight into MI deficits. The development of this understanding can help improve the development of MI training protocols for individuals of varying age.

**Infant Affect During Tummy Time**

Janet Hauck; Yuenmei Lu; Anna Bradley; Julia Jaske, Michigan State University

Introduction: Prone position, or tummy time, is the deliberate placement of an infant on their belly while awake. This position promotes motor, social, and cognitive development. Adequate tummy time is vital for timely growth and development, but there is limited knowledge of constraints influencing this behavior. The current investigation uses in-home video data to identify how specific environmental characteristics influence an infant’s affective vocalizations and reactive behavior while in prone position. Method: Thirty-four bouts of tummy time were video recorded from eight 6-month old infants while at home. Videos were coded for environmental characteristics (caregiver proximity, caregiver contact, toy availability), infants’ affective vocalizations (negative, non-neg/none) and infants’ reactive behavior (escape, attention seeking, content). Within each variable, several qualities were observed and their duration of time present was recorded. Bivariate correlations were used to identify relationships between variables. Results: Having the caregiver within 1 ft proximity ($r = 0.447$, $p = 0.029$), no physical contact with caregiver ($r = 0.476$, $p = 0.016$), and toys within reach ($r = 0.709$, $p = 0.001$) are positively associated with non-negative affect. Having the caregiver close in proximity ($<1$ ft: $r = 0.886$, $p = 0.019$; ≥1 ft: $r = 0.888$, $p = 0.044$) to the infant, toys within reach ($r = 0.948$, $p = 0.004$), and non-negative affect ($r = 0.733$, $p = 0.025$) positively associate with escape behavior. The caregiver within 1 ft proximity ($r = 0.555$, $p = 0.021$) and no physical contact ($r = 0.616$, $p = 0.002$) positively relates to content behavior. Negative vocalization and attention seeking reactive behavior did not correlate with any of the environmental codes. Conclusion: These results imply that the infants respond with non-negative vocalizations and physical movement when the caregiver is close by and toys are within reach and are content with the caregiver close by when toys are out of reach. This information could help caregivers to better implement tummy time.

**Correlation Between Forward and Backward Treadmill Walking in School-Aged Children**

Gena Henderson; Diego Ferreira; Jianhua Wu, Georgia State University

Backward walking (BW) has been characterized as being a simple time-reversal of forward walking (FW). High correlations in joint kinematics between FW and time-reversed BW overground are seen in adults and school-aged children. However, little research has been conducted in children comparing BW and FW patterns on a treadmill. Significant differences in gait patterns are established between overground and treadmill walking in both adults and children. Thus, we aim to investigate the correlation between FW and BW kinematics in school-aged children during treadmill walking at different speeds. We recruited 19 children (10M/9F) aged 6–12 years. Participants completed bouts of treadmill walking for 2 minutes each; each bout represented a different walking condition. These conditions included FW and BW at 3 speeds: slow (75% of self-selected), self-selected, and fast (125% of self-selected). Kinematic data were collected using a Vicon motion capture system. Electromyography (EMG) data were collected from the leg muscles using a Delsys EMG system. Correlations between FW and time-reversed BW were calculated at the hip, knee, and ankle for each speed condition. Participants demonstrated consistently high correlations between FW and BW kinematics at the hip ($r = 0.83–0.99$) and knee ($r = 0.76–0.99$) that were largely unaffected by speed. At the ankle, however, correlations were much lower at all speeds ($r = 0.31–0.44$) and inter-subject variability was high. School-aged children adapted their ankle motion differently than adults during BW treadmill walking, limiting their ankle range of motion and utilizing their plantarflexors less. This suggests that, although a similar neural control mechanism for BW may be present in school-aged children during overground walking, they are not yet able to fully adapt to BW on a treadmill. This is in line with previous findings that treadmill walking patterns continue to mature into adolescence. We suggest that proximal control at the hip and knee may be mature by this age, but distal control at the ankle is still lacking.

**The Multidimensionality of the Physical Self-Concept: A Differentiation Between Descriptive, Evaluative, and Affective Components**

Lena Henning; Dennis Dreiskämper; Maike Tietjens, University of Münster

Children’s perceived motor competence is strongly associated with positive developmental trajectories of health (Robinson et al., 2015). Children’s perception of motor competence is often only referred to as a descriptive variable. However, research on self-concept of children highlights that also evaluative and motivational-affective components are to be considered as parts of self-perception. They are said to be strongly associated with children’s behavior (Marsh, 1999, Arens et al., 2011; for the physical self-concept: e.g., physical activity; EVT, Wigfield & Eccles, 2000). Therefore, this study aims to a) examine the dimensionality (i.e., descriptive, evaluative, and affective) of children’s perception of competencies and b) analyze which dimension is more strongly related to physical activity in children. In total, $N = 91$ children from third and fourth grade participated (8–11 yrs.). The descriptive component was measured with two items of the PMC-C (Dreiskaemper et al., 2018). The evaluative and affective component was assessed by an adapted version of the PMC-C (two items in each subdimension). Physical activity was recorded in a differentiated manner: quantity and intensity were measured in three settings (school, sport club, additional activities) via questionnaires. The descriptive, evaluative and affective scales show very good reliability scores ($a_{desc} = 0.85$, $a_{eval} = 0.92$, $a_{affect} = 0.84$). However, correlations between those seem to be strong ($r = 0.81–0.88$, $p < 0.01$). Furthermore, all dimensions are correlated to the overall quantity of physical activity in this age group ($r_{desc} = 0.49$, $r_{eval} = 0.40$, $r_{affect} = 0.33$, $p < 0.01$) as well as the quantity x intensity score ($r_{desc} = 0.46$, $r_{eval} = 0.39$, $r_{affect} = 0.30$, $p < 0.01$). However, no significant correlations were found with sport club participation (79% of participants). Results indicate that all dimensions are related to physical activity. However, the variance within the affective scale seems to be very small in this age group. Further data collection and analysis (e.g., CFA and SEM) are currently ongoing and will be presented and discussed.
Investigating prospectively symptoms of ASD within the orders (ASD) until after four years of age even though a stable and reliable determination of the development of gross motor function with qualitative and quantitative measures during the onset of sitting in infants at low- and high-risk for ASD (familial and born prematurely with low birth weight). Three groups of infants were recruited: two HR groups, siblings of children with ASD and premature infants of LBW and one group of infants at low risk with no familial history of ASD, prematurity, or LBW. Qualitative and quantitative measures of gross motor development included the Mullen Scales of Early Learning (MSEL) and sitting postural control respectively. Sitting posture at 6 months was evaluated using a simple paradigm where infants sat on a force platform while center of pressure (COP) data were acquired to describe body sway. The MSEL revealed no differences in gross motor development among the three groups of infants. Sitting postural control however, revealed multiple differences among the three groups, with linear, nonlinear and frequency measures of COP data. This preliminary study may provide the foundation to explore early postural control differences and the possible cascading effects of early motor delays in at-risk populations for ASD. Funding source: System Science Initiative.

Motor, Perceptual and Language Differences in Infants at High- and Low-Risk for ASD

Siblings of children with autism spectrum disorder (ASD) have a greater risk of ASD due to genetic factors. However, premature infants of low birth weight (LBW) also have increased risk of ASD. Few studies have examined the course of development of ASD due to prematurity and LBW. Early signs of ASD related deficits may first become noticeable within the development of the motor system, since it may affect object exploration skills, learning and subsequently cognitive, language and social development. Therefore, the purpose of this study was to determine the differences in motor, perceptual and language function between infants at low-risk (LR) versus two high-risk (HR) groups: due to genetic disposition or prematurity and LBW. The Mullen Scales of Early Learning (MSEL) was administered. The MSEL was designed to evaluate learning ability across areas of visual reception, gross motor, fine motor, receptive language, and expressive language. Among all MSEL areas evaluated at age of onset of sitting, significant differences were found only in the visual reception scores between the HR siblings’ and the LR group. General trends of the group averages showed the LR group to have higher scores than both HR groups in gross motor, fine motor, and visual reception. However, the HR premature and LBW group had higher scores in both receptive and expressive language than the LR group, although the HR siblings group scored lower than the other two groups in these areas. The general trends shown among groups may indicate delayed development in both HR groups related to ASD, however there were differences in language trends. Further research supporting these trends may indicate that ASD develops and progresses differently in those born prematurely and of LBW compared to those with genetic disposition. Funding source: System Science Initiative.

Bringing Objectivity to Motor Skill Assessment in Children

Background: The study purpose was to use Inertial Measurement Units (IMUs) to objectively assess children’s motor competence in seven...
Development of Postural Stability in Children with Autism Spectrum Disorder

Yumeng Li; Ting Liu; Elizabeth Venuti, Texas State University

Autism spectrum disorder (ASD) is a group of neurological developmental disorders that typically last throughout an individual’s lifetime. Appropriate motor function and the ability to maintain an upright body posture are crucial for balance and participation in physical activity in daily life. However, children with ASD demonstrated impaired postural stability. Moreover, development of postural control in children with ASD is still not well understood. Therefore, the purpose of the study was to investigate the age effect on postural stability for children with ASD. 29 children (6 to 14 years) with mild ASD were assigned into one of the three groups based on age: 6–8 yr (U8), 9–11 yr (U11) and 12–14 yr (U14). Participants were instructed to stand barefoot with both feet on a force platform and maintain a stationary position for 15 seconds during eyes-open and eyes-closed conditions. Center of pressure (COP) data were collected. COP variables were calculated, including displacements, total distances, sway areas, and sample entropy. The COP variables were compared among the three age groups using a mixed-model (group by condition) ANOVA. The group effect was significant for mediolateral COP displacement ($p = 0.04$) and total COP sway distance ($p = 0.02$). Post hoc comparisons revealed that U8 exhibited greater COP mediolateral displacement (5.1–11.6 cm) and total distance (45.6–95.8 cm) compared to U14 (3.4–3.9 cm and 29.1–33.4 cm, respectively), regardless of test conditions. In conclusion, some age-related changes in postural control were observed in children with ASD. The U14 group exhibited improved mediolateral postural stability compared to U8, whereas no differences were found between U8 and U11 or between U11 and U14. This may suggest that children with ASD could slowly develop postural stability but only demonstrate significant changes over a long period of time. We recommend early intervention programs specifically focused on improving anteroposterior stability and complexity of postural control as potentially beneficial for children with ASD.

Motor Competence and Sensory Processing in Children With Autism Spectrum Disorder

Ting Liu; Michelle Hamilton, Texas State University

Children with autism spectrum disorder (ASD) have an atypical sensory processing pattern that affects their ability to sustain and engage in physical activities. They are discouraged from participating in structured physical activities because of their sensory processing deficits and low motor competence. However, studies on the relationship between motor competence and sensory processing are limited. The purpose of this study was to assess motor competence and sensory processing in children with ASD and to examine whether the two factors were related. Twenty-six children with ASD (ages 7–14 years; 23 males, 3 females) participated in this study. The Movement Assessment Battery for Children-2 was used to assess the children’s motor competence and the Short Sensory Profile was used to examine the children’s sensory processing response. Findings revealed that children with ASD were significantly delayed in both fine and gross motor competence and sensory processing when compared to the normative data. The Pearson correlation analysis showed a significant positive relationship between children’s motor competence and sensory processing. This finding indicated that children with delayed motor skill performance tended to have greater sensory processing difficulties. It is recommended that practitioners and educators include sensory and motor skills as they develop and implement training programs for children with ASD to help them succeed in school and in their daily life.
A Qualitative Analysis of Undergraduate Students’ Experiences During an Adapted Physical Activity Intervention for Individuals with Developmental Disabilities

Emily E. Munn; Sidney B. Peach; Kaitlin M. Freeman; Sheri J. Brook; Melissa M. Pangelinan, Auburn University

Experiential learning opportunities are critical for undergraduate students to enhance their core knowledge of kinesiology, develop career-related skills, and improve self-efficacy in working with individuals from diverse populations (Kolb & Kolb, 2017; Pangelinan et al., 2018). The present study describes a qualitative analysis of student experiences resulting from an experiential learning opportunity in which undergraduate students work one-on-one with a child or adult with a developmental disability in the context of adapted physical activity and sport interventions (N=241 undergraduate students). Prior to the start of the intervention, the students complete four days of training (common developmental disabilities, adapted curriculum for developing motor skills, behavioral strategies). Undergraduate research assistants, graduate students, and faculty provided multiple levels of support to improve the quality of the interactions between students and their participants as they rotated through activity stations to increase fundamental and sport-specific motor skills. At the end of the program, students completed an open-ended survey about the student’s experience of the program. Of the 241 students, 238 reported that they had an overall positive experience during the program. Key themes included: the students want to work with individuals with disabilities in the future (n=195), students enjoyed/loved the experience (n=179), the program changed the student’s attitude/understanding of individuals with disabilities (n=133), the student is prepared to work with individuals with disabilities in the future (n=132), the students received support/encouragement from instructors (n=121), the student enjoyed interacting with their participant (n=112), and the student liked the structure of the program (n=105). Key quotes from students will be used to provide details for each theme. This program had a profound impact on a large number of undergraduate students through the direct application of key concepts in motor learning and development in individuals with disabilities.

Changes in Relative Power Using EEG in Preterm Infants Across the First Months of Life

Ryota Nishiyori, University of Southern California; Ran Xiao, Duke University; Douglas Vanderbilt, Children’s Hospital Los Angeles; Beth Smith, University of Southern California

Introduction: Extensive empirical evidence supports the need for identifying impaired neuromotor control early in life to implement intervention for infants at risk for neurodevelopmental disabilities. Our ultimate goal is to provide further evidence that will support targeted early intervention that will facilitate optimal neurodevelopmental outcomes. In our project, we used both electroencephalography (EEG) and wearable sensor data to characterize the developmental status of preterm infants. Here, we explored EEG measures of relative power and their relationship with age. We hypothesized that peak relative power will increase with age, as motor skills emerge. Method: We acquired longitudinal sessions, in monthly increments, of resting-state EEG from 10 preterm infants (range 56 to 295 days adjusted age). We computed peak relative power from a minimum of 2-minutes of resting-state EEG. Additionally, we examined the relationship between infant mu-band (6–9 Hz) powers in the motor cortices and the corresponding adjusted age in days. Results: In our preliminary analysis, we found that peak relative power in the 6–9 Hz frequency band is not observed until 6 months adjusted age. Additionally, at 3 and 4 months adjusted age, there was a peak in relative power observed between 4 to 5 Hz. Spatial pattern changes in the mu-band power showed tendencies surrounding the motor regions, but no significant correlation with age (r=0.36; p=0.09). Discussion: Similar to data in infants with typical development (TD, Xiao et al., 2018), peak relative power is not present until 6 months of age in infants born preterm. However, peaks in relative power were observed in the 4–6 Hz frequency band at 3 and 4 months of age, a different pattern than in infants with TD. Such differences could be due to small sample size or natural variability in infants’ cortical oscillation patterns. Further exploration of EEG variables, such as variance of relative power and coherence, and their relationships to motor development status are needed to support the current findings of relative power. Funding source: Eunice Kennedy Shriver National Institute of Child Health and Human Development of the National Institutes of Health under Award Number R03HD096137.

Latent Growth Curve Modeling in Exercise Science

Christine E. Pacewicz, Saginaw Valley State University; Nicholas D. Myers, Michigan State University

A common aim within the field of exercise science is to understand change – both within and between individuals. To understand change, we need to design longitudinal studies and collect multiple measurements across time. Once measurements are collected, we must then effectively examine change with appropriate analytical techniques. One analytical technique that can be used to examine change is latent growth curve modeling (LGCM). This approach enables the assessment of both observed and latent variables as well as residual or measurement error. These characteristics distinguish this technique from traditional methods of change (e.g., repeated measures analysis of variance). Thus, the purpose of this study was to describe and demonstrate the use of LGCM to examine change using multiple measurements within the field of exercise science. Demonstrating this analytical approach is salient because (a) the recent call for studies with multiple measurement points, (b) the increasing use of LGCM in the field, and (c) the ability to extend LGCM to fit an array of research questions. We first provide a review of the LGCM framework for studies with multiple measurement points. We describe the use of unconditional models to find the appropriate model of change over time (e.g., linear model, latent basis model), how and why to utilize structured residuals (i.e., autoregressions), and how to examine predictors of change in conditional models. Following, we provide a brief illustration of the approach using data from the Michigan State University 30-year motor performance study. This demonstration highlights the advantages of using structured residuals when examining change in the motor performance of youth. We conclude with strengths and weaknesses of LGCM with structured residuals and offer future directions when assessing longitudinal data within exercise science.

Play-Based Physical Activity for Motor Skill Improvement in Young Children with Autism

Stephanie Palmer; Venkata Pradeep Ambati, Southern Illinois University Carbondale

Clinically significant motor impairment affects 50–100% of those with Autism Spectrum Disorder (ASD). Although not included in the diagnostic criteria, research suggests that motor impairments appear during infancy, precipitate the onset and progression of classical autistic symptomology, and are associated with the severity of autistic deficits. Presently, few studies directly address motor impairment in ASD. In those that do, physical education, exercise, and exergaming interventions have been found to
enhance motor skill proficiency. Little is known about the effect of unstructured physical activity on motor skills in children with autism. This pilot study sought to examine the impact of unstructured, one-on-one, physically active play on motor skill proficiency as defined by the Test of Gross Motor Development-2 (TGMD-2) in autistic children between ages 3 and 10. Twenty, one-on-one, 60-minute play-based physical activity sessions were administered over a 10-week period (2x/week). The physical activity environment was arranged according to the North Carolina Treatment and Education of Autistic and Related Communications Handicapped Children (TEACCH) guidelines. Session structure precluded skill teaching and sought to elicit gross and fine motor activity within physical activity opportunity stations, but without regard to type or intensity of activity. A comparison of pre-and post-intervention TGMD-2 scores captured motor skill outcomes. Preliminary findings suggest that unstructured physically active play is not sufficient to improve overall motor skill competency in young children with autism. Despite non-significant statistical analysis, trend towards improvement was noted in nearly every participant. Future research should consider using assessments more sensitive to acute changes in motor skill efficacy, measurement of time spent in physically active play, and qualitative analysis of parent-perceived outcome and improvement.

Neonatal Adverse Outcomes and Socioeconomic Status: The Influence on Preterm Infants’ Cognitive, Language, and Motor Development

Carolina Panceri, Universidade Federal do Rio Grande do Sul; Nadia Cristina Valentini, Universidade Federal do Rio Grande do Sul; Beth Smith, University of Southern California; Rita de Cassia Silveira, Universidade Federal do Rio Grande do Sul; Renato Procianoy, Universidade Federal do Rio Grande do Sul

Background: Considerable work has been conducted regarding the negative repercussion of preterm birth and low birth weight on infants’ neurodevelopment. However, much less is known concerning the combined effects of neonatal birth risks, neonatal adverse outcomes, and socioeconomic risk factors on preterm cognitive, language, and motor development, the objective of this study. Method: Data were collected as part of a longitudinal study of preterm infants attending a follow-up clinic. Infants born before 32 weeks gestation or with birth weight less than 1500 g were included (N = 184). Hospital files were used to assess the incidence of neonatal birth risks (gestational age, birth weight, and height), neonatal adverse outcomes (periventricular hemorrhage, leukomalacia, mechanical ventilation, and APGAR), and socioeconomic status (mother and father formal education, and income). Infant development was assessed using the Bayley Scales of Infant Development III. Structural equation modeling was conducted with three latent variables (neonatal birth risks, neonatal adverse outcomes, and socioeconomic risks) and three outcomes (cognitive, language, and motor composite scores). Results: The structural equation model showed that combined neonatal adverse outcomes were the most consistent predictor of infants’ cognitive (B = .45, p < .001), language (B = .23, p = .001), and motor (B = .51 p < .001) development. Socioeconomic risk also explained the variances in the infant development (cognitive: B = .20 p = .006; language: B = .28 p = .001; motor B = .21 p = .004), whereas the neonatal birth risks remained significant only in the motor development model (B = .15, p = .040). Conclusion: We extended previous research by providing evidence that neonatal adverse outcomes explained the majority of variation observed in the infants’ neurodevelopment and that vulnerable environments increase those risks. The results provided evidence for the critical role of follow-up programs for at-risk preterm infants to monitor growth, development, and the repercussion later in the life of the neonatal adverse outcomes. Funding source: CAPES and Bill and Melinda Gates Foundation.

Neurodevelopment Curves of Preterm Infants in a Follow up Brazilian Program

Carolina Panceri; Nadia Cristina Valentini; Rita de Cassia Silveira; Renato Procianoy, Universidade Federal do Rio Grande do Sul

Background: Assessment of the development outcomes in preterm infants is necessary to guide clinical care, provide orientation to parents, and preterm referral infants to compensatory interventions if needed. Objective: To describe the cognitive, language, and motor development of preterm infants during the first 18 months of adjusted age at a follow-up clinic of a hospital in southern Brazil. Methods: A total of 37 infants (gestational age M = 28.86, SD = 2.63; birth weight M = 1072.70 g, SD = 332.41) were assessed with the Bayley Scales of Infant Development III (BSID III) at 4, 8, 12, and 18 months of adjusted age. Composite score and categorization were used. Results: Cognitive composite scores range from approximately 93 to 99 across the 14-month assessment period (BSID III categorization: average); 21 to 25% of these infants showed cognitive delays. Language composite scores increased from 92 to 94 (BSID III categorization: average). However, 30 to 40% of the infants showed language delay in some specific period of development. Motor composite scores showed higher variability, compared to cognitive and language scores, decreases and increases were observed in a short period from 86 to 97 (BSID III categorization: low average to average). However, 32 to 58% of the infants showed motor delays at 4, 8, and 18 months. At 12 months of age, the scores decreased 10 points in the composite scores, and delays were observed in 62% of the infants. Conclusion: So far, a large number of preterm infants are at risk for neurodevelopmental delays and were referred to intervention programs. Neurodevelopment follow-up with a multidisciplinary team is essential to provide adequate care for infants at risk. Funding source: CAPES and Bill and Melinda Gates Foundation.

Cortical and Muscle Activation During Isometric Knee Extensions Following a Bicycle Training Intervention in Children and Adolescents with Autism

Melissa M. Pangelinan, Auburn University; Robyn S. Feiss, Auburn University; Justin R. Moody, Samford University

Previous studies have shown improvements in knee extension/ flexion strength following a 5-day bicycle training intervention (iCanBike) in children and adolescents with Down syndrome and autism spectrum disorder (ASD) (Hauck et al., 2017; MacDonald et al., 2012). However, the mechanisms underlying those strength changes have yet to be elucidated (i.e., do these changes result from differential activation at the cortical, muscular, or both levels). To address this knowledge gap, we conducted a pilot study investigating changes in cortical and muscle activation following a 5-day bicycle training intervention in children and adolescents with autism spectrum disorder (N = 6; 1 female; M age = 12.87; SD = 2.63). fNIRS (fNIRx) was recorded from the right quadriceps and the left premotor/motor cortex during the performance of isometric knee extensions (Biodex System 4) before and after the intervention. All participants were unable to ride a 2-wheel bicycle before the intervention, but all were able to independently ride a 2-wheel bicycle at the end of the intervention. Four of the six participants increased maximum isometric torque from pre- to post-test. Interestingly, idiosyncratic cortical and muscular activation patterns were observed from pre to post-test. For the four participants who exhibited greater maximum isometric torque, three patterns of cortical and muscular activation patterns were observed: an increase in muscular activation (with no difference in cortical activation), an increase in cortical activation (with no difference in muscular activation), and an increase in both cortical and muscular activation. For the two participants who exhibited no change or a decrease in maximum isometric torque, Funding source: CAPES and Bill and Melinda Gates Foundation.
torque, both exhibited decreased cortical and muscular activation from pre to post-test. These results emphasize the need to record both cortical and muscular activation patterns to identify neuromuscular strategies employed by children and adolescents with ASD during goal-directed motor behaviors and how those strategies may change following motor skill interventions.

Qualitative and Quantitative Analysis of Manual Exploratory Behaviors During Early Childhood

Priya Patel; Mei-Hua Lee, Michigan State University

Manual exploration of objects coupled with learning to perceive object physical properties lays the foundation of an important motor skill — “tool use” during infancy. Understanding exploratory behavioral changes as a function of different object properties provide valuable insight into the development of tool use and open up a window to early intervention in case of delayed development. Although this dynamic interplay continues past infancy, exploratory behaviors in relation to different object properties are yet to be studied throughout early childhood. Here, we provide a systematic qualitative and quantitative analysis of such exploratory behaviors as a function of size and object properties (size, texture, and shape) during early childhood. To address this aim, manual exploratory behaviors were observed in typically developing infants (longitudinally: 5–12 months) and toddlers (cross-sectional: 2–5 years) for different objects. Data were collected using video cameras (for qualitative analysis) and wireless sensors that were embedded in all objects (for quantitative analysis). During each lab visit, participants explored 8 objects that varied in size (2” vs. 4”), texture (soft vs. hard), and shape (ball vs. cube). Our preliminary behavioral findings indicate an effect of age on how infants and toddlers changed their exploratory behaviors for different object properties. Participants’ hand preference during approach and exploration of objects was influenced by object size and texture, while their exploratory behaviors were affected by object size and shape. Our sensor data findings indicate that it is feasible to quantitatively characterize commonly observed behaviors of rotation, fingering, and throwing. Together these findings provide a basis for the assessment of manual exploratory behaviors, which may provide insight into atypical exploration in developmental disorders such as autism.

Explaining Age-Related Declines in Cognitive and Motor Function with EEG Power Spectra: A Cross-Sectional Feasibility Study

Anupriya Pathania; Mindie Clark; Rhiannon Cowan; Ellen Williams; Tiphanie Raffegeau; Matt Euler; Kevin Duff; Keith Lohse, University of Utah

Previous studies have suggested the slope of the electroencephalography (EEG) power spectrum may be sensitive to changes in excitation and inhibition across the brain. For instance, when anesthetized (excitation is greatly reduced), the slope is much steeper than during wakeful rest. When engaged in a difficult task, the slope is also steeper, but not as steep as anesthesia (as inhibition is important for performance, but not a constraint during rest). The goal of the current study was to assess the spectral slope as a biomarker for age-related declines in cognitive and motor function. We collected EEG during wakeful rest and during a battery of tasks in cognitively intact younger (age < 35 y; n = 22) and older adults (age > 65 y; n = 22). Participants completed the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) and the Simulated Feeding Task (SiFT). Analyses during rest revealed that older adults showed flatter spectral slopes, p < .001, and less regional differentiation in the spectral slope than young adults, p = .014. Average RBANS scores were lower for older adults in the sample, p = .075, and negatively associated with spectral slopes in the sample, p = .081, but this relationship was attenuated by controlling for age, p' = .401. Time to complete the SiFT task was slower for older adults, p < .001, and slower times were associated with flatter slopes overall, p = .044, but this relationship was also attenuated by controlling for age, p' = .610. Flatter power spectra for older adults are partially consistent with the “neural noise” hypothesis of cortical aging, as it suggests an imbalance of excitation to inhibition in resting neural networks. However, resting neural activity did not explain age-related declines in cognitive or motor performance, after accounting for age. These results suggest that older adults may be engaging in compensatory neural activity during the tasks to overcome these neurophysiological differences. Detailed analyses of on-task activity may provide insights into non-invasive biomarkers for age-related cognitive and motor changes.

Fundamental Motor Skills of Preschool Children Receiving Early Intervention Services: 2012 NYFS

E. Andrew Pitchford, Iowa State University; E. Kipling Webster, Augusta University

Objective: Delays in fundamental motor skill proficiency have been observed in a variety of populations with disabilities. Early identification and intervention through special education services are both critical to minimize these delays. The purpose of this study was to examine differences in fundamental motor skills between preschool children based on the status of receiving early special education services. Methods: This secondary data analysis utilized the 2012 NHANES National Youth Fitness Survey (NYFS). Variables of interest included the Test of Gross Motor Development, 2nd edition (TGMD-2) and parent-reported status of receiving early intervention services. Of note, children with “physical limitations requiring a wheelchair; amputations of the leg, foot, arm, or hand; paralysis of one or both arms or hands; hand/arm/shoulder/leg surgery in last 3 months; or mental impairment” (CDC, 2012), were excluded from TGMD-2 collection and are not reflected in this sample. Group differences were analyzed using independent-samples t-tests. Results: In total, 352 preschool children were selected for analysis (51% male, 49% female; M = 4.11 ± 0.86 years of age) including 36 that were identified as receiving special education services (64% male, 36% female; M = 4.19 ± 0.79 years). Significant group differences in TGMD-2 gross motor quotient (p = .009) and both locomotor (p = .015) and object control (p = .002) subscales were found. Further analysis of specific TGMD-2 skills identified significant group differences in the gallop (p = .037), jump (p = .017), slide (p = .033), dribble (p = .001), and catch (p = .055). Conclusion: Significant deficits in fundamental motor skill proficiency were identified among preschool children receiving special education services. Given the exclusion criteria for completing the TGMD-2, these children are likely receiving special education services for speech/language impairments or global developmental delays. The results suggest that motor development should be a part of an early intervention assessment for all children in the initial evaluation process to identify delays/deficits.

Associations of Fundamental Motor Skills and Physical Fitness in 5-Year Old Children: 2012 NYFS

E. Andrew Pitchford, Iowa State University; E. Kipling Webster, Augusta University

Objective: The Stodden et al. (2008) conceptual model purports associations between physical activity, fundamental motor skills (FMS), physical fitness, perceived motor competence, and obesity among children. However, there is limited literature addressing the relationship between physical fitness and FMS, especially for younger children. Methods: A total of 102 five-year old children (M = 5.08 ± 0.27 years; 50% male) were identified
from the 2012 NHANES National Youth Fitness Survey (NYFS). Each child completed the Test of Gross Motor Development, 2nd edition, two physical fitness measures (i.e., plank and modified pull-ups), height and weight measurements, and parental report of demographics, physical activity, and sedentary behaviors. Associative relationships between physical fitness and FMS proficiency were examined using correlation and linear regression. Results: FMS gross motor quotients were average ($M = 97.82 \pm 14.19$), while physical fitness results were highly variable for both plank ($M = 28.24 \pm 22.90$ seconds) and modified pull-ups ($M = 2.10 \pm 2.74$ reps). Significant correlations were identified between FMS gross motor quotients and both the plank ($r = .41, p < .001$) and pull-ups ($r = .23, p = .011$). The two physical fitness measures were also significantly correlated ($r = .334, p = .001$). Linear regression models explained 21% and 17% of the variance in plank and pull-up scores, respectively. The only significant predictor of the plank was FMS ($\beta = .335, p = .001$), while FMS ($\beta = .254, p = .011$) and race/ethnicity category ($\beta = .216, p = .032$) were significant predictors of pull-ups completed. Conclusion: This secondary data analysis identified multiple significant associations between FMS and two indices of physical fitness. However, there were no significant associations with physical activity or obesity status. Despite being a national sample, this analysis remains limited by a small sample size. Large, multi-site projects addressing FMS are likely needed to better examine these relationships.

**Visual Behavior During an Infant Contingency Learning Study**

Marcelo Rosales, University of Southern California; Isabel Reed, University of Southern California; Jose Carlo Pulido, Universidad Carlos III de Madrid; Nina Bradley, University of Southern California; Maju Mataric, University of Southern California; Beth Smith, University of Southern California

Introduction: Infant contingency learning in the mobile paradigm is defined as an increase in the amount of movement (Rovee-Collier & Gekoski 1979). However, an increase in movement could be driven by multiple variables; hence, current methods may misclassify non-learners as learners. Additional behavioral measures, such as anticipatory gazes directed toward the reinforcement (i.e., predictive gaze), may provide information to better examine contingency learning in young infants. To explore this, we measured the timing of gazes directed at a robot to identify evidence of anticipatory behavior in a contingency learning study. Our hypothesis was that learners would perform predictive gaze. Methods: Twelve infants (6–9 months) participated in a contingency learning task where movement of their right leg resulted in a robot kicking a ball. Head-mounted eye-tracking was used to estimate the position of the infant’s gaze during the task. Trained personnel, performing a frame-by-frame analysis, identified the onset of a predictive gaze each time the infant activated the robot. Predictive gaze was defined as a gaze shift with a visual fixation on the robot 0–400 ms prior to its activation. Lastly, predictive gaze data were plotted in minute blocks and inspected for trends. Results: Five of twelve infants had usable eye tracking data. Four infants were categorized as learners based on leg movement rate. Three of the four learners were able to visually anticipate the majority of the robot’s kicks in a minute period. The remaining infants (1 learner, 1 non-learner) did not demonstrate predictive gaze for the majority of the robot’s kicks. Discussion: Overall, this study shows that the analysis of eye tracking data can provide valuable insight into infant learning. In summary, the majority of learners displayed predictive gaze, supporting our hypothesis. Also, our initial findings suggest previous criteria misclassified one infant as a learner. We will continue to collect data and determine best practices for including predictive gaze in the assessment of infant contingent learning. Funding source: National Science Foundation (CBET-1706964)

**3-2-1 Lift Off: Adaptations in Early Infant Walking When Wearing a Flexible Support Garment**

Jennifer Sansom; Zachary Burkhardt; Brooke Phillion; Andrew Zeider, Central Michigan University

The onset of independent walking is an important developmental milestone. However, understanding how control for this dynamic skill emerges in infants remains challenging, requiring quantitative and qualitative examination. The purpose of this study was to examine how the stability of the developing control system for independent walking was affected by the use of robot 2 garments with differing properties. We tested 8 typically developing infants (4 F, 4 M) at walk onset (WO) and once per month for 2 months in 3 conditions: control (C), wearing a flexible lycra garment (LG), and wearing two bulky diapers (DD). We examined gait parameters, right thigh segment kinematics, and dynamic phase plots. Our results showed that with increased independent walking experience, infants took longer, faster, narrower, more frequent strides with decreasing double limb support, regardless of condition. Minimal differences were found between the C and DD conditions for right thigh segmental positions, velocities, and accelerations at toe off and touchdown across visits. However, when wearing the LG while walking at each visit, infants showed >40% increases in right thigh segmental velocities and accelerations at toe-off compared to the C or DD conditions. A qualitative examination of dynamic phase plots revealed increased consistency of stride trajectories when infants wore the LG. Our results show that movement properties of the right thigh at toe-off were influenced by wear of an LG around the pelvis and thighs, facilitating adaptive use of passive mechanics to progress the leg forward on more consistent trajectories during the first 2 months of independent walking experience. These findings may provide valuable insights for future research investigating the wear of LGs in infants with neuromotor delays learning to walk.

**Developmental Trajectories of Cognitive Function Across a Nine-Month Motor Skill Intervention in Preschoolers From Low SES Backgrounds**

Julia Sassi, Auburn University; Jerraco Johnson, Ohio State University; Alexandra Carroll, Auburn University; Paola Mattiko Martins Okuda, Federal University of Sao Paulo; Hugo Cogo-Moreira, Federal University of Sao Paulo/Freie Universitat Berlin; Danielle Wadsworth, Auburn University; Mary Rudisill, Auburn University; Melissa M. Pangelinan, Auburn University

Exposure to challenging and cognitive-demanding physical activities or motor skill programs, create opportunities to enhance motor and cognitive skills, including executive functions (EF). However, for children at greatest risk for motor and cognitive deficits (i.e., those exposed to poverty), the relationship between motor skills and EF in young children remains unclear. Therefore, this study examined the developmental trajectory of cognitive functions across a nine-month motor skill intervention for preschoolers from a Head Start program ($N = 143$). The intervention consisted of two climates – one in which motor skills were promoted using a mastery motivational framework (intervention group, $n = 84$), and the other in which free play was promoted using an autonomy-supported framework (comparison group, $n = 59$). Cognitive functions were assessed using the Dimensional Change Card Sorting task, Flanker, and Head, Toes, Knees, and Shoulders task at three time points: before (time 1), during (time 2), and after (time 3) the intervention. A latent profile analysis (LPA) was conducted to identify cognitive profiles in our sample, then a latent transitional analysis (LTA) was used to evaluate the probabilities of transition between the classes in the three time points for each group. The model fit indices favored two latent classes solution: Good Cognitive
Function (GCF) and Poor Cognitive Function (PCF) for the total sample. For the intervention group, of those classified as PCF at time 1 (71.4%), 21.7% were classified as GCF at time 2. For those classified as PCF in time 1 and 2, the probability of been classified as GCF was 6.8% in time 3. For the comparison group, of those classified as PCF at time 1 (69.5%), 19.5% were classified as GCF at time 2. For those classified as PCF in time 1 and 2, the probability of been classified as GCF was 76.3% in time 3. Overall, the motor intervention program did not significantly influence changes in the classification of cognitive function in this population. Implications and future directions of this study will be discussed.

Parents’ Perceptions, Support, and Knowledge About Motor Skills and Physical Activity
Katherine Scott-Andrews; Leah Robinson, University of Michigan

Background. The purpose of this study was two-fold. To examine parents’ perceptions, support and knowledge of motor skills and physical activity in their children and gauge interest in a social media motor skill intervention. Methods: Primary caregivers (N = 250; 86% mothers; 65.6% White) of children aged 6–12 years old residing in Michigan completed a questionnaire distributed through the online platform Qualtrics. Results. Chi-square tests for independence were used to compare parents’ perceptions and support. Percentages were used to examine knowledge and interest. Parents demonstrated accurate perceptions with agreement (χ²(1, N = 250) = 23.98, p = .00) between “how physically active would you say your child is?” and “do you think your child needs to be more physically active?”. However, 38% of parents incorrectly classified between these two questions. Parents perceived a link between physical activity and motor skills (χ²(1, N = 250) = 26.96, p = .00) through “do you think your child needs to be more physically active?” and “do you think your child needs improvements in their motor skills?”. Parents support both physical activity and motor skills (χ²(15, N = 250) = 63.98, p = .00), but 82.8% of parents provide their children with physical activity opportunities every day while only 54.5% of children receive motor skill opportunities every day. 88% of parents acknowledged a difference between physical activity and motor skills and 99.6% responded that motor skills support healthy development. 85.6% of parents responded that they are interested in a family-based social media intervention to increase motor skills and physical activity. Discussion. Parents have accurate perceptions, support, and knowledge about motor skills and physical activity in their children and demonstrate high interest in a social media intervention to promote healthy behaviors. Even though insignificant, parents tend to misclassify their child’s physical activity and parents promote physical activity more than motor skills.

Jump Process Partially Mediates Intervention Effects on Jump Distance: A Pilot Study
Katherine Q. Scott-Andrews, University of Michigan; Kara K. Palmer, University of Michigan; Michael A. Nunu, University of Michigan; David F. Stodden, University of South Carolina; Leah E. Robinson, University of Michigan

Background: The purpose of this study was to explore if jump process performance mediates intervention effects of jump distance across a 2155-minute motor skill intervention. Methods: Preschoolers (N = 55, Mage = 4.5, 24 boys, 31 girls) were randomly assigned to either the intervention (n = 36) or control (n = 19) condition. Children’s jump performance was assessed using both process (Test of Gross Motor Development-3) and product (distance in cm) measures before (pre), during (mid), and after (post) the intervention. Linear mixed models were fit to examine the (1) intervention effects on jump process, (2) intervention effects of jump product, and (3) potential mediation of process on product intervention effects. Models were fit with fixed effects of time and treatment, covariates of sex and height, and a random intercept for each individual. All analyses were completed in SPSS v. 26, and alpha levels were set to 0.05 a priori. Results: There was a significant intervention effect for jump process at mid (β = 1.48, p = .01) and a trend toward intervention effects at post (β = 1.25, p = .06) Not controlling for jump process, there were significant differences where the treatment group started with higher product scores compared with the control group (β = 18.40, p = .02), and significant intervention effects, controlling for baseline scores, where children in the intervention had greater jump product at mid (β = 22.86, p = .01) and post (β = 16.44, p = .01). Jump process was a significant predictor of jump product (β = 3.76, p < .001). Controlling for jump process, the treatment group started with higher product scores compared with the control group (β = 15.92, p = .03). Controlling for baseline product and jump process, there were significant intervention effects at mid (β = 17.08, p = .03) and a trend towards intervention effects at post (β = 11.45, p = .06). Discussion: Controlling for baseline scores, there were significant intervention effects for both process and product jump, and the jump process measure partially mediates the intervention effects for jump product. Funding source: This work was supported by the National Institutes of Health under Grant NHLBI-1R01HL132979; the North American Society for the Psychology of Sport and Physical Activity Graduate Student Research Grant; and the Rackham Graduate School Post-Candidacy Research Award.

Effects of Locomotion Task Constraints on Running in Boys with Overweight: The Mediating Role of Developmental Delays
Mohsen Shafizadeh, Sheffield Hallam University; Shahab Parvinpour, Kharazmi University; Marzie Balali, Islamic Azad University; Fatemeh Samimi Pazhuh, Kharazmi University; David Broom, Sheffield Hallam University; Ludvik Valtr, Palacký University Olomouc; Reza Abdollahipour, Palacký University Olomouc

The aims of this study were to examine the effects of a locomotion task constraints intervention on body composition, motor performance, and running efficiency in overweight boys with different levels of motor development. Forty young boys (Mage: 8.21 ± SD: 1.01 years) whose body mass index (BMI) was above the 85th percentile normative ranked score were divided into 4 independent groups according to their development and BMI: intervention-typical, intervention-delay, control-typical, and control-delay. A 6-week task constraints intervention with an emphasis on improving locomotion skills such as fast walking, running, jumping, hopping, skipping, and leaping were carried out in the intervention group. The pre- and post-intervention difference score on the sample dependent variables showed decreases in body mass and BMI and improvements in agility, joint kinematics, and running economy in the intervention-typical group relative to other groups. In conclusion, the findings highlight that the boys with overweight and typical development can benefit more from a short-term developmentally-appropriate intervention to refine the running pattern and agility skill that was accompanied by positive changes in body composition. Funding source: This work was supported by a grant from the Czech Science Foundation, GAČR 18-16130S.

Country and Gender Differences in Object Control Skills Among Children From the USA, Indonesia, and Wales
Blaise Shiebler, The Ohio State University; Ruri Famelia, The Ohio State University; Jacqueline Goodway, The Ohio State University; Amanda John, University of Wales Trinity St David; Nalda Wainwright, University of Wales Trinity St David; Jerraco Johnson, The Ohio State University; Sue Sutherland, The Ohio State University; Yang-Ju Chen, The Ohio State University

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University; Alexandria Commoto, The Ohio State University; Obidiah Atkinson, The Ohio State University

Background: Developing object control (OC) competence, especially in the early years is critical to later physical activity. However, many children demonstrate developmental delays (DD) in OC skills with girls worse than boys, and children from disadvantaged environments are at greater risk of DD. No clear evidence exists on the extent of this problem globally and comparative data are needed. This study examined the influence of gender and country on the OC skills and DD of young children from the USA, Indonesia, and Wales. Methods: Participants (N = 395) included Indonesian (n = 156), American (n = 186), and Welsh (n = 94) children aged 4–5 yrs. All children were tested on the OC subscale of TGMD2 with <25% representing DD. Results: The majority (M = 87%) of children were DD including 97% of Indonesian, 100% of Welsh, and 64% of USA children. A 3 (Country) X 2 (Gender) ANOVA reported significant Gender (p < .001; ES = .03) and Country (p < .001; ES = .29) effects and a Gender X Country interaction (p < .01; ES = .05). Across all countries, boys (M = 12.85%) were significantly better than girls (M = 7.55%) at OC skills. Post-hoc Tukey tests examined differences between countries and found children in the USA (M = 17.57%) were significantly better at OC skills than both children in Wales (p < .001, M = 2.11%) and Indonesia (p < .001, M = 5.66%). However, children in Indonesia were significantly (p < .05) better at OC skills than children in Wales. Evaluation of within country gender differences revealed in both the USA (p < .001) and Indonesia (p < .05) boys were significantly better than girls at OC skills. However, in Wales there were no significant gender differences. This study has implications for physical literacy policy development in these countries. National policy needs to prioritize evidence-based motor skill intervention programs to remediate the DD delays found in this study.

The Impact of Restricted vs. Non-Restricted Location on the Level of Physical Activity and Achievement of Motor Milestones

Alicia Springfield; Alyssa Pimentel; Do Kyeong Lee, California State University Fullerton

Infants achieve motor milestones, such as walking, at varying ages. Our preliminary study found that socioeconomic status may impact infants’ gross motor skills (crawling, cruising, or walking). However, the reasoning behind this correlation has yet to be explained. The purpose of the present study is to investigate the role of physical spaces on early infant movements and the achievement of motor milestones. Our participants consisted of eight infants; five females and three males. All participants currently reside in California (USA) either in Los Angeles County or Orange County. Observations began at or just before 3 months of age (M = 60.44 days), through monthly home visits. As a naturalistic observation study, the researcher records the infants’ spontaneous movement for 20–30 minutes without intervening with their activities. All infants were observed as they achieved walking skills (10ft without falling and stopping). In our presented study, infants’ play was analyzed at 3, 6, 9, and 12 months. First, the duration and frequency that infants spent in restrictive locations versus open ones were observed. Restrictive locations may include being held by a caregiver or in a bouncing chair. As compared to nonrestrictive locations such as playing on the floor, or in an open space. Through frame-by-frame video coding, frequency and duration of infants’ posture (prone, supine, sitting, and standing) with and without support was measured. Additionally, the infants’ movements (kicking, waving, rolling, and walking) were observed. The previous data showed infants achieve motor skills as they spend more time in nonrestrictive locations. Further implications can be drawn about the impact of open and restrictive locations on the achievement of gross motor skills. The amount of time infants spend in each location may dictate their posture, or ability to be physically active and as a result, affect their achievement of motor milestones. Through these observations parents/caregivers are then able to create precedents to develop pediatric interventions for healthy motor development.

The Influence of Gross Motor Competence and Physical Activity on Rate of Weight Gain From 6 to 12 Months

Kerri Staples; Carissa Wengrovius; Mark Ricciardi; Dale Ulrich, University of Michigan

With rapid weight gain being a strong predictor of infant obesity, understanding factors that influence trajectories of weight gain is becoming a much-needed research focus. The results of our earlier research suggest that at 3 months of age, levels of gross motor (GM) competence and physical activity (PA) at the wrist independently predicted 18% and 4% of the rate of weight gain from birth to 6 months. The purpose of this study is to extend these findings to determine if GM competence and PA at 6 months influence the rate of weight gain from 6 to 12 months. The sample included 25 infants (13 boys, 12 girls) born at full term; 18 Caucasian, 3 Asian, 2 Hispanic, 1 African American, and 1 of mixed race. At the 6-month assessments, the age of the infants was 6.50 +/- .31 months. GM competence and PA were assessed using the Bayley Scales of Infant and Toddler Development – 3rd ed. and ActiGraph GT3X-BT accelerometers. PA was measured over 3 days and the average activity counts per minute at the wrist and ankle were calculated following. Rate of weight gain was calculated by entering each infant’s weight for length percentiles at 6, 9, and 12 months into a linear regression. Based on GM competence and PA at 6 months, linear regressions were used to predict the rate of weight gain from 6 to 12 months. Non-significant regression equations were found for GM competence (F(1,23) = .134, p = .718) and PA at the wrist (F(1,23) = 3.551, p = .073) with R² of .006 and .145, respectively. PA at the ankle significantly predicted rate of weight gain (F(1,23) = 7.879, p = .011) with an R² of .273. The results of this study suggest that at 6 months of age, levels of PA at the wrist and ankle independently predict approximately 15% and 27% of the rate of weight gain from 6 to 12 months of age. As infants become more independently mobile, PA becomes an important consideration for controlling how quickly they gain weight. These results provide a foundation to examine factors that, along with feeding practices, influence the rate of weight gain across the first year of life.

Understanding Health Disparities Among 3- to 9-Year-Old Children with Autism Spectrum Disorder

Kerri Staples, University of Michigan; Leah Ketcheson, Wayne State University; Andrew Parks, Louisiana Tech University

Children with autism spectrum disorder (ASD) experience a greater number of health disparities compared to neurotypical children of the same age, including higher rates of obesity and lower levels of PA. Although there is mounting evidence that suggests these health disparities begin early in development and continue throughout childhood and adolescence, children with ASD remain an overlooked and underserved population when it comes to examining health as a primary outcome. The Stoddlen Model of Development highlights the components of health that are integral to being physically active. It demonstrates how the relationships between levels of PA and motor skill competency (MC) change with age, development, and level of physical fitness to influence the risk of obesity. The purpose of this research was to examine the relationships among components of health in early and middle childhood between children with and without ASD. 51 children with ASD (39 boys, 12 girls) and 52 neurotypical children (41 boys, 11 girls) were divided evenly into two age groups, 3 to 5 years and 6 to 9 years. Measures of body composition, PA, MC, and physical fitness were measured using BMI.
percentiles, GT3X+ accelerometers, the TGMD-3, and 4 items from the Brockport Physical Fitness Test. Across early and middle childhood, children with ASD had significantly \( (p < .05) \) higher BMI percentiles. Children with ASD had significantly \( (p < .05) \) lower levels of competency performing ball skills and all measures of fitness. Similar levels of PA were demonstrated across all groups and PA was not related to other components of health. Stronger relationships among measures of MC and physical fitness were found for children with ASD for both age groups. Although motor skills have been recognized as 1 of 8 primary areas that should be targeted in intervention, the primary focus of early intervention has remained almost exclusively on improving social communication skills. The findings of this study underscore the need for longitudinal and intervention research aimed at improving health outcomes among children with ASD. Funding source: Organization for Autism Research; W.K. Kellogg Foundation.

Starting the Physical Literacy Journey: Strategies to Cultivate Chinese Preschoolers’ Physical Literacy

Xiaojuan Tao, East China Normal University; Jacqueline Goodway, The Ohio State University; Xiaozan Wang, East China Normal University

Physical literacy (PL) is critical in promoting lifelong physical activity and maintaining a healthy lifestyle. Yet, PL is a new concept and largely neglected in China. The aims of this study were to explore Chinese preschoolers’ PL and provide guidelines for the development of a model for cultivating PL for preschool children from China. First, we conducted a literature review of interdisciplinary studies of PL. We found several gaps regarding PL development in early childhood with little to no evidence from China. The review of the literature revealed no system for cultivating PL in early childhood in China. Next, we proposed a theoretically sound and integrated system for promoting PL for all stages of development, starting with preschoolers (Chinese Early Years Physical Literacy Framework). The overall goal of the framework is to implement a systematic program of developmentally appropriate activities and creative games to promote fundamental motor skills, movement concepts, dance and gymnastics to increase PL in Chinese preschoolers and to integrate these activities into the preschool system of education. A second goal was to create a method for systematic evaluation of PL. The overall PL framework would help to increase children’s interests in sports, foster fundamental motor skills, enhance enjoyment of physical activity, and increase self-confidence. Professional P.E. teachers would provide guidance for implementing high-quality games and activities to enhance preschool PL. Together with schools and parents, children would participate in these physical activities throughout the school day and at home to help develop early years PL. This system would be evaluated using the Chinese Childhood Physical Literacy report, which could be submitted to the government and released to the public. Overall, the proposed system and evaluation can greatly enhance young Chinese children’s PL. This system would be connected with six other PL systems to promote PL across all grade levels and adulthood to enhance PL across different developmental stages. Thus, the proposed PL system and evaluation may lead to healthier lifestyles through the cultivation of PL in China. Funding source: Chinese Scholarship Council

Are There Reciprocal Relations Between Motor Competence, Physical Fitness and Executive Functions in Primary School-Aged Children?

Edda van Meurs; Till Utesch; Dennis Dreiskämper, University of Muenster

In 1964, Piaget proposed a reciprocal development of motor and cognitive functions throughout childhood. He stated that the maturation of executive functions (EF) enables more advanced motor skills, which allow for new cognitive stimulation (see also Thelen & Smith, 1998). Cross-sectional interrelations were found for various ages and constructs (van der Fels et al., 2015); however, longitudinal and especially reciprocal research are rare (Oberer, Gashaj, & Roebers, 2018; Roebers et al., 2014). Moreover, the constructs physical fitness (PF) and motor competence (MC) have not been considered separately with regard to EF. This study examines potential reciprocal effects between EF and PF as well as between EF and MC in primary-school children over three years. A longitudinal cohort study took place in 2017 (t1), 2018, 2019 and is scheduled for March 2020 (t4). Data from two cohorts (three assessments) will provide sufficient power to study reciprocal relations. Children complete two motor tests: the FitnessGram (PACER, broad jump, 20m sprint; 2016) assesses PF while the TGMD-3 (Ulrich, 2018) assesses MC (locomotion, object control). EF is measured by inhibition (Flanker Task) and working memory (N-Back Test). After the first two years, \( N = 198 \) children \( (M = 8.08 \text{ years}, SD = 1; 50\% \text{ male}, 50\% \text{ female}) \) had taken part. Cross-lagged panel models (CFI > .95, IFI scaled > .95, SRMR < .05) interlinking the first two years revealed stability for the PACER \( (\beta = .55) \), broad jump \( (\beta = .75) \), sprint \( (\beta = .58) \), locomotion \( (\beta = .50) \), and object control \( (\beta = .62, \text{ all } p < .001) \). EF showed moderate stability \( (\beta = .31, p < .01) \), working memory \( (\beta = .31, p < .001) \). Cross-lagged relations were found for locomotion \( (\beta = .20) \) and object control \( (\beta = .21) \) predicting working memory while inhibition predicted object control \( (\beta = -.17, \text{ all } ps < .05) \). Results support that PF and MC are more stable than EF. The present findings pinpoint the necessity to distinguish between MC and PF with regard to cognitive development during childhood. Analyses of the reciprocal effects will be presented in June.

Like Mother, Like Child? The Relationship Between Maternal Sport Participation and Attitudes Towards Exercise and Child Motor Behaviors

Lianne van Setten; Marleen H. M. de Moor; Mirjam Oosterman; Carlo Schuengel; Geert J. P. Savelbergh; Annik Ledebt, Vrije Universiteit Amsterdam

Parental modeling has been put forward as one of the mechanisms that might enhance child physical activity (Yao and Rhodes, 2015). Studies on parental modeling usually focus on parents’ own physical activity, yet little research additionally focused on parental attitudes towards sports and physical activity, in relation to child physical activity or motor development. The aim of our study was to clarify to what extent physical activity behaviors and attitudes of mothers are related to child motor competence, sport participation and physical fitness. Our sample consisted of 177 mother-child dyads who participated in a Dutch longitudinal study on parenting and child development and visited the university sports center when children were 6–7 years old. Mothers reported on their own and child’s sport participation and their attitudes towards exercise (perceived health benefits and barriers); children participated in the Körperkoordinationstest für Kinder (KTK) measuring motor coordination, and in the Shuttle Run Test (SRT) measuring physical fitness. Maternal sport participation was positively related with perceived benefits to exercise, \( r = .31, p < .001 \), and negatively related with perceived barriers, \( r = -.40, p < .001 \). Perceived benefits and barriers to exercise were negatively related, \( r = -.39, p < .001 \). Controlling for child age, maternal health benefits, and sport participation, more perceived barriers predicted lower levels of child motor coordination, \( t = -2.21, p = .029 \). Other aspects of maternal and child motor behavior were not significantly related. Parental attitudes towards their own exercise behavior seem to be more important for child motor competence than the actual parental sport participation. Children of parents who experience more barriers to participate in exercise, have lower levels of motor coordination. Future research concerning parental behaviors and
Learning From High-Performance Coaches’ Opinions and Practice Regarding Perceptual-Cognitive Skills to Facilitate Research and Knowledge Exchange

Joe Vecchione, University of British Columbia; Joe Baker, York University; Nicola J. Hodges, University of British Columbia

An online survey was developed and sent to high-performance coaches in Canada across a range of sports, with the aim of identifying knowledge and application gaps (between researchers and coaches) that exist in perceptual-cognitive (PC) skills’ assessment and training. There is little to no direct knowledge of current practice among high-performance coaches with respect to the language and definitions of PC skills, as well as their judged importance and impact in assessment and training. The survey consisted of multiple-choice, ranked-choice and open-ended questions. Seventeen coaches, all with significant experience at the high-performance level completed the survey. These coaches represented a variety of different sports, so in addition to some global analysis, we compared coaches based on whether the sport was team-based (n = 9, e.g., field hockey) or individual (n = 8, e.g., athletics). When defining PC skills, nearly all (89%) team-based coaches referenced both decision-making and visual skills compared to less than half (38%) the individual sport coaches. No reference was made to any of our predetermined PC skills (decision-making, vision, anticipation) by three of the individual sport coaches. PC skills were defined as “read and react” skills among 44% of team-based coaches only. Nearly all the coaches defined PC skills as critical to sport success, although less than 10% of training time within a practice session was spent on PC skills (up to 30% in a week). Decision making was ranked as the most important PC skill, regardless of sport-type. Coaches relied mostly on personal experience to acquire their knowledge. When combining the three subcategories of PC skills, team-based coaches ranked them as “very important” ($M = 3.63$; 0–4 scale) compared to individual sport coaches who ranked them as “important” ($M = 2.25$). Although these data are based on a small sample, with increased participants, we hope to learn more about current methods for assessing and training PC skills and identify knowledge gaps to inform research and effective knowledge exchange. Funding source: The authors would like to acknowledge initial funding from this project from “Own-The-Podium”, Canada (NJH and JB) as well as from an NSERC Discovery grant awarded to NJH.

Comparison of Lab-Based and Field-Based Measurements of Overhand Throwing Product Scores

E. Kipling Webster, Augusta University; Michael J. MacLellan, University of Prince Edward Island; Alex C. Garn, Louisiana State University

Background: Fundamental motor skills (FMS) are a critical aspect of early childhood health and development. Therefore, accurate measurement of FMS is essential to understanding their role in health. Currently, there is limited evidence comparing commonly used FMS field-based methods with laboratory-based techniques. The purpose of this research is to compare peak ball velocities acquired using a research-grade motion capture system with a handheld radar gun during the performance of an overhand throwing task from three distances. Methods: One individual participated in 15 overhand throwing trials. Ball speed was measured simultaneously using an 8-camera Vicon 512 motion capture system and a handheld radar gun held in three positions (in front of the thrower, 6 feet behind the thrower, and 12 feet behind the thrower). The baseball was covered with a layer of retroreflective tape to facilitate detection by the Vicon system and recorded at 250 Hz. Ball velocity was determined by numerically differentiating the ball’s three-dimensional position data at each frame of the trajectory. From these data, the peak instantaneous velocity was used for comparison with the radar data. Paired sample t-tests evaluated differences between the two recording methods. Results: Peak ball velocities acquired using the motion capture system were determined to be significantly greater than those measured using the handheld radar gun in each of the overhand throwing distances. Specifically, in front of the thrower ($t = 3.067$, $p = .003$), 6 feet behind the thrower ($t = 8.659$, $p = .001$), and 12 feet behind the thrower ($t = 37.048$, $p < .001$). Conclusion: Based on these findings, caution should be used when utilizing field-based measurements for overhand throwing product scores. Advanced methodologies such as motion capture enhance FMS measurement accuracy and, in turn, can clarify relations with key outcomes such as health.

High Levels of Moderate-to-Vigorous Physical Activity Reduce Sleep Problems in Children and Adolescents with Autism Spectrum Disorder

Carley S. Wilson; Melissa M. Pangelinan, Auburn University

Daytime physical activity and regular exercise has been associated with improved sleep efficiency (Kredlow et al., 2015). Children and adolescents with autism spectrum disorder (ASD) are less physically active than typically-developing peers. In addition, sleep problems have been reported in 40–80% of children and adolescents with ASD and may exacerbate core behavioral symptoms in this population (Richdale & Schreck, 2009). Yet, only a few studies have examined the relationship between physical activity and sleep efficiency in individuals with ASD (children or adults). To address this knowledge gap, accelerometry data (Actigraph GT3X) were acquired from 15 children and adolescents with ASD (12 males/3 females, mean age: 9.72, SD: 2.52) and 15 matched controls (12 males/3 females, mean age: 9.42, SD: 2.04) during participation in a 3-week summer program (9am–3pm) aimed at increasing motor skills and physical activity. Daytime moderate-to-vigorous physical activity (MVPA) and sleep efficiency were examined over a minimum of 3 days per week for each of the 3 weeks of the summer camp program. During the summer camp (9am–3pm), all participants achieved between 55–120 minutes of MVPA. In the afternoons/evenings following the summer camp (4–10pm), participants achieved an additional 20–115 minutes of MVPA. There were no significant group differences in the total amount of daytime MVPA achieved and there were no significant differences across the three weeks for either group. Interestingly, there were also no significant group differences in sleep efficiency or differences across the three weeks for either group. These data suggest that achieving high levels of MVPA (at least the recommended daily amount of MVPA) may have an immediate and consistent effect on sleep efficiency in children and adolescents with and without ASD. Future studies are needed to determine if a similar physical activity intervention would improve sleep, behavioral outcomes, and need for sleep medications in children and adolescents with ASD receiving treatment for sleep problems/disorders.

Association Between Advanced Movement Skills, Fundamental Motor Skills, and BMI in 9- to 12-Year-Old Children

Sz-Yan Wu; Jody Jensen, University of Texas at Austin

Background and Purpose: Proficiency in Fundamental Motor Skills (FMS) has been positively associated with physical activity, health-related fitness, academic performance, and negatively associated with BMI. Our hypothesis, however, is that tests of FMS lack sensitivity, leading to
overestimating competency in performing complex inter-segmental coordination tasks (Advanced Movement Skills, AMS) and inadequate predictions of health indices. The purpose of this study is to examine the specific relationship between competency in AMS and BMI as a better health status indicator for children, in contrast with proficiency in FMS. Methods: A total of 86 participants (44 girls and 42 boys) aged 9–12 years (10.75 ±/− 1.04) performed three single-leg movement tests for assessing competency in AMS: single-leg hop for distance, single-leg hop – stick series, and figure-eight hops for time. In addition, hopping distance/time was scaled and weighted by movement quality. Two sub-domains, Balance and Running speed and agility, of the Bruininks–Oseretsky Test of Motor Proficiency-2nd Ed. (BOT-2) were chosen to represent proficiency in FMS. Each individual’s BMI was transformed by using shifted logarithm due to violations of normality and homoscedasticity. Density plots and skewness of scoring distributions between BOT-2 and AMS were inspected to compare test sensitivity. Incremental predictability of BMI was also examined by applying linear regression models and calculating Cohen’s r². Results: Comparing the left-skewed (0.37) scoring distribution for BOT-2, total AMS scores distributed more symmetrically (0.08). The overall model explained 25.7 % of the variance in BMI (p < .001). Significant main effect of total AMS scores (p = .004) were identified when age (p < .001) and gender (p = .59) were controlled. Moreover, adding total BOT-2 scores into the model could not improve the predictability of BMI (Cohen’s r² < .001). Conclusion: We determined that tests of AMS have better test sensitivity and predictability of BMI for 9- to 12-year-old children compared to tests of FMS.

Early Motor Signs of Autism Spectrum Disorders: A Systematic Review

Meiqi Zhang; John Liu, Springfield College

Background: Autism spectrum disorder (ASD) is a common neurodevelopmental disability that can cause significant social, communication, and economic challenges. In the U.S, the total annual societal cost of caring for and treating an entire birth cohort of ASD patients was estimated to be $335 billion. Considering children in the early childhood stage have more neural plasticity, early recognition and diagnosis are crucial to prevention and treatment for children with ASD. However, it is hard to differentiate between growth retardation and ASD just by social communication performance. Therefore, early motor signs should be used as a better indicator of early ASD screening. The purpose of this study was to shed light on early motor signs in ASD by systematically evaluating and reviewing current publications that examined motor behavior in infants and toddlers who had subclinical ASD symptoms or were diagnosed with ASD. Methods: Researchers of this study searched electronic databases with language restricted to English and Chinese. Studies related to ASD children’s motor development were screened and reviewed. Results: A total of 31 studies were included. The results of the systematic review showed that motor signs could help to identify children with higher ASD risk in early childhood. Relatively delayed motor milestones were prevalent and pervasive in children with a high risk of ASD; atypical motor development (e.g., excessively repetitive movements) was another early sign of children with a high risk of ASD. Also, it is worth noting that the signs were relatively limited and subtle within the first year of life, atypical motor performance was more pronounced since the second year of life. Conclusions: Motor sign was plausible for recognizing ASD risk in early childhood. Advances in ergonomics, biomechanics, and neuroscience provided more opportunities for early recognition of ASD. More attention is needed in future research on exploring the underlying mechanisms of early motor signs of ASD and developing technologies of motor diagnosis for ASD screening.

Motor Learning and Control

The Effects of Attentional Focus on Children’s Motor Skill Learning Depends on Their Motor Imagery Ability

Reza Abdollahiopour, Palacky University Olomouc; Moslem Bahmani, Kharazmi University; Mehdi Babak, Kharazmi University; William M. Land, University of Texas at San Antonio; Jeffery T. Howard, University of Texas at San Antonio; Jed A. Diekfuss, Cincinnati Children’s Hospital Medical Center

Emergent evidence indicates an external focus enhances motor learning for visual-imagery dominant learners, whereas an internal focus improves motor learning for kinesthetic-imagery dominant individuals. However, these studies have been conducted in adults and may not generalize to children in early stages of motor development. The purpose of this study was to determine the influence of motor imagery ability for motor learning of a ball-throwing task when children adopted an internal or external focus. One hundred and thirty-eight boys (Mage = 10.13, SD = 0.65) completed the Movement Imagery Questionnaire – Children (MIQ-C) to determine imagery modality dominance (kinesthetic, internal-visual, or external-visual). Participants were randomly assigned to either an internal (n = 71) or external (n = 67) attentional focus group. Participants completed 60 trials of an overhead tennis-ball throwing task using their non-dominant arm. Children in the internal focus group were asked “to focus on the throwing arm,” whereas children in the external focus group were instructed “to focus on the ball” as they threw towards a target. A retention test without instructions was conducted 24 hours later to assess motor learning. Results of a hierarchical multiple-regression analysis indicated that adopting an external focus of attention was associated with greater motor learning in children with high external-visual imagery ability (p = .002), whereas an internal focus of attention was associated with higher levels of motor learning in children with high internal-visual imagery ability (p < .001). Higher levels of kinesthetic motor imagery were not associated with greater motor learning for any attentional focus group (p > .05). These findings indicate that the degree to which internal or external focus influences children’s motor learning is dependent upon their motor imagery ability. The current findings shed light on the discrepancies in previous studies examining the effect of focus of attention on children’s motor learning and warrant the assessment of motor imagery in future research. Funding source: This work was supported by a grant from Czech Science Foundation, GAČR 18-16130S.

Preliminary Validation of the Dot Task for Measuring Cognitive and Physical Functioning

John F. Adamek, University of Illinois at Urbana-Champaign; Daniel Palac, University of Illinois at Urbana-Champaign; Arthur F. Kramer, Northeastern University; Edward McAuley, University of Illinois at Urbana-Champaign; Sean P. Mullen, University of Illinois at Urbana-Champaign

Mobility assessments are valued for their robust associations with physical activity behavior and health outcomes. However, such assessments often fail to capture dynamic and asymmetric movements required in recreational and leisure-time activities and fall prevention. Dynamic motor tasks vary in difficulty according to the degree of cognitive engagement and agility skills required, and greater measurement variability and precision may enhance utility. The purpose of this study was to evaluate the reliability and validity of a novel “Dot Task” (DT; a timed mobility task involving pre-defined stepping patterns on a 5-dot floor mat) in middle-aged adults (N = 119; Mage = 53.87, 14 of 133 removed due to reported pain/ injury) across a 5-month exercise trial. Test-retest intraclass correlation coefficient (ICC) and bivariate correlations were tested.
with other established measures. DT and a battery of cognitive tests (Digit Symbol Substitution Task [DSST], Trail Making Test [T-A,B]) and mobility assessments (Four Square Step Test [FSST], Timed Up & Go [TUGO], and 30s One-Leg Balance [OLB]) were repeatedly administered. Baseline to 5-month ICC was .73 for DT (baseline M = 3.21 ± .74s). Low correlations (p < .05) between the DT and DSST (r = -.37) and T-A, B (r = -.36, .23) were found. A moderately high correlation was found between DT and FSST (r = .73) and low to moderate correlations were found with OLB (r = -.34) and TUGO (r = .47), respectively. Additionally, DT showed no and low correlations with age (r = .18) and body fat % (r = .23). As expected, DT correlations were higher than FSST for cognitive tasks. The opposite was found for mobility tasks. In brief, shorter task times were associated with more favorable outcomes, and the pattern of correlations reflected stronger associations with tasks involving similar cognitive-motor skills. Our preliminary evidence supports the reliability and construct validity of a brief tool for assessing mobility. Future studies should explore the degree to which DT performance is sensitive to motor learning and control in other populations. Funding source: National Heart Lung and Blood Institute.

Bilateral Transfer Asymmetry of a Visuomotor Skill Learning in a Workspace Requiring Midline Crossing for Left-Handed Participants
Reuben Newton Addison; Arend W. Van Gemmert, Louisiana State University

Introduction: Bilateral transfer occurs when a learned behavior transfers from one group of effectors(s) to another. The strength of transfer of movement parameters differs from one hand to the other (i.e., asymmetry of transfer). Based on the dynamic dominance model, the asymmetry depends on the information each arm controller can access. For instance, the dominant hand accesses directional information while the non-dominant hand accesses information about final movement position. Purpose: The purpose of this study was to explore how workspace use requiring midline crossing of the body affects bilateral transfer asymmetry of a visuomotor task for left-handed individuals. Methods: Twenty-four left-handed young adults were recruited and randomly assigned to one of four groups. Two groups trained with the right hand while the other two with the left hand. Of each of these two groups, one subgroup trained and performed the task during retention with the same hand (ipsilateral groups) whereas the other-with different hands (bilateral groups). All participants trained the visual aiming task in a workspace outside their shoulder opposite to the hand holding the stylus. Performance (Movement time, Normalized jerk, Path length (PL) and Endpoint error (EE)) before and after training was hand holding the stylus. Performance (Movement time, Normalized jerk, Path length (PL) and Endpoint error (EE)) before and after training was hand holding the stylus. Performance (Movement time, Normalized jerk, Path length (PL) and Endpoint error (EE)) before and after training was hand holding the stylus. Performance (Movement time, Normalized jerk, Path length (PL) and Endpoint error (EE)) before and after training was hand holding the stylus. 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Performance (Movement time, Normalized jerk, Path length (PL) and Endpoint error (EE)) before and after training was hand holding the stylus. The results were compared with those of previous studies. The aim of the present study was to assess whether bilateral transfer asymmetry was consistent across different tasks. Results: Bilateral transfer asymmetry was found for PL (diff = -0.744, p = .047), whereas for the right hand, transfer occurred for EE (diff = -0.946, p = .000). All groups showed retention from pre-to post-test for all variables. Conclusion: A pattern of asymmetry of bilateral transfer for the studied workspace was observed, but our findings with left-hand dominant individuals seemed to contrast with expectations derived from the dynamic dominance model.

Effects of External and Internal Attentional Focus on Fractionated Reaction Time on the Lower Extremity
Mohammed Aljahni, Jazan University; Lia Qin, Wayne State University

A renewed interest in fractionated reaction time has resulted in understanding that RT is affected by both central processing and peripheral activation. Our previous experiment showed external focus (EF) of attention decreased reaction time, specifically for premotor time (PMT), indexing the central process compared to internal focus (IF). However, it is unknown whether attentional focus affects peripheral motor time (MT). The aim of the present study was to further investigate how attentional focus affects fractionated RT on the lower extremity using within-subjects design. Participants were 12 male college volunteers who signed an informed consent prior to study. Each participant was seated on a chair and asked to place the front of the right foot on a pedal. The task was to depress the pedal by the plantar flexion of the right foot as quickly as possible after the presentation of a visual stimulus on screen. Participants were directed to focus on the pedal during the EF condition and on the plantar flexion for the IF condition. All the participants completed this simple RT task for 4 blocks (8 trials each) of each attentional condition with counter-balanced order. RT was provided as feedback for each trial. The electrodes were placed on the lateral gastrocnemius and tibialis anterior of the right lower extremity. A customized data acquisition system, integrating Biopac’s EMG, E-Prime, and serial response box with foot pedal, was used to acquire fractionated RT. A 2 x 4 ANOVA with repeated measures on both factors revealed a main effect of attentional focus for RT [F(1, 21) = 27.47, p < .01], PMT [F(1, 11) = 23.57, p < .01], and MT [F(1, 11) = 7.06, p < .05] on the gastrocnemius. Tukey’s HSD tests demonstrated external focus produced shorter latencies for all the components of RT relative to internal focus. These results were replicated on the tibialis anterior. The present findings indicated that external focus might facilitate the central information processing by decreasing premotor time and internal focus might delay muscle activation by increasing motor time.

Error Estimation During Practice May Hinder Motor Learning: Evidence From a Self-Controlled Feedback Paradigm
Mariane Baceler, Auburn University; Juliana Parma, Auburn University; Mark McClure, Auburn University; Brandon Barnes, Auburn University; Jack Holley, Auburn University; Daniel Cabral, Auburn University; Marcos Dao, Coastal Carolina University; Keith Lohse, University of Utah; Matthew Miller, Auburn University

Engagement in error estimation is suggested as one of the possible explanations behind the self-controlled feedback learning effect, yet error estimation has rarely been manipulated in self-controlled feedback paradigms. The present study aimed to address this shortcoming by cross-fading self-controlled feedback with error estimation in the same experimental design. Participants (N = 90) performed a beanbag toss with their non-dominant arm under one of four conditions wherein feedback schedule was either controlled by the participant (self-control) or matched to a counterpart (yoked) and error estimation was either mandatory (error estimation) or not enforced (traditional). After pre-test, participants were quasi-randomly assigned (based on sex) to their condition and performed ten blocks of ten trials of the beanbag tossing task in the acquisition phase. Self-control groups could choose when to receive feedback, whereas yoked groups received feedback on a matched schedule, but without choice. Additionally, participants in the error estimation groups were asked to estimate their performance after each trial, whereas engagement in error estimation was not enforced in the traditional groups. To assess learning, participants returned approximately 24 hr after Day 1 to complete a retention and a transfer test of the same/similar beanbag task. Radial error was indexed as a measure of tossing accuracy. Results showed that participants significantly improved from pre-test to post-test, across groups. There were no main effects nor interactions involving self-control (ps ≥ .05), but there was a main effect of error estimation (p = .037), such that error estimation led to worse learning. Thus, results are consistent with a recent bias-corrected meta-analysis that questions the effectiveness of self-controlled practice on
motor skill learning, and suggest having learners estimate their errors during practice may hinder learning rather than help it.

Stabilization Control of Single Leg Standing Balance on Inclined and Declined Sloped Surfaces

Jacey Baldridge; Adam King, Texas Christian University

Single leg standing is an inherently unstable task with evidence of interlimb discrepancies in regard to the contributing roles of each leg in the stabilization of upright posture. Examination of the dynamic structure of the center of pressure (COP) trajectory may distinguish control differences between the right and left legs. Therefore, the purpose of this study was to investigate how single leg standing on sloped surfaces influences the amount and structure of the COP trajectory. Sixteen participants (11 females, 5 males) completed a total of 14 randomized 30-second posturography tests. A rigid angled platform was used to induce changes in proprioceptive and haptic sensory information during upright stance with participants standing on one foot at a time in flat (0°), inclined (10°, 15°, 20°), and declined (-10°, -15°, -20°) conditions. Both linear and non-linear analyses were used to examine the anterior-posterior COP displacement. An analysis of variance (ANOVA) showed a significant main effect for condition $F(6, 209) = 3.34, p = 0.004$, for COP velocity in that as slope deviated from the flat condition, the amount of sway increased. Additionally, a significant main effect was found for condition $F(6, 209) = 5.41, p = 0.000$, for detrended fluctuation analysis. Results showed that declined conditions produced more COP complexity, which was significantly different than the more regular COP trajectory during the flat and inclined conditions. No main effect for foot or interaction effects were found. Therefore, the results indicate that stabilization control between limbs was symmetrical, yet distinct control strategies appeared across the sloped conditions.

The Effects of Attentional Focus Instructions During Mental Practice in a Reciprocal Tapping Task

Amanda Barclift; Masa Yamada; Louisa Raisbeck, University of North Carolina at Greensboro

Attentional focus research has shown that an external focus (EF) is better than an internal focus (IF) for performance and learning (Wulf, 2013). These findings are specific to physical performance with limited research on mental practice (MP). Therefore, this study examined attentional focus and MP. Healthy younger adults were randomly assigned to an EF condition ($n = 15, 21.87+/-2.00$) or an IF condition ($n = 15, 22.60 +/-3.14$). All participants completed 3 baseline trials moving a cube between two targets at a pace of 667.7ms. During acquisition, participants completed 3 days of 3 x 10 trials of MP. The EF condition was told to mentally practice moving the cube focusing on the weight, speed and position for accuracy. The IF condition was told to mentally practice the cube focusing on the weight, speed and position for accuracy. Participants returned for a 4th day to complete a retention test of 3 physical trials with no attentional focus cues. Compliance checks were provided at the end of each MP session. To examine the effects of MP, accuracy (mean radial error) and consistency (bivariate variable error) were measured with a 2 (Group) x 2 (Time) ANOVA with repeated measure on the 2nd factor. Alpha was set at .05. Results showed a significant difference in the left target accuracy in time $F(1,28) = 1.92, p > .18$, partial eta squared = .06. Significant differences were not observed for in group or interaction, $p > .05$. No differences exist for time, group, and interaction on the right target and consistency on both targets. Results showed that MP was effective for learning, however, differences between EF and IF were not observed. Therefore, physical trials combined with MP may be essential to see the benefits of external focus cues on MP.

Anticipatory Neuromotor Control in Catching Under Load Uncertainty (LU)

William Berg; Michael Hughes, Miami University

Humans use anticipatory muscle activation when catching under conditions of load uncertainty (LU). Questions addressed were: a) on what information referent do catchers base their anticipatory behavior when catching balls of unknown weight, and b) how do catchers use that referent? Thirty-six participants caught visually identical balls dropped from 0.75m. Participants performed 40 trials, half with knowledge of ball weight and half without. Group L caught balls with a large weight range, and group S caught balls with a smaller range. EMG integrals were computed for the ball drop period in 5 muscles. Anticipatory EMG integrals in the unknown weight condition were normalized to EMG integrals for the maximum, minimum, and average possible ball weights in the known ball weight condition. We assumed participants would base anticipatory control in the unknown weight condition on similar information, regardless of group. Differences in normalized EMG integrals between groups would suggest that the specific referent tested (e.g., minimum possible ball weight) was not used to scale anticipatory muscle activation under LU. Two sample t-tests ascertained differences in EMG integrals between groups. Anticipatory EMG integrals under LU normalized to anticipatory EMG integrals for the maximum ball weight under load knowledge did not differ between groups for any muscle. Anticipatory EMG integrals under LU normalized to anticipatory EMG integrals for the minimum ball weight under load knowledge differed between groups for all muscles except the triceps. Anticipatory EMG integrals under LU normalized to anticipatory EMG integrals for the average ball weight under load knowledge differed between groups for wrist flexors only (extensors, $p = .054$; deltoid, $p = .114$; all-muscle average, $p = .057$). The information referent participants used to catch balls of an unknown weight was knowledge of the maximum ball weight. Participants used this referent to generate anticipatory muscle activation between of 92% & 95% of that used to catch the heaviest ball when weight was known in advance.

Time-Scale of Consolidation for Motor and Spatial Representations of a Bimanual Action

John J. Buchanan, Texas A&M University; Inchon Park, Korea Institute of Sports Science; Austin T. McCulloch, Texas A&M University

Motor skills are encoded in both motor and spatial representations. Consolidation as a process operates on multiple time-scales. Short time scales are defined as a single practice session (encoding) with a retest (consolidation) occurring over a wake interval that can be from 5 mins to 12 hrs. This study examined the extent of consolidation that emerged in motor and spatial representations of a bimanual task over a short time scale. Thirty-two adults were trained on a 90 relative phase pattern using flexion-extension index finger motion. One training session with ten 30 sec trials was provided. A Lissajous plot/cursor setup provided on-line augmented feedback during each trial to facilitate rapid training. Participants were not allowed vision of their hands, only of the Lissajous plot/cursor. Measures of relative phase (mean, bandwidth, standard deviation) revealed significant performance improvements across training. After training participants were put into one of two groups to be retested after either a 30-min or 6-hr interval. The retest consisted of performing the bimanual task to evaluate the extent of consolidation of the motor representation and performing a visual perception task to evaluate the extent of consolidation of the spatial representation of the action. The motor retest did not reveal any difference in the extent of consolidation of the motor representation between the groups. The visual evaluation task revealed that the 6-hr group more accurately recognized the finger motions for the bimanual task used during training compared to
the 30-min group. Overall, a difference in the time-scale of consolidation of the encoded motor and spatial representations for the trained bimanual pattern was found. In the motor retest, the Lissajous plot provided on-line feedback and this may have removed any chance of seeing more consolidation at 6-hrs compared to 30-min. The visual test was taken after the motor retest, thus the group difference probably resulted from a reactivation of a more consolidated spatial representation for the 6-hr group.

**Imagined and Executed Upper Extremity Reach in Children Diagnosed with Autism Spectrum Disorder**

*Patrick Cereceres; Rhonda Manning; Jason Boyle, University of Texas at El Paso*

Autism spectrum disorder (ASD) is a developmental disorder characterized by social skills, repetitive behaviors, speech, and nonverbal communication. Moreover, recent research has shown that children with ASD may present issues in upper extremity coordination and control, particularly with movements across the midline. One aspect that has yet to be examined is the role of internal models of action or imagined reach. Therefore, the purpose of the following study was to 1) Examine if differences exist between ASD and NT children in imagined reach and 2) Compare kinematics of executed movements to projected targets. All participants were children between the ages of 6–12, with ASD diagnosis provided from a licensed medical provider. A counterbalanced projection of single targets inside and outside of the child’s maximum voluntary reach (MVR) were displayed on a tabletop in front of the children. The child was asked to report if they thought they could reach the target with a verbal “Yes” or “No.” A total of 7 targets (4 inside the MVR; 3 outside) were displayed on the Right, Midline, and Left side of the body. Then the children were asked to accurately place a wooden block on single projected targets (all with in their MVR). Movement of the hand was tracked by an 8-camera motion capture system. Although scoring lower on correct responses (64%) to their NT peers (75%), Independent samples t tests revealed no differences between ASD and NT children in imagined reach to all sides and target combinations. It is important to note that a trend towards significance is present as the targets move away and across the midline to the contralateral side in the ASD group. Regarding executed movements, children in the ASD group presented overall slower movement times compared to their NT peers, most notably on the right side of the body. This is likely a result of high arm trajectory seen in the ASD group. These results suggest that feedforward mechanisms of planning are intact in this population and irregularities are more likely a result of issues in online/feedback systems. Funding source: Texas Physical Therapy Foundation Research Grant.

**Effects of Physical Driving Experience on Middle-Aged Virtual Passengers’ Body Movement and Motion Sickness**

*Chih-Hui Chang; Chung-Chieh Li; Yi-Hsuan Chiu; Yi-Ting Lu, National Kaohsiung Normal University*

Virtual vehicles can give rise to visually induced motion sickness (Chang, Pan, Tseng, & Stoffregen, 2012). Experience of driving physical vehicles influence virtual drivers’ body movement before the onset of motion sickness (Chang, Chen, Kung, & Stoffregen, 2017; Stoffregen, Chang, Chen, & Zeng 2017). The present study focused on motion sickness among middle-aged adults who were exposed to virtual vehicles as passengers. The effects of participants’ previous experience of driving physical vehicles on motion sickness and the postural precursors of motion sickness were investigated. Drivers were middle-aged adults (n = 20; M = 54.1, SD = 5.33 years) with 22.00 (SD = 2.77) years of experience driving physical automobiles, while Non-Drivers were individuals in the same age group (n = 20; M = 54.3, SD = 5.71 years) who did not have a driver’s license or had never driven an automobile for more than 15 years (3 of them). Participants were required to view a recorded car racing video games for up to 40 minutes. A magnetic tracking system (Flock of Birds, FOB) was used to track their head and torso movement at 60 Hz. Simulator Sickness Questionnaire (SSQ) was administrated before and after exposure to the video game. The incidence of motion sickness was determined by their forced choice, yes/no statement. After exposure to the virtual vehicle, the incidence and severity of motion sickness did not differ between Drivers and Non-Drivers. However, positional variability differed between participants who later became motion sick and those who did not. Non-Drivers had greater positional variability with the increase of exposure time while Drivers’ positional variability remained constant. The results are consistent with the postural instability theory of motion sickness (Riccio & Stoffregen, 1991), and help to illuminate the influence of previous physical driving experience on virtual passengers. Funding source: The Ministry of Science and Technology, Taiwan (MOST: 107-2410-H-017-026).

**Perceived Changes About Underlying Factors of Motor Skills Acquisition: Age and Gender Effects**

*David D. Chen; Matthew Brown; Xinyue Yang; Andrew Mutsakkisana, California State University, Fullerton*

Motor control and learning is a core course for kinesiology majors, where students learn psychological and neurophysiological mechanisms of how motor skills are controlled and acquired. With recent advances in research and theory development, twelve key principles of motor skill have been identified (Chen, 2019), including intention, goal, task-orientation, external focus, reflection, expert guidance, conscious control, beyond mastery, benefitting from errors, mental practice, and tolerance of setback. The objective of this study was to examine if students’ perceptions about these principles would change after completing a motor learning and control class. We surveyed 139 undergraduate students (M = 22.58; SD = 2.55) using the Perceived Changes about Underlying Factors of Motor Learning Scale (Chen, 2019), a 12-item measure with a 5-point Likert scale. Ages were broken into two groups (i.e. between 18 and 24 and 25 or older). A mixed-design ANOVA with repeated measures did not yield any significant findings. Chi square analyses of independence were conducted to examine how age and gender would affect the way the 12 survey questions were answered. The significant relation between age and mentoring showed that students age 25 or older tend to emphasize the benefits of learning under expert guidance. (χ²(4, n = 138) = 9.516, p < .05). Other significant age effects showed that students ages 18 and 24 are more inclined to appreciate the value of taking time to master the basics (χ²(3, n = 138) = 11.208, p = .011) and are more inclined to agree that conscious control decreases with practice (χ²(4, n = 138) = 14.372, p = .006). Age effects cross-tabulation shows females are in favor of using mental practice for skill acquisition (χ²(2, n = 139) = 6.769, p < .05). Overall, students agree that taking the class has altered their perceptions (Grand Mean = 4.254, SD = .061). The results will be discussed in the context of current trends in motor learning research and theory development.

**Effects of Trait Mindfulness on the Performance of an Executive Function Task: A Curse or a Blessing?**

*David D. Chen; Xinyue Yang; Matthew Brown; Andrew Mutsakkisana; Rhina Acain, California State University, Fullerton*

Mindfulness represents one’s ability to pay deliberate and nonjudgmental attention to experiences as they occur. Being mindful can disengage
individuals from habitual actions and thought tendencies that may interfere with performance. Executive function is a higher order cognitive ability that controls basic, underlying cognitive functions for purposeful, goal-directed behavior. Executive function has been linked to mindfulness and enriched learning. This preliminary study examined how trait mindfulness may affect the performance of an executive function task. We hypothesized that higher trait mindfulness would produce faster decision making times. Thirty-three undergraduate students (males = 12, females = 21) volunteered to participate in the study. After completing the Mindful Attention Awareness Scale (MAAS) (Brown & Ryan, 2003), they performed 4 practice trials and 80 test trials of a Stroop task, which required placing the index and middle fingers of both hands on the keys “c,” “v,” “m,” and “n,” keys on a computer keyboard. These keys were relabeled 1, 2, 3, and 4, representing four colors: green, red, yellow, and blue, respectively. A congruent condition was created when the color of the word matched the meaning whereas incongruence did not have the match. The mean of MAAS served as the cut-off to group all participants into high and low mindfulness groups for data analysis. No significant findings were identified when error scores were analyzed. A 2 (Mindfulness) x 2 (Congruence) mixed design ANOVA on the mean RTs revealed the only significant finding, i.e., a mindfulness by congruence interaction \( p = .033 \). Follow-up analyses indicated that trait mindfulness did not affect performance with congruent trials. Contrary to the hypothesis, lower mindfulness resulted in faster reaction times than higher mindfulness in incongruent trials. These findings suggest that taking MAAS before testing might have had negative influences, especially for those with higher trait mindfulness. Suggestions for future studies will be discussed.

The Effect of Concurrent Tremor Feedback on Air Pistol Shooting

Hsiu Hui Chen, National Taitung University

Introduction: It has been shown that the tremor of the hand is related to the performance of air pistol shooting, the less the better. On the other hand, postural control before triggering is also important. It is proper to have smaller and coordinated body sway. How concurrent feedback of tremor performance of air pistol shooting is unclear. Therefore, the present study aimed to examine the effect of providing concurrent feedback of tremor by audio to the shooting performance of air pistol athletes. Method: 32 air pistol athletes were recruited and were divided into four groups according to their skill level (elite and pre-elite) and experiment requirement (experimental and control). Every participant took three tests. In addition, the experimental groups took 8 sessions of training of CBT. The testing sessions lasted 75 min and were implemented under the rule of the qualification round in real competition and each CBT took about 30 min. Before tests, a 3D accelerometer was attached on the barrel and 5 reflective markers were attached on the right side of the body (head, shoulder, elbow, wrist, hip) and one barrel of pistol respectively. Two high-speed cameras and a force plate were set for capturing the motion and COP. For the audio-feedback practice, a wireless earphone was provided and the Noraxon system was applied for providing the audio feedback and for collecting the data of accelerometer and force plate. An electronic scoring system was set for recording the outcome score. Results: A significant outcome score was found higher for elite groups. In addition, the lateral motion of the whole body and vertical movement at wrist and pistol were significantly larger. However, no significant effect for CBT in movement amplitude or outcome scores was found. Only some individual participants in the experimental groups decreased the tremor of the hand and pistol. According to the interviews, after each piece of training, the acceptance of the CBT might influence that effect. Funding source: Ministry of Science and Technology, R.O.C.

Comparing the Effect of Feedback From a Robot and Human (Coach) on Reaching Kinematics in Adults

Yuping Chen, Georgia State University; Cortney Armstrong, Georgia State University; Reba Childers, Georgia State University; Anna Do, Georgia State University; Kathryn Thirey, Georgia State University; Jin Xu, Georgia Institute of Technology; De’Aira Bryant, Georgia Institute of Technology; Ayanna Howard, Georgia Institute of Technology

Recently, humanoid robots, due to their similarities in appearance to the human body, have served as playmates or coaches to provide encouragement or feedback in rehabilitation and education. However, determining whether the robot’s feedback is as effective as a human’s feedback during movement execution is still an open question for investigation. As such, we conducted a study to answer this question. Twenty healthy adults (9 males and 11 females; \( M = 0.3 \) years) were randomly assigned to receive either robot or human feedback while playing a virtual reality (VR) game. All participants were asked to play 7 trials of bubble popping games run on our developed VR platform (Super Pop VR*), which can precisely measure reaching kinematics (including movement time [MT], straightness, jerkiness, and speed [SP]) in real time. In each trial, participants popped virtual bubbles 10 times. The first 2 trials served as the baseline, followed by 3 trial acquisition, and 2 trial extinction. MT of the baseline was computed immediately and 80% of the average MT was set as the target time. If the subject’s MT during acquisition was less than the target, the robot (or human) would turn to look at the subject and say “Fantastic! Let’s move at the exact same speed.” If the MT exceeded the target time, the agent would turn and say “Good job! Move a little bit faster.” During extinction, the robot or human would be silent. There was no statistically significant difference found in any of the kinematic variables between robot and human (all \( p > .05 \)). As expected, number of reaches that were faster than the target time were statistically more during acquisition and extinction phases, as compared with baseline (all \( p < .02 \)). MT and SP during acquisition and extinction phases were statistically shorter and larger than baseline (all \( p < .05 \)). Our findings indicate that using a humanoid robot is as effective as a human in offering verbal feedback to adults to alter their reaching movements. The changes in reaching movements, which occurred during the feedback cycle, remained even after the feedback was withdrawn.

Effect of Task Constraints on Reaching Kinematics During Virtual Reality Game

Yuping Chen, Georgia State University; Cortney Armstrong, Georgia State University; Reba Childers, Georgia State University; Anna Do, Georgia State University; Kathryn Thirey, Georgia State University; Jin Xu, Georgia Institute of Technology; De’Aira Bryant, Georgia Institute of Technology; Ayanna Howard, Georgia Institute of Technology

Object size (large vs small) and task goal (reach as fast as possible vs reach at your comfortable pace) are well-accepted task constraints that influence reaching kinematics. However, it is unclear whether these two task constraints affect reaching in the virtual environment (VE). The purpose of this study is to examine the effects of these two task constraints in VE. Forty-one healthy adults (11 males and 30 females; \( M = 24.9 \) years old) participated in this study. All adults were asked to play bubble popping games run on our developed virtual reality (VR) platform (SuperPop VR*), which can precisely measure reaching kinematics (including duration, straightness, jerkiness, and speed) in real time. Participants were blinded with the study purposes and 2 task constraints were manipulated: bubble size (small vs large) and goal (comfortable vs fast). Participants began with their dominant hand for each condition and alternated hand after each condition was tested 3 times. A repeated ANOVA was used for...
analyses. For both dominant and non-dominant hands, reaches for small bubbles had longer duration, jerkier and less straight trajectories than reaches for large bubbles; reaches for small bubbles had slower speed than reach for large bubbles only when requesting participants to reach as fast as possible (all \( p < .01 \)). There were no differences on speed with respect to size when requesting participants to reach at their comfortable pace. In addition, reaches during the subject’s comfortable pace had longer duration and slower speed than reaches during fast pace for both dominant and non-dominant hands (all \( p < .01 \)). Reaches during comfortable pace also had straighter trajectories than fast pace only when popping small bubbles (\( p < .01 \)); no differences were found between comfortable and fast pace when popping large bubbles. Our findings confirmed that object size and task goals affected reaching kinematics even during VR games. When designing a VR intervention program for clinical populations, it is important to consider the virtual object size and task goals as factors in influencing their performance.

**Control Modes Quickly Shift When Learning to Reach with a Small Visuomotor Distortion in a Novel Environment**

Zacharie Cheng-Boivin; Darrin O. Wijeyaratnam; Erin K. Cressman, University of Ottawa

Recent work from our lab indicates that the motor control processes underlying reach adaptation in a novel visuomotor environment differ depending on participants’ awareness of the visual distortion. Specifically, participants who are aware of the visuomotor distortion engage in more offline control processes, engaging in a strategy to move their hand in a new movement direction (i.e., away from the target) in order to get the cursor to the target. In contrast, participants who are unaware of the visuomotor distortion engage in more online control processes, correcting their movements during execution in response to a visual error. In the current experiment, we asked if motor control processes are dependent on awareness when the visual errors experienced are limited in magnitude. Twenty-two participants were divided into 2 groups (Strategy vs. No Strategy) and reached to three visual targets while seeing a cursor that was rotated 20° clockwise relative to their hand motion. Participants in the Strategy Group were instructed on how to counteract the visuomotor distortion (i.e., reach to the left of the target). As expected, these participants immediately adopted an offline mode of control in order to employ the given strategy to counteract the cursor rotation. Specifically, participants in the Strategy Group took longer to initiate their movements, had shorter path lengths and reached more accurately during initial reach training trials compared to participants in the No Strategy Group. In contrast, the No Strategy group demonstrated evidence of online control throughout reach training. Within as little as 10 trials, participants in the Strategy Group began to reach in a similar manner as participants in the No Strategy Group with respect to movement errors and temporal performance, demonstrating a shift to online control. Together, these results suggest that when the magnitude of a visuomotor distortion is small, and hence errors experienced by participants are limited in magnitude, individuals tend to engage online corrective processes regardless of awareness. Funding source: This research was supported by the Natural Sciences and Engineering Research Council of Canada awarded to Erin K. Cressman.

**Sports Expertise and Gap Interceptive Behavior: A Perception and Action Approach**

Hyunchae Chung; Hui Li, Kunsan National University

Road crossing is a dynamic interceptive behavior in which the pedestrians must accurately perceive the information of the moving traffic gaps (distance, speed of the moving vehicles), and constantly control their movement based on the perceived information to achieve a successful crossing. Previous studies revealed that sports experience in interceptive activities enhanced perception-action coupling (Le Rumigo et al., 2005; Mallek et al., 2017). It was known that non-athletes had more collisions and less successes than athletes when they intercept a moving traffic gap (Chaddock et al., 2011). Thus, the present research investigated the sports expertise effect on pedestrians’ velocity regulation and timing accuracy in a virtual reality road-crossing environment. A total of ten athletes (\( M = 20.10 \text{ yrs}, SD = 1.37 \text{ yrs} \)) and 10 non-athletes (\( M = 20.50 \text{ yrs}, SD = 1.35 \text{ yrs} \)) performed the road-crossing task by actually walking in a virtual environment. Participants’ task was to cross the moving inter-vehicle gaps. We manipulated the initial distances (near, intermediate, far) and vehicle speeds (40 km/h, 60 km/h). And we examined the changes in participants’ approaching velocity, safety margin, and time to initiate their movement. The results indicated that by manipulating initial distance, both athletes and non-athletes increased their movement velocity while approaching to the moving gap. Athletes had faster velocity at the beginning of approach and they maintained their velocity at the last moment of approach. However, the non-athletes constantly increased their movement velocity over the entire approach. Also, athletes left with greater safety margin and initiated their movement earlier as compared to non-athletes. In addition, there was no difference between athletes and non-athletes by manipulating the vehicle speed. These findings suggested that athletes had a more effective strategy to control their movement velocity and they timed their movement more precisely with the moving object than non-athletes.

**Developmental Activities and Pathways to Excellence in Elite Alpine Skiers**

Rhiannon L. Cowan, University of Utah; Brady DeCouto, University of Utah; Brad Fawver, University of Utah; Keith R. Lokse, University of Utah; Paul R. Ford, University of Brighton; A. Mark Williams, University of Utah

While talent development is well researched in youth sport, limited work exists in alpine ski racing; a domain which presents unique practice and environmental demands. Thus, skiers may adopt non-traditional developmental trajectories to achieve elite status. We examined the activities engaged in, and development pathways followed, by sub-elite adolescent ski racers. Practice history profiles were collected from 174 youth skiers (\( M = 15.9 \text{ yrs}, \text{women} = 91 \)) enrolled in the elite development pathway in the United States. National technical ranking/points (slalom and giant slalom) were used to assess performance. Mixed-effect models showed that hours in ski related activities generally increased over time (\( p < .001 \)), with the exception of play, which decreased over time (\( p = .002 \)). Analyses of skiers’ ranks showed that rank generally improved (-30.99 pts/year; \( p < .001 \)) and greater total ski-activity hours were associated with greater rates of improvement (\( p < .001 \)). Furthermore, there was an interaction between time, age, and hours (\( p < .001 \)), such that more total hours of ski-activity were associated with a faster rate of improvement, particularly in younger skiers. Subsequent analyses of different practice types showed this effect was driven by time in group practice (\( p < .001 \)), as no other sub-types were statistically significant (\( p’ > .05 \)). Earlier first engagement in skiing was associated with better rankings across development (15.40 pts better on average, \( p = .024 \)). In contrast, an earlier age of non-ski training was associated with flatter trajectories over time (i.e., a slower rate of improvement; \( p = .001 \)). Finally, across development, accumulating hours in other sports was associated with a greater rate of improvement (\( p = .006 \)). In sum, better performance in competition on average was associated with an earlier age of first engagement, while more total hours in practice and in other sports across development were also associated with greater rates of improvement. However, earlier non-ski training was associated with...
slower rates of improvement. Funding source: United States Ski and Snowboard.

Assessing Coordination Dynamics in Children

Madison Davis; Lorinda Cohen Gomez; Yiyu Wang; Deanna Kennedy, Texas A&M University

Research investigating coordination dynamics and research directly comparing bimanual coordination in children and young adults have typically used in-phase and antiphase coordination tasks. The current investigation was designed to compare coordination dynamics between children and young adults using more challenging relative phase coordination patterns. Children (N = 8, M_age = 9.1 years) and young adults (N = 8, M_age = 22.5 years) were required to produce relative phase patterns between 0° and 180° in 30° increments. Lissajous displays and goal templates were provided to guide performance. Absolute error (AE) of the continuous relative phase was calculated to measure the degree to which the required goal relative phase (f = 0°, 30°, 60°, 90°, 120°, 150°, 180°) was achieved. Variable error (VE) and constant error (CE) of relative phase were calculated to measure stability and bias of the performed coordination pattern. The results indicated both children and young adults could effectively produce a large range or coordination patterns that typically act as repellers when provided Lissajous information. However, young adults performed more accurately and with less variability than children. The results also indicated children were more biased toward in-phase coordination than adults. These results suggest that children and young adults can overcome incidental constraints in the testing environment, but children may have more difficulty counteracting inherent constraints than young adults. Funding source: PESCA, TAMU to DM Kennedy.

Assessing Explicit Adaptation Leads to a Decrease in Implicit Adaptation When Reaching in the Absence of Visual Cues

Amelia Decarie; Sarvenaz Heirani Moghaddam; Erin Cressman, University of Ottawa

Visuomotor adaptation has been shown to arise due to implicit (unconscious; IA) and explicit (conscious; EA) processes. The Process Dissociation Procedure (PDP) and the Verbal Report Framework (VRF), evaluate both IA and EA within the same participant. It is currently unclear whether assessing EA leads to the promotion of EA at the expense of IA. To test this question, 70 participants were divided into 4 groups: PDP, Control PDP, VRF and Control VRF groups. All participants performed reach training trials in a virtual environment while seeing an aligned cursor (Block 1; 45 trials) or a cursor that was rotated 40° clockwise relative to their hand motion (3 Blocks; 45 trials). Following each block of reach training, IA was assessed for all groups by having participants reach so that their hand motion (3 Blocks; 45 trials) or a cursor that was rotated 40° clockwise relative to their hand motion (3 Blocks; 45 trials). Following each block of reach training, IA was assessed for all groups by having participants reach so that their hand went to the target in the absence of visual feedback (i.e., no cursor was present). EA was assessed in the PDP and VRF groups, such that (1) participants in the PDP group were instructed to reach using any strategy they had learned [1], and (2) participants in the VRF group were to report the direction that they planned to reach in order to get the cursor to the target prior to reaching. Results indicated that all groups performed similarly during the reach training trials and adapted their reaches to the 40° cursor rotation. The extent of IA was larger in the Control PDP group compared to all other groups after all 3 rotation training blocks. The remaining 3 groups (PDP, VRF and Control VRF groups) demonstrated a similar extent of IA. Consistent with previous results, IA decayed quickly over time for all groups of participants. Taken together, results indicate that the influence of assessing EA on IA depends on the method of assessment, such that assessing EA within the PDP framework leads to a decrease in the extent of IA observed. Future research will look to determine if the difference between assessment methods has to do with the instructions provided and/or the presence of continual visual cues in the workplace.[1] Heirani Moghaddam et al., (2019). [Abstract]. JEMS Funding source: Supported by Natural Sciences and Engineering Research Council of Canada [EKC].

Association Between the Functional Gait Assessment and Spatiotemporal Gait Parameters in Individuals with Obesity Compared to Normal Weight Controls

Phillip Desrochers; Daekyoo Kim; Laura Keeghan; Maria Ayoub; Danny Shin; Simone Gill, Boston University

Obesity is a significant global health concern that also involves motor impairment, including deficits in gait and balance. As such, a simple and affordable tool would be useful to capture gait and balance impairment in both research and clinical settings. The purpose of this study was to examine how the functional gait assessment (FGA) captures impairment in gait and balance in individuals with obese BMI (≥30 kg/m2) as compared to normal weight control participants. The FGA comprises 10 tasks that assess locomotion, balance, and coordination. Additionally, we investigated how differences in spatiotemporal gait parameters were associated with impaired gait in people with obesity. Fourteen individuals with obese BMI and twenty individuals of normal weight underwent the FGA. Additionally, participants walked on a pressure sensitive walkway under five conditions: pre-baseline (flat ground walking), small, medium, and high obstacles, and final-baseline. During this gait task, spatiotemporal gait parameters (step length, step width, step velocity, single and dual limb support time, and cadence) were measured. We found that individuals with obesity had significantly lower scores on the FGA indicating impairment in gait and balance. Additionally, individuals with obesity showed less efficient spatiotemporal gait parameters than healthy controls, particularly when crossing over obstacles. Finally, we found that in the participants with obesity, lower FGA scores were associated with decreased gait velocity and extended single and double limb support times, but only during obstacle crossing. Together, these results suggest that the FGA is a useful tool to capture gait impairment in populations with obesity. Further, the presence of obstacles during gait tasks may be helpful in revealing meaningful gait impairments in obesity and other populations. To our knowledge, this is the first study to examine the FGA in a sample of individuals with obesity. Funding source: NIH RO3 AR066344-01A1.

Upper Extremity Control in Children Diagnosed with ASD: The Role of Vision and Proprioception in Sine Wave Tracking

Clarissa Diaz; Patrick Cercerelli; Anita Bielskasa; Rhonda Manning; Jason Boyle, The University of Texas at El Paso

In a recent experiment by Gamez et al., 2019, children with autism spectrum disorder (ASD) showed enhanced upper extremity performance on a target task following a brief training period of rhythmical sine wave tracking. Given sensory deficits have been shown in this population, the purpose of the following study was to examine the effect of isolated visual and proprioceptive inputs during the sine wave tracking task to better understand the enhancement. All participants were children between the ages of 6–12, with ASD diagnosis provided from a licensed medical professional. A custom-built robotic arm bar apparatus was used, which allowed frictionless flexion and extension of the limb in the horizontal plane in both an active and passive (robot assisted) manner. Positional data of the limbs’ displacement was integrated into a graphic user interface that relayed information regarding the position of the participant’s limb on a projection screen. All participants completed 15 trials of a challenging target task (pretest) followed by 30 trials in a randomly designated training condition.
group (Original Sine wave, Proprioception only, Vision only, Target Task Control) and 15 more target task (posttest) trials. Results show movement enhancements in both the original sine wave replication and proprioception only conditions \((p < .05)\). These enhancements were specifically seen in faster movement times between the targets in a smooth/harmonic fashion in the posttest. No improvements in performance from pretest to posttest were seen in the visual and control conditions \((p > .05)\). These results suggest that the visual representation of the movement might not play a large role in the later development of enhanced motor actions in children with ASD. Funding source: Dodson Research Grant.

Comparison of Learning Curves Regarding Two Types of Visual Feedback: Which One is Better for Novice Between Qualitative or Quantitative Feedback?

Lee DongYoun, Seoul National University; Seo DongHwi, Seoul National University; Kim SeonJin, Seoul National University; Kim MinJu, Kyung Hee University

Background: The purpose of this study was to evaluate which type of feedback, qualitative augmented feedback (QL) or quantitative augmented feedback (QN) is better for squat skill learning on learning curves. Methods: 30 young male without any squat training experience were randomized into 3 groups (QL, QN, Control). Participants were asked to perform parallel squats, 10 trials for pretest, 150 trials for practice (10 trial x 3 set per day, total 5 days). After practice, 1 day later, a post-test was performed. Participants received feedback information after every 10 trials. All participants were given their capture video when they requested. Guideline data and video clips were collected from experts. Experts were fitness trainers with more than 10 years of experience and held several related certifications. Pedar-X was used to capture data and offer numerical value and colored space of foot pressure distribution. Also, IMU sensors were used to assess the lower limb coordination pattern by measuring hip, knee and ankle angles movements. Results: Our study showed better performance and improvement in foot pressure pattern for both QL and QN groups. QL group showed faster learning in early practice stage than QN. Pressure pattern from QN showed gradual improvement in 5 days and posttest. Especially, as practice period passed, QN group showed a more stable pressure pattern. Conclusions: Both qualitative and quantitative augmented feedback improves squat exercise and helps participants learn to squat. Qualitative feedback information seems to be effective for faster learning. Quantitative feedback could be effective when participants have plenty of time to practice.

The Effects of Increased Contextual Interference in Practice on Freestyle Swimming Improvement in Children: A Pilot Study

Collin Dowling; Yuhua Li, University of Memphis

The current culture of youth competitive swimming promotes the use of traditional training methods primarily focusing on repetitions with increased workload. A great amount of research evidence showed that increased contextual interference (CI) level in practice, such as random practice during initial training, leads to enhanced motor skill performance and learning. The present study aimed to investigate the effectiveness of CI manipulations on freestyle swimming performance in children. Twenty-eight children aged from six to fourteen were initially recruited to participate in the study. A parent’s or guardian’s written informed consent was obtained from each participant before the study. All participants were randomly assigned to one of the two practice conditions: blocked or serial. They practiced freestyle swimming skill in either a blocked (low CI) or serial (high CI) condition on four different training drills for three weeks. A pre- and a post-training test were conducted using a freestyle swimming speed test, which included four test trials on a 25-yard distance. Nineteen participants completed the study (13 girls and 6 boys). A 2 (Group) X 2 (Test) two-way ANOVA with repeated measures on the second variable was performed on the speed of freestyle swimming to examine if there would be a positive effect on increased CI practice. The results of data analysis on swimming time revealed a significant test effect, \(F(1,17) = 6.22, p < .05\), suggesting that all participants performed faster in the posttest compared to the pre-test. However, no difference between the two practice conditions was found. It is worth noting that the serial practice group improved swimming speed in the first trial of the post-test, however, the blocked practice group had no such an improvement. Further research is necessary to investigate the effects of contextual interference using a longer training period on swimming skill training in children.

Changes to Coordination Variability Following a Visual Feedback Running Training Protocol

Scott Ducharme; Will Wu; Hsiang-Ling Teng, California State University, Long Beach

Gait training using kinematic visual feedback has emerged as a potentially beneficial mechanism to improve gait form and reduce running-based injuries. The ability to perform gait tasks, such as modifying trunk position, may necessitate increasing the number of coordination patterns in lower body segments and joints. The purpose of this study was to determine if changes to coordination variability occur after individuals perform a running task with visual feedback. Methods: Healthy adult participants (2 men; aged 20 and 28 years) ran on a treadmill and underwent a 20-minute gait training protocol. Gait training consisted of participants receiving real-time feedback regarding their trunk orientation, and were instructed to increase their trunk flexion 10 degrees (compared to baseline). Coordination of the sagittal plane right femur segment and knee joint angles during the stance phase of running was compared pre and post training and quantified using a modified vector coding technique. Each percentage (0–100%) of the stance phase was binned into one of 4 phasing categories: in-phase (IP), anti-phase (AP), proximal-leading (PL), and distal-leading (DL). Coordination variability was calculated as the standard deviation within each phase. Results: Participants displayed increased coordination variability in multiple phasing categories following gait training. However, this result was not universal, as coordination variability decreased in two phasing categories for one participant. Discussion: Coordination variability appears to be modulated in response to the task constraint of modifying vertical trunk posture, albeit differently for each participant. Results of the study will be discussed as it relates to the similarities and differences of coordination and coordination variability within the phasing categories. These results are encouraging because greater coordination variability historically corresponds with healthier gait patterns.

Cognitive Loading During and After Continuous Task Execution Alters the Effects of Self-Controlled Knowledge of Results

Jeffrey Fairbrother; Kaylee Woodard, University of Tennessee, Knoxville

Previous research has repeatedly demonstrated that providing learners with self-control over their feedback schedules enhances motor skill learning. It is thought that increased information processing under self-control conditions may contribute to these benefits (e.g., Carter & Ste-Marie, 2017). However, the timing of critical information processing for self-control participants during the acquisition of continuous tasks is unknown. The present study was designed to enhance clarity related to this issue. Participants learned a continuous tracing task under self-control (SC) or yoked (YK) conditions. Groups of participants also completed a secondary...
cognitive load task either during or after the execution of each primary task trial. Results of a 2(FB schedule) x 3(load) x 2(test) repeated measures ANOVA showed that SC facilitated faster movement times in retention and transfer compared to a YK group, when no cognitive load task was administered in acquisition ($p < .01$). Facilitation did not occur, however, when the cognitive load task was administered either during or after the primary task. Results for number of errors showed that participants with SC committed more errors in retention and transfer compared to YK participants, regardless of whether or not the cognitive load task was administered during acquisition ($p < .05$). These findings provide initial evidence that SC may not always yield a learning benefit, but may simply induce differences in learning effects (e.g., faster movement time with greater errors). Further, the results of this study suggest that disruption of task-related information processing both during and after continuous task execution can mitigate the effects of self-controlled practice. Practitioners should consider learners’ information processing burdens when determining optimal feedback schedules.

An Examination of Physical Fitness, Practice Time, and Performance Among Developmental Alpine Ski Racers

Bradley Fawver; Brady DeCouto; Keith Lohse; A. Mark Williams, University of Utah

Fitness tests are routinely used to assess the physical aptitude of athletes, with the assumption that these traits might translate to superior performance. However, researchers have failed to integrate the time spent in practice into statistical models. Such data are necessary considering that prolonged training is believed to contribute to fitness levels as well as indirectly influence performance through an athlete’s physical capabilities. In the present study, we examined whether physical fitness tests are associated with performance in a sample of adolescent alpine ski racers after controlling for age, gender, and time spent in sport-specific practice. A total of 82 alpine ski racers completed a retrospective practice history profile and were assessed using a variety of physical fitness tests: aerobic capacity (i.e., 20-meter shuttle run); anaerobic capacity (i.e., 60-second box jump); and anaerobic power (i.e., 20-meter sprint, standing long jump, triple jump). Performance data were collected from national technical rankings via U.S. Ski and Snowboard. An initial factor analysis revealed that scores on fitness tests did not load onto separate “physical fitness” constructs. Only the 20-m shuttle run was positively associated with hours spent in practice ($p = .018$), but this test was not statistically associated with ranking. Lower body strength (standing long jump, $p = .035$; triple jump, $p = .044$) and anaerobic capacity (box jumps, $p = .022$), were significantly associated with better ski national ranking; however, these tests only accounted for 5.42–6.43% of the variance in performance after controlling for age (23.74–30.10%), gender (3.06–4.78%), and time spent in practice (0.02–0.83%). Findings suggest that aerobic fitness develops through time spent in practice but might not necessarily be essential for performance outcomes in this domain. Results also underscore the importance of anaerobic power for alpine ski performance, although the utility of these tests within homogenous athlete populations remains in question.

Spontaneous Interpersonal Synchronization of Gait: A Systematic Review

Danielle Felsberg; Christopher Rhea, University of North Carolina at Greensboro

Sensorimotor synchronization (SMS) refers to the coordination of human movement with a rhythmic external stimulus. SMS can occur under both intentional and unintentional (spontaneous) conditions. In interpersonal synchronization (human-to-human interaction), it is possible that a healthy individual could act as an attractor signal for an unhealthy individual, making it an intriguing area of investigation. Intentional synchronization with an external stimulus has demonstrated positive effects on the dynamics of gait in healthy adults, as well as clinical populations, such as those with Parkinson’s disease and stroke. However, less is known about the role of unintentional interpersonal synchronization in shifting the dynamics of human movement. The purpose of this review was to systematically survey the current state of the literature investigating unintentional interpersonal synchronization in gait behavior of humans. Fourteen studies were included for review. Of those, 12 performed laboratory-based experiments to investigate intentional interpersonal synchronization, and 2 reviewed previously recorded video footage of a professional sprint race. Of the 12 experimental investigations into spontaneous interpersonal synchrony, all demonstrated instances of unintentional interpersonal synchronization during gait tasks beyond that which would occur purely by chance during human interaction, with the majority using a side-by-side walking paradigm. Thus, side-by-side walking may be an effective intervention to improve gait. Walking alongside an intact locomotor system may provide a more effective, and biologically variable, attractor signal for rehabilitation of gait behavior. Moreover, unintentional synchronization may be beneficial because it could lead to fewer corrective movements to maintain synchrony relative to intentional synchronization. Further research needs to be done to fully understand the influence of unintentional interpersonal synchronization on the variability of gait behavior, and implications for use as a rehabilitation tool.

Changes in Cervical Position Modulate Slow Gait Speeds

Amanda B. Firoved; Nicholas Reilly; Daniel M. Russell, Old Dominion University

During walking, an upright head position may optimize visual and vestibular information maintenance balance. In contrast, healthy elderly tend to increase neck flexion and look more toward their feet during walking. Previous studies have found that older adults produce slower preferred walking speeds (PWS). Typically, reduced PWS has been attributed to increased weakness or fear of falling in older participants. However, prior studies did not account for changes in neck flexion that often occur with older age. The aim of this study was to determine if cervical postural changes influence gait speed in healthy adults. The participants in this study were healthy adult individuals ($N = 20$) ages 18–50 with mean age of 36.3 years. Participants walked 28m at each of the 9 conditions. The nine conditions included a combination of three instructed walking rates (slow, preferred, and fast) and three neck positions (flexed, neutral, and extended). Walking speed was determined using timing gates. A two-way repeated measures ANOVA was performed on the walking speeds and followed up with planned contrasts. As instructed, participants adopted three significantly different walking (preferred, slow and fast), $F(1,19) = 2891.96, p = .000$. Neck position significantly affected walking speed, $F(2,38) = 6.60, p = .003$, with extended position resulting in significantly slower walking speeds ($p = .001$). The interaction of neck position and walking rate was significant, $F(3.49, 66.32) = 4.04, p = .015$. Contrast analyses revealed that going from the control condition (preferred gait speed with neutral neck position) to a slow walking rate produced significantly reduced walking speed during neck flexion condition, ($p = .020$), and neck extension condition, ($p = .002$). These results show that healthy adult participants slowed their walking speed with alterations of cervical positions. Altered vestibular and visual information from neck flexion or extension could be altering gait stability. Compensatory neck flexion position could contribute to destabilizing gait and slowed PWS observed in older adults.
Baseball pitchers show different performance in the game from that in practice, and it also changes within the game. What factors impact on performance? We examined the relationship among heart rate (HR), pitching motion, and pitching performance between the practice, the game, and within the game. Ten elite baseball pitchers (two professional and eight semi-professional players in Japan) participated in this study. The HR, pitching motion duration, and pitching performance were measured in real games. The ball speed and pitching error (distance between the catcher’s mitt location before the pitch and that at the catching) were measured as pitching performance indices. The same data were acquired from the same pitchers in practice sessions. The HRs of all pitchers were significantly higher in the game than in practice. In parallel, the pitching motion became faster and the ball speed increased from the practice values, while the pitching error slightly decreased but did not appear related to the change in the pitching motion. This indicates that pitching performance is higher in an actual game than in practice. The increase in HR might be related to the increase in exercise intensity as compared to practice in addition to pressure in the game. On the other hand, HR changed as the game progressed. When HR increased, the pitching motion became faster. Shortening the pitching motion duration reduced the pitching error but was unrelated to the change in ball speed. This indicates that the change in HR is not related to the change in exercise intensity but is caused by other factors such as the pressure in the game; it is strongly related to pitching motion duration and pitching error. These results suggest that the performance change between practice and game is different from that within the game. During the game, the duration of pitching motion might be unconsciously varied with a change in HR which would impact ball command.

Choice of End-State Comfort Based on Time Spent at the Beginning State and the Precision Requirement of the End State

Tucker G. Gamble; Julio Hernandez-Zaniga; Breanna Studenka, Utah State University

Choice of posture while grasping an object typically depends upon several factors including the time spent in that posture, what postures were held prior to choosing that posture, and the precision required by the posture. The purpose of this study was to test a trade-off between choice of end-state comfort based on time spent in a posture at the beginning-state and the precision requirement of the end-state. To determine the trade-off between choice of comfort and choice of precision, we varied how long a subject held the initial grasp longer, and the end-target was large, we predicted that we would see more comfortable postures adopted at the beginning state. When the final placement was small and the initial posture was not constrained, we predicted we would see comfort adopted at the end state. On average, we found that, as beginning-state grasp time increased, individuals chose beginning-state comfort a greater percentage of the time. We also found a difference between grasp choices for large and small targets when the beginning-state grasp time was held for less than 5 seconds. Perhaps, not surprisingly, we found distinct individual differences within our sample. Some individuals seemed to choose beginning-state comfort nearly 100% of the time, while other individuals chose end-state comfort nearly 100% of the time. Both the time spent in a posture and its precision requirements influence planning, but not necessarily in a universal way. This trade-off between time and precision is likely influenced by both motor and cognitive individual differences.

Speech as an Indicator of Mental Workload During an Upper Limb Task

Christopher Gaskins, Food & Drug Administration; Rodolphe J. Gentili, University of Maryland; Kimberly L. Kontson, Food & Drug Administration

The use of physiological measures to assess mental workload during upper limb prosthetic performance can inform the neural underpinnings of cognitive-motor performance. However, the examination of mental workload has been restricted to the laboratory with little consideration for practical application within a social context. The assessment of mental workload within a verbally communicative social environment, may better inform real world prosthesis use. Speech analysis is objective, is less expensive and obtrusive than other physiological measures used in mental workload assessment such as electroencephalography and pupillometry and can be used in ecologically valid social scenarios. Past research has shown that an increase in mental workload results in a decrease in speech intelligibility which can be represented by a reduction in speech variability. An elevation of vocal pitch (fundamental frequency) and intensity has also been associated with an increase in mental workload. In this study, our goal was to assess mental workload using speech analysis during a concurrent cognitive and upper limb motor task in able-bodied individuals. This work will lay the foundation to examine speech correlates of mental workload during upper limb prosthetic performance in real world environments. In a within subject design, eight able-bodied participants completed a cognitive demand task (story recall task) which required them to listen to a short story (13–15 seconds in length) and recall key details of the story. Participants also completed a low (block transport) and high (shape transport) motor demand task for 2 minutes each. Lastly, participants completed the story recall and motor tasks concurrently. Two measures of speech variability (jitter and shimmer) decreased as cognitive-motor demands increased. Fundamental frequency and vocal intensity were positively associated with cognitive-motor demands, although not significant. These findings support the utility of speech analysis for the assessment of mental workload in prostheses users within a social context. Funding source: U.S. FDA Critical Path Initiative (CPOSEL13), DARPA Biological Technology Office Hand Proprioception and Touch Interfaces (HAPITX) program under Dr. Al Emond (DARPA-FDA IAA 224-14-6009), and by appointments to the Research Participation Program at the CDHR administered by the Oak Ridge Institute for Science and Education through an interagency agreement between the U.S. Department of Energy and the U.S. FDA.

Implicit Motor Sequence Task Paired with Five Separate Bouts of High Intensity Aerobic Exercise in Older Healthy Adults

Brian Greeley; Christy Jones; Briana Chau; Lara Boyd, University of British Columbia

A single-bout of exercise has been shown to enhance motor learning in tasks with a spatial component. A single session of exercise enhanced spatial accuracy (Snow et al., 2016) and sequence learning (Statton et al., 2015) in young adults. Exercise can enhance learning in healthy older adults following a single-bout of exercise.
Moderating Effects of a Partner on the Learning of Different Timing Tasks

Georgia Grieve, University of British Columbia; April Karlinsky, University of Toronto; Sowmya Gopakumar, University of British Columbia; Nicola J. Hodges, University of British Columbia

Little is known about the moderating effects of a partner on the practice and retention of multiple skills, especially when partners can take turns practicing the same (matched) or different (mismatched) skills. In previous work from our lab practice with a partner impacted practice decisions when choice was given regarding how to practice. However, we did not find partner effects in a putting task when individuals either matched or mismatched their partner on alternate trials. Because of the potential complexity for novices learning to putt with different putters, here we examined whether EA and IA differ depending on method of assessment (VRF, VRF-No Cursor) and hand preference did not influence participants’ choice; instead, participants’ behaviours were based on remaining consistent across all conditions. These results support the idea that participants do not consider their relative body position in an allocentric reference frame, which subsequently changes their reaching/tapping behaviour. Funding source: NSERC.

Perceptual Tasks Promote Explicit Adaptation

Sarvenaz Heirani Moghaddam, University of Ottawa; Amelia Decarie, University of Ottawa; Romeo Chua, University of British Columbia; Erin Cressman, University of Ottawa

Two adaptation processes have been shown to underlie visuomotor adaptation: (1) Explicit adaptation (EA), associated with conscious processes, that rapidly influences motor performance and (2) Implicit adaptation (IA), associated with unconscious processes that arises slowly and develops over time. EA and IA have been assessed within the (1) Process Dissociation Procedure (PDP; action task) and (2) Verbal Report Framework (VRF; perceptual task). The objective of this experiment was to examine whether EA and IA differ depending on method of assessment (PDP, VRF), as the neural processes underlying the control of action versus perception have been shown to be dissociated [1]. Sixty participants were evenly divided into three groups (PDP, VRF and VRF-No Cursor) and trained to reach in a virtual environment with an aligned cursor (1 Block, 45 trials) and then a cursor rotated 40° clockwise relative to hand motion (3 Blocks, 45 trials). EA and IA were assessed immediately following each Block of reach training trials, and again 5 minutes later. The PDP group reached while using any learned strategy (EA+IA), or while not engaging in a strategy (IA). The VRF and VRF-No Cursor groups reported their aiming direction based on an array of numbers surrounding the target (EA) before reaching to the target (EA+IA), with (VRF) or without (VRF-No Cursor) visual feedback of their hand position. All groups adapted their reaches to the 40° cursor rotation and showed evidence of EA and IA. However, the groups differed with respect to the...
stability and extent of EA and IA observed over time. The VRF group demonstrated the greatest EA and more stable IA over time in comparison to the PDP and VRF-No Cursor groups. In contrast, IA decayed quickly within the PDP and VRF-No Cursor groups. Thus, results suggest that having participants perform a perceptual task promotes EA, but only when visual feedback is available during assessment. Funding source: Supported by the Natural Sciences and Engineering Research Council of Canada [EKC].

Variability of Response to Whole-Body Vibration and Treadmill Training in Ambulatory Children With Cerebral Palsy
Gena Henderson; Diego Ferreira; Jianhua Wu, Georgia State University

Single bouts of whole-body vibration (WBV) have been shown to reduce spasticity and increase active range of motion (ROM) in adults and children with cerebral palsy (CP). The effects, while transient, may persist for 30 minutes or longer, thus providing a time window for potentially adding another intervention modality. Treadmill training (TT) is a common intervention that allows for the massed practice of walking in a controlled environment. It is ideal if these practiced steps can be performed with the best possible form in order to facilitate gait improvements rather than reinforce maladaptive patterns. Therefore, the use of WBV as a preparatory tool prior to TT may be more effective than using either of these modalities in isolation. This study aimed to investigate the acute effects of a bout of WBV followed by a bout of TT on walking patterns and lower extremity spasticity in ambulatory children with CP. Nine children (3M/6F) with CP between the ages of 6–17 years, GMFCS levels I-III participated in this study. Participants’ lower extremity spasticity and overground walking ability were evaluated before and after two interventions: 10 minutes of TT alone, and 12 minutes of WBV (20 Hz, 2 mm) followed by 10 minutes of TT. Response to the interventions was highly variable across the participants. Four participants demonstrated more notable improvements in spasticity after the WBV. The remaining demonstrated similar responses to both interventions. During overground gait, three participants increased step lengths and walking speeds after both bouts of TT, while one subject only increased step length after WBV and TT. Additionally, improvements in spasticity after WBV were not associated with improved gait during the subsequent bout of TT. This suggests that even those who responded favorably to WBV were not able to immediately access the improved ROM during gait. Our preliminary data show that WBV appears to be a promising tool to decrease spasticity; however, further research is needed to understand individual differences in response to WBV training. Funding source: Healthcare Innovation Program/Georgia Clinical & Translational Science Alliance Seed Grant.

Responses to Frequency Scaling of 90° Rhythmic Coordination: When the Switching of Modes Entails a Switch in Information
Rachel A. Herth, Indiana University Bloomington; Qin Zhu, University of Wyoming; Geoffrey P. Bingham, Indiana University Bloomington

Two rhythmic coordinations, 0° and 180° relative phase, can be performed stably at preferred frequency (~ 1 Hz) without training. Both 0° and 180° coordination entail detection of the relative direction of movement. At higher frequencies, this yields instability of 180° and spontaneous transition to 0°. The ability to perform 90° coordination can be acquired by learning to use relative position as information. We now investigate the skilled performance of 90° coordination with frequency scaling. The questions are (1) Will 90° coordination exhibit instability at higher frequencies and if so, (2) Will coordination switch to 0° or 180°? Unlike the switching from 180° to 0°, a transition from 90° to 0° or 180° would entail a change in information. We tested both unimanual and bimanual coordination. In Experiment 1, we used noninterference instructions intended to allow spontaneous (unintentional) switching. To evaluate performance, we examined histograms of proportion of time spent at a sampling of relative phases between 0° and 180°. Proportion of time at 90° decreased with increasing frequency of unimanual movement, but performance did not transition simply or reliably to 0° or 180°. Bimanual performance remained stable at 90°. Given the need to change information when switching, instructions may have confused participants. Did the instructions mean “do not correct to 90°,” or “do not change the information”? In Experiment 2, participants performed in different sessions with either noninterference or correction instructions. The contrast made clear that noninterference meant “do not correct.” Results with correction replicated those of Experiment 1 implying that noninterference was understood to mean “do not change information.” Now, noninterference instructions yielded switching plus extended time spent at intervening phases. Once performance had recognizably wandered away from 90°, participants switched information to perform stably at 0° or 180°, in both unimanual and bimanual tasks. Extension of the Bingham model (2004a, b, 2011) addressed these findings.

Postural Control During and Following a 12-Week Attentional Focus Balance Training Intervention for Older Adults with Fall Risk
Lauren Higgins, University of North Carolina at Greensboro; Ruth Stout, University of North Carolina at Greensboro; Amanda Barclift, University of North Carolina at Greensboro; John Palazzolo, University of North Carolina at Greensboro; Taniya Wilson, University of North Carolina at Greensboro; Jeffrey Labban, University of North Carolina at Greensboro; Jeffrey Fairbrother, University of Tennessee, Knoxville; Christopher Rhea, University of North Carolina at Greensboro; Louisa Raisbeck, University of North Carolina at Greensboro

Interventions for the reduction of fall risk primarily focus on neuromotor aspects related to balance and postural control. Additional benefit may be derived from the inclusion of cognitive factors such as attentional focus; directing a learner’s attention to the effects of their movement (external) or on the movement itself (internal). This study examined a 12-week balance training intervention using attentional focus instructions in older adults with a history of falls. Older adults (N = 45, 71% female) were randomized into an external focus (EF; n = 27, 80.0 ± 5.8 yrs) or internal focus (IF; n = 18, 80.3 ± 6.7 yrs) group. Participants completed 20 minutes of balance training on a wobble board, twice per week for 12 weeks. Instructions for the IF group were “focus on keeping the board parallel to the floor”, while instructions for the EF group were “focus on keeping your feet parallel to the floor”. Following the completion of each training session, a manipulation check was performed by asking participants what they focused on while balancing on the wobble board. Answers were recorded and coded as IF or EF. Postural control was assessed on a wobble board equipped with an inertial measurement unit for a 35s trial at weeks 0, 6, and 12 (intervention), and 13, 16, and 20 (retention). Mean power frequency was calculated for the anterior posterior (MPF-AP) and medial lateral (MPF-ML) directions. A piecewise linear growth model was estimated using hierarchical linear modeling to assess treatment effects on individual growth trajectories of MPF-AP and MPF-ML axes during the intervention and retention periods. In sensitivity analyses with groups reassigned based on the attentional strategy participants reported using during training sessions (≥ 13-week sessions), condition significantly predicted the MPF-ML intervention growth curve (G11 = -0.0053, p = .013) with the utilization of IF predicting lower frequency postural adjustments. These results suggest that compared to IF, EF leads to more flexible (higher frequency) postural adjustments. Funding source: NIH National Institute on Aging 1R15AG053866-01A1.
Preliminary Associations Between Heart Rate Variability and Movement Variability During Balance Training with Attentional Focus Instructions

Lauren Higgins, University of North Carolina at Greensboro; Ruth Stout, University of North Carolina at Greensboro; Amanda Barcift, University of North Carolina at Greensboro; John Palazzolo, University of North Carolina at Greensboro; Tanya Wilson, University of North Carolina at Greensboro; Jeffrey Llaban, University of North Carolina at Greensboro; Jeffrey Fairbrother, University of Tennessee, Knoxville; Christopher Rhea, University of North Carolina at Greensboro; Louisa Raisbeck, University of North Carolina at Greensboro

Age-related loss of physiological variability is associated with an inability to respond and adapt to physical perturbations, which can increase fall risk in older adults. Similarly, loss of movement variability has been connected to elevated fall risk in this population, but the link between physiological and movement variability has yet to be explored. An external focus of attention enhances movement variability during a balance task, but it is unclear if similar benefits are observed in the physiological domain. Our goal was to examine the relationship between measures of physiological and movement variability under conditions of internal or external attentional focus instruction in older adults with a history of falls. Participants (N = 14, 79.8 ± 7.4 yrs) received external focus (EF; n = 8) or internal focus (IF; n = 6) instructions as they completed 20 minutes of wobble board balance training, twice per week for 12 weeks. Variability outcomes were assessed at weeks 1, 3, 6, 9, and 12. Physiological variability was measured as the root mean square of the successive differences (RMSSD) from R-R intervals collected via a heart rate monitor worn during training sessions. Movement variability was measured immediately following sessions as the mean power frequency in the anterior-posterior (MPF-AP) and medial-lateral (MPF-ML) directions during a 35-second balance trial on a board equipped with an inertial measurement unit. Repeated measures correlations were used to quantify the association between HRV and MPF-AP and MPF-ML for EF and IF groups. At baseline, there were small, non-significant correlations between HRV and movement variability in both groups. In the repeated measures model for the EF group, moderate positive correlations were observed between RMSSD and MPF-AP (r (31) = .43, p = .01, CI: 0.09, 0.68). However, only small, non-significant correlations were observed with MPF-AP and IF for the IF group. These data highlight that attentional focus instructions provided with a balance task can influence the association between physiological and movement variability. Funding source: NIH National Institute on Aging IR15AG053866-01A1.

Effects of Different Observational Angles on Learners’ Choice of Video Self-Modeling

Yuya Hiromitsu; Tadao Ishikura, Doshisha University

This study aimed to examine the learning effects of different observational angle on learners’ chosen video self-modeling from the perspective of cognitive load. Thirty-nine participants were randomly assigned to three groups: (1) objective group (participants watched a video taken from the front), (2) subjective group (participants watched a video taken from the back), and (3) control group (without watching a video). The experimental task was 3 x 6 x 3 cup stacking of three sequential laps. This task was conducted in four blocks of five trials each for the acquisition test (baseline, test 1 (T1), T2, and T3). The participants were asked to perform 10 trials of one lap of cup stacking as practice, after baseline, T1, and T2. After each practice, participants in the objective and subjective groups were asked to choose, based on their feeling, three of ten video materials for self-modeling. This video was viewed before the test block; meanwhile, the control group was given a rest period. Two blocks for the retention tests (R1, R2) were conducted one week after the acquisition test. No video was provided for the retention tests. We measured the actual movement time for cup stacking, and then calculated its difference from the baseline on movement time (DMT). The results revealed that the DMT of the subjective angle group at T1 and T2 was significantly shorter compared with the other groups, indicating that they stacked the cups faster. As for the retention tests, R2 was faster than R1 for both movement time and DMT, and no differences were seen among the groups. These results suggest the possibility of increasing the speed of acquisition of motor behaviors, such as eye–hand coordination, by viewing videos with a lower observational angle of informational processing. However, video perspective may not have an impact on learning effects.

Kinematic Analysis of Functional Reaching Demonstrates Differential Performance Strategies as a Result of Age

Andrwe Hooyman; Peiyuan Wang; Sydney Schaefer, Arizona State University

Introduction: The capability to use tools to manipulate objects in one’s environment is imperative for everyday life and often deteriorates with age. Previous research has shown that older adults demonstrate reduced motor skill acquisition and performance compared to their younger counterparts. Such age differences, however, are often described in terms of speed or accuracy, not in terms of performance strategy. Methods: We measured the motor performance of 22 young and 18 older adults performing 15 trials of a functional reaching task, where they used a spoon with the nondominant hand to scoop pairs of kidney beans from a home cup to one of three target cups. Kinematic data were recorded via a sensor on the spoon. Time for completing one outward reach was decomposed into dwell time (the time to scoop beans for transport), and transport time (time to move the beans between cups). Results: Older adults had longer average reach times compared to the young adults (p < .01). Linear regression indicated that the largest predictor of reach time was dwell time (p < .001), even though these are independent task components. To determine behavioral strategies linked to longer dwell time (worse performance), principal component analysis (PCA) was used on the kinematic data to calculate proportions of movement variance. Results demonstrated a significant PCA x Age interaction (p < .05), whereby older adults with disproportionate movement variance had longer dwell times. Younger adults did not demonstrate this relationship. These results indicate that older adults’ overall performance on task were driven by the dwell phase (a fine motor skill) rather than the transport phase, likely due to inconsistent, unsuccessful motor attempts during scooping. Exploratory analysis did not find correlation between motor performance and various cognitive assessments with a false discovery rate correction, although participants were cognitively intact. Future studies will test the association between movement variance and specific cognitive impairments that interfere with motor learning. Funding source: This research was funded by the National Institutes of Health (K01 AG047926).

Role of Event vs. Emergent Timing in the Interaction Between Rhythmic and Discrete Movements

Charlend Howard; Nikita Kaznetsov, Louisiana State University

Previous research suggests that rhythmic and discrete movements are two distinct motor primitives used by the nervous system to generate complex actions (Sternad, 2008). One question has been how rhythmic and discrete elements are combined in unimanual and bimanual actions, and what are the constraints on their interaction? It is known that performing a discrete movement against a base rhythmic movement leads to a phase shift of the
rhythm. However, the focus has been on continuous rhythmic movements, whereas several types of rhythmic movements are possible (Hogan & Sternad, 2007). Different types of rhythmic movements may be controlled differently, which may affect the nature of rhythmic-discrete interaction. Rhythmic movements with contact points (tapping) rely on event-timing (clock mechanism), whereas continuous movements (circle drawing) are controlled by emergent timing (Zelaznik et al., 2002). We examined whether these two classes of rhythmic movement exhibit different phase-correction signatures following the initiation of a discrete movement. Participants \( N = 5 \) performed finger tapping (300 and 600 ms period) with and without physical contact with the surface using their right hand. After the tapping movement was established, participants were instructed to initiate a single finger flexion of the contralateral hand (discrete movement), while maintaining the rhythm. The results showed that only one subject slowed their rhythmic movement immediately after the discrete response (69.7% slower than baseline in 300 ms and 43.3% slower in 600 ms) regardless of the type of rhythmic movement. The movement period was then restored back to baseline. Whereas the other four participants did not modulate their tapping period after the discrete response (4.5 and 0.6% change). These preliminary results suggest that the nature of interference between discrete and rhythmic movements is independent of the type of rhythmic movement and shows strong individual differences. Higher-order attentional factors may interrupt the rhythm regardless of its underlying timing structure.

**The Effect of Training Frequency on Learning and Transfer of a Novel Pattern of Bimanual Coordination**

Shaochen Huang, University of Wyoming; Qin Zhu, University of Wyoming; Jacob Layer, University of Wyoming; Boyi Dai, University of Wyoming; Jiachen Yang, Shanghai University of Sport; Geoffrey Bingham, Indiana University

Studies of rhythmic coordination have shown that the stability of coordination is strongly affected by movement frequency. Typically, coordination performance decreases with increasing movement frequency. For rhythmic coordination ranging from 0° to 180° relative phase, 90° coordination has proven to be the most challenging to perform. Perceptual (visual, auditory or haptic) feedback on the relative phase has been provided to facilitate learning of 90° coordination. However, it remains unclear what effect the prescribed training frequency might have on the subsequent performance, particularly at frequencies different from the training frequency. The goal of the current study was to examine the effect of training frequency on learning and transfer of 90° coordination when visual and auditory feedback were provided to facilitate learning. Twenty adult participants naïve to the purpose of study were recruited and their performance of 90° coordination using a joystick-computer system was assessed at five frequency levels ranging from 0.5 Hz to 2.5 Hz. Then, participants were assigned to train with visual and auditory feedback at either a low or high frequency. The Proportion of Time on Task (PITT) was used to quantify coordination performance before, during and after training. Participants had to demonstrate performance of 90° coordination at the assigned training frequency consistently above 60% of PTT to complete the training. Their PTTs were assessed across the five frequency levels again after training. The results showed that both groups improved performance the most at the training frequency. Significant improvement of coordination was also detected at frequencies neighboring the training frequency. Compared to the training at low frequency, training at high frequency took longer but yielded more transfer of performance to neighboring frequencies. We conclude that training frequency determines the frequencies at which the best performance of the learned coordination will occur, and performance is not intrinsically good (or bad) at low (or high) frequency.

**The Effect of Attentional Focus on Movement Variability in a Balancing Task: An Uncontrolled Manifold Approach**

Cheng-Ju Hung; Kevin Becker, Texas Woman’s University

The advantage of an external focus for motor performance has been well documented (Wulf, 2013). Recently, several studies have attempted to determine if part of this benefit stems from improved functional movement variability when using an external focus, but results have so far been unclear. An uncontrolled manifold (UCM) approach allows for distinguishing between variability that does and does not affect the COM displacement when balancing. The purpose of this study was to investigate the effects of an external focus (EF) and internal focus (IF) during a balancing task on inflatable discs. Traditional measures of postural sway (SD of COP in the anterior/posterior and medial/lateral directions, SD_{COPx} and SD_{COPy}) were analyzed as well as movement variability as assessed by UCM (V_{UCM} and V_{ORT}). Young healthy adults \( N = 40 \) completed three familiarization trials standing on balance discs, followed by three trials each using an EF (focus on minimizing movement of the disc) and an IF (focus on minimizing movement of the feet). All trials were 20 seconds in duration, and focus condition order was randomized. The balancing motions and COP data were captured by 9 Vicon infrared cameras (250 Hz) and 2 AMTI force plates. Separate repeated-measures MANOVAs were used to assess differences due to focus for postural sway (SD_{COPx} and SD_{COPy}) and movement variability (V_{UCM} and V_{ORT}), and Sidak post-hoc tests were used for pairwise comparisons. Results showed no differences in postural sway between an EF, IF, and baseline \((p > .05)\). Variability measures also showed no differences between an EF and IF, but there was a reduction of V_{UCM} in both focus conditions compared to baseline \((p = .007 and .002, respectively)\). The benefit of an external focus in balance performance identified in previous research was not replicated, and no evidence of improved functional movement variability with an external focus was found. It is possible that the task difficulty in this experiment was too low to identify differences due to attentional focus.

**Effect of Message-Evoked Pleasant or Unpleasant Feelings on Pre-Performance for Motor Performance and Mood**

Tadao Ishikura; Yuya Hiromitsu; Takeshi Kitajima, Doshisha University

The message-evoked feelings from an instructor on pre-performance may influence a participant’s mood and performance. This study aimed to investigate the effects of message-evoked pleasant or unpleasant feelings on pre-performance for motor performance and mood, self-confidence, and motivation. Participants of this study were university students (10 men and 10 women). The participants were asked to practice stacking cups of 3” diameter and an IF (focus on minimizing movement of the feet). All trials were 3–6 or 3 stacks in 20 attempts. Subsequently, they were asked to carry out the same task as a performance test after they were provided with one of three conditions: a message-evoked pleasant feeling (PF) condition, a message-evoked unpleasant feeling (UF) condition, or a no message (NM) condition. The performance test was conducted in six random attempts, whereby the participants experienced the three message conditions at least twice. The messages were presented via video clips of male experimenters. The results showed that the performance speed increased throughout the 20 practice trials. However, there were no significant differences shown in performance time concerning the three message conditions. The message-evoked PF condition showed a higher positive mood, rest mood, self-confidence, and motivation than the message-evoked UF condition. Additionally, the PF condition showed a lower negative mood than exhibited in the UF condition and NM condition. The males performed the task faster and showed higher self-confidence and motivation when message-evoked pleasant feelings were provided compared to the females. These results indicate that although the message-evoked pleasant or unpleasant feelings

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on pre-performance did not influence the performance time of the stacking of cups task, the message-evoked pleasant feelings led to a positive effect on the performance mood, self-confidence, and motivation.

Providing Relatively Easy Criteria for Success Enhances Motor Skill Learning

Takehiro Iwatsuki; Claude Regis, Pennsylvania State University, Altoona College

The purpose of this study was to examine whether enhancing expectation through providing relatively easy criteria for success enhances motor learning outcomes. Participants were asked to throw soft-golf balls towards a circular target, using their non-dominant arm. Participants performed 7 blocks of 12 trials from the distance of 5.5 m on Day 1, and one block of 12 trials on the retention and transfer test each on Day 2. After performing the 1st block on Day 1, participants practiced six blocks of 12 trials either in a relatively easy success (RES) or difficult success (DS) group. Participants in the RES group had a task that was relatively easy to meet while those in the DS group were given a task in which reaching the criteria for success was difficult. On Day 2, participants performed the retention and transfer tests. Results showed that participants in the RES group outperformed those in the DS group on both the retention and transfer test. The RES had higher perception of competence after the practice session than the DS group. Thus, enhancing expectation through providing different success criteria influences motor learning outcomes.

Minimal Clinically Important Difference of Cognitive Assessment Tools in Older Adults Who Fall: A Secondary Analysis of a Randomized Controlled Trial

Deborah Jehu, University of British Columbia; Jennifer Davis, University of British Columbia-Okanagan Campus; Teresa Liu-Ambrose, University of British Columbia

Impaired executive functions are often observed in older adults who fall and should be included in fall-risk assessments. The minimal clinically important difference (MCID) is important for understanding whether observed changes are clinically meaningful. However, MCID values for cognitive assessment tools are not established. The objective of this study was to determine the MCID of three main measures of executive functions: the Digit Symbol Substitution Test (DSST; a measure of processing speed), the Stroop (a measure of inhibition), and the Trail Making Test (TMT; a measure of set-shifting), using the Montreal Cognitive Assessment (MOCA; a measure of global cognition) as an anchor measure, in 242 older adults who attended the Vancouver Falls Prevention Clinic and participated in a 12-month randomized controlled trial of home-based exercise program [Action! Seniors (AS!); NCT01029171; NCT00323596]. A complete case analysis of 242 participants of the 344 total participants was included; 114/242 participants received the Otago Exercise Program. All participants received usual care from a geriatrician. Participants were assessed on the cognitive outcomes (i.e., DSST, Stroop, TMT, MOCA) at baseline and 1-year. A distribution-based approach was also employed to derive the MCID (i.e., standardized effect size of 0.5), a valid and reliable approach for handling within-data variability. The DSST accurately discriminated between meaningful improvements (area under curve (AUC) = 0.763) and declines (AUC = 0.752) in detecting clinically important changes on the MOCA (≥ 3, ≤ 3 points, respectively). The range of the anchor- and distribution-based MCIDs was ≥2–3 symbols for a meaningful improvement and ≤ -3 symbols for a meaningful decline in the DSST. The distribution-based MCID for the Stroop and TMT were: 16.0 s and 50.5 s, respectively. Improvements exceeding MCIDs established above 2–3 symbols on the DSST are indicative of significant progress in processing speed in older adults who fall. Funding source: Canadian Institutes of Health Research, Alzheimer’s Society of Canada Research Program, Heart and Stroke Foundation of Canada, Michael Smith Foundation for Health Research, Jack Brown and Family Alzheimer Research Foundation Society Funding, Vancouver Foundation, Vancouver Coastal Health Research Institute, Canada Foundation for Innovation, BC Knowledge Development Fund, and Rosetta Stone Canada.

The Comparison of Timing Accuracy and Motor Coordination According to the Movement Continuity and Speed

Jaek Jeong; Seonjin Kim, Seoul National University

In the research on motor control, there are two theoretical perspectives about movement accuracy and variability. First, information processing theory, which focuses on explaining the mechanism of discrete movements through motor planning and feedback control, and secondly dynamic system theory, which explains the phenomenon and principle of rhythm, continuous motion with movement coordination. Movement continuity is a fundamental factor in understanding complex human movements and behaviors in the research area of motor control. Also, movement speed is another crucial control parameter for controlling movement timing accuracy and variability. But, the relation between continuity of movement and timing performance has remained unclear with the speed of motion. The purpose of this study is to clarify the timing accuracy, consistency, and motor coordination in timing tasks according to the motion continuity and speed. Twenty-four participants were randomly assigned to two groups (continuous or discrete) and performed a synchronization timing task (tempo: 30, 45, 60 bpm). Results showed that, a) continuous movement was more effective than discrete ones for timing accuracy and consistency, b) better timing performance at the fast tempo condition than slow one, and c) as the tempo change slowed down, timing accuracy decreased. Kinematic features showed that the maximum speed is high in discrete movement. The variability of peak speed and the time point of the peak speed were significantly higher, but the result of mean CRP (Continuous Relative Phase) and SD of CRP analysis to confirm harmonious coordination of movements did not show any significant differences. In conclusion, timing accuracy can be improved by continuous and relatively fast movement, not motor coordination. These findings provide important clues that can be applied to everyday simple motions to sports motor skills that require timing ability. Furthermore, it is expected to contribute a positive effect on direction of timing strategy.

Investigating Interference Between Learning Two Different Motor Sequences with the Upper and Lower Extremities

Brian Johnson; Christopher Heydrick; Jill Whitall; Kelly Westlake, University of Maryland

Introduction: Learning, including acquisition and consolidation, often underlies rehabilitation in people with a variety of diagnoses. However, when learning two different tasks within a short time span, consolidation of one task can help, or hurt, the learning of a second task. Since individuals undergoing physical rehabilitation often attend several rehabilitation sessions per day (or week) with various therapies (e.g., occupational, physical, speech therapy), this study investigated the possible interference effects of learning two different explicit motor sequences with the upper (UE) and lower extremities (LE) within the same day in healthy young adults. The study aimed to determine if acquisition of a LE task can interfere with the consolidation of a previously learned UE task. Methods: All participants performed two explicit motor sequences, one involving reaching (Task A) and another involving stepping (Task B). Participants completed the tasks...
in either ABA format (Tasks A and B separated by 5 minutes; Task A again 24 hours later) or AAB format (Tasks A and A separated by 24 hours; Task B 7 days later). The outcomes were change scores in sequence recall and spatial error of Task A. Results: Results indicate a between-group difference in change scores for sequence recall (t = 2.31; p = 0.043) and spatial accuracy (U = 31.00; p = 0.041) from the end of Task A to the start of Task A retest, between Group AAB (n = 6) and Group ABA (n = 6), but not for the within-session acquisition of sequence A or B. Conclusion: These initial findings support the occurrence of interference while learning different explicit motor sequences with the upper and lower extremities during the same day in healthy young adults. Further data collection is underway, including the addition of two additional groups to vary the time between tasks and the number of repetitions of tasks in an attempt to prevent an interference effect from occurring. Funding source: The first author was supported by the University of Maryland Advanced Neuro-motor Rehabilitation Research Training (UMANRRT) Program (NIDRR 90AR50280, NIDLRR 90AR5004 formerly H133P100014).

Yoga Facilitates Postural Control in Individuals with Parkinson’s Disease
Alicia Jones; Qin Lai; Joelle Berry; Cassandra Viselli, Wayne State University

Yoga is a commonly practiced mind-body activity with components that center on meditation, breathing, and posture. Previous studies indicated that yoga practice yielded improvements in overall motor functions, balance and gait initiation, however it was unknown if yoga can facilitate postural control under isolated static and dynamic tasks. The purpose of this study was to determine the effects of a 6-week yoga program on static and dynamic postural stability in individuals with mild to moderate Parkinson’s disease (PD). Eleven patients with a diagnosis of mild to moderate PD signed an informal consent prior to participation. Participants underwent pre-testing of static and dynamic balance, then admitted into a 6-week yoga program administered by a certified yoga instructor within one week of the test, followed by post-testing within 1-week of yoga program completion. Static and dynamic postural control was executed by performing unilateral standing and tandem walking on a balance platform (NeuroCom), respectively. First, participants placed their feet on an identified area of the platform and maintained unilateral standing for 3 trials each side with eyes open. After that, tandem walking on the platform was performed for 3 trials. Terminal feedback was provided upon completion via computerized calculated results. One-way ANOVA with repeated measures demonstrated significant differences on COP sway in the right-sided unilateral standing [F(1,10) = 5.59, p < .05], and end sway in tandem walking [F(1,10) = 14.11, p < .01] as well as trending significance on lateral step width in tandem walking [F(1,10) = 4.80, p = .05], but not in left-side unilateral standing [F(1,10) = 0.93, p > .05] or walking speed [F(1,10) = 1.09, p > .05]. SNK post-hoc analysis further revealed a reduction of sway velocity in right-sided unilateral standing as well as end sway in tandem walking. The results indicated that a 6-week yoga program facilitated postural control for static and dynamic tasks in individuals with Parkinson’s disease.

Body Talk: Body-Part Compatibility Effects in Men Do Not Depend on the Body-Type of the Model
April Karlinsky; Saba Taravati; Kristen Lucibello; Catherine Sabiston; Timothy Welsh, University of Toronto

Exposure to physique-salient media images has been linked with negative psychological consequences for both men and women, particularly when the images depict an idealized physique. However, the cognitive processes that underpin these negative effects have received limited empirical attention, especially within male populations. The current study used a response time (RT) task to assess men’s implicit cognitive processing when exposed to images of males with different body shapes. If men differentially process the bodies of other males with various body types, then RTs to targets presented on the various body types will differ. Thirty-nine adult males (18–33 years old) completed a computerized RT task in which they used their hand and foot to respond to colored targets presented on the hands or feet of a same-sex model. On each trial, the model had one of four physiques in randomized order, ranging from thin/very muscular to overweight/not at all muscular. Although the location of the target on the model’s body is irrelevant for the task, previous research has revealed that RTs are shorter when the target appears on the model’s body-part that is compatible with the individual’s responding limb than when is it on an incompatible body-part (a body-part compatibility effect). As anticipated, findings from the present study revealed that RTs were shorter for responses made by the hand than by the foot (p < .001), and in response to compatible targets compared to incompatible targets (p < .001). These initial analyses, however, did not reveal any differences in the magnitude of the body-part compatibility effect across the different model physiques. These results suggest that men processed the different body-types in a similar fashion. In the future, factors such as individuals’ social comparison tendencies, body-related shame, and body-related envy will be considered towards understanding how body image-related variables influence the neurocognitive processing of bodies, and ultimately the psychological effects of exposure to physique-salient media. Funding source: Social Sciences and Humanities Research Council.

The Influence of Integrated Feedback Information on Bipedal Force Control
Deanna Kennedy, Texas A&M University; Yiyu Wang, Texas A&M University; Osmar Pinto Neto, Anhembi Morumbi University

An experiment was designed to determine the extent to which individuals are capable of using integrated feedback information to coordinate bipedal force patterns and to determine if participants exhibit interference between the left and right lower limbs. Right limb dominant participants (N = 12, mean age = 21.7) produced 1:1 in-phase and 1:2 multi-frequency patterns of isometric forces with their feet. Lissajous displays were provided to guide performance. The Lissajous displays involved a goal template and a cursor indicating the forces produced with both limbs. The cursor moved from left to right as force was produced with the right foot and from bottom to top as force was produced by the left foot. The templates illustrated the specific pattern of force requirements needed to produce the goal coordination patterns. Participants performed 13 practice trials and one test trial per pattern. On the test trial, muscle activity from the tibialis anterior muscles were recorded. EMG-EMG coherence between the two EMG signals were calculated using both Fourier-based coherence and wavelet coherence. The behavioral results indicated very effective temporal performance of the bipedal coordination patterns. This result is similar to that observed in our earlier work with bimanual force patterns and provides additional evidence for the robust utility of Lissajous displays in facilitating complex coordination pattern. The EMG coherence analysis indicated higher coherence in the 1:1 than 1:2 tasks. The results also indicated consistent and identifiable distortions in the left limb forces that could be attributable to the production of right foot forces, however, similar distortions in the forces produced by the right foot that could be attributable to the left limb were not observed. This type of right to left limb influence was also evident in our earlier work when participants were required to coordinate force with the upper limbs.
Using Virtual Reality to Assess Cognitive and Motor Skills in Tennis Serve Return
Toshtaka Kimura, NTT Communication Science Laboratories; Kei Saito, Keio University; Katsutoshi Masai, Keio University; Maki Sugimoto, Keio University

Systematic assessment of athletic cognitive and motor skills is limited because the capture of behavioral data during actual sports generally lacks controllability and reproducibility. Thus, we propose to use virtual reality (VR) systems that provide highly reproducible, immersive, visual stimuli to players that allows realistic data to be captured in various sports scenarios. VR also offers the significant advantage of allowing the arbitrary configuration of visual situations impossible in the real world. We have developed a head-mounted VR system for tennis serve return whereby the player can experience returning a service on a virtual tennis court. The player's hand and racket movements were measured using nine-axis inertial sensors; the values are replicated by a virtual avatar in real time. In experiments, two types of services, flat (fast) and spin (slow), both based on previously recorded ball trajectories, were pseudo-randomly presented to the participants by a server avatar that replicated recorded motion capture data. Three groups of players, advanced, intermediate and novice, were asked to return the services (motor experiment) or to press a button as soon as they identified the motion of the server, but only advanced players used the prediction to adjust their racket movement. In the cognitive experiment, we found that novices responded before the ball impact. These results suggest that experienced players, advanced and intermediate, predicted the type of serve based on the motion of the server, but only advanced players used the prediction to adjust their racket movement.

Motor Sequencing Training has Positive Effect on Motor and Executive Functions in Preschool Children
Sergey Kiselev, Ural Federal University

Background: It is known that preschool age is a sensitive period for development of motor and executive functions. The goal of this study was to assess the impact of 12 weeks of motor sequencing training on the executive and motor abilities in preschool children. Participants and Methods: The participants were 25 typically developing children aged 5–6 years ($M_{age} = 5.1$). Children were randomly assigned to the intervention and comparison group. Children from the intervention group participated in 12 weeks of motor sequencing training. This training trains the child to plan, sequence and process information more effectively through repetition of goal-directed movements. The training is built on the conceptual framework derived from the work of Luria’s theory of restoration and development of neurocognitive functions (Luria, 1974). The Luria’s child neuropsychological assessment battery was administered before and after the intervention period. Results: Analysis of covariance tested the effect of motor sequencing training on four scales of the Luria’s child neuropsychological assessment battery: Executive scale; Motor scale; Visuo–spatial scale; Memory scale. Group differences ($p < .05$) were found for the Executive scale and Motor scale. Posttest mean for the intervention group were significantly ($p < .05$) greater than the control group. Conclusion: Received results show that motor sequencing training in typically developing preschool children benefits both motor abilities and executive functions. Funding source: Act 211 Government of the Russian Federation, agreement no. 02.A03.21.0006.

Children with ADD Can Benefit From Body-Oriented Training
Sergey Kiselev, Ural Federal University

Introduction: It is known that children with attention deficit disorder (ADD) have a deficit in cognitive abilities, specifically in executive abilities. It is important to develop the trainings to overcome this deficit in children with ADD. Objectives: The goal of this study was to reveal the effect of body-oriented training on executive abilities in ADD children. We compared the efficacy of two methods of treatment (body-oriented training for children vs. conventional motor exercises) in a randomized controlled pilot study. Methods: 20 children with ADD between 5 to 7 years of age were included and randomly assigned to training conditions according to a 2x2 cross-over design. The body-oriented training included the exercises from yoga and breathing techniques. To assess the executive functions and attention in children we used 4 subtests from NEPSY (Tower, Auditory Attention and Response Set, Visual Attention, Statute). Effects of training were analyzed by means of an ANOVA for repeated measurements. Results: The ANOVA revealed ($p < .05$) that for all 4 subtests on executive functions and attention the body-oriented training was superior to the conventional motor training, with effect sizes in the medium-to-high range (0.39–0.81). Conclusions: The findings from this pilot study suggest that body-oriented training can effectively influence the executive abilities in children with ADD. However, it is necessary to do further research for revealing the impact of body-oriented trainings on the prevention and treatment of ADD in children. Funding source: Act 211 Government of the Russian Federation, agreement 02.A03.21.0006.

Visuospatial Training Can Improve the Language Abilities and Visuospatial Functions in Children with SLI
Sergey Kiselev, Ural Federal University

Background: It was shown that children with specific language impairments (SLI) have deficits not only in producing and understanding language but also in visuospatial abilities (Kiselev et al., 2016). We assume that training programs that are aimed to develop the visuospatial abilities can help children with SLI. The goal of this study was to assess the impact of visuospatial training on the language abilities in children with SLI. Participants and Methods: The participants were 25 children aged 7–8 years ($M_{age} = 7.8$) with SLI. Children were randomly assigned to the intervention and comparison group. Children from intervention group participated in 36 weeks of visuospatial training. This program trained the child to do different visuospatial exercises both on a motor and cognitive level. This program is built on the conceptual framework derived from the work of Luria’s theory of restoration of neurocognitive functions (Luria, 1963, 1974). We used the subtests from Luria’s child neuropsychological assessment battery to assess language abilities in children before and after the intervention period. Results: Analysis of covariance tested the effect of the visuospatial training program on five language subtest from Luria’s child neuropsychological assessment battery. Group differences ($p < .05$) were found for subtests that assessed understanding prepositions that describe the spatial relations between objects. Posttest mean for the intervention group were significantly greater ($p < .05$) than the control group. Conclusion: It can be assumed that visuospatial training in children with SLI benefits specific language abilities for understanding sentences with spatial prepositions. Funding source: Act 211 Government of the Russian Federation, agreement no. 02.A03.21.0006.
Eye, Head, and Body Coordination in Baseball Batting

Yuki Kishita, Tokyo Institute of Technology; Hiroshi Ueda, NTT Communication Science Laboratories; Makio Kashino, NTT Communication Science Laboratories

In baseball, batters swing in response to a ball moving at high speed within a limited amount of time — about 0.5 seconds. In order to make such movement possible, quick and accurate trajectory prediction and subsequent swing motion with optimal body-eye coordination are essential, but the mechanisms involved are not clearly understood. The purpose of this study is to elucidate the visual strategies and the relationship between gaze and swing motions of baseball batting for a wide range of ball speeds. Nine college baseball players hit balls projected by a pitching machine operating at four different ball speeds (80, 100, 120, and 140 km/h). Eye movements were measured with a wearable eye-tracker, and body (head and hip) movements were measured with an optical motion capture system. We found that their visual strategies exhibited two characteristics. First, in the early period of the ball’s flight (when the change in the visual angle is small), batters foverted the ball by using a typical vestibulo-ocular reflex (rotating their head in the ball’s flight direction while moving their eyes in the opposite direction) for the two slower ball speeds (80 and 100 km/h) and only head rotations for the two faster ball speeds (120 and 140 km/h). These different strategies are probably the result of a long period of training involving tracking balls with head movements and responding to other sudden speed changes with eye movements. Second, we also found that batters shift the gaze position towards the predicted future ball position by using a saccade and a quick head rotation, and their onsets were temporally aligned with the bat-ball impact and rotation of the hip (approximately 200 ms before the impact), regardless of the ball speed. These results indicate that the gaze movements in baseball batting are not solely driven by external visual information (ball position or velocity) but are determined by predicted impact time or in relation to other body movements. Funding source: partially funded by JST CREST (JPMJCR14E4).

Effects of Explicit and Implicit Motor Instruction Methods in Pupils with Special Needs: The Relationship with Verbal and Visuospatial Working Memory

Marjan Kok, Vrije Universiteit; Elmar Kal, Brunel University; John van der Kamp, Vrije Universiteit

Physical Education (PE) teachers need to apply learning methods that suit the individual constraints of their pupils and will benefit motor learning experiences. This is particularly challenging in special education, in which all pupils have special and diverse educational needs. This study examined the effects of type of instruction and feedback on motor learning and perceived competence of pupils with special educational needs practicing a balancing task in a PE-setting. The main aim was to test if and how pupils’ verbal and visuospatial working memory capacities (WMC) were related to changes in motor performance and perceived competence due to practice, and whether these relations were affected by type of instruction and feedback. A cohort of 82 special education pupils aged 9–13 years practiced balancing on a slackline in two sessions (week 2 and 3) during PE-classes. A PE-teacher provided them with either explicit (internal focus) or implicit instructions and feedback (a combination of analogies and external focus) on movement execution. Balancing performance and perceived competence were measured at pretest (week 1) and posttest (week 4). Furthermore, we measured verbal and visuospatial WMC. The pupils significantly increased their balancing performance and perceived competence from pre- to posttest, with no differences between groups. The relation between verbal WMC and learning outcomes was significantly mediated by instruction type. Verbal WMC significantly predicted improvements in perceived competence in the explicit instruction group and improvements in balancing outcome in both instruction groups. Yet, whereas verbal WMC was positively associated with improvements in balancing outcome in the explicit instruction group, a negative relationship was present in the implicit instruction group. This implies that PE-teachers may need to align their instructions with the verbal WMC of their pupils, by providing analogies and external focus instruction in pupils with low verbal WMC and internal focus instruction in pupils with high verbal WMC. Funding source: The Netherlands Initiative for Education Research.

Vibro-Tactile Stimulation as a Non-Invasive Neuromodulation Treatment for the Voice Disorder Spasmodic Dysphonia

Jürgen Konczak, University of Minnesota; Sanz Khosrevani, Harvard University; Arash Mahnan, University of Minnesota; I-ling Yeh, Singapore Institute of Technology; Joshua Aman, University of Minnesota; George Goding, University of Minnesota; Yang Zhang, University of Minnesota; Peter J. Watson, University of Minnesota

Spasmodic dysphonia (SD) is a focal dystonia of the voice that leads to strained or choked speech. At present, there is no cure for SD. It is unresponsive to speech therapy. Current treatment is periodic injection of the botulinum toxin into laryngeal muscles controlling the vocal cords. We report on a series of recent studies from our group that determined: 1) the electrotocortical signature of SD and 2) the short-term effect of vibro-tactile stimulation (VTS) on voice quality and cortical activity in patients with SD. Method: Cortical activity was monitored with EEG as patients repeatedly vocalized of the vowel /a/ while receiving VTS for a duration of 30 minutes. Results: SD voice symptoms were associated with two atypical patterns of cortical activity during voice production: 1) a reduced movement-related desynchronization of motor cortical networks, 2) an excessively large synchronization between left somatosensory and pre-motor cortical areas. Eight out of 13 patients (69%) responded to VTS exhibiting significant improvements in acoustic measures of voice quality. Laryngeal VTS induced a significant suppression of theta band power over the left somatosensory-motor cortex and a significant rise of gamma rhythm over right somatosensory-motor cortex. Conclusion: These findings document that pathophysiology of SD is characterized by an abnormally high synchronous activity within and across cortical speech motor networks. Our results document that a one-time application of laryngeal VTS can effectively reduce the voice symptoms of SD. The neural signature behind its effectiveness is the suppression of excessive theta band oscillations. This feature has been observed in patients with cervical dystonia who apply effective sensory tricks, suggesting that VTS in SD may activate a similar neurophysiological mechanism. We currently conduct a randomized clinical trial that investigates the long-term effects of VTS on voice symptoms in SD. In an effort to translate our science into medical treatment, we developed a wearable device that applies laryngeal VTS for people with SD. Funding source: U.S. National Institutes of Health NIH 1R21DC011841 to PW and JK; NIH 1 R01 DC016315-01A1 to JK.

The Influence of Foreperiod Duration on the Preparation and Control of Sequential Aiming Movements

Aryan Kurniawan, University of Windsor; Madison Khan, Western University; Michaela Khan, University of British Columbia; Kristy Smith, University of Windsor; Gavin Lawrence, Bangor University; Michael Khan, University of Windsor

Reaction and movement times to the first target are typically longer for two-target sequential movements compared to one-target movements.
were modulated in each group. Although testing is ongoing, preliminary results suggest that tDCS paired with observational practice has the potential to be a useful training tool for enhancing short-term motor learning.

Changes in Resting State Brain Networks and Performance on a 2-Ball Juggling Task Following Observation and Transcranial Direct Current Stimulation

Harvey Lee, Western University; Rebecca Kenny, University of British Columbia; Thalía Otamendi, Djavad Mowafaghian, University of British Columbia; Leyla Bruca, University of Maastricht; Beverley Larssen, University of British Columbia; Lena Walther, University of British Columbia; Meagan Pelletier, University of British Columbia; Taylor Seidell, University of British Columbia; McKenzie Summers, University of British Columbia; Cassidy Kapaiwai, University of British Columbia; Nicola J. Hodges, University of British Columbia; Naznin Virji-Babul, University of British Columbia

Observational practice of a motor task typically improves subsequent task performance, although there are limits to its efficacy. Moreover, there is debate about the role of the motor system in learning from observation and whether learning can be enhanced through activation of the motor system. Here we used transcranial direct current stimulation (tDCS) to stimulate the premotor cortex during observational practice of a 2-ball juggling task. In addition to studying the behavioral effects, we also measured changes in electroencephalography (EEG) power following observational practice paired with tDCS stimulation. Eighteen participants (4 males and 14 females) aged 18–29, with no experience juggling, completed the study in the following order: 2-trial juggling test, baseline resting state EEG, 15-min treatment period, resting state EEG, and 30-trial juggling test. During treatment, participants either watched a video of 2-ball juggling, received tDCS stimulation only, or watched the video while receiving tDCS stimulation (+tDCS group) or tDCS stimulation only (-tDCS group). The results of Experiment 1 revealed that while the one-target advantage in reaction time was not influenced by foreperiod duration, the one-target advantage in movement time increased as foreperiod duration increased. There were also greater decreases in variability from peak velocity to the first target in the two- compared to one-target condition. In Experiment 2, the one-target advantage in both reaction and movement time increased as the length of the foreperiod increased. However, there was no difference in limb trajectory variability between target conditions. Collectively, these results support the movement integration hypothesis by demonstrating that planning and execution of sequential aiming movements is influenced by the interval prior to the stimulus. Support for the Movement Constraint Hypothesis was revealed only when the number of targets was the same from trial to trial.

Neuromuscular Response to a Single Session of Whole-Body Vibration in Children with Cerebral Palsy

Huaping Liang, University of Illinois at Chicago; Gena Henderson, Georgia State University; Jianhua Wu, Georgia State University

Cerebral palsy (CP) is the most common motor disability in childhood. Children with CP often display neuromuscular impairments such as spasticity and develop abnormal gait patterns. Whole-body vibration (WBV) has shown its potential to reduce spasticity and improve motor function in children with CP. The purpose of this study was to evaluate the neuromuscular response to a single session of WBV with different amplitudes in children with CP. Ten children with CP (7 Male, 3 Females, age = 10.1 years old) at GMFCS level I–III participated in this study. Two sessions of side-alternating WBV were presented with the same frequency of 20 Hz but different amplitudes: low-amplitude at 1 mm and high-amplitude at 2 mm. Each session included six sets of 90 seconds of WBV and 90 seconds of rest. Before and after each WBV session, modified Ashworth scale (MAS) was used to evaluate the spasticity of leg muscles, and overground walking was performed to assess gait patterns. A 2D video.
system was used to examine spatiotemporal gait parameters and joint range-of-motion (ROM). Four muscles were tested including lateral gastrocnemius, tibialis anterior, vastus lateralis, and biceps femoris from the affected side for those with hemiplegia and from the less affected side for those with diplegia. The non-parametric Friedman test was conducted on the MAS mean ranks. A series of one-way ANOVAs with repeated measures were conducted on the gait parameters. Results show that both WBV sessions similarly reduced the spasticity of the ankle plantarflexors and reduced background noise of the tibialis anterior activities during walking. Moreover, the high-amplitude WBV increased the ankle ROM during walking. This study demonstrates that a single session of WBV with either a low or high amplitude can reduce spasticity and improve gait patterns in children with CP. It suggests that low-amplitude WBV may induce similar neuromuscular response as high-amplitude WBV in children with spastic CP and can be used for those who are not able to tolerate stronger vibration.

Hysteresis Effect of Attractor State Transition in Rollerball Dynamics
Yeou-Teh Liu, National Taiwan Normal University; Karl M. Newell, University of Georgia

The development and learning of motor skills are individual processes that reflect a change in perceptual-motor control. In dynamical systems theory, the transition from one attractor state to another occurs when the values of the control parameter reach a critical value. The transition may also depend on not only the present state but also the previous state. The purpose of this study was to examine task difficulty as the control parameter and the effect of increasing/decreasing the control parameter on the hysteresis of roller ball dynamics. The initial speed of the roller ball was manipulated as the task difficulty. Twenty participants practiced the rollerball task 50 trials a day for at least 10 days. The post-test was performed 1 day after the last practice day and consisted of 11 initial speed conditions from 10–30 rps in 2 rps increment. Each condition had 5 trials. The task goal was to maintain or increase the ball speed above the initial speed at the end of the 10-s trial. The directions of increasing and decreasing initial ball speed were counterbalanced among the participants. The slope of the ball speed within a trial was used to examine the bi-stability in the increasing and decreasing directions of initial speed. The results showed all but 1 participant experienced failure/success transition and 8 participants transitioned at the same initial speed condition for both increasing and decreasing directions. For the remaining 11 participants, the high skilled participants who were successful at 18 rps and above showed significantly greater slopes in decreasing than increasing difficulty direction at the transition condition, demonstrating the hysteresis effect. The low skilled participants, however, also showed a significant difference in slopes at the transition condition but in the opposite direction. Hysteresis has been shown in human locomotion to be a consistent direction effect. Skill level interacted with the transition dynamics and, therefore, affects hysteresis. Funding source: Ministry of Science and Technology of Taiwan.

Balance Improvements After a Single Bout of Virtual Reality Obstacle Course Training: Preliminary Data
Chanel T. LoJacono; Louisa D. Raisbeck; Christopher K. Rhea, University of North Carolina at Greensboro

Falling poses a risk of injury for older adults, thus decreasing quality of life. A major fall-risk factor is a decrement in balance. Fall prevention programs have been designed to improve fall-risk factors, but can be costly and require unavailable resources. Virtual Reality (VR) may provide a solution, as it is cost-effective and resource-efficient. Previous research has been limited to non-immersive VR training on a treadmill, which can constrain natural movement. Thus, it is unknown whether an immersive overground VR obstacle course may affect balance. The purpose of this study was to determine the extent to which balance may be improved via an overground VR obstacle course environment. Healthy young adults (N = 19, 21.8 +/- 1.3 yrs) were placed into either the training (TRN) group (n = 6) or control (CON) group (n = 13). The TRN group completed 15 trials of an immersive VR obstacle course with obstacles designed to be targeted and avoided in all 3 directions. The VR environment was implemented in a head mounted display with foot trackers to give real-time feedback of foot position in VR. The CON group walked overground for 15 minutes to control for physical activity duration. Both groups completed the BTrackS Balance Test (BTT) pre- and post-training. BBT Error Scores and SampEn of the center of pressure were calculated. Following training, a moderate effect size was observed in the improvement in the TRN group for both Error Score (Pre M = 20.0 +/- 4.0, Post M = 18.7 +/- 2.9; Cohen’s dz = -0.62) and SampEn (Pre M = 1.06 +/- 0.12, Post M = 1.17 +/- 0.11; Cohen’s dz = .79). The CON group showed a very minimal effect in Error Score (Pre M = 21.3 +/- 4.5, Post M = 21.2 +/- 6.1; Cohen’s dz = -.02) and small effect in SampEn (Pre M = 1.14 +/- .07, Post M = 1.17 +/- .09; Cohen’s dz = .32). Decreases in error score and increases in SampEn as seen in our TRN group are associated with improvements in postural control, and thus balance. Our preliminary results suggest that a VR obstacle course environment is effective in improving postural control and balance compared to an active control group. Funding source: NASPSPA Student Research Award.

The Formation of a Categorization System for Spinal Manipulative Thrust Force Profiles Based on the General Motor Program Theory
Quinn Malone; Jaden Harms; Steven Passmore, University of Manitoba

Excluding preload and post manipulation events, the temporal characteristics of a spinal manipulative thrust tend to be invariant, while the magnitude of the force delivered by a clinician varies based on their intention. In a secondary analysis of normalized spinal manipulation force-time profiles delivered by chiropractors (N = 21), it was observed that there were differences between individuals in the slope characteristics of each phase (preload, thrust, and resolution). Findings consistent with the generalized motor program theory appeared to exist. Individuals were placed into phase-groupings according to invariant features of their force-time profiles in each phase. Three preload groups (Ramping, Slow-Discrete, and Rapid-Discrete), two thrust groups (Slow and Rapid), and two resolution groups (Slow and Rapid) were identified. Two root mean squared error (RMSE) values were computed for each participant: 1) the RMSE between the participant’s average curve and the grand pooled mean curve from all participants in the study; and 2) the RMSE between the participant’s average curve and the pooled mean curve from all participants within their phase-grouping. The two RMSE values were compared using one-tailed paired t-tests within each grouping to determine if a lower value was found between individuals and their group, compared to the individual and the study population. The group RMSE values were significantly lower than the grand RMSE (all p < 0.05), indicating that variability is significantly lower within the phase-groupings. Other variables, including integrals and peak-to-peak ratios, are discussed. The results provide evidence that the invariant features of motor programs controlling spinal manipulation thrust delivery cause individuals to express force-time profiles that fall into distinct phase-groupings. We propose a categorization system based on general motor program theory for the different aspects of spinal manipulation, potentially laying the groundwork for further clinical study into the efficacy of various manipulation delivery approaches. Funding source: Research Manitoba (Formerly Manitoba Health Research Council).
An Examination of Motor and Physiological Behavioral Changes When Using a Virtual Reality Treadmill

Logan T. Markwell; Jessica L. Katz; Jared M. Porter, University of Tennessee, Knoxville

The development of virtual reality (VR) technology has greatly improved over the last few decades. During this progression, the use of VR has transformed from a two-dimensional interface into a fully immersive environment. This innovative technology is projected to continue to become more widely available and accessible to the general public as costs continue to fall. Recent research has shown that skill acquisition in VR can positively transfer to non-VR settings. However, little is known about the behavioral effects of practicing in a more immersive VR setting. This study examined differences in physiological and motor behavioral measurements while walking on a traditional treadmill compared to a 360-degree virtual reality treadmill. Participants (N = 16) completed four 5-minute walking trials in a random order: two on a traditional treadmill (TT) and two on a 360-degree virtual reality treadmill (VRT). For both treadmill types, participants completed a self-selected walking pace and a set walking pace at 97 steps per minute. Significant differences were observed between walking trials in all physiological and behavioral measurements (p < 0.001). Rating of perceived exertion, heart rate, oxygen consumption, and respiratory exchange were lower while walking on the TT compared to the VRT (p < 0.005, all measures). The biomechanics of walking on the VRT also differed compared to the TT. In addition, the oxygen consumption on the VRT was approximately 50% greater compared to the TT. Most noteworthy, the variability of oxygen consumption was nearly three times greater on the VRT (16.7 ± 3.4 SD) compared to the TT (11.5 ± 1.2 SD). Research has shown that as individuals learn new motor patterns, there is a reduction in oxygen consumption. The results of the present study suggest that walking on the VRT was more efficiently executed by some participants relative to others. This finding underscores the learnable nature of the practiced task. Additional research examining the acquisition of motor skills in immersive virtual reality environments is warranted.

The Effects of Attentional Focus on a Sport-Specific Skill and Efficacy Beliefs

Dimitrio Martinez, Denison University; Doug Hamman, Texas Tech University; Melanie Hart, Texas Tech University

Researchers have consistently found that a learner’s attentional focus can influence motor skill learning, and most recently, cognitive and affective outcomes. Although external focus is often associated with superior performance acquisition, questions are emerging about types of external foci and the conditions under which they might be most effective. This experimental study examined the influence of attentional focus on performance of a complex sport-specific skill and related efficacy beliefs. Sixty-five college students were randomly assigned to one of 3 attentional foci groups (i.e., internal focus, proximal external focus, and distal external focus) in a between-subject research design. Repeated measures analyses of variance were conducted to examine tennis serve performance and efficacy beliefs’ changes over time, along with differences among treatment groups. Results of the analyses revealed significant group differences on serve performance (p = .028), with distal external focus group performing most accurately, whereas assignment to internal focus condition was associated with the least accurate performance (p = .015). Findings revealed motor performance differences, but no differences in self-efficacy. These findings offer support for the constrained action hypothesis and highlight the advantages of adopting a distal external focus for optimal motor skill performance in a complex sport-specific task.

Perceptual Recalibration as a Window to Understand Motor Skill Transfer and Learning

Anthony M. Mayo; David I. Anderson; Danila Burshteyn; Kimberly T. Liu, San Francisco State University

The study of perceptual motor recalibration could provide insights into the nature of motor control. Understanding the limits of recalibration can help us understand how units of action are organized in addition to the contexts in which transfer of skill learning is likely to happen (Rieser, Pick, Ashmead, & Garing, 1995). We conducted a study on how vision influences the control of locomotion (walking [W] and crab-crawling [C]) using a prism adaption paradigm similar to the one used by Martin, Keating, Goodkin, Bastian, and Thach (1996). Participants walked and/or crab-crawled 10 meters toward a target in three phases: 1) while blindfolded (pretest – three trials), 2) while wearing prism goggles that shifted vision 30 degrees to the right (adaptation – five trials), and 3) blindfolded again (posttest – three trials). We expected the adaptation trials would bias locomotion toward the left of the posttest trials. Twenty participants were randomly assigned to one of four conditions: (a) WWW, (b) WCW, (c) CCC, and (d) CWC. The dependent measure was the difference in the final lateral deviation from the target between the pretest and the posttest trials. The results indicated no significant differences in pre- to post lateral deviation scores between the conditions WWW (M = 63.16 cm; SD = 25.49 cm) and WCW (M = 11.00 cm; SD = 47.71 cm) t(8) = 2.16, p = 0.07 and the conditions CCC (M = 85.06 cm; SD = 66.68 cm) and CWC (M = 58.02 cm; SD = 161.20) t(8) = 0.35, p = 0.74. All groups showed evidence of adaptation to the visual distortion over the adaptation trials, evidenced by a reduction in the maximum lateral displacement during locomotion to the target. Our findings showed that perceptual recalibration can transfer across different locomotor patterns, however we urge caution in accepting the findings due to the small sample size and large variability within conditions. We discuss the findings relative to traditional and contemporary theories of motor control as well as the contexts in which transfer may occur.

Finding One’s Challenge Point Using Self-Control of Task Difficulty

Laura McIntosh; Cheryl Coker, Plymouth State University

Evidence exists that self-control of task difficulty facilitates skill acquisition (Andrieux et al., 2012, 2016) supporting the challenge point hypothesis (Guadagnoli & Lee, 2004). Whether these results generalize to clinical practice however, remains in question since the tasks employed were computer based. The purpose of this study was to determine if those with autonomy over task difficulty would benefit when learning a clinically relevant balance task. The task was to maintain balance over a 30-second period on a balance board with an adjustable base that allowed for three different levels of difficulty. Participants selected the level of difficulty was self-controlled throughout two practice sessions by autonomous group participants (AG; n = 11) and imposed on yoked group participants (YG; n = 11). Each participant performed a pre, post, and retention test at the Easy level. A board with a smaller diameter platform was used for the transfer test. Participants also completed the NASA TLX to assess workload of the task. Results indicated that participants significantly improved time in balance during the post, retention and transfer tests compared to pretest performance. No significant differences between AG and YG were found. All AG participants chose to progress from easy to medium to hard in the first practice session although the number of trials at each level varied. In the second practice session, all but 4 participants followed the same progressive pattern. There was no significant difference in the number of times a level of difficulty was chosen. Different strategies for maintaining balance were observed during practice and were dependent.
on the degree of movement allowed by the angle of inclination. On the easy level, participants predominantly adopted an ankle strategy. As the difficulty level increased, the use of hip strategies to maintain balance also increased suggesting that the postural control strategies adopted as a function of task difficulty may have influenced the results.

**Incidental Choices Enhance Perceptions of Autonomy but not Motor Performance or Learning**

*Bradley J. McKay; Diane M. Ste-Marie, University of Ottawa*

Two experiments employed pre-specified designs of increasing precision (N = 56, N = 128) in order to test five predictions made by OPTIMAL theory: 1) incidental choices enhance autonomy, 2) autonomy enhances motor performance, 3) autonomy enhances motor learning, 4) autonomy enhances self-efficacy, and 5) in general, variables that enhance performance enhance learning. OPTIMAL theory also recommends self-control of feedback and practice scheduling in practical settings in order to enhance autonomy. In contrast, recommendations emanating from the guidance hypothesis and schema theory suggest important effects of feedback and practice schedules and recommend specific scheduling constraints. These competing recommendations were examined by exploring possible interactions between autonomy and scheduling. Using 2 x 2 factorial designs, Experiment 1 had self-control (incidental choice vs. yoked) crossed with feedback schedule (100%-KR vs. 50%-faded-KR), and self-control was crossed with practice schedule (variable vs. constant) in Experiment 2. Autonomy and scheduling did not interact in either experiment. In Experiment 2, constant practice was more effective for performance but less effective for learning than variable practice, and this change in effectiveness was significant (p = .005), thus contradicting prediction 5. Further, a random effects meta-analysis of the two experiments suggested that incidental choice enhanced perceptions of autonomy support (g = .44, 95% CI: 0.16, -0.72), however, it did not enhance motor performance (g = -0.09, 95% CI: -0.55, 0.37), motor learning (g = -0.09, 95% CI: -0.32, 0.14), or self-efficacy (g = 0.9, 95% CI: -0.12, 0.31). These results fail to support four of the predictions tested within OPTIMAL theory, despite providing evidence that incidental choices can enhance autonomy.

**A Systematic Review of Interventions to Improve Gait Asymmetries**

*Krissa G Meder; Christopher K Rhea, University of North Carolina at Greensboro*

Musculoskeletal and neurological diseases can lead to the development of gait asymmetries that can increase energy expenditure, reduce overall function, and/or increase fall risk. A variety of interventions have been used to improve gait asymmetries, but the literature lacks a systematic review on this topic, which could help guide future research and clinical practice. This review examined the current non-invasive and non-pharmacological methods used to reduce gait asymmetries. Keyword searches were conducted using SPORTDiscus, PsycINFO, and PubMed, resulting in 320 journal articles. Studies were included if they focused on the following: (1) adults, (2) lower extremity motion, (3) asymmetrical gait, and (4) an intervention to correct the asymmetries. This inclusion criteria led to 26 studies. Participants studied were primarily stroke survivors (n = 19), followed by people with Parkinson disease (n = 3). Most studies had sample sizes of thirty or less (n = 22). Gait asymmetries were mainly assessed using motion capture (n = 12), GAITRite (n = 6), force plates (n = 6), or electromyography (n = 4). The most common techniques used to correct gait asymmetries were split belt treadmills (n = 4), weight shift training (n = 4), orthoses or insoles (n = 5), resistance mechanisms (n = 3), and auditory cues (n = 2). The intervention duration ranged from 1 session to 12 weeks of training. Gait asymmetries were quantified by spatial and temporal asymmetry parameters, such as step length (n = 21), swing and stance phase durations (n = 15), single leg support time (n = 4), and ground reaction forces (n = 5). Improvement in at least one asymmetrical gait variable was demonstrated in most studies (n = 21). Collectively, this systematic review highlights the range of methods, sample sizes, and participant characterizations examined in gait asymmetry research. Future work should focus on linking specific gait asymmetry metrics to functional outcomes and/or fall risk, as well as exploring the necessary frequency, intensity, and duration of various intervention strategies to get the desired gait symmetry.

**Bilateral Symmetry of Balance Measures in Healthy Young Adults**

*Ben Meyer, Shippensburg University*

Several investigators have utilized balance measurement systems in athletic populations to examine the influence of balance on improving performance. In young healthy athletes, it has been suggested (Brown et al., 2018) that single-leg balance may better represent an athlete’s potential to maintain balance as opposed to two-legged balance. The purpose of this project was to compare balance index scores between the right and left legs in healthy young adults. Twelve males and seven females (82 +/- 18 kg, 1.74 +/- 0.11 m, 21 +/- 1 years) performed a Bilateral Comparison Test. The test required participants to stand on a single leg on a static platform for 30 seconds while maintaining upright balance. A Biodex Balance System SD (Biodex Medical Systems, Shirley, NY) was used to measure the sway index about the medio-lateral (MLI) and antero-posterior (API) axes of the participants, as well as an overall sway index (OSI). Sway index measures the mean absolute deviation of the patient’s average position during the balance test. The larger the sway index, the more unsteady the person was during the test. The sway index values were slightly smaller for the left leg than for the right leg across all axes: API 1.26 vs 1.35; MLI 0.88 vs 0.92; and OSI 1.54 vs 1.65. The percent differences between left and right legs were 29%, 17%, and 21% for the API, MLI, and OSI, respectively. The correlation r-values between legs were small to moderate: API 0.33, MLI 0.53, OSI 0.44. The results of this study add to the existing literature on bilateral symmetry in balance tasks. The mean OSI values from the present study fall within the range given by Brown et al. (2018) for rugby forwards and backs. The percent differences found in the current investigation are within the range shown by Riemann and Davies (2013), who found differences between dominant and non-dominant legs of -4%, 36%, and 12% for the API, MLI, and OSI, respectively. In order to make useful comparisons, future research should address the lack of normative data unique to the type of sport, position, and leg.

**The Relationship Between Visual Search Strategy and Responses in Baseball Infielders**

*Kanta Miyashita; Syunpei Kikumasa; Masahiro Kokubu, University of Tsukuba*

The purpose of the present study was to conduct two experiments of different scales among small-sized and actual-sized baseball fields to examine the visual search strategy of infielders who respond better to a ball hit by a batter. Twelve infielders belonging to university baseball clubs participated in the series of experiments. In the task, a batter hit a pitched ball, and the participants, standing at the shortstop position, responded as quickly and accurately as possible to catch the ball. In the small-sized field, the distance between the batter and the pitcher was 3.5 meters, and the distance between the batter and the participants was 7 meters. In the regular field, the distance between the batter and the pitcher was 18.44 meters, and
The distance between the batter and the participants was 37 meters. Two experts evaluated participants’ response in the small-sized field. Based on their responses, they were classified into three groups: superior, intermediate, and inferior groups. During the experiment, the participants wore an eye tracker and their gaze direction was measured from the time of pitch initiation to the bat-ball impact time. The analysis parameters were the gaze position, the gaze pattern, and the number of gaze shifts from the time of pitch to the bat-ball impact. All parameters were compared between groups. Results showed that at the time of pitch initiation, the superior and intermediate groups usually watched the batter, whereas the inferior group watched the pitcher. At the time of bat-ball impact, all groups watched the impact position. The number of gaze shifts and gaze shift patterns decreased as the response skill level increased. These results suggest that, first, players with superior response have stable and less gaze movement; second, maintaining gaze in the direction of the batter leads to improved response; and third, the visual search strategy performed in small-sized fields reflects the visual search strategy used in the regular field.

The Effects of Weight of the Baseball Bat During Training on the Swing Characteristics of Elite Baseball Players

Erika Mora, Louisiana State University; Olivia Smit, Louisiana State University; Neil Johannsen, Louisiana State University; Michael MacLellan, University of Prince Edward Island; Jack Marucci, Louisiana State University; Nathan Lemoine, Louisiana State University; Arend Van Gemert, Louisiana State University

The purpose of this study is to determine whether training with a lighter bat will increase regular weighted bat swing velocity. Baseball players who engaged in previous collegiate or professional play volunteered to participate. They were randomly assigned to begin with a bat 20% heavier or lighter than their preferred bat. Participants were tested four times over six weeks. They were tested at baseline, trained with the assigned bat (light or heavy bat) for 2-weeks, and returned for post-testing. Weeks three and four consisted of a washout period with no training. Weeks five and six participants were tested for a pre-test, trained with the alternate bat assigned and returned in 2-weeks for a final testing session. Testing sessions consisted of hitting a baseball with participants preferred bat off a tee into a net. Preliminary findings suggest that a light bat resulted in a marginal increase of average bat peak velocity (ABPV) in m/s from baseline (M=31.51, SD=1.61) to post-test (M=32.04, SD=1.11). Currently, we are testing whether ABPV is altered significantly after training with the heavy bat. The preliminary findings suggest that utilizing a light bat may help to increase swing velocity. We are still determining whether the use of a heavy bat during training will significantly improve swing velocity. The current study may guide as to whether baseball athletes should implement a training regimen during practice that requires training with a light and/or heavy bat specified to their preferred weighted bat. As previous research has failed to observe the effects of using weighted bats in training with ball contact or live hitting practice, the current study would provide an alternative training regimen to increase batting performance.

Individual Differences in Incentive Sensitivity Moderate Performance in a Pressure Situation

Florian Müller; Marie Wellnitz; Katharina Abad Borger; Christina Maria Kellermann; Rouwen Cañal-Bruland, Friedrich Schiller University Jena

That the presence of incentives influences behavior is a basic finding of animal studies and learning psychology (e.g., Thorndike, 1905). Naturally, corresponding findings have been reported in the domain of motor learning and performance (e.g., Abe et al., 2011; Wächter et al., 2009). Building on the idea that incentives’ effects are highly dependent on the organism’s needs (Lewin, 1935; e.g., food is only an incentive for hungry rats) motive disposition theory (McClelland et al., 1989) postulates that individuals exhibit stable differences in their achievement, affiliation, and power motives – shaping their capacity to perceive performance, social affiliation, or competitive contexts as rewarding. To assess these interactive effects of individuals’ motives and contextual incentives on motor performance, we built on paradigms from choking research in golf (Beilock & Carr, 2001), that often use competitive or team settings in order to create performance pressure. Note though, that competitive and team settings also constitute prime examples of power and affiliation incentives. Consequently, we hypothesized participants’ power (vs. affiliation) motive to be related to golf putting performance in competitive (vs. team) settings. Specifically, after a familiarization phase a total of 121 participants completed a baseline assessment of golf putting performance, followed by an experimental block manipulating the task’s incentives (competition, team, control) between participants. Analysis of participants’ previously assessed motives revealed that – in line with hypotheses – their affiliation motive was positively related to performance in the team setting (p = .02). In contrast, no relationships were found for the power motive (p > .9) and the achievement motive (p > .1). These findings highlight the role of personality differences in predicting motor performance variability in established paradigms and underline the need to further explore the boundary conditions for the arousal of specific motives (for a recent review on the issue see Müller & Cañal-Bruland).

Do Baseball Batters Perceive Straight Ball Trajectory as Straight?

Daiki Nasu; Toshitaka Kimura; Makio Kashino, NTT Communication Science Laboratories

Ball trajectory can be easily measured in baseball with the recent development of ball tacking systems. However, the trajectory output by the system and the trajectory perceived by the batter may be different. For example, a four-seam fastball, the most basic type of pitch, is slightly deflected, but batters, anecdotesly, perceive the trajectory as being straight. We hypothesized that this is because the batters have learned the pitching motion and the ball trajectory in an integrated manner. This study verified this hypothesis by psychophysical examinations in a realistic situation. Seven semi-professional batters and two coaches viewed the delivery of balls launched from a pitching machine synchronized to videos of actual pitchers. They verbally respond whether the trajectory deflected to inside or outside the line of pitch. The machine created 5 types of throws in which the horizontal deflections were -46 ± 5, -24 ± 6, -2 ± 5, 19 ± 5, 41 ± 4 cm (3rd base side was positive) and ball speed was about 130 km/h. 3 types of pitching motion videos (L: left handed pitcher, M: pitching machine, R: right handed pitcher) were indicated. Each batter underwent total 180 trials (4 pitches × 5 deflections × 3 videos × 3 sessions). One-way repeated measures ANOVA indicated a significant main effect among the video conditions for the Point of Subjective Equality (PSE), calculated as the horizontal deflection at a 50% response rate, from the psychometric function (L: -8.2 ± 14.3 cm, M: -2.2 ± 9.3 cm, R: 6.4 ± 11.1 cm; F(2, 16) = 19.5, p < 0.001, partial eta squared = 0.71). Multiple comparison indicated significant differences in PSE between all conditions. That is, the batters perceived the ball trajectory was straight when the mean deflection was 6 cm to the 3rd base side for right handed pitcher and the mean deflection was 8 cm to the 1st base side for left handed. This suggests that the batters learned the pitching motion and the ball trajectory in an integrated manner. To summarize, the batter’s perception is modulated by the pitching motion and differs from the physics. Funding source: JST CREST, Grant Number: JPMJCR14E4, Japan.
The Effects of Differences in the Executive Functions Between Decision-Making and Visual Search Strategies of Soccer Players

Takayuki Natsuura, Tokyo Seikoku University; Takaaki Kato, Keio University; Masao Nakayama, University of Tsukuba; Takeshi Asai, University of Tsukuba

To achieve superior performance under intense temporal and spatial constraints, it is necessary to quickly and accurately assess the situation and react accordingly. In recent years, executive function has been getting attention from researchers as one of the factors predicting the performance of soccer players. The purpose of this study was to examine the effects of differences in the executive functions between decision-making and visual search strategies of soccer players. The participants were 42 university soccer players with different skills. Prior to a decision test, we conducted three design fluency tests as an executive function test for the players and ranked each variable accordingly. Out of the 42 players who completed this test, only ten scores were analyzed—the five good players (GPs) that scored the highest, and the five poor players (PPs) that scored the lowest. Following this, we conducted a decision test on both groups. During this test, while both groups were asked to determine the best player in the attacking scene, we measured eye movements simultaneously. In the executive function test, GPs had a significantly higher score than PPs. There was a significant difference in the accuracy of decision-making between the groups. In visual search behaviors, neither the gaze count nor the mean fixation duration per gaze revealed any significant differences between the groups. In the percentage of viewing time, a significant difference was observed between the groups during the time that was taken to direct their gazes toward the defenders. GPs had a higher accuracy of decision-making and this was characterized by a prolonged gaze toward the defender, compared with the PPs. The results supported previous studies, which have reported a positive relationship between successful sports performances of soccer players and their cognitive creativity (Kovac, 1996). Based on these facts, one can conclude that in ball sports such as soccer, executive functions—such as creativity, reaction suppression, and cognitive flexibility—are important factors for soccer players. Funding source: This work was supported by JSPS KAKENHI Grant Number JP19K20012.

Consistency of Postural Control Characteristics of Young Adults Across Multiple Testing Administrations

John Palazzolo; Scott Ross; Christopher Rhea, University of North Carolina at Greensboro

Balance testing is a way to measure neuromotor control, which can be compromised after sport- or military-related head trauma. A change in neuromotor control can result from a decline in neurological functioning from the head trauma, but it can also be due to a learning effect. Parsing out these confounding issues will assist in a more valid identification of neurological dysfunction. Phase one of this study used a custom smartphone app (AccWalker) to measure dynamic balance in a military population (n = 46) exposed to sub-concussive blast exposure and monitored their balance performance before blast exposure, and 24 hours, 72 hours, and 2 weeks post-blast exposure. The data showed a decline in neuromotor control in all the post-blast exposure testing points (p < .05), potentially highlighting the harmful neurological effects of blast exposure. However, it is unknown the extent to which these changes in performance may be related to a learning effect from multiple testing administrations of the balance test. Phase 2 of this study enrolled civilians (n = 5) with no self-reported head trauma and they were tested at the same four testing points (baseline, 24 hours later, 72 hours later, and 2 weeks later). In addition to AccWalker, the civilian participants completed two other common balance assessments [Neurocom Sensory Organization Test (SOT) and BTrackS Balance Test] in each testing session. It was hypothesized that no changes in neuromotor performance would be observed in any of the balance tests across the multiple testing administrations. No differences were observed across time in AccWalker, $F(3,9) = 1.00, p = .44$, or the BTrackS balance test, $F(3,12) = 0.88, p = .48$. However, a learning effect was observed for the Neurocom SOT in the composition score, $F(3,12) = 9.00, p < .01$, somatosensory ratio, $F(3,12) = 3.98, p = .04$, and vestibular ratio, $F(3,12) = 7.56, p < .01$. These data indicate that changes observed in AccWalker and the BTrackS Balance Test are likely not due to a learning effect from multiple testing administrations, whereas the Neurocom SOT may present this issue.

Learning of 1:2 and 2:1 Bimanual Coordination Patterns: Proactive Effects on Learning

Stefan Panzer, Saarland University; Christina Pfeifer, Saarland University; Charles Shea, Texas A&M University

At times individuals are required to modify a previously learned bimanual coordination pattern when circumstances require some part of the original pattern to be changed. For example, a piano player must sometimes switch between coordination patterns, e.g., from one key-press with the left and two key-presses with the right hand (1:2) to two with the left and one with the right (2:1). The important theoretical questions are: How does the motor system accomplish this transition? Does the system create a new representation in parallel by borrowing a template from the previously learned pattern, or does the motor system modify or edit the previously learned movement structure, effectively “overwriting” the old pattern? Overwriting would appear as retroactive interference if the performer is once again asked to reproduce the original pattern. However, if the system creates a new representation in parallel by borrowing a template from the previously learned/consolidated pattern proactive facilitation should be observed. The task was a multi-frequency continuous bimanual coordination pattern (1:2 or 2:1). A limb model consisting of two lines representing the positions of the two limbs was presented for 20 s prior to each practice trial. Then participants were required to perform the pattern for 20 s. In a proactive-retroactive interference design, participants (N = 24) were randomly assigned to one of three groups: an experimental group where participants practice the 1:2 and 2:1 pattern on two consecutive days (1:2–2:1) and two control groups where participants practice the 1:2 or the 2:1 pattern on one day. Retention performance was assessed 48 hr (1:2)/24 hr (2:1; 1:2–2:1) following acquisition. The results of the retention test indicated proactive facilitation of the absolute error of cycle duration ratio for the 2:1 pattern arising from previous practice of the 1:2 pattern for the experimental group. Thus, the representation underpinning the 1:2 pattern seemed to be borrowed to facilitate the development of a 2:1 representation in parallel. Funding source: grant number: PA 774/13-1; SPP 1772.

Forced Use of the Affected Leg During Walking Improves Gait in Individuals with Stroke

Seoung Hoon Park, Northwestern University; Jui-Te Lin, Shirley Ryan AbilityLab; Weena Dee, Shirley Ryan AbilityLab; Chao-Jung Hsu, Shirley Ryan AbilityLab; Elliot Roth, Northwestern University; William Rymer, Northwestern University; Ming Wu, Northwestern University

Background: Because individuals with stroke rely more on the non-paretic leg to compensate for motor impairments of the paretic leg, a way to force them in using the paretic leg intensely during walking may be effective for recovery of gait function. Objective: To determine whether applying a backward resistance force to the lumbar area during stance phase of the paretic leg (targeted resistance) would enhance muscle activities of the...
paretic leg and reduce step length asymmetry in individuals with stroke, compared with a common rehabilitation method applying a resistance force constantly during walking. Methods: Thirteen individuals with stroke participated in two experimental sessions. Each session included the treadmill walking either with targeted resistance or constant resistance and the overground walking before and after the treadmill walking. Results: The treadmill walking with targeted resistance significantly increased medial hamstring (MH) muscle activity of the paretic leg and step length symmetry in individuals post-stroke, compared with the constant resistance training \((p < 0.03)\). The increased MH muscle activity of the paretic leg and step length symmetry were retained even after the removal of resistance force \((p < 0.01)\). Further, the increase in symmetrical step lengths transferred from treadmill to overground walking \((p = 0.01)\). Conclusion: Forced use of the paretic leg induced by applying a resistance force during stance phase of the paretic leg while walking on a treadmill may lead to reduction in asymmetric gait patterns, which may transfer to overground walking in individuals with stroke. Funding source: R01 HD082216 NIH/NICHD.

Task Matters: Cognitive Task Type and Difficulty Level Differentially Mediate Age-Related Dual-Task Gait Performance

Miranda Pearce; Iris Martinez; Asha Vas; Hui-Ting Goh, Texas Woman’s University

Dual-task gait involves the coordination of motor and cognitive processes; aging has a differential impact on both. While age-related dual-task gait interference is well documented, the impact of different secondary cognitive tasks on dual-task gait remains unknown. The purpose of the study was to investigate the effects of cognitive task type and difficulty level on aging-related dual-task gait performance. Young adults \((n = 20, \text{M}_{\text{age}} = 26.3)\) and older adults \((n = 15, \text{M}_{\text{age}} = 71.8)\) walked for 30 seconds at a self-selected speed under single-task and dual-task conditions. The dual-task conditions involved a combination of 4 types of cognitive tasks (counting backward, verbal fluency, reaction time, and list recall) and 2 difficulty levels (easy vs difficult) for each task, yielding a total of 8 dual-task conditions. Participants were instructed to prioritize the cognitive task while dual-task walking. The outcomes were dual-task cost on gait speed and cognitive task performance under both single- and dual-task conditions. Overall, older adults walked slower than younger adults, and all participants walked slower under dual-task conditions \((p < .01)\). Repeated-measures ANOVA revealed a significant interaction between task type, difficulty level, and age on dual-task cost. The difficult counting task resulted in an increased dual-task cost compared to the easy counting task for young adults \((p = .03)\), but not for older adults \((p = .72)\). In contrast, the difficult reaction time task resulted in an increased dual-task cost for older adults \((p = .04)\), but not young adults \((p = .90)\). Both older and younger adults had a similar response to the change in difficulty level for the list recall and verbal fluency tasks. Regarding cognitive task performance, the change in difficulty level had a greater impact on older adults for all tasks (except list recall) in both single and dual-task conditions \((p < .01)\) for difficulty by age interactions. The findings suggest that age-related dual-task gait performance is differentially mediated by secondary task type and difficulty. Funding source: Small Research Grant (Texas Woman’s University).

Varying Effects of Rhythmic and Non-Rhythmic Auditory Stimuli on Movement Control

Carrie M. Peters; Cheryl M. Glazebrook, University of Manitoba

Rhythmic auditory stimuli (RAS) heard before a goal-directed reaching movement have been shown to elicit shorter reaction times, improve endpoint consistency, and supplement movement control when vision is unavailable. Mechanisms for improved performance with additional temporal information with RAS include attentional cueing, precueing, and improved movement planning. The current experiment used auditory stimuli before movement initiation, including a 1200ms 295Hz tone that stayed the same (tone same), a 1200ms tone that increased in pitch from 195Hz to 500Hz (tone change), three beats (RAS), and a no sound control. We predicted that the auditory conditions that gave precise timing information, including RAS and tone change, would elicit shorter reaction times and smaller endpoint error. We predicted that precise timing information about when the go signal would occur would enhance movement planning, which in turn would improve movement execution. The auditory condition was presented before a visual go signal, and participants were instructed to move quickly and accurately to one of two targets in the left and right hemispace. Four auditory conditions were presented with and without vision for a total of eight conditions. Fifteen young adults \((M = 25, SD = 1.7)\) performed 24 trials per blocked condition in a counterbalanced order, with target location randomized. Movements were quantified with 3D motion capture, and vision was occluded upon movement initiation with visual occlusion spectacles. A 4 Sound by 2 Vision repeated measures ANOVA was used to analyze dependent variables. All sound conditions had shorter reaction times compared to no sound, and tone change had faster movement times compared to RAS and no sound. No sound had lower peak velocities compared to tone same and tone change. Both the rhythmic and non-rhythmic auditory stimuli impacted movement control. However, how movement control was affected differed, indicating that how auditory information impacts movement planning and execution strategies depends on the type of auditory information. Funding source: Funding for this research was provided by the Natural Sciences and Engineering Research Council of Canada.

A Dual-Task Degrades Response Execution Based on a Visual-Spatial Movement Sequence Representation

Christina Pfeifer, Saarland University; Charles H. Shea, Texas A&M University; Stefan Panzer, Saarland University

An experiment was designed to investigate the impact of a dual-task (DT) on a previously learned movement sequence and if different movement sequence representations (visual-spatial/motor) are vulnerable to a secondary task in pre-planned or online controlled sequences. The experiment consisted of an acquisition phase where participants acquired the movement sequence under a single-task (ST) condition, a retention and two effector transfer tests where participants performed the sequence under a ST and DT situation. The primary task was a production of a 2000 ms spatial-temporal sequence pattern of elbow extension/flexion movements. Participants \((N = 45)\) were randomly assigned to either a pre-plan (PP), an online (ON) or an intermediate condition (IM). Half of the participants were permitted one-day of practice and the other half were allowed two days of practice followed by retention and transfer tests. Visual information during sequence execution was reduced from ON to PP. The transfer tests under DT included a simple reaction time task, which were randomly triggered when the participant reached one of the reversal points in the sequence. The mirror transfer test required the same pattern of muscle activation and joint angles in the contralateral limb as experienced during the acquisition phase, while in the non-mirror transfer test the visual-spatial locations of the target waveform were reinstated but the contralateral limb was used to produce the response. The results of the acquisition phase indicated that all groups increased their performance across two-days of practice. The analysis of the transfer test indicated that performance of the PP group on the non-mirror test deteriorated under DT condition compared to ST condition. This pattern of result was not observed for the mirror transfer test. These findings suggest that a dual-task degraded response
execution based on a visual-spatial representation in pre-planned movement sequences. However, response execution based on a motor representation was not affected by a dual-task. Funding source: Funding source: German Research Foundation (grant number: PA 774/13-1; SPP 1772).

Does Time Matter? Cognitive-Motor Integration Deficits in College Students with a History of Concussion from High School

Brandon Phillips, University of Kentucky; Briasha Jones, Louisiana State University; Marc Dalecki, Louisiana State University

Prolonged movement execution deficits during a cognitive-motor integration (CMI) task have been shown in youth with sport-related concussion history ~1.5 years post-event. However, it remains unclear whether these deficits do or do not transfer into young adulthood. Thus, the present study investigated CMI performance in young adults with a concussion history from high school. 20 college students with sport-related concussion history (CH; M = 21 yrs.; M = 49 months post-event) and 20 age-matched controls with no-history (NoH) performed two visuomotor tasks. In a standard task, they slid a finger along a vertical touch screen to move a cursor from a central target to one of four peripheral targets, i.e., eyes- and hand movement direction was aligned. In the CMI task, the finger was slid along a horizontal touch screen to move the cursor on the vertical screen. Cursor and finger movements were reversed 180°, i.e., eyes and hand movement direction was spatially decoupled. We analyzed movement planning, timing, and execution across groups and conditions, as well as the relation between CMI performance and the time since last concussion (months) in the CH group. ANOVA revealed no significant group effects for movement execution measures but a significant task x group interaction for a movement planning variable. The CH group had a larger initial direction error compared to NoH in the CMI condition (p < 0.01), and also tended to more direction reversal errors (i.e., finger was initially moved to target direction instead of away in CMI condition, p = 0.078). Correlation analysis within the CH group revealed a positive relation between CMI direction reversal errors and time since last concussion (r = 0.504; p < 0.05). Our results suggest that college students with a concussion history ~4 years did not show similar CMI movement execution deficits observed in youth 1.5 years post-event. Instead, the CH group developed CMI related spatial movement planning deficits, and their ability to decouple the naturally aligned eye-hand movement direction seemingly decreased with time post-event.

The Impact of the OPTIMAL Theory on Transfer Tasks

Mackenzie Pierson; Christopher Rhea; Louisa Raisbeck, University of North Carolina at Greensboro

The Optimal Theory (OT) has shown success in aiding motor learning and retaining new or modified movements (Wulf & Lewthwaite, 2016). As our research group presented at NASPSPA in 2019, OT along and an external focus of attention paired with components of OT did aid learning and retention of the box squat. A transfer task was also collected in combination with the squat. The purpose of the present study was to examine those transfer data to examine the extent to which safer mechanics at the knee can be transferred to similar tasks. The depth drop was used as the transfer task. Participants (F = 51, M = 24, 21.6 ± 2.2 y/o; 172.5 ± 14.4 cm; 76.8 ± 13.6 kg) completed the 2-day study where they were randomly assigned to one of five training groups: (1) OT, which included an External Focus (EF), Autonomy of Support (AS), and Enhanced Expectancies (EE), (2) only EF & EE, (3) only EF & AS, (4) only EE & AS and (5) control (no instructions). Participants performed 10 depth drops on day 1. After a 24-hour period, a retention test of 10 depth drops was conducted. No instruction related to knee separation distance (KSD) was given to participants for the depth drop. Instructional usage only was given in regard to the box squat. Task performance was based on knee separation distance (KSD) compared to hip width at peak knee flexion, recorded as the absolute error value from the neutral position. An error score was created for each trial. A 2 (day) x 5 (group) repeated measures ANOVA was used to compare groups across days. A day x group interaction was observed, F(4, 70) = 2.53, p = 0.048, partial eta .126. Follow-up paired samples t-tests showed that the OT group (p = .016) and EF & AS group (p = .01) showed a significant decline in error score (i.e., better performance) on the day 2 transfer test. All other groups showed no significant change when comparing day 1 to day 2 (p ranged from .08-.94). Our results suggest that with use of the OT in a stationary task, transferred skills for safer knee mechanics can be seen between the box squat and the depth drop.

The Influence of Timing and Spatial Parameters on Bayesian Inference

Osmar Pinto Neto, Anhembi Morumbi University; Leonardo Crespin, Universidade Camilo Castelo Branco; Victor Curty, Universidade Camilo Castelo Branco; Deanna Kennedy, Texas A&M University

Research has indicated that individuals use Bayesian inference to make predictions during sensorimotor tasks in uncertain conditions. The current investigation was designed to determine the influence of timing and spatial parameters on sensorimotor estimation. Participants (N=30) were required to estimate when and where a computer generated cursor arrived at a target location. The target location was predetermined using a Gaussian distribution. Participants first performed 300 certain trials in which feedback of the cursors position was displayed through its entire trajectory. Participants then performed 300 uncertain trials in which feedback of the cursors position was only available at the start, middle, and end of the trial. Performance accuracy was calculated using mean absolute error and performance variability was calculated using root mean square errors. A Bayesian analysis using subsets of participants’ total variance was also performed. As expected, the results indicated that participants were more accurate and less variable for both timing and spatial estimations in certain than uncertain conditions. During the uncertain condition, participants followed Bayesian principles with estimations towards the mean of the first 300 trials. The result also indicated a decrease in variability in spatial performance when the cursor’s end-point location was away from the mean. Overall, the results are consistent with Bayesian inferences for spatial estimations. Understanding how individuals respond in uncertain situations has both practical and theoretical importance. Funding source: FAPESP Process 2012/09400-9 to Osmar Pinto Neto.

Using Doppler Radar to Measure Motor Behavior

Jared Porter; Ozlem Klicic; Aly Fathy, University of Tennessee, Knoxville

Researchers and practitioners have used a variety of technologies to effectively measure human kinematics for several years. Common examples include two and three-dimension motion capture systems, using software to analyze recorded video or wearing some form of technology to record movement characteristics. All of the above mentioned methods require the use of expensive hardware and software, can be time consuming to calibrate, can only be used indoors in some cases, and may be uncomfortable for the participant. The present study investigated the use of Doppler radar technology to measure kinematics and artificial intelligence to process kinematic data. The experimental hypotheses were that this emerging technology would successfully measure and evaluate walking kinematics when a single or multiple persons were walking in a static environment. Participants walked at speeds ranging between 0.5 ms⁻¹ and 1 ms⁻¹ with arms folded or freely swinging. While participants walked, a
step frequency continuous-wave radar system with a fast frame rate assessed gait related behaviors. Data were then interpreted using algorithm-based artificial intelligence to understand micro-Doppler vibrations created by the movements of the arms, legs and torso of the walking participants. The results of the analysis indicated the ability to accurately interpret radar waves into accurate kinematic measures of movement frequency, velocity and movement coordinates. The radar was also able to measure multiple participants moving in the same space. In addition to measuring gait related behaviors, the radar also successfully detected heart rate. The findings of this study are far reaching and provide an alternative method to measure human kinematics. The technology described in the present study can be adopted to improve methods across a variety of settings including research laboratories, sport, military and rehabilitative environments as a cost effective solution to investigate the complexities of motor behavior.

Age-Related Changes When Turning in Anxiety-Inducing Environments: A Cross-Sectional Feasibility Study

Tiphanie E. Raffgeau, University of Utah; Ashlee D. McBride, University of Utah; Bradly Fawver, University of Utah; Mindie Clark, University of Utah; William R. Young, Exeter University; A. Mark Williams, University of Utah; Keith R. Lohse, University of Utah; Peter C. Fino, University of Utah

Older adults (OA) with a fear of falling demonstrate slower walking and poorer adaptive stepping performance, which can exaggerate fall-risk. Falling while turning increases the odds of hip-fracture eight-fold; however, researchers have yet to adequately examine the relationship between mobility-related anxiety and turning behavior in OA. We assessed age-related changes in turning performance under postural threat using virtual reality (VR). Ten healthy young adults (M_age = 28.5 +/- 8.5 yrs) and six OA (66.2 +/- 4.7 yrs) wore a head-mounted VR system displaying a 0.4 x 2.2 m virtual walkway matched to a real path. Participants turned 180 degrees on the walkway at a self-selected and ‘fastest comfortable’ speed in virtual low (ground) and high (15m) elevation settings. Self-reported levels of cognitive and somatic anxiety, confidence, and mental effort were obtained after each condition, while inertial sensors on the lumbar spine and both feet measured turning velocity. We used linear mixed-effect regressions to determine the effect of age, height, and instructed walking speed on self-report ratings and peak turning velocity. Ratings of cognitive (+1.1 pts, p = .004) and somatic anxiety (+1.1 pts, p = .003) and mental effort (+9.8 pts, p < .001) increased at height, whereas confidence decreased (-0.72 pts, p = .016). On average, participants slowed their peak turning velocity 16.1 deg/s from low to high height (p = .005) and increased turning velocity 28.5 deg/s during the fast condition (p < .001). An Age x Speed x Height interaction was revealed (p = .020), indicating that for OA reductions in peak turning velocity from the low to high settings were greater during self-selected (-4.4 deg/s) than fast (-2.3 deg/s) turns (p = .011). Findings support the efficacy of virtual height illusions for increasing anxiety, reflected in slower turning velocities and changes in self-report measures in both groups. The results suggest OA mobility may be affected to a greater extent in anxiety-inducing settings, warranting further research.

The Effects of Using Attentional Focus Cues during a Balance Intervention for Fall Risk

Louisa Raisbeck, The University of North Carolina at Greensboro; Lauren Higgins, The University of North Carolina at Greensboro; Ruth Stout, The University of North Carolina at Greensboro; Amanda Barclift, The University of North Carolina at Greensboro; John Palazzolo, The University of North Carolina at Greensboro; Taniya Wilson, The University of North Carolina at Greensboro; Jeffrey Labban, The University of North Carolina at Greensboro; Jeffrey Fairbrother, University of Tennessee, Knoxville; Christopher Rhea, The University of North Carolina at Greensboro

Attentional focus (AF)—both internal (directing attention to the movement) and external (directing attention to the effects of a movement)—affects the learning and performance of motor tasks. However, AF has not been evaluated as a longitudinal intervention to enhance motor performance. This study examined the effects of using AF cues during a 20-week dynamic balance intervention study that enrolled older adults with an elevated fall risk. Older adults, age 65–90 years, who reported falling at least once in the past 12 months (N = 51) were enrolled and assigned to either an internal focus (IF) (n = 22) or external focus (EF) (n = 29) group. All participants completed 20 minutes of balance training, twice weekly for 12 weeks using a wobble board. The EF group was cued to ‘keep the board parallel to the floor’ and the IF group was cued to ‘keep your feet parallel to the floor’. The abstract focuses on static balance control prior to, during, and after the 12 weeks of training. Participants stood still with both feet on a force plate for three 20s trials with eyes closed at week 0, 6, and 12 (intervention) and 13 and 16 (retention). Sample entropy (SE) of the COP displacement velocity for each trial was calculated then averaged together at each timepoint for each participant. Based on a manipulation check, participants were re-assigned to either the EF or IF group based on the type of AF they reported to use >50% of the time during the balance intervention sessions. A significant interaction effect was observed, F(4, 192) = 2.56, p = .04, η² = .05. Follow-up univariate analysis revealed SE was significantly greater (p = .01) for the EF group (1.21 ± .13) at week 16 relative to the IF group (1.10 ± .14). These results suggest that an EF cue continues to be effective during prolonged retention periods, further supporting the benefits of using a balance strategy facilitated by an external focus of attention. Funding source: NIH National Institute on Aging 1R15AG053866-01A1.

Gait Variability Alterations in Relation to Prior History of Concussion

Nicholas Reilly; Jacqulyn Moxey; Jessica Prebor; Eric Schussler, Old Dominion University

Concussion is associated with the adoption of a conservative gait pattern. Modifications are typically seen in the forms of decreased speed and cadence and increased stride width in order to maintain stability throughout the gait cycle. Variability of gait parameters has been shown to be a useful metric for determining dynamic stability and falls risk in multiple neuropsychological pathologies. However, gait variability is often not addressed when screening for concussion, leaving the duration of impairment following injury difficult to objectively quantify. The purpose of this study was to determine if individuals with a history of concussion exhibit differences in gait variability beyond the clinical determination of recovery. Fifty-three healthy participants were divided based on whether they reported no history of concussion (n = 27) or a history of one or multiple concussions (n = 26). Those with a history of concussion reported an average of 6.92 (± 5.67) years since their most recent injury. Gait parameters were collected by having participants walk across a 20-ft. pressure-sensitive walkway. Participants were instructed to walk along the pathway looking straight ahead first using their preferred gait pattern and second, a heel-to-toe tandem gait. There were no significant differences in mean gait velocity, cadence, stride length, stride width, or percent of time spent in double stance between groups. However, individuals with history of concussion displayed significantly lower variability of gait velocity (p = .007) and cadence (p = .046). Additionally, there was a group-condition interaction for stride length (p = .042). Collectively, observed decreases in variability seen in individuals that have a history of concussion support the notion that concussion results in an adapted gait pattern in order to...
maintain dynamic stability during movement. These differences indicate that concussion results in a reduced ability to adjust to external perturbations in the environment during gait, and that these deficits can persist for years following the initial injury.

**Stationary Cycling Exercise Improved Fine Motor Control in Older Adults with Down Syndrome**

Shannon Ringenbach, Arizona State University

Down syndrome (DS) is one of the most common developmental disabilities across all races and societies. One of the hallmarks of people with DS is that they have deficits in cognitive control compared with their peers. In addition to broad cognitive impairment, persons with DS have physical characteristics which limit their ability to perform activities of daily living (ADL) including deficits in fine motor control needed for handling money, self-care, eating, etc. As the relative prevalence of DS at birth lessens, and as life expectancy increases, DS will be most commonly represented amongst the elderly. Thus, intervention is needed in older adults with DS to improve their manual dexterity to sustain their independence and quality of life. The aim of this study was to examine the influence of Assisted Cycling Therapy (ACT) compared to voluntary cycling (VC) and no cycling (NC) on fine motor control in older adults with Down Syndrome (DS). Twenty-five older adults with DS were randomly assigned to one of three 30-minute interventions, which took place over an eight-week period of time. 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) Ten older adults with DS completed voluntary cycling (VC); and 3) Two older adults with DS were in no cycling (NC) intervention. Fine motor control was measured with the Purdue Pegboard placing pegs in small holes in 30 s with the right hand alone, the left hand alone, and bimanually pre and post 8 weeks of intervention. Our results showed that bimanual and total score (i.e., right, left and bimanually) fine motor control improved following both ACT and VC cycling exercise but not NC. This suggests that 30 minutes of exercise over 8 weeks has some positive effects on manual dexterity. Different mechanisms for this improvement will be discussed. This information is important to the independence and quality of life of older adults with DS. Funding source: Project HoneyBee.

**Distality Effects on Postural Regulation Mechanisms**

Karen Roemer, Central Washington University; Christian Kupper, Goethe University; Elizabeth Jusko, Central Washington University; Karen Zentgraf, Goethe University

Previous data from our lab revealed distinct distality effects of attentional focus on balance performance (Kupper et al., 2020). Distality dimensions investigated included both visual proximity/distality of the movement effect and the body-related proximity/distality of the controller. This study aims to investigate the postural regulation processes within the leg joints that led to the reported changes in balance performance. We hypothesized that the complexity of postural regulation during single leg stance (SLS) tasks (hop into stance, step into stance with three half squats, and stance on an airex pad) would be greater with more distal compared to proximal attentional focus. Distality of attentional focus was manipulated by varying the distance of the laser pointer attached to the head on a cone. Repeated measures design was used (N = 18; 10 M, 8 F) to investigate effects of these two aspects of distality on postural regulation processes in SLS tasks (hop, step, airex). OpenSim was used to compute joint kinetics. Joint contribution to postural regulation was quantified by multiscale entropy (MSEN) measures and overall complexity index (CI) of joint torque. Statistical analysis employed generalized mixed model and repeated-measures ANOVA. With more distal to the wall (W5 > W2.5, p < 0.05) MSEN measures indicated increased complexity for all joint torques. Additionally, distal compared to proximal focus (i.e., laser pointer controlled) indicated decreased hip joint contribution for the airex (F(1,68) = 5.16, p = 0.03) as well as reduced hip joint contribution while ankle joint contribution increased for the step task (F(1,68) = 5.00, p = 0.03). In conclusion, joint contribution to postural regulation is influenced by distality of the movement effect as well as the focus condition suggesting more automated postural regulation and particularly via the ankle joint with increased distality.

**Emotion and Joint Action: Valence and Arousal Sustain the Joint Simon Task’s Shared Representations**

John T. Roman; Christopher M. Janelle, University of Florida

Emotion’s influence on motor performance has been widely studied in individuals, but humans rarely act in isolation. When two individuals (a dyad) act together in joint action, shared representations enable dyadic members to account for each other’s unique actions and cognitions. The purpose of this investigation was to determine how shared representations and resulting joint actions are influenced by emotion. Per the referential coding account, we predicted that variations in emotion would sustain shared representations among dyads. A joint Simon task (JST) was performed in which participants (N = 70) with no perceptual information of their partner responded to images with opposing stimulus-response compatibilities. Response times (RSPT) to stimulus onset substantiated the joint Simon effect (JSE), indexing shared representation magnitude during joint action. Importantly, and contrary to the seminal work of Kuhbandner et al. (2010), unpleasant stimuli did not eliminate the JSE. Similar JSEs (ps > .05) emerged across differing levels of arousal and valence. Entering the testing room individually, the first participant of each dyad sat farthest from the exit and behind the divider curtain alone for five minutes. (J1L). Due to this context and perceptual difference, J1Ls possibly felt increased isolation but more attentive, manifesting in less closeness to their partner (d = .52, p = .05) and faster responses (d = .46, p < .001). Previous works suggested that closeness altered shared representations, but J1Ls only had faster RSPT while maintaining the same JSE as counterparts. Collectively, our data suggest that despite the variability in emotional intensity and pleasantness among dyads, they represented one another similarly. Nuanced and minor variation in environmental context yielded altered views of dyadic members, which affected ensuing responses but not susceptibility to shared representations. Our findings suggest potentially novel training approaches for dyads to perform better while maintaining valuable shared representation content.

**Microsaccade Dynamics Reveals Skilled Soccer Players’ Ability to Modulate Scope of Visual Spatial Attention for Scene Anticipation**

Naoki Sajo, NTT Communication Science Laboratories; Takaaki Kato, Keio University; Makoto Yoneya, NTT Communication Science Laboratories; Makio Kashino, NTT Communication Science Laboratories

Quick and accurate scene anticipation is critical for superior performance in interactive sports such as ball games and martial arts. While many studies have investigated how players control the direction of gaze, few studies have examined the span of visual spatial attention for anticipating the next scene. Based on previous studies suggesting linkage between spatial attention and microsaccade dynamics, we developed a novel method to estimate the span of visual attention from the dynamic properties of microsaccades (Yoneya, et al., 2017). Using this method, we examined
how the skill level of players affects the attention span to anticipate the next event in a sport scene. In the behavioral experiment, skilled and sub-skilled college soccer players were asked to report the direction kicked balls presented on a screen by pressing a button as fast and accurately as possible. The scene was occluded immediately after the kicking. There were two video conditions depending on the angle of view, namely wide-view and zoomed-view conditions. In both conditions, the results indicated that the skilled players generally reacted more quickly and accurately than the sub-skilled ones. The microsaccade dynamics changed not only with video size but also with skill level. The amplitude of microsaccades increased and the natural frequency decreased in the zoomed-view condition. These changes in the properties were observed when the attention span widened in a cue-target task. Additionally, the skilled players exhibited lower microsaccade rates and larger damping factors in the wide-view condition than the sub-skilled ones, indicating that the skilled players made their attention span narrower than the sub-skilled ones did. Moreover, this tendency was inverted in the zoomed-view condition, indicating that the skilled players set their attention span wider than the sub-skilled ones did. These results suggest that the scope of attention is modulated by the field of view and that skilled players control the scope of their attention effectively for quick and accurate scene anticipation.

**Rehabilitation of Self-Perceived Fall Risk vs. Objective Fall in Parkinson’s**

**Kishoree Sangarapillai; Benjamin Norman; Quincy Almeida, Wilfrid Laurier University**

Background: 70% of people with Parkinson’s disease (PD) report falls, which can lead to injury and increased hospital/long-term care facility stays, yet there is limited effectiveness of gold standard PD medications for reducing falls. As an adjunct, many exercise therapies succeed in objectively reducing the number of falls, but this may not translate to self-perceived fall risk. But importantly, self-perceived fall risk has a greater influence on activities of daily living, and hence QOL in those with PD. Purpose: To examine the association between self-perceived fall risk and characteristics of gait that are commonly linked to falls after a 12-week exercise intervention. Methods: 44 participants with idiopathic PD completed 12 weeks of PD SAFEx™. Pre/post assessment involved the Activities-specific Balance Confidence Scale (perception), objective falls characteristics (stride time, step width, step variability), and symptom severity (UPDRS-III) after participants were stratified into a mild (no-balance impairment) vs. severe (balance impairment) groups. Results: Overall disease severity (t(43) = 8.75, p < 0.0001) and all objective fall parameters improved (t(43) = -2.38, p < 0.032) in both groups, yet self-perceived fall risk improved in the severe PD group (n(43) = 9, p < 0.022 only). While no correlations between actual falls and self-perceived fall risk were identified in the mild group (R² = 0.022, n = 44, p = 0.059), there was a moderate negative correlation in the severe group (R² = -0.289, n = 44, p = 0.047). Conclusion: PD SAFEx™ was effective in improving actual fall risk and disease severity across both groups, however only the severe group showed improvements in self-perceived fall risk. Since fall risk-perception is more closely related to improved quality of life, identifying exercise strategies that improve both fall perception and objective falls may be important.

Using fNIRS to Investigate the Effect of Fidget Spinners on Cognitive and Motor Performance in Adults with ADHD

**Austin Schimmel; Reza Koiler; Elham Bakhshipour; Nancy Getchell, University of Delaware**

Introduction: Fidget spinners have been marketed as repetitive motion devices that improve attention and motor performance, and as such, they have become quite appealing to the ADHD population. To date, no studies have explored changes in brain activity that may occur due to fidgeting. Our aim was to use functional Near-Infrared Spectroscopy (fNIRS) to examine the prefrontal cortex (PFC) during performance of a standardized fine motor skills test after using a fidget spinner. Methods: Eight right-handed adults with ADHD and eight age and gender matched typical adults without ADHD (each group had 4 Females/4 Males, 4 control/4 fidget) performed the Purdue Pegboard Test (PPT) while their brain oxygenation was monitored using fNIRS. The design included 3 identical blocks, each consisting of either fidget spinning or doing nothing for 1 minute followed by 4 PPT subtasks and a rest condition. The first 4 subtasks (right unilateral, left unilateral, bimanual, and rest, 30 sec each) were pseudo-randomized for each participant with an additional assembly subtask always last (1 min). There was 15 seconds of rest between subtasks. Results and Discussion: Students t-tests were performed between typical and ADHD groups as well as subgroups including fidget and control. In the typical group there was a significant difference in ΔHbO for the more cognitively demanding assembly subtask between groups (p < 0.01), with the control group having a higher change in oxygenation than the fidget group. This suggests that fidget spinners may reduce the cognitive load on the PFC during a challenging fine motor task. In addition, the ADHD-fidget group showed significantly more PFC activation than the typical-fidget group in the assembly subtask (p < 0.03). This difference supports the findings that fidgeting may be a compensatory mechanism for those with ADHD, enabling them to increase attention as well as augment CNS arousal.

**The Relationship of Sensorimotor Adaptation and Learning According to Visual Information in Perceptual Motor Performance (in Virtual Reality)**

**Hyejin Seo; Seonjin Kim, Seoul National University**

The human brain has the capability to rapidly adapt to changing circumstances by using visual information corresponding to errors. Depending on the types of visual feedback provided, our brain chooses two different strategies for reaching movement, which affects motor adaptation and motor learning. In this study, we examined how adaptation arises through various types of visual feedback in virtual reality (VR) environment and examined the most effective feedback method that can be used while training for adaptation and motor learning. The following experiment examined 40 university students (40 males; age range 20–35 yrs, M = 27.4 yrs, SD = 4.3 yrs). Participants had no history of neurological disease and were right-handed. The 40 participants were divided into four groups of ten participants each which included: Group A (VA; visual adaptation task group), Group B (NVA; no-visual adaptation task group), Group C (VFA; visual first adaptation task group), and Group D (NVFA: no-visual first adaptation task group). The participants performed a reaching task in which they experienced 45 degrees clockwise visual-motor rotation. Despite any perturbation, participants were required for the adaptation task to reach the target accurately and rapidly. To evaluate task performance, we analyzed the following measures: total time to complete each trial, spatial error (computed differences between the straight line to the target and actual cursor trajectory), and initial spatial error. All groups showed improved sensorimotor adaptation from Day1 to Day 2. Spatial error was reduced in each subject. The initial phase of the reaching movement mostly relies on visual information so the spatial error of group A is more likely steady-state than group B. However, group B also became stable like group A in the rest of the adaptation section. Group C showed a pattern of quicker recovery to straight movement line than Group D in the wash-out region. Two different cognitive strategies according to the existence of visual information work synergistically to produce the sensorimotor adaptation.
Effects of Practicing Structured and Unstructured Complex Motor Sequences on Performance and Mental Workload

Alexandra Shaver, University of Maryland; Isabelle Shuggi, University of Maryland; Garrett Katz, Syracuse University; Gregory Davis, University of Maryland; James Reggia, University of Maryland; Rodolphe Gentili, University of Maryland

Although many studies have focused on motor practice and learning, few have examined performance and mental workload during practice of complex motor sequences. The latter involves the coupling of both cognitive and motor planning mechanisms to achieve a given task goal. While the processes that are engaged in breaking down the information for subsequent processing (chunking) have been studied in cognitive tasks, the analysis of such mechanisms in the cognitive-motor domain is limited. Thus, this study aimed to assess the performance and mental workload in individuals who practiced either a structured or unstructured action sequence, which enabled and hampered the identification and chunking of sub-sequences, respectively. It was predicted that the practice of structured sequences would lead to higher performance and reduced mental workload relative to unstructured sequences. Two groups of participants were asked to practice the imitation of a disk drive dock maintenance task after watching a demonstration of a structured or an unstructured action sequence presented via a virtual environment over several trials. Performance was evaluated by comparing the Levenshtein distance (LD) between the demonstrated and executed action sequences. Participants also completed the NASA Task Load Index survey every five trials to measure their perceived level of mental workload. The findings suggest that for both types of sequence, the performance improved (as indexed by a reduction of the LD) and the mental demand decreased from early to late practice. Also, compared to structured sequences, the execution of unstructured sequences led to poorer performance and higher mental demand during early practice whereas such differences were attenuated by late practice. This suggests that the practice of action sequences that can be chunked leads to a more efficient engagement of cognitive-motor processes to execute this complex task. This work can inform human motor behavior as well as the evaluation/validation of cognitive-motor robotic architectures and their interactions with humans. Funding source: This work was supported by The Office of Naval Research (N00014-19-1-2044).

Effect of Spatial Working Memory Resource Depletion on Attentional Reserve and Performance Under Various Cognitive-Motor Task Demands

Emma Shaw; Christopher Gaskins; Alexandra Shaver; Isabelle Shuggi; Rodolphe Gentili, University of Maryland

Prior work has validated the use of resource depletion as a means to directly probe the role of specific cognitive functions on human performance. However, much of this work was not conducted within the context of cognitive-motor performance and/or did not examine the underlying cortical dynamics. Thus, considering the relationship between attention and working memory, this study aimed to examine the effects of depletion of spatial working memory (SWM) resources (which are critical for spatial information processing) on performance and attentional reserve (i.e., pool of available attentional resources). Specifically, EEG and behavioral performance were collected as nineteen individuals with minimal prior videogame experience completed a cognitive-motor task (Tetris®) of low and high demand before and after undergoing SWM resource depletion. The latter took the form of an intensive mental rotation task. Attentional reserve was assessed via the novelty-P3 component of the event-related potential. The results revealed a reduction of attentional reserve as reflected by an attenuated novelty-P3 component amplitude and increased task performance post-depletion. These findings suggest that the resource depletion task which used repeated mental rotation applied to various shapes may have trained individuals to utilize similar cognitive processes critical for Tetris® (e.g., rotation of pieces) and ultimately resulted in enhanced task performance. However, the depletion of SWM also resulted in a reduction of attentional reserve which may have been due to the central executive reducing the allocation of attentional resources to task-irrelevant information in an effort to maintain information related to task-relevant goals in a depleted working memory. Thus, although the depletion task led to an improved performance on Tetris®, it also came at the expense of a reduction of attentional resources. Future work will consider EEG spectral and connectivity analyses to further understand the relationship between cognitive and motor mechanisms during performance.

Mental Workload, Performance and Psychological Processes Under Various Levels of Team Interdependence

Isabelle Shuggi, University of Maryland; William Galway, University of Maryland; Emma Shaw, University of Maryland; Christopher Gaskins, University of Maryland; Alexandra Shaver, University of Maryland; Matthew Miller, Auburn University; Hyuk Oh, University of Maryland; Rodolphe Gentili, University of Maryland

Past work has examined mental workload during performance of a cognitive-motor task in a team environment. Other studies have shown that trust influences efficacy beliefs, which can impact performance. While interesting, these efforts did not manipulate the teammate interdependence or directly consider the relationships between mental workload, motor performance and psychological factors. Examination of the relationship between cognitive, motor and psychological processes during teamwork is vital to understanding the key mechanisms of team performance. Thus, this work aimed to study the cognitive-motor and psychological (trust and efficacy beliefs) processes in humans while team interdependence was manipulated. First, participants practiced controlling a virtual robotic arm to reach targets via limited head motion. Then, they completed the same reaching task where the control of the robotic arm was shared with a synthetic partner. With this synthetic teammate, participants executed the task under three levels of interdependence where performance: I) mostly relied on the human (H) partner, II) mainly relied on the synthetic (S) teammate and III) resulted from equal control (EC) by both teammates. Results revealed that reaching performance in EC and S was comparable, while it declined in the H condition. Also, perceived mental workload was lower for the S compared to the H condition. Participants trusted their teammate more in the EC and S conditions relative to the H condition. No difference in efficacy beliefs was found. Overall, results suggest that: I) human participants were comfortable outsourcing components of the task to their teammate, II) the lack of difference in efficacy beliefs may be due to the uniqueness of the task impeding use of prior experience to develop efficacy beliefs and III) the cognitive-psycho-motor processes examined here may have different temporal dynamics. Future work will examine, via electroencephalography, the cortical dynamics underlying the relevant cognitive-psycho-motor processes under various levels of team interdependence.
Can Walking the Plank Identify Older Adults at Risk of Falling?

Ben Sidaway; Joseph Bennett; Robert DiMonte; Kerianne Downing; Shelby McGibney; Sarah Pare; Jeff Rome, Husson University

Examinations of gait in older adults have shown that mediolateral instability is a significant risk factor for falls. Thus, a simple assessment of dynamic mediolateral stability might be a useful tool in identifying older adults at risk of falling. To this end the current study assesses the performance of older adults walking on a series of planks, records the variability of gait parameters using a gait mat, and examines established clinical assessments of balance. Fifty community dwelling older adults (65–95 yrs. age) and 20 younger adults (20–35 yrs. age) attempted to walk along 6 m planks (12, 9, 6 cm wide) three times. Participants also walked unrestricted on a gait mat, performed the Narrow Path Walking Test (NPWT) on the mat, and completed the Activity-Specific Balance Scale and the Dynamic Gait Index. The number of falls 6 months before and 6 months after testing was also recorded. Analysis of variance revealed that older adults with a history of falling walked a shorter distance on the 9 cm plank and took fewer steps. Analysis of unrestricted gait velocity revealed no difference between older adults who had fallen (F) and those who had not (NF). No differences between F and NF were found for step length and step time but the NF group had significantly lower variability (CV) in these gait parameters than the F group. During the NPWT the F group exhibited greater errors than the NF group. The CV of step length and step time was greater in the F group than the NF group during the NPWT. Prior history of falls was inversely correlated with distance walked ($r_s = -0.73$) and number of steps ($r_s = -0.56$) on the medium beam. Falls were also correlated with step length CV and step time CV on the gait mat. The number of falls in the 6 months after testing was significantly correlated with medium beam distance walked ($r_s = -0.85$), number of steps ($r_s = -0.64$), and velocity ($r_s = -0.60$). These data indicate that walking performance on a 9 cm wide beam might be a cost effective way in which to identify older adults at risk of falling.

Relatedness Support Enhances Motor Learning in Older Adults

Carlos Ricardo Becker Silva; Suzete Chiviacowsky, Universidade Federal de Pelotas

Relatedness, identified as a fundamental psychological human need, represents the need to experience satisfaction regarding interpersonal closeness and acceptance. Recent studies have shown that providing individuals with instructions supporting the need for relatedness has improved motor learning in young adults (Gonzalez & Chiviacowsky, 2018; Chiviacowsky, Harter, Del Vecchio, Abdollahiapour, 2019). In the present experiment, we evaluated relatedness effects on the learning of a dynamic balance task in older adults. Forty-five participants were divided into three groups. A relatedness support group (RS) received instructions that emphasized acknowledgment, care, and interest in the participants’ experiences. In a relatedness frustration group (RF), participants received instructions that emphasized alienation and disinterest in the participant as a person. Participants in the control group did not receive specific relatedness instructions. The task required participants to ride a Pedalo for a distance of 7 m. They completed repetition and transfer tests one day later. After a pre-test and the practice phase, and before the retention test, participants answered questionnaires to evaluate perceived self-efficacy and affective levels in each group. The results showed higher performance and learning for participants in the RS group relative to the RF and Control groups. Higher scores of self-efficacy and positive affect were also found for the RS group. These findings demonstrate that practice conditions offering instructions that express proximity and interest in learners’ experiences, meeting the need for social relatedness, increase motor performance and learning as well as self-efficacy and affection in older adults.

The Distance Effect and Level of Expertise: Is the Optimal External Focus Different for Novices and Experts?

Harjiv Singh; Gabriele Wulf, University of Nevada

Focusing attention on a movement effect that is farther away from body (distal external focus) has been shown to result in more effective motor performance or learning than focusing on an effect that is in greater proximity to the body (proximal external focus). Yet, there has been some indirect evidence in line with the suggestion by Wulf and Prinz (2001) according to which novices who are in the process of acquiring the basic movement pattern might benefit from a technique-related (or proximal) external focus, whereas experts might benefit more from a distal focus that triggers the whole action necessary to achieve the desired movement outcome. No previous studies seem to have directly compared the effectiveness of distal versus proximal focus as a function of level of expertise. Thus, the present study examined whether the distance of the external focus impacts the performance of novices and experts differently. Novice ($n = 17$) and expert ($n = 12$) volleyball players passed a volleyball continuously to a target approximately 1.5 m in front of them. In the proximal focus condition they were asked to concentrate on the “platform,” whereas in the distal focus condition they were instructed to concentrate on the target. Experts’ accuracy scores were higher in the distal relative to proximal focus condition. However, novices’ accuracy scores were greater in the proximal relative to distal focus condition. Participants were also asked what their preferred focus was. Similar to performance, novices’ preferred the proximal focus to a greater extent and experts’ preferred the distal focus. We argue that the optimal distance of the external focus depends on the level of expertise when the skill requires a specific movement technique. An external focus on that technique seems to be more advantageous for novices. In contrast, when the movement pattern has become more automatic (experts), a focus on the overall movement effect is more beneficial.

Maximal Force Production Requires OPTIMAL Conditions

Harjiv Singh, University of Nevada; Arthur Hockwald, Purdue University; Nicholas Drake, University of Nevada; Jason Avedesian, University of Nevada; Szu-Ping Lee, University of Nevada; Gabriele Wulf, University of Nevada

One implication of the OPTIMAL theory of motor learning (Wulf & Lewthwaite, 2016) is that standardized motor performance assessments likely do not reflect maximal capabilities unless they are “optimized” with appropriate testing conditions. The present study examined the effects of three key motivational (enhanced expectancies, EE, and autonomy support, AS) and attentional (external focus, EF) variables in the OPTIMAL theory on maximum force production. In Experiment 1, a hand-held dynamometer was used to assess handgrip strength task. Participants ($n = 48$) were assigned to one of two groups. EE, AS, and EF were implemented in a counterbalanced order, on consecutive trial blocks in the optimized group. A control group performed all blocks under neutral conditions. While there were no group differences on block 1 (baseline), the optimized group outperformed the control group on all other blocks, $F(1, 46) = 10.24, p = .002, \eta^2_p = .182$. In Experiment 2, participants ($n = 32$) performed two one-repetition maximum (1-RM) back squat lift tests, separated by one week. Two groups had similar 1-RM values on Test 1 (neutral conditions). However, on Test 2, a group performing under optimized conditions (EE, AS, EF) showed a significant increase in 1-RM (+8.75 lbs), while there was no change from Test 1 to Test 2 for a

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control group (+0.625 lbs). The interaction of group and test was significant, $F(1, 30) = 6.98, p = .013, \eta^2 = .24$. We argue that standard test conditions do not produce true maximal performance. The findings corroborate the importance of key factors in the OPTIMAL theory and should be applied to ensure adequate strength performance assessment.

The Effect of Different Precision Demand and Visual Focus on Upper Limb Joint Kinematics and Muscle Activation During Object Transport While Walking

Ahyoung Song; Nikita A. Kuznetsov, Louisiana State University

Precise object manipulation while walking requires coordinated upper limb dynamics to preserve stability of the grasped object when it is perturbed by reaction forces from the ground. Previous studies have found that stability of the upper limb and the object can increase by modulating limb stiffness and damping via altered muscle activations as well as predictive control of grip force. Our recent study showed that the stabilization of the shoulder and elbow joints by anticipatory proximal-to-distal muscle activations also contribute to maintaining the stability of the object.

The current study investigates upper limb strategies for object transport with different levels of precision demand and visual focus of attention. Three-dimensional kinematics and surface electromyography were recorded from major upper limb muscles in three healthy young adults who walked on a treadmill while carrying an object (ball-in-cup system) in their dominant hand. Participants performed the task with high and low precision demands (with vs. without a small ball in cup) and two visual focus conditions (looking forward vs. looking at the cup). Upper limb damping behavior quantified using a ratio of vertical displacement of C7 and MCP joint, elbow joint angle, ball trajectory, and mean muscle activation were analyzed. Results showed that there was higher damping when carrying the object with a ball while looking at the object. The range of relative elbow flexion angle was higher when looking forward in both precision demands. The amplitude of the ball movement increased when looking at the object. During the high precision demand, participants showed higher muscle activations in eight upper limb muscles when they were not allowed to look at the cup and the ball, while in low precision demand condition, participants showed higher activations in seven muscles when they were allowed to look at the cup. Our preliminary results suggest that higher levels of muscle co-contraction are used to maintain stability of a carried object when visual information is not available.

Is There a Relationship Between Global Strength and Measures of Balance Control for Older Adults with an Elevated Fall Risk?

Ruth D. Stout, University of North Carolina at Greensboro; Lauren Q. Higgins, University of North Carolina at Greensboro; Amanda D. Barchlit, University of North Carolina at Greensboro; John M. Palazzolo, University of North Carolina at Greensboro; Taniya M. Wilson, University of North Carolina at Greensboro; Jeffrey D. Labban, University of North Carolina at Greensboro; Jeffrey T. Fairbrother, University of Tennessee, Knoxville; Christopher K. Rhea, University of North Carolina at Greensboro; Louisa D. Raisbeck, University of North Carolina at Greensboro

Fall risk is challenging to quantify in older adults since many variables interact to alter dynamic stability. Once such variable is strength, in which loss of leg strength has been implicated to increase fall risk. A proposed mechanism for this association is the declined ability to support body weight after a trip or slip has occurred. However, it is unclear the extent to which strength is related to a variety of clinical balance tests that are commonly used to assess fall risk. That is, it is unknown if strength is only related to more challenging balance assessments or to all balance assessments from which fall risk can be derived. This study examined the association between grip strength—a surrogate for global strength—and clinical balance assessments that included the Functional Gait Assessment (FGA), Berg Balance Scale (BBS), Timed Up and Go (TUG), and the BTrackS Balance Tracking System. The Activities-specific Balance Confidence scale (ABC)—a measure of perceived functional ability—was also included. Global strength was quantified by averaging left- and right-hand strength assessed via a hand dynamometer. Pearson correlations where used to assess the associations among global strength and balance/perception tests for 59 older adults (80.8 ± 5.9 years) who have fallen once in the past year, a group known to have an elevated risk of future falls. Global strength was positively correlated to the FGA, $r(57) = .29, p = .02$ and ABC, $r(57) = .40, p < .012$. Global strength was not associated with the BBS ($p = .21$), TUG ($p = .10$), and BTrackS ($p = .91$) assessments. These data suggest global strength as assessed via hand dynamometer may be associated with clinical balance assessments that are more dynamic in nature (FGA) or assess perceived functional ability (ABC), but may not be related to more static balance tests (BBS, TUG, and BTrackS). Future work will determine the extent to which strength may change in these participants during a 12-week balance training program, as well as the manner in which the examined relationships may be altered after balance training. Funding source: NIH/National Institute on Aging Grant Number: 1R15AG053866.

The Influence of Postural Stability and Yoga Experience on Perceptions of Other’s Postural Stability

Breanna Studenka; Melanie Athens; Kristina Casos; Joanna Coltrin; Eric McKinney; Juergen Symanzik, Utah State University

The aim of the current experiment was to determine whether judgment of other’s action capabilities is based on one’s own action experiences. We examined the stability judgments of individuals viewing an actor holding different postures. Two groups of participants were examined, one with extensive yoga experience (at least two times per week for the past three months), and one with minimal experience (no history of yoga, gymnastics, etc...). Furthermore, we measured postural stability and eye gaze as participants made stability judgments. We hypothesized that perceptions of other’s stability would be influenced by the unique experiences of the participant. More specifically, we hypothesized that those with yoga experience would judge an actor to be more stable than those without stability-specific experience. Furthermore, we hypothesized that the visual information used to judge stability would differ between different groups of individuals with unique action experiences. Lastly, we hypothesized that individuals with less experience balancing would exhibit more sway while making decisions about another’s stability, in particular for more difficult postures. Preliminary findings indicate that individuals who participate in regular yoga classes, or those who had participated in some yoga, scored better on a postural assessment (COBALT). Interestingly, those with better balance scores perceived another person to be less stable, and those who perceived themselves to be more fit had higher perception of another’s stability. One’s own fitness perception did not influence the perception of another’s fitness. Eye tracking and postural components of data are still being examined.

Different Learning Effect on Squat Exercise Regarding Types of Visual Feedback

Donghwi Suh, Seoul National University; Dongyoon Lee, Seoul National University; Seonjin Kim, Seoul National University; Seondeok Eun, National Rehabilitation Center, South Korea; Doohoon Koo, National Rehabilitation Center, South Korea; Minjoo Kim, Kyung Hee University

This study aims to compare the effects of visual feedback type on the parallel squat. We offered numerical value and color space of foot pressure.
increase in autistic traits negatively correlate with ML size estimation. Thus, the lack of AQ and SQ correlation with ML used in the present study, increases attentional load and promotes a superior press, and performance was measured as response accuracy. Performance analysis of both kinematic and quantitative data shows that participants in the feedback group had significantly lower variability than the control group, indicating more precise control of the ball. The results suggest that providing feedback on the variability of performance can be an effective means of improving motor skill learning.
Learning not to Dwell on it: Determining Components of a Functional Reaching Task Most Predictive of Learning in Older Adults

Peiyuan (Boki) Wang; Sydney Y. Schaefer, Arizona State University

Our recent studies have demonstrated that, contrary to common thought, older adults can learn and retain new motor skills regardless of their age. In our studies, participants manipulated a spoon with the non-dominant hand to acquire and transfer objects sequentially between center-out targets, very similar to common activities of daily living. To date, we have focused on how trial time changed due to practice. It remains unclear, however, how the skill is performed differently as the task is learned. Thus, we investigated whether selective training on the dwelling phase can improve learning, identify what movement strategies result in shorter dwell times, and test whether interhemispheric transfer also influences reaction times. Using the Poffenberger paradigm to indirectly measure neural crosstalk on response biases indicated that reaction time with the left limb was shorter and harmonicity was higher at ID = 5 for both unimanual groups. However, element duration was shorter and harmonicity was higher at ID = 3 for the bimanual group than for both unimanual groups. These results indicate that the accuracy demands of the task can influence both performance and learning of motor sequences and suggest there is a bimanual advantage for tasks that require low accuracy demands and a bimanual disadvantage for tasks that require high accuracy demands.

Response Biases: The Role of Interhemispheric Transmission Time

Yiyu Wang; Madison Davis; Sara Safdari; Deanna Kennedy, Texas A&M University

A recent experiment (Kennedy et al. 2019) investigating the influence of neural crosstalk on response biases indicated that reaction time with the contralateral limb was influenced by right limb force production, but not left limb force production or head position. The current investigation was designed to replicate the findings of the left limb reaction condition and to determine if interhemispheric transfer also influences the time required to react to stimuli. Using the Poffenberger paradigm to indirectly measure interhemispheric transmission time, right-limb dominant participants (N = 28, M_age = 21.9 yrs; 15 females and 13 males) were required to produce unimanual left, unimanual right or bimanual movement sequences using elbow extension and flexion movements to hit a series of illuminated targets. When one target was hit the illumination was turned off and the next target in the series was turned on. The targets were illuminated in a repeating sequence of 16 elements. Participants performed 20 practice trials (60 s). Thirty minutes following the practice trials participants performed a retention test. Element duration (time interval between target hits) and segment harmonicity (hesitations/adjustments in movement pattern) were calculated. The results indicate longer element duration and lower harmonicity values (more adjustments) when the task required higher accuracy demands (ID = 5) compared to low accuracy demands (ID = 3). Element duration was shorter and harmonicity was higher at ID = 3 for the bimanual group than for both unimanual groups. However, element duration was shorter and harmonicity was higher at ID = 5 for both unimanual groups than the bimanual group. These results indicate that the accuracy demands of the task can influence both performance and learning of motor sequences and suggest there is a bimanual advantage for tasks that require low accuracy demands and a bimanual disadvantage for tasks that require high accuracy demands.
participants to produce an isometric contraction with the left limb. Reaction time was calculated as the time interval between the color change of the waveform and the initiation of the response. The results indicated mean reaction time for the left limb was significantly influenced by force production by the right limb, regardless of visual stimuli location. Mean left limb RT was faster for trials in which both limbs initiated force simultaneously compared to trials in which the left limb initiated a force pulse while the right limb was producing force. This result replicates previous findings and supports the notion that neural crosstalk can influence the time required to respond to a stimulus. However, given that there were no significant differences with lateralized visual stimuli the results point to lower-level constraints through the uncrossed fibers of the descending tracts rather than inter-hemispheric interactions via the corpus callosum for the observed influence of right limb force production on left limb reactions.

**Practicing and Learning Dance Phrases With and Without a Mirror: A Comparison Study**

Emily Weber; Jennifer Didier, Sam Houston State University

Mirrors are commonplace in dance studios; however, there has been no research that has looked at when the mirrors are most beneficial during the learning of dance phrases. Mirror visual feedback has been found to increase neural activity for attention and cognitive control (Deconick et al., 2015) as well as enhance motor performance and induce neuroplasticity (Rjosk et al., 2017). Mixed results have been observed with the use of mirrors during learning. Dearborn and Ross (2006) and Radall and Adame (2003) found a benefit of mirrors for dancers, and power clean movements were better with the use of mirrors (Sewall et al., 1988). Mirrors, however, were not found to improve balance or Pilates movements (Notamica et al., 2014; Lynch, et al., 2009). The varied results could be due to experience levels or the type of movement activity. The aim of this study was to determine if mirrors were more beneficial at the demonstration and explanation (D) or practice (P) phase of learning dance phrases. Twenty experienced dancers were randomly placed in one of three groups. Group 1 (n = 7, Mage = 21, Dance years M = 14 ± 2) had D with mirror, P no mirror. Group 2 (n = 7, Mage = 20, Dance years M = 8 ± 5) had D no mirror, P with mirror. Group 3 (n = 6, Mage = 20, Dance years M = 9 ± 5) had D with mirror, P with mirror. Videos of dance performance for each participant were blind reviewed by four independent experienced dance instructors for movement accuracy and timing/musicality errors on scales of 1–5, with 5 equal to no errors. The results of a Kruskal–Wallis test were not significant for accuracy (H = 3.53, 2 df, p = .171) or errors (H = 4.55, 2 df, p = .103). Results showed group 1 to have the highest accuracy, while group 2 showed the best timing. This indicates movement accuracy may be increased using mirrors during D, while timing accuracy using mirrors during P. This data suggests additional data is warranted to determine the effect of experience level and learning strategies used with or without mirrors present.

**Perceived Workload During a 12-Week Attentional Focus Balance Training Intervention in Older Adults with a History of Falls: Preliminary Data**

Taniya Wilson, University of North Carolina at Greensboro; Lauren Higgins, University of North Carolina at Greensboro; Ruth Stout, University of North Carolina at Greensboro; Amanda Barchliff, University of North Carolina at Greensboro; John Palazzo, University of North Carolina at Greensboro; Jeffrey Labban, University of North Carolina at Greensboro; Jeffrey Fairbrother, University of Tennessee, Knoxville; Christopher Rhea, University of North Carolina at Greensboro; Louisa Raisbeck, University of North Carolina at Greensboro

Age-related increases in the attentional demand of postural control contribute to elevated fall risk for older adults. The literature supports that an external focus of attention reduces this attentional demand by allowing more automatic control processing. However, attention is only one aspect of the workload required for task execution, and it is unclear if attentional focus globally impacts workload. Thus, we investigated the effect of different attentional focus instruction on perceived workload during a 12-week balance training intervention in older adults with a history of falls (N = 18, 78.9 ± 6.1 yrs). Participants were recruited from the community and assigned to either an external focus (EF) group (n = 9, 76.3 ± 7.9 yrs) or internal focus (IF) group (n = 9, 81.5 ± 4.1 yrs). All participants completed 20 minutes of balance training using wobble boards, twice per week for 12 weeks. The EF group was instructed to “focus on keeping the board parallel to the floor,” while the IF group was cued to “focus on keeping your feet parallel to the floor.” Immediately following the first (session 1) and last training (session 24) days, participants completed the NASA Task Load Index (NASA-TLX). Scores for the six NASA-TLX dimensions were summed to calculate a global perceived workload score. Following the 12-week balance intervention, a small-to-medium effect size improvement (i.e., decline in perceived workload) was observed for the EF group (baseline M = 366.7 ± 83.7, week 12 M = 289.4 ± 140.9; Cohen’s dz = −.43), while a small effect size improvement was observed in the IF group (baseline M = 305.0 ± 114.4, week 12 M = 261.7 ± 179.3, Cohen’s dz = −.27). These preliminary findings suggest balance training can reduce perceived workload while maintaining upright stance during a challenging balance task, and that an external focus may reduce perceived workload to a greater degree relative to an internal focus. Funding source: NIH National Institute on Aging 1R15AG053866-01A1.

**The Influence of Thumb Posture on Muscle Patterns During Piano Performance**

Sara A. Winges, University of Northern Colorado; Justin Krawitz, University of Northern Colorado; K. Otto Buchholz, Shenandoah University; Jonathan Nichols, University of Northern Colorado

Developing expertise on a musical instrument requires extensive, repetitive practice making precisely controlled movements. For musicians, prevention and treatment of injury can include learning and selecting postures that reduce strain while still being comfortable and supporting the performance of the movements over relatively long periods of time (Fry, 1988). Novices have not yet learned how to move in this way so instruction regarding postures and movements that can help them reduce strain while playing is essential for injury prevention. Although some postures of the arm and trunk are typically prescribed, such as maintaining a neutral wrist position (Okawa et al., 2011), the more precise instructions of how to perform specific keystrokes are more variable across instructors/schools of piano performance. This study examined differences in muscle activity associated with different thumb postures while playing the piano. The specific hypothesis was: shifting the thumb posture to a more vertical “standing” position would result in less muscle activity than a more horizontal posture at thumb contact. We suspect that the shifted thumb contact point we propose will result in a thumb/hand posture that will allow pianists to better utilize their hand structure to create a stable segment that can transfer force derived from the forearm movement to the key and reduce the need for thumb muscle activity. Surface EMG was recorded from six muscles of the right and left arms from five piano students. Each student played two pieces short pieces and a set of exercises using their preferred posture followed by instructed “standing” or “side” thumb postures. A within-subjects repeated measures design revealed no significant differences in the amplitude of EMG (p > .05). Three of five participants had a trend for decreased EMG in the intrinsic thumb muscle for the “side” compared to “stand” thumb posture while the opposite trend
occurred for the extrinsic thumb muscle in both right and left hands. Individual results will be described using the relative difference in thumb postures.

**The Effects of Internal and External Focus Instructions on Performance and Learning of a Double Dutch Turning Task**

Kaylee Woodard; Jeffrey Fairbrother, University of Tennessee, Knoxville

A substantial body of research has supported the effectiveness of external focus instructions for motor performance and learning (Wulf, 2007, 2013). The benefits of external focus cues have been demonstrated most consistently using discrete tasks, while findings have been less consistent for continuous tasks. Presumably, the inconsistent findings might be attributable to the longer duration of continuous tasks, which affords greater opportunity to drift away from adherence to attentional cues. The present study was designed to expand current understanding regarding the effects of focus instructions on a continuous task and the nature of participants’ cue adherence during performance and subsequent tests of learning. Participants practiced Double Dutch turning under internal focus (IF) or external focus (EF) instructions before completing retention and transfer tests. Results of a 2 (group) × 6 (block) repeated measures ANOVA showed that the EF group performed significantly better than the IF during acquisition (p < .001). However, results of retention and transfer tests showed no learning differences between groups. Self-reported adherence ratings also suggested that participants in both groups focused on a variety of cues during acquisition and retention and typically adhered only partially to their given focus instructions. These results support the Constrained Action Hypothesis in that performance was superior for the EF group compared to the IF group. It is plausible that varied foci during learning tests contributed to the lack of between-group differences in retention and transfer.

**Using Novel VR Technology to Test Postural Control and Cognition May Detect Low-Level Changes Following Repetitive Subconcussive Head Impacts**

W. Geoffrey Wright; Jonathan Marchetto, Temple University

Sports-related TBI has been linked to impairments in postural control and cognition, which present significant challenges to athletes’ ability to participate in sports or perform activities of daily living. What is less well-understood is how accumulation of subconcussive impacts, which fall below the threshold of TBI, can contribute to short and long-term deficits. Of recent interest is the impact of soccer heading in subclinical sports-related trauma. This study examined postural and cognitive function head impacts using an experimental soccer heading model. Twenty-eight college-aged participants with soccer experience (n = 14 control; n = 14 experimental) were tested over 3 sessions. Both groups performed simultaneous virtual reality (VR) balance and Stroop cognitive assessments using a dual-task paradigm while wearing an Oculus Rift VR headset (HMD) and standing on a Wii Balance Board. Participants were asked to maintain their balance in 6 blocks of 3 trials (18 total) which varied based on the visual scene (stable, dark, rotating), surface (firm vs foam), and Stroop condition (none, visual, auditory). Center of pressure, head kinematics, and Stroop task accuracy and reaction time were recorded. The protocol was performed by both groups, however the soccer-heading group performed 10 headers at 25 mph between the baseline and post-test sessions (immediately and 24 hrs post). Using repeated measures ANOVA (3 sessions × 3 Stroop tasks × 6 postural conditions) for within-subject factors, and group as a between subject factor numerous significant findings suggest postural control and cognitive performance were impacted as a result of experimental manipulations. The effect of soccer heading was less clear, where a significant between group difference (p < .05) and marginal between group interaction (p = .10) suggest only low level effects. Because of the low intensity of the head impacts, this highlights the need for very sensitive metrics to detect behavioral or cognitive signs that may occur due to repetitive subconcussive blows early in an athlete’s career. Funding source: PA Cure.

**Spatial Working Memory Capacity in Elite Baseball Players**

Yoshiko Yabe; Makio Kashino, NTT Communication Science Laboratories

Spatial working memory has been shown to contribute to explicit learning process of motor tasks aiming at a target (Christou et al., 2016). Recognizing positions of balls and other players is a critical skill in many ball games. Here we conducted a spatial working memory capacity test in nine professional baseball players of Nippon (Japan) Professional Baseball Leagues, 12 semi-professional baseball players of Japan Amateur Baseball Association, and five university students of Tokyo Big6 Baseball League. At the beginning of each trial, we presented a circular array of red dots and a central fixation cross. The number of red dots was between three and six. The red dots disappeared after one second of presentation. Following a waiting period of four seconds, a black dot came out. Participants were required to judge if the black dot was presented on the position where one of the red dots was presented. Participants were required to keep looking at the central cross during the whole trial. We calculated K-value to estimate the working memory capacity using a standard formula: $K = S(H-F)$, where $S$ is the array size of the presented dots (mean K value for array sizes 5 and 6 was calculated for each participant), $H$ is the observed hit rate and $F$ is the false alarm rate (Vogel et al., 2005). The mean ± SD of the K values was 3.48 ± 1.24 (n = 26). The K value measured using the same task in 34 young healthy individuals by Christou et al. was 2.54 ± 0.21 (mean ± SEM). There was a significant difference between the K values in baseball player group measured by us and those in healthy individuals measured by Christou et al. ($t = 2.94$, p = 0.0048). When the K values were broken down into three groups, the mean K values were 4.01 ± 1.36 in the professional players, 3.3 ± 1.23 in the semi-professional players, and 2.95 ± 0.65 in the university league players. Although there was no significant difference among groups ($F_{2,23} = 1.47$, p = 0.25), our preliminary data indicates that the spatial working memory capacity is high in skillful players. Funding source: This study was partially funded by JST CREST (JPMJCR14E4).

**Knowledge and Attentional Focus in a Goal-Directed Task That Varies in Difficulty**

Masahiro Yamada, University of North Carolina at Greensboro; Christopher Rhea, University of North Carolina at Greensboro; Keith Lohse, University of Utah; Randy Schmitz, University of North Carolina at Greensboro; Louisa Raisbeck, University of North Carolina at Greensboro

Although the beneficial effects of using an external focus (EXF) over an internal focus (INF) have been consistent in motor learning (Wulf, 2013), how an EXF leads to superior learning is still ambiguous. This study investigated the effects of attentional focus on memory by assessing explicit knowledge (EK). Participants (EXF, n = 14; INF, n = 14; control (CON), n = 13) practiced a reciprocal tapping task for 30s. The tapping task was further segmented into 3 task difficulties that varied in size and distance. Participants completed 4 blocks of 9 trials (3 trials of each difficulty) for two days. Following practice, a 5-minute, 48-hour retention, and a transfer dual-task were completed. Participants were asked about their attention, thoughts, and techniques after each block and test. The EXF were coded into “no thoughts,” “techniques,” “affective,” “irrelevant,” and “sensations.” The amount of EK, regardless of the categories, was
analyzed with repeated measures of ANOVA for Group × Difficulty × Time during practice and tests. The five categories of the responses were analyzed with a chi-square. Post hoc tests were conducted with Bonferroni correction for ANOVA’s; for chi-square, the adjusted residuals were used after adjusting the p-value by the number of tests (i.e., z-criteria = -2.71). Alpha was set at .05 a priori. During practice, EK significantly decreased with time ($F_{2, 34} = 8.89, p < .01$) and was lower for easier tasks ($F_{2, 76} = 10.29, p < .01$). During the testing, a significant interaction between difficulty and groups was found ($F_{4, 76} = 6.40, p < .01$). Post hoc tests showed a greater EK during the 48-hour retention test in the EXF relative to the CON. The results of the chi-square showed a significant difference ($X^2 = 15.51$). Post hoc tests showed that the INF had a greater distribution of “no thoughts” and fewer “techniques,” which was opposite to the EXF group. The results are inconsistent with previous findings that INF led to greater EK; however, the task in the present study was simpler. Thus, the desirable amount of EK may be task-specific.

Potentially Deceptive Influences of the Vertical-Horizontal (V-H) Illusion on Manual Length Estimations

Shijun Yan; Jan Hondzinski, Louisiana State University

We examined potentially deceptive influences of the vertical-horizontal (V-H) illusion on manual length estimations. When viewing V-H illusory configurations, people perceive that vertical segment length exceeds horizontal segment length when segments are actually equal. Twelve right-handed participants (23 ± 4.9 years old) used vertically directed movements to estimate lengths of horizontal baselines for upright orientations of V-H configurations and used horizontally directed movements to estimate lengths of vertical baselines for rotated orientations of V-H configurations. They moved their finger off the 2D surface during curved pointing in a touch-lift-touch pattern, so that movement distance did not directly correspond to displacement, thus visual perceptions of baseline length. Movements also occurred toward or away from configuration intersections. Configurations included the inverted T (IT), modified IT (MIT, with off center bisection of the baseline), and L. For variation, we used two baseline lengths (45 mm or 60 mm), which were the horizontal segment for upright orientations and the vertical segment for rotated orientations. Relative lengths of the perpendicular segment included: equal to baseline; 10% increase in baseline length; 10% decrease in baseline length. Results revealed a significant configuration (IT, MIT, L) × orientation (upright, rotated) × movement mode (toward, away) interaction ($F(2, 22) = 11.47, p < .001, ES = .51$). Manual length estimations differed between upright and rotated orientations and followed common V-H illusionary perceptions only when moving away from configuration intersections to support that exploitation of deceptive two-dimensional influences can direct general upper limb control for sensorimotor coordination. However, manual length estimations for MIT and L exceeded those for IT only for rotated orientations when moving away from and not toward configuration intersections. These results differ from expected perceptual responses to support a control separation between perception and action for manual length estimations.

Eye-Hand Coordination and Postural Control Vary According to Changes in Cognitive-Motor Load

Matthew Yeomans; Shijun Yan; Jan Hondzinski; Marc Dalecki, Louisiana State University

Results from previous research reveal that people perform eye-hand coupling tasks faster and/or with greater accuracy compared to eye-hand decoupling tasks whether sitting and or standing. However, it is not known whether changes in body posture influence both tasks equally or whether the eye-hand coordination tasks alter sway during stance. With the possible existence of a bidirectional control strategy in mind, we addressed two aims in the present study. We investigated whether performance of eye-hand coupling/decoupling tasks differs when participants perform the tasks sitting or standing and to examine whether performance of eye-hand coupling/decoupling tasks alters postural control while standing. Eighteen healthy young adults (Mean age = 21 years) moved a cursor using finger movements as quickly and accurately as possible along a vertical touchscreen while sitting or standing. In the eye-hand coupling (EH) task, participants moved their finger/cursor from a central target to a peripheral target on the touch screen (up, down, left, right). EK required participants to move the finger and eyes to the target. The eyes-to-target and hand-away from target (EHR) task included a feedback reversal, (e.g., moving the finger to the left moved the cursor to the right), which induced a decoupling of eye and hand movement directions. Performing 40 trials for sitting and standing by condition generated 160 total trials. ANOVAs yielded greater speed and accuracy for EH over EHR ($p < .05$), but no significant effects of posture or its interaction on speed or accuracy ($p > .05$). In contrast, significantly lower medial-lateral, anterior-posterior, and radial displacement sway values for the EHR than EH existed for standing ($p < .05$). Our results show that eye-hand coupling/decoupling performance is similar between sitting and standing, and that postural sway decreases during a challenging eye-hand decoupling task compared to a simple eye-hand coupling task. The latter result provides support that the use of greater cognitive-motor demand for supra-postural control decreased postural sway.

A Comparison of Penalty Goalkeeping Between Male and Female Soccer Goalkeepers

Run Zhang, Vrije Universiteit; Xinyong Song, Shandong Sport University; John van der Kamp, Vrije Universiteit

Many studies (e.g., Causer et al., 2017) examined what information soccer goalkeepers use to predict the future direction of a penalty kick by employing video-based technology. In this experimental paradigm, goalkeepers watch video-clips of penalty takers and move a joystick to indicate the direction of ball travel. However, recent in-situ studies have underlined that soccer goalkeepers’ action capabilities are crucial constraints in predicting ball direction, which only transpires when goalkeepers actually make a dive to intercept the ball (Dicks et al., 2010). These studies only investigated male goalkeepers. However, since male and female athletes have different kicking (Chappell et al., 2002) and jumping (Ziv, 2010) abilities, the time constraints of penalty kicks (i.e., ball flight time in relation to goalkeepers’ action capabilities) may differ between female and male goalkeepers. Hence, female and male goalkeepers might adopt different goalkeeping strategies (e.g., initiating lateral dive early or late relative to ball contact). To this end, 11 male and 11 female goalkeepers of similar age, training experience and performance level were recruited for the current study. In addition, 12 female and 11 male soccer players of similar level were recruited as penalty takers, and required to kick towards the left or right corner area (0.81 × 1.50 m) of the goal either with or without deception for a total of 40 kicks. Two video cameras were used to record participants’ movements for off-line analysis. The preliminary results based on 5 male and 5 female goalkeepers show that male kickers ($M = 584$ ms) kick faster than female kickers ($M = 642$ ms) and male goalkeepers ($M = 746$ ms) dive faster than female goalkeepers ($M = 858$ ms). Combining diving time and ball flight time, the time constraint is stricter for female than male goalkeepers. In accordance with the difference in time constraint, the results also revealed that female goalkeepers initiated lateral dives (184 ms before ball contact) earlier than male goalkeepers (118 ms) and consequently were more vulnerable to deceptions.
Scanning Frequency Affects Coordination Performance Independent of Scanning Direction

Qin Zhu, University of Wyoming; Shaochen Huang, University of Wyoming; Jacob Layer, University of Wyoming; Boyi Dai, University of Wyoming; Jiahao Yang, Shanghai University of Sport; Geoffrey Bingham, Indiana University

Two intrinsically stable rhythmic coordination patterns can be readily produced without practice: in-phase (0° relative phase) and anti-phase (180° relative phase) coordination. One needs a significant amount of practice to be able to perform a 90° coordination, but it can be learned. With increasing frequency, 180° coordination exhibits decreasing stability, and eventually switches to 0° coordination. It remains unknown what happens as frequency is increased during performance of 90° coordination. Frequency scanning has been used to measure stability in performance of different coordination patterns. A low to high frequency scanning is typically done because switching (with hysteresis) can occur at sufficiently high frequency in some cases. However, it is unknown whether the direction of scanning might affect the results (without switching). In the current study, twenty untrained adult participants naïve to the purpose of study performed a rhythmic bimanual coordination task using a computer-joystick apparatus at 0°, 180°, and 90°. Each coordination was scanned at five levels of frequency: 0.5 Hz, 1.0 Hz, 1.5 Hz, 2.0 Hz, and 2.5 Hz. Half of the participants were scanned from low to high, and the other half from high to low. Coordination performance was measured by Proportion of Time on Task (PTT). Coordination performance was generally better at 0° than 180° and then 90°. A significant effect of scanning frequency was found for each coordination independent of scanning direction. For 0°, performance at 0.5 Hz was worse than that at all other frequencies. For both 180° and 90° coordination, performance dropped significantly with increasing frequency.

Sport and Exercise Psychology

“Getting Out of My Comfort Zone”: Service-Learning Experiences Serving as Physical Activity Coaches in Local Parks

Brittney Aceron; Briana Hubbard; Kathleen Wilson; California State University, Fullerton

The promotion of physical activity requires a wide variety of skills such as motivational interviewing and the implementation of behavior change techniques. To develop future practitioners, it is important for students to gain applied experiences. Incorporating service learning into courses may be one way for students to develop such skills. This study explores the service-learning experience of kinesiology university students coaching physical activity (PA) at local parks. Students (N=75) from three sessions of an applied exercise psychology course engaged in a service-learning by serving as physical activity coaches. Pairs of students were assigned to a local park for two hours a week. When at the park, students talked with residents about physical activity, set goals, introduced residents to the exercise equipment and helped residents cope with barriers. Students reported the number and type of contact they had with residents in checklists completed following each coaching session. To examine their experiences, students’ reflections on their service-learning experience and a letter to the city in which they were placed were analyzed using a basic thematic analysis. Across the three semesters, students introduced themselves to residents 758 times and reported coaching (a more in-depth interaction) 254 times. The overarching themes included the opportunity to exercise their problem-solving skills, developing communication skills, and increasing their confidence. In terms of problem-solving skills, students were most effective when they were creative in their approach to coaching. With respect to communication, students talked about improving their skills interacting with residents by applying skills learned in class. The weekly outreach at the parks helped students get out of their comfort zones and increase their confidence as leaders. One major challenge was that some parks did not have very many visitors so the student’s experience was limited. Students’ service-learning experience appeared to be applicable to their future careers and life in general.

Online Social Comparisons and Physical Activity: The Influence of Upward and Downward Social Comparisons

Brittney B. Aceron; Spencer Valles; Maria Beitzel; Briana Hubbard; Kathleen S. Wilson; California State University, Fullerton

Social comparisons are a way to evaluate where we stand relative to others (Festinger, 1954). Upward comparisons occur when the comparison is to someone perceived as better and downward comparisons occur when the comparison is to someone perceived as worse (Pila et al., 2016). Social network sites (SNS) provide many opportunities for such comparisons (Fardouly et al., 2014). Upward social comparisons on SNS have been linked to negative outcomes that may be related to mood and behavior (Fardouly et al., 2017). Downward comparisons may have a different effect on mood and behavior (Gibbons & Gerrad, 1989). This study examined how appearance-related social comparisons on SNS were related to physical activity and resistance training behavior. Participants who were SNS users (n=223; 57% female) completed an online cross-sectional survey. This survey included measures of physical activity (Goddin Leisure Time Exercise Questionnaire; Godin & Shephard, 1985), resistance training behavior (Bryan & Rocheleau, 2002), an adapted measure of social comparisons (Pila et al., 2016) and SNS use (general usage & friendship scale; Rosen et al., 2013). Hierarchical regressions analyses examined the influence of upward and downward comparisons (step 2) on physical activity and resistance training after controlling for gender, SNS use and SNS friends (step 1). For physical activity, the first step was significant (R² = .07, p = .002). The addition of both upward and downward social comparisons improved the regression model adding an additional 3% of the variance (p = .035). SNS use (β = -.15, p = .033), SNS friends (β = 0.24, p < .001) and downward social comparisons (β = 0.21, p = .015) were all significant predictors of physical activity. Social comparisons did not predict for resistance training behavior (R² = 0.04, p = 1.65). These findings align with the social comparison theory that suggests downward comparison may be associated with positive outcomes. However, the strength of the relationship was weak, which may be because SNS are just one context where people make social comparisons.

Effects of a Peer-Supported Physical Activity Program as an Adjunct or Alternate Treatment for Depression and Anxiety in College Students

Sheila Alicea, St. Edward’s University; Linda Keeler, Western Washington University

Depression and anxiety affect millions of people and the prevalence is increasing, especially in college students. Campus health centers are often not able to provide enough services, and adjunct or alternate treatments are needed. The purpose of this experiment was to examine the effects of a peer-assisted physical activity program as an adjunct or alternate treatment for depression and/or anxiety in college students. Participants included 62 college students diagnosed with depression and/or anxiety who participated in the physical activity program during one of five semesters. In this program, participants are matched up with a physical activity buddy to participate in self-selected physical activities twice a week for one hour, for 10–12 weeks. Participants completed the Zung Depression Scale, the
Depression, Anxiety and Stress Scale–21 Items (DASS-21), the Psychological Need Satisfaction in Exercise Scale, the Self-Efficacy for Exercise Scale, and the Godin Leisure-Time Exercise Questionnaire at the beginning and end of the 10- to 12-week program. Depression scores significantly decreased on both the Zung ($t = 7.826$, $p < 0.001$, $\eta^2 = 0.50$) and the DASS-21 ($t = 6.731$, $p < 0.001$, $\eta^2 = 0.47$). Anxiety scores ($t = 6.935$, $p < 0.001$, $\eta^2 = 0.48$) and stress scores ($t = 6.204$, $p < 0.001$, $\eta^2 = 0.42$) from the DASS-21 decreased as well. Scores for all three basic psychological needs increased: competence ($t = -4.478$, $p < 0.001$, $\eta^2 = 0.32$), autonomy ($t = -4.514$, $p < 0.001$, $\eta^2 = 0.32$), and relatedness ($t = -3.906$, $p < 0.001$, $\eta^2 = 0.29$). Weekly physical activity levels increased for strenuous exercise ($t = -3.539$, $p = 0.001$, $\eta^2 = 0.23$), moderate exercise ($t = 2.144$, $p = 0.038$, $\eta^2 = 0.10$), and total physical activity ($t = -2.308$, $p = 0.025$, $\eta^2 = 0.10$). The program has proved to be helpful in the treatment for depression and/or anxiety in college students. In addition, participation in the program helped participants begin or maintain higher weekly physical activity levels. In the future, other colleges/universities should consider adopting a similar physical activity program to help students experiencing depression and/or anxiety.

Physical Activity and Mental Health in Young Adult Males

Greg Anson; Lynley Bradnam; Jessebel Chan; University of Auckland

Physical activity is frequently touted as beneficial to mental health. A recent Cochrane review noted the effectiveness of exercise in treating depression was mixed. New Zealand has one of the highest suicide rates in the world, 13.93 per 100,000 in 2018–2019, a 15.7% increase in 10 years. The rate is higher in males, particularly in the 15–19 and 20–24 age groups. In this exploratory study we investigated the relationship between level of physical activity and mental health in young males (aged 18–30, $n = 10$). Two young adult male participants on anti-depressant medication also took part in the study. Participants completed the Beck Depression Inventory (BDI), International Physical Activity Questionnaire (IPAQ) and Short Form-36 Health Survey (SF-36). Height and weight were measured; participants wore an activity tracker (GeneActiv) for one week (24/7). Participants completed an activity diary twice daily at lunchtime and before bed. BDI results identified one participant not on medication as “borderline clinical depression” and the participant was referred to their general practitioner. SF-36 (mental) and BDI results were strongly correlated ($r = -0.87$, $p < .05$). SF-36 (physical) and IPAQ results were weakly associated ($r = .2, p > .05$). Activity tracker data were weakly correlated ($r = .02, p > .05$) with BDI results – low BDI scores were unrelated to amount of physical activity. All non-medicated participants reported significantly fewer minutes of physical activity in their activity diary ($M = 577$ minutes) than recorded by the activity tracker ($M = 1914$ minutes), Wilcoxon signed rank test, $z = -2.803$, $p < .05$. Overall, activity tracker results indicated on average, participants spent 19% time engaged in vigorous activity, 5.3% in moderate, 12.08% in light and 82.43% in sedentary activities. Generally participants perceived they engaged in substantially less physical activity than recorded by the activity tracker. Whether this distortion of objective versus subjective assessment of engagement in physical activity contributes to mental health status remains to be investigated.

A Decade of Youth Sport Coach Education Interventions on Athlete Outcomes and Coaching Effectiveness

Obidiah Atkinson, The Ohio State University

An estimated 60 million children aged 6 to 18 years participate in some form of organized sport in the United States. Youth sport has evolved, becoming a more adult-driven and ultra-competitive environment where more children decide not to return. Coaches have the potential to influence athlete development and learning. Coaching is complex, where mediated, unmediated, and internal learning experiences can occur. Reviews on non-formal coach education interventions have been conducted with no firm conclusions on the effectiveness of the interventions. The purpose of this study was to provide a critical review of the literature on the effectiveness of coaching interventions examining the common theories, methodological approaches, and major findings while identifying gaps and weaknesses to inform recommendations for future research. Four electronic databases were searched with seven key words, followed by secondary referencing and manual searches from January 2010 to December 2019. Inclusion criteria included: participants were sport coaches and athletes, intervention attempted to alter coaches’ effectiveness on athletes’ behaviors, and published in refereed journals. A total of 33 articles were reviewed and summarized concluding: a) correlational and qualitative studies were most common, b) athletes typically ranged from 11–18 years of age, c) a variety of sports were used with club level soccer representing just over 30% of studies, d) few studies described the intervention with sufficient detail, e) few studies used an aligned theoretical framework but self-determination and achievement goal theories were most common, and f) a wide variety of psychological constructs were measured for both the coach and athlete outcomes. Although, most studies were reported to be effective, few reported fidelity of the intervention implementation or coach training program, had theoretically developed coaching interventions with a theoretical basis, or involved a broad range of sports. Recommendations for future research are concluded.

Burnout in Coaches’ Spouses: Major and Minor Sports

Diana Avans; Noah Eley; Kaleb Bryant; Bethany Hinson; Brianne Wiens; Vanguard University

The purpose of this study was to determine if spouses of coaches at the NAIA and NCAA Division III level experience burnout and to determine if a difference in levels of burnout exist between major and minor sports. We hypothesized that burnout did exist in this population and that there would be a difference based on sport. There is a wealth of information regarding coaches and burnout, but no empirical study was found regarding coach’s spouses. Research has shown that burnout experienced by one spouse at work can be translated over to the other spouse at home (Westman & Etzion, 1995). This study used the Maslach Burnout Inventory General Survey (MBI-GS) to measure burnout. The inventory measures three components of burnout: exhaustion (EX), cynicism (CY), professional efficacy (PE) (Maslach, Jackson & Leiter, 1997). An email with a link to the survey on SurveyMonkey was sent to 720 coaches’ spouses. We received a total of 65 completed surveys. The data was analyzed using independent sample t-tests and descriptive statistics. No significant difference was found between major and minor sports within the EX and PE categories. A significant difference was found in the CY category ($p = .026$) with the Minor sport’s reporting higher levels. Generalized findings showed up to 20% of the participants scored high in both exhaustion and cynicism. Moderate levels were found for the personal efficacy category. Between football and basketball, a significant difference was found within the EX category ($p = .021$). The mean score on a 0–100 coping with stress scale was 76.21, $s = 19.4$. Thirty-six percent attributed their burnout symptoms to their spouse’s occupation. It is difficult to isolate one reason for experiencing burnout. We know from the literature that there are multiple factors and coping skills plays a large role. We did receive feedback from our open-ended questions that can be further analyzed and contribute to refining the survey for the next study. We can also use an adaptive version of the Coaching Burnout Survey and have the coach and spouse respond together.
The Relationship Between Leadership Style and Burnout in Collegiate Coaches
Diana Avans; Savannah Evans; Hailey Gordon; Vanguard University

Research shows that one in four sports coaches experience extreme fatigue, symptomatic of burnout, at the end of a competitive season (Haugen, 2015). Leadership styles have been studied in NCAA coaches and the general workforce burnout literature. This study purposed to examine these variables in the often-overlooked NAIA coaches. Identifying the factors that contribute to burnout in coaches could help coaches potentially avoid burnout and improve job satisfaction and performance (Rad & Ghalenoei, 2013). The aim of this study was to determine if there is a relationship between leadership style and burnout in collegiate athletic coaches from the Golden State Athletic Conference (GSAC) of the National Association of Intercollegiate Athletes (NAIA). Burnout was measured using the Coaching Burnout Questionnaire (CBQ, Harris & Ostrow, 2008) and the Leadership Scale for Sports (LSS, Chelladurai & Saleh, 1980). The components of burnout are physical/emotional exhaustion, reduced personal accomplishment and sport devaluation. The LSS behavior subscales are training/instruction behavior, democratic behavior, autocratic behavior, social support, and positive feedback. Forty-nine out of 236 surveys sent were returned. Pearson’s correlation was used to analyze the data. The highest mean scores were in sport devaluation (M = 4.26, 6 pt. scale) and autocratic behavior (M = 3.4, 5 pt. scale). The results showed a significant correlation with autocratic style and personal/emotional exhaustion (r = 0.338, p = 0.027) and with reduced personal accomplishment (r = 0.350, p = 0.019). There was a significant, negative correlation with the positive feedback score and personal/emotional exhaustion (r = −0.360, p = 0.018). The results provide support for the hypothesis of a relationship between burnout and leadership style. As with any burnout study, there are multiple contributing factors. Identifying the variables that are more strongly related can provide a starting point for addressing symptoms early with interventions such as adapting leadership style and stress coping training.

Primary Motor Cortex Activation and Injury-Related Fear in Patients After Anterior Cruciate Ligament Reconstruction
Shelby Baez, Michigan State University; J. D. DeFreese, University of North Carolina at Chapel Hill

Injury-related fear after anterior cruciate ligament reconstruction (ACLR) has led to failure to return to sport. It has been postulated that increased fear may lead to a protective motor response, such as freezing, that coincides with decreased primary motor cortex activation in healthy adults. Patients after ACLR have exhibited depressed primary motor cortex excitability; however, we do not know whether a relationship between injury-related fear and primary motor cortex activation exists in patients after ACLR. The purpose of this study was to examine the relationship between self-reported fear and primary motor cortex activation in females with a history of ACLR. We hypothesized that self-reported fear would be negatively associated with activation in the primary motor cortex. A total of 12 female right-hand dominant participants (M_age = 21.5 ± 6.8 yrs, M_height = 168.9 ± 16.5 cm, M_mass = 68.5 ± 22.8 kg) with a history of left-sided ACLR (≥ 1-year post-operative) were enrolled in the study. Participants were instructed to physically and mentally imagine themselves completing the images shown while undergoing full brain functional magnetic resonance imaging in a Siemens 3T Prisma scanner. After completion of the scan, all participants completed the Fear-Avoidance Beliefs Questionnaire (FABQ-S), measuring self-reported injury-related fear for sport. Neural activation data were acquired with Blood Oxygen Level Dependent echoplanar imaging. Increased neural activation in the anterior cingulate cortex (ACC) was observed during the PIT. The ACC is associated with regulation of overall emotion due to dense connectivity with key limbic system structures. Interestingly, self-reported injury-related fear for sport was more associated with the ACC during the imagination of ADLs as compared to the SST. A large correlation was observed between the FABQ-S and the ACC (r = 0.607, p = 0.036) during imagination of ADLs. Contrary to our hypothesis, these findings suggest that females with a history of ACLR may exhibit an increased neural fear response for ADLs rather than SSTs. Decreased exposure to SSTs and continuous exposure to ADLs are potential explanations to probe in future work.

Autonomy Support, Satisfaction of the Need for Autonomy, and Autonomous Regulation for Physical Activity in Older Adults
John M. Baier; Jorge Banda; Elisabeth A. Richards; Steve Amireault, Purdue University

Background: Regular physical activity (PA) is an effective strategy for people of all ages to promote healthy aging. However, as adults grow older, they are less likely to be regularly active. According to the Self-Determination Theory, higher sense of autonomy and autonomous regulation predict higher PA participation. This is relevant to older adults, as autonomy is valued in this population. Yet, there is limited evidence establishing how autonomy support and the need for autonomy influence both autonomous regulation and PA. The purpose of this study was to examine the pathways through which autonomy support and the need for autonomy exert their influence on autonomous regulation and PA behavior. Methods: Adults aged ≥ 55 years, without severe cognitive impairment, from the ALL IN for Health! voluntary registry were contacted.
via email to complete online surveys. Autonomy support, need for autonomy and competence, autonomous motivation, were assessed at baseline using the PNSE and BREQ-2. PA was assessed weekly for four weeks with the Physical Activity Scale for Elderly. Multiple linear regression was performed to test the mediation effect. The Monte Carlo 95% confidence interval [95% CI] (5,000 bootstrap samples) for the mediated effect were obtained using Hayes SAS macro. Results. The need for autonomy partially mediated the relationship between autonomy support and autonomous regulation, but only for those engaging in PA two days/week (0.0195 [0.0004, 0.0438]) and ≥4 days per week (0.0390 [0.0098, 0.0774]). Further, the need for autonomy and autonomous regulation were found to sequentially mediate the relationship between autonomy support and PA, but only for younger adults (58 years) who were active ≥4 days/week in the last month (5.3066 [0.3046, 12.6440]). Conclusion. Support for an older adult to be autonomous (e.g., providing likable PA choices) may positively impact PA through its effect on autonomous regulation – especially among the youngest of that population who are already active. Experimental studies are needed to confirm these findings.

Does the Nature of Co-Regulation Change with a Younger Athlete?
Modeling Coach-Athlete Interactions in a Figure Skating Dyad
Lisa Bain; Bradley W. Young, University of Ottawa

In coaching psychology, models address leadership, coach-athlete (C-A) relationships, coaching roles, and coaching efficacy (Bloom, 2016) but less focus is on dyadic communication/co-regulation. A case study (Bain & Young, 2019) interpreted how essential C-A interactions occurred during intensive practice settings, resulting in a Co-regulatory Coaching Interface Model (CCIM). It described how members in a figure skating dyad integrated their knowledge during micro-level interactions to optimize skill acquisition and athlete self-regulated learning. We aimed to deductively analyze this CCIM in a new dyad with the same female coach (aged 53, national level), but with a younger female skater (aged 11) to explore replication with a less mature athlete. Methods included season long observation and audio recording of 16 practices, field notes, and 2 interviews with each member. Deductive analyses showed that co-regulated mixing of perspectives was influenced by coach prerequisites, skater prerequisites, and shared prerequisites, as per the prior CCIM. Key features of the CCIM were confirmed, including the coach’s prerequisite of having capabilities to visually diagnose performance, and to provide solutions verbally and/or via demonstrations. In terms of central co-regulatory strategies, ‘forming solutions’ and ‘counter solutions’ were absent with this younger skater and the coach more prominently used ‘sustaining comments’ upon exit from the interface. Particular nuances in this dyad not previously seen included: the coach’s prerequisite to more proximally monitor the skater; rudimentary expectations for the skater to communicate their kinesthetic awareness; and less consistent implementation of self-regulated learning expectations and competencies by the skater at practice. Findings suggest that the CCIM pertains to this less mature C-A dyad. Although co-regulation was interpreted, there was greater emphasis on the coach’s role in providing information to a younger skater and trying to co-regulate the skater into becoming aware of her own learning within practice.

How Can Parents Help Their Preschool Child Develop Positive Perceptions of Their Movement Skills?
Lisa M. Barnett; Jill A Hnatiuk; Jo Salmon; Kylie D Hesketh, Deakin University

Background: A positive self-perception of movement skill is important for physical activity participation. The aim of this prospective study was to investigate which modifiable factors (child behaviors, maternal beliefs, parental behaviors, home environment, organized activity) predict children’s perceived movement skills. The sample consisted of up to 300 children (depending on model) from the Melbourne InFANT Program Follow-Up. Methods: Mothers completed questionnaires (factors hypothesized to influence perceived movement skills) when their child was 3.5 years old. At 5 years old, children’s perceived movement skill was assessed (pictorial scale of Perceived Movement Skill Competence). Separate linear regression models examined which factors predicted children’s total perceived movement skills (object control, locomotor and active play), adjusted for relevant confounders. Factors with p < 0.20 were entered into a multivariate model. Results: Time with same age children, time with older children (both higher tertiles) and parental physical activity facilitation (sum of facilitation in last month, e.g. taking child to park) were initially associated with higher perception. Maternal self-efficacy for child physical activity was associated with lower perceptions. Other child behaviors (time spent: physically active with mum; free to move about; outside), maternal beliefs, play equipment and swimming lessons were non-significant. In the final model (n = 226), parental physical activity facilitation (β = 0.13, 95% CI = 0.35, 0.23) and maternal self-efficacy (β = −2.30, 95% CI = −4.26, −0.33) were significant (p < 0.05). Discussion: Theoretically, interaction with others helps children understand their own movement performance, and the data generally support this. Results suggest that an active parental role in child physical activity is more important than access to equipment. There was a negative association between maternal self-efficacy and perception, suggesting mothers’ confidence is not consistent with the child’s perceived skills. Funding source: The Melbourne InFANT Program and follow-ups were funded by National Health and Medical Research Council Project Grants (APP245801 & APP1008879). KDH is supported by an Australian Research Council Future Fellowship (FT130100637) and an Honorary Heart Foundation of Australia Future Leader Fellowship (100370). The funders played no role in the conduct of the study.

The Effectiveness of Fun for Wellness: A Web-Based Randomized Controlled Behavioral Intervention Promoting Physical Activity in Adults with Obesity
André Bateman, Michigan State University; Adam McMahon, University of Miami; Isaac Prilleltensky, University of Miami; Seungmin Lee, Michigan State University; Samantha Dietz, University of Miami; Ora Prilleltensky, University of Miami; Karin A. Pfeiffer, Michigan State University; Nicholas D. Myers, Michigan State University; Ahnalee Brincks, Michigan State University

Fun For Wellness (FFW) is a self-efficacy theory-based online behavioral intervention developed to promote growth in well-being and physical activity by providing capability-enhancing opportunities. This study evaluated the effectiveness of FFW to increase physical activity in adults with obesity and overweight in the United States of America (USA) in a relatively uncontrolled setting. The study design was a large-scale, prospective, double-blind, parallel group randomized controlled trial. Participants were recruited through an online panel recruitment company and eligible participants were randomly assigned to the intervention (i.e., FFW) or the usual care (i.e., UC) group. Data collection was web-based, fully automated, and occurred at three time points: baseline, 30 days and 60 days after baseline. Participants (N = 461) who were assigned to the FFW group (nFFW = 219) were provided with 30 days of 24-hour access to the web-based intervention. There was evidence for a positive direct effect of FFW on transport-related physical activity self-efficacy, domestic-related physical activity self-efficacy, and self-efficacy to regulate physical activity at 30 days after baseline. Further, there was evidence for a positive indirect effect of FFW on physical activity at 60 days after baseline through
self-efficacy to regulate physical activity at 30 days after baseline. This study provides initial evidence for the effectiveness (e.g., a positive indirect effect of FFW on physical activity through self-efficacy to regulate physical activity), of the FFW web-based behavioral intervention to increase physical activity in adults with obesity and overweight in the USA. More broadly, FFW is a scalable web-based behavioral intervention that may effectively, although indirectly (i.e., through self-efficacy to regulate physical activity), promote physical activity in adults with obesity and overweight and therefore may be useful in responding to the global pandemic of insufficient physical activity in this at-risk population.

Perceptions of Social Support Related to Physical Activity Among Older Adults Living Alone

L. Jayne Beselt; Meghan H. McDonough; Jennifer Hewson, University of Calgary

Social support is associated with physical activity behavior and positive experiences in physical activity contexts. Social support and inclusion, and physical activity, are important for the health and well-being of older adults, yet many older adults are not sufficiently active and are socially isolated. Older adults living alone can be particularly susceptible to having insufficient social support; therefore, it is important to understand ways they are supported and the barriers they face to being physically active and included in group activity. The aim of this study was to understand the experiences of older adults living alone who are currently participating or have participated in physical activity, with attention to social support, social connections, and social barriers. Seventeen older adults (n = 16 female, n = 1 male) who self-identified as living alone participated in this study. Participants had a mean age of 66.9 years and most were Caucasian (n = 16). Participants were single (n = 8), divorced (n = 5), widowed (n = 2), separated (n = 1), and one did not report marital status. Interviews were thematically analyzed. Participants’ perspectives on living alone varied. Some felt they were well suited to living alone and that it allowed for freedom they might not have if they lived with another person. Others identified their living situation as ‘not ideal’ due to difficulties with self-motivation for both physical activity and getting themselves out of the house to be active. Some did not think living alone influenced their physical activity. The presence of others in physical activity settings influenced activity by helping people push themselves, feel accountable to attend, and to provide comparisons—both to inspire and contrast with what they had done. Findings highlight ways living alone influences experiences with physical activity, as well as challenges faced by those who live alone to being physically active. Funding source: University of Calgary Brenda Strafford Center on Aging Catalyst Grant.

The Association of Parental Pressure and Sport Enjoyment: Does the Parent-Child Relationship Matter?

Jordan A. Blazo, Louisiana Tech University; Daniel Fleming, Utah State University; Travis E. Dorsch, Utah State University

Parents invest significant time, money, and energy into the sport participation of their children. When accompanied by more directive parenting behavior, children often experience pressure (Wuerth et al., 2004). Further coloring children’s perceptions of parent behavior in sport is the nature of the parent-child relationship. Whether relationships are marked by warmth or conflict can have implications for young athletes’ perceptions of parent pressure and sport enjoyment. Guided by Dorsch and colleagues’ (in review) conceptualization of the youth sport system, the purpose of the present study was to examine whether relational warmth and conflict moderate the association of parent pressure with athlete enjoyment in sport. We hypothesized that athletes’ perceptions of relational warmth would buffer the inverse association of parent pressure with athlete enjoyment whereas perceptions of relational conflict would exacerbate the association. Youth athletes (N = 129; M age = 13.5 years, SD = 2.9 years) completed valid and reliable measures of study variables. Moderation analyses resulted in significant two-way interactions of perceived fathers’ pressure with warmth (R² = .07, F(3,112) = 2.73, p < .05) and conflict (R² = .24, F(3,112) = 11.98, p < .05) in predicting sport enjoyment. In line with hypotheses, associations were not as pronounced in the presence of higher relational warmth and were more pronounced in the presence of higher relational conflict. Perceived pressure from mothers did not interact with relational warmth or conflict in predicting athletes’ sport enjoyment. Findings suggest that relationships with fathers may uniquely tie to the association of children’s perceptions of parent pressure with sport enjoyment. Future work should consider the collective contributions of others within the family subsystem (e.g., siblings) and broader youth sport system (e.g., coaches and peers) to youth experiences of parent pressure and enjoyment in sport.

Parents’/Guardians’ Experiences with Their Adolescents’ Recovery From a Sports-Related Concussion: A Developmental Sport Psychology Perspective

Nicole Boller, San Francisco State University; Shelley Lucas, Boise State University; Laura Petranek, Boise State University; Kurt Nilsson, St. Luke’s Concussion Clinic; Kristi Pardue, St. Luke’s Concussion Clinic; Hilary Flint, St. Luke’s Health System

Research points to an alarming trend: incidents of sports-related concussion (SRC) among high school athletes have doubled in the previous decade. Moreover, studies reveal that adolescent athletes report more severe symptoms and take longer to recover from SRCs compared to collegiate athletes and younger athletes (Covassin et al., 2019; McKay et al., 2016). To better understand SRCs specifically among adolescents, a developmental approach is needed to account for the cognitive, social, and psychological changes that accompany adolescence (Horn & Newton, 2019; Weiss, 2019). Parents are a key part of the SRC recovery process for adolescents, at a time when relationships with peers and personal independence are ever more important developmentally (Gagnon et al., 2008). The purpose of the present study was to explore parents'/guardians’ experiences with their teenagers’ SRC through a developmental lens. The sample (N = 12) included 11 parents (9 mothers/2 fathers) and 1 guardian (grandparent) of adolescents (7 girls, 5 boys; 14–17 years old) who had persistent concussion symptoms (>6 weeks) or were diagnosed with post-concussive syndrome following a SRC. Each parent/guardian completed an individual semi-structured interview focused on their active role in their teenager’s recovery process, such as navigating and advocating for their teen with the school, sport team, and medical system. Based on an inductive content analysis, five themes emerged relevant to our developmental focus: (a) difficulty enforcing cognitive rest, (b) difficulty restricting physical activity, (c) experiences of social isolation, (d) challenges to athletic identity, and (e) understanding concussions and consequences. These results highlight developmental considerations for adolescent concussion recovery, and offer practical guidelines for parents, coaches, and peers who support adolescents recovering from SRCs.

An Exploration of the Lived Acculturation Experiences of Newcomer Varsity Athletes in Manitoba

Craig Clifton Brown, University of Manitoba

Immigration has grown exponentially in Canada and according to Sport for Life (2018), it will be the primary source of net population growth by 2030. Therefore, understanding the acculturation (learning a second culture...
Motor vs. cardiovascular exercise training, which also impacts the steroid hormone secretion. The present study aims to investigate 1) the effect of a motor vs. cardiovascular exercise training on salivary Testosterone (T), Estradiol (E) and Progesterone (P) and 2) whether changes in steroid hormones are predicting exercise-induced cognitive benefits. Methods: In a randomized control trial, we examined 71 school children (39 girls) at the age of 9–10 years split into: A cardiovascular exercise group (CE), a motor exercise group (ME) and a control group (CON) in which students were attending assisted homework. Students participated three times per week, for a total of 10 weeks (the exercise intensity was light in the two interventional groups (Garber et al., 2011)). Steroid hormones in the saliva, working memory performance (WMP) and state-trait anxiety levels, were determined before and after the intervention. Results: Statistic analysis showed no changes in hormones through the interventions. Within the ME, we found increases in T to be positively (β = .39) and initial E levels to be negatively (β = −.46) associated to WMP. Within the CE, increases in P were related to decreases in WMP (β = −.43). Anxiety significantly decreased after intervention only in the CE (p = .045, d = .42). Conclusion: Our findings suggest, that 1) a 10-week exercise training of light intensity has no chronic effect on salivary T, E and P in preadolescents and 2) the exercise-induced cognitive benefits, can partly be explained by changes in T and P, as well as initial E levels. Funding source: Deutsche Forschungsgemeinschaft (DFG).

### Thriving in Olympic Cycling: An Athlete-Centered Approach to Understanding the Promotion of Athlete Well-Being and Performance in Olympic Environments

**Daniel J. Brown, University of Portsmouth**

With growing concerns about the win-at-all-costs mentality present in high-performance sporting environments, a shift in attention is required to protect and promote athlete welfare. The aim for this project was to offer novel insight into how elite sport environments can be shaped to promote both high performance and well-being (i.e., thriving). A longitudinal design was employed with one-to-one interviews conducted with eleven international track cyclists on three occasions over a six-month period. Interview data were iteratively analyzed using reflexive thematic analysis to construct themes and describe areas of change. From this analysis, themes were presented as demands (e.g., lack of income, need for results and improved performance) and supports (e.g., mind-coach, non-sport friends), with some social agents (e.g., coach, family, training partners) and environmental features (e.g., concurrent study or vocational commitments) labeled as both demands and supports. Themes were also constructed for environmental areas of improvement pertaining to the coaching team, the Federation, innovation and expertise, and squad cohesion. Lastly, agents of changes (e.g., race schedule, selection decisions) were forward as events and circumstances which created fluctuations in the cyclists’ experiences. The findings from this study provide the first longitudinal account of sport performers’ attempts to thrive in high-performance environments and, thus, represent a unique attempt to understand these experiences over time. These findings are discussed in line with practical applications, offering coaches and practitioners a better understanding of how to facilitate thriving in their Olympic athletes. Funding source: This research was supported by an Early Career Academics Research Grant from the International Olympic Committee Olympic Studies Centre.

### The Effects of an Exercise Training on Steroid Hormones in School Children – A Predictor for Enhanced Cognition?

**Henning Budde; Davin Patrick Akko, Medical School Hamburg**

Objective: Research demonstrated different cognitive benefits induced by motor vs. cardiovascular exercise training, which also impacts the steroid hormones. We aimed to investigate whether an exercise training intervention influences salivary steroid hormones in school children. Methods: In a randomized control trial, we examined 71 school children (39 girls) at the age of 9–10 years split into: A cardiovascular exercise group (CE), a motor exercise group (ME) and a control group (CON) in which students were attending assisted homework. Students participated three times per week, for a total of 10 weeks (the exercise intensity was light in the two interventional groups). Steroid hormones in the saliva, working memory performance and state-trait anxiety levels, were determined before and after the intervention. Results: Statistic analysis showed no changes in hormones through the interventions. Within the ME, we found increases in T to be positively (β = .39) and initial E levels to be negatively (β = −.46) associated to WMP. Within the CE, increases in P were related to decreases in WMP (β = −.43). Anxiety significantly decreased after intervention only in the CE (p = .045, d = .42). Conclusion: Our findings suggest, that 1) a 10-week exercise training of light intensity has no chronic effect on salivary T, E and P in preadolescents and 2) the exercise-induced cognitive benefits, can partly be explained by changes in T and P, as well as initial E levels. Funding source: Deutsche Forschungsgemeinschaft (DFG).

### Mental Health in University Student-Athletes: Differences Between Genders and Across Years

**Taylor Budgell, Brock University**

Students face unique challenges adapting to the transition to university, as well as throughout their university career. Furthermore student athletes face unique challenges such as extensive commitments related to practice, travel, and games or competition (Giovannetti et. al, 2018). Research has shown fairly robust gender differences in mental health among university students (Gitay et al., 2018), and these issues may differ across the four years of university education (Bosso et al., 2018). Because university student-athletes may be a unique population with respect to mental health issues (Van Slingerland et al., 2018), the current study investigated the differences in perceptions of mental health issues in university student athletes between genders and across year of study. One hundred and sixty five student athletes (112 females, 52 males) from a single mid-size university completed a comprehensive survey on mental health issues, perceptions, barriers and suggestions. Analysis by gender and year of study, which was divided into first year (n = 69) and returning student athletes (n = 96), revealed several significant effects. Females reported significantly higher perceptions of mental health issues among their peers (e.g., anxiety, drug use, purging, self-harm, and suicidal thoughts) than males. Females were also significantly less likely than males to feel that the university provided adequate support for their mental well-being. Females also prioritized a variety of mental health initiatives significantly more highly than males. The only differences between first year and returning student athletes were found in rating of suggestions to improve mental health resources; returning student-athletes had higher ratings of making mental health sessions mandatory parts of coaching education and team training camps than first year students. These results offer greater detail to our current understanding of the mental health challenges of university student-athletes and may provide the basis for more versatile and effective support and interventions. Funding source: Brock Graduate Funding.

### Do Kinesiology Students Have Anti-Fat Biases, and if so, Can they be Reduced by Serving in a Mentoring Program?

**Taylor Calamese; Thomas D. Raedeke, East Carolina University**

Objective: Research demonstrated different cognitive benefits induced by motor vs. cardiovascular exercise training, which also impacts the steroid hormones. The present study aims to investigate 1) the effect of a motor vs. cardiovascular exercise training on salivary Testosterone (T), Estradiol (E) and Progesterone (P) and 2) whether changes in steroid hormones are predicting exercise-induced cognitive benefits. Methods: In a randomized control trial, we examined 71 school children (39 girls) at the age of 9–10 years split into: A cardiovascular exercise group (CE), a motor exercise group (ME) and a control group (CON) in which students were attending assisted homework. Students participated three times per week, for a total of 10 weeks (the exercise intensity was light in the two interventional groups (Garber et al., 2011)). Steroid hormones in the saliva, working memory performance (WMP) and state-trait anxiety levels, were determined before and after the intervention. Results: Statistic analysis showed no changes in hormones through the interventions. Within the ME, we found increases in T to be positively (β = .39) and initial E levels to be negatively (β = −.46) associated to WMP. Within the CE, increases in P were related to decreases in WMP (β = −.43). Anxiety significantly decreased after intervention only in the CE (p = .045, d = .42). Conclusion: Our findings suggest, that 1) a 10-week exercise training of light intensity has no chronic effect on salivary T, E and P in preadolescents and 2) the exercise-induced cognitive benefits, can partly be explained by changes in T and P, as well as initial E levels. Funding source: Deutsche Forschungsgemeinschaft (DFG).
Anti-fat biases, reflected by negative implicit and explicit attitudes toward obese individuals, occur in health care settings (e.g., Schwartz et al., 2003). These biases are potentially associated with weight-related discrimination and lower quality of care that may contribute to body image concerns, reduced quality of life, and unhealthy lifestyle behaviors. Given the pervasiveness of weight-related stigma, it is not surprising that kinesiology students have reported negative attitudes toward obese individuals (Chambless et al. 2003). Currently, it is unknown if these biases are unique to kinesiology students or whether they reflect what generally occurs in university students. In addition, minimal research has evaluated intervention strategies to reduce potential biases. Therefore, Study 1 was designed to compare students on implicit and explicit attitudes toward obesity from three majors that prepare students to work with individuals including kinesiology, nutrition, and psychology. Study 2 evaluated whether participating in a mentoring program, in which students worked with an overweight adolescent, was associated with reduced anti-fat biases. Study 1 included undergraduate students majoring in kinesiology (n = 60), nutrition (n = 34), or psychology (n = 58). Study 2 participants were 25 kinesiology students involved in a one-semester mentoring program. Participants completed the Implicit Association Test (Greenwald et al., 1995) and the Attitudes Toward Obesity Scale (Allison et al., 1991). Overall, results revealed that students across all three majors had strong implicit anti-fat biases (Cohen d effect sizes greater than 1.5). Minimal differences exist across the three majors on implicit attitudes. For explicit attitudes, kinesiology majors had the strongest negative attitudes while nutrition students had the weakest. Study 2 results revealed that serving in a mentor program was associated with a small decrease in implicit attitudes regarding obese being lazy versus motivated (Cohen d = .33) and explicit attitudes toward obese individuals (Cohen d = .21).

Perceived School-Level Concussion Care and Support and Concussion Disclosure Behaviors Among Collegiate Student-Athletes

Christine Callahan, The University of North Carolina at Chapel Hill; Kenneth Cameron, Keller Army Hospital; Steve Marshall, The University of North Carolina at Chapel Hill; Paula Gildner, The University of North Carolina at Chapel Hill; Karen Peck, Keller Army Hospital; Megan Houston; Steven Svoboda, Keller Army Hospital; Melissa Kay, University of Southern Mississippi; Zachary Kerr, The University of North Carolina at Chapel Hill; Johna Register-Mihalik, The University of North Carolina at Chapel Hill

Introduction: Limited data exist concerning factors that impact athletes’ perceived care and support following sport-related concussion (SRC). This study assessed if concussion knowledge, attitudes, intention to report symptoms, and perceived control of symptom reporting were associated with perceived school care and support following SRC among collegiate student-athletes. Methods: First-year collegiate student-athletes from two institutions (n = 389, mean age = 18.3±0.8 years, 66.8% male) completed a pre-validated survey assessing demographics, concussion history, and concussion behavioral factors. Primary outcomes included athletes’ perception of school-level care and support after SRC. Exploratory variables included concussion knowledge, attitude, intention to report symptoms, and perceived control of symptom reporting. Multivariable binomial regression analyses controlling for concussion history, gender, and high school sport exposure examined the relationship between the four explanatory variables and both primary outcomes. Prevalence ratios (PR) and p-values were reported. Results: Overall, 360 (94.2%) student-athletes believed their school provided appropriate care and 332 (85.4%) believed their school would provide support after SRC. There were no significant associations between the explanatory variables and perception of care (p >0.05). There were no significant associations between concussion knowledge and attitude and perception of school support (p >0.05).

The proportion of student-athletes who agreed/strongly agreed they would feel supported by their institution after SRC was higher among those with higher intention to report symptoms (PR = 1.46, 95% CI = 1.05–2.02, p = 0.03) and higher perceived control over reporting symptoms (PR = 1.62, 95% CI = 0.99–2.64, p = 0.05). Conclusion: Student-athletes with higher intention to report and perceived control over reporting SRC symptoms may also perceive their institution as more supportive. Findings may inform future interventions targeting institutional support as a way to improve concussion disclosure and outcomes. Funding source: This study was funded by an NCAA-DOD Mind Matters Research Challenge Award.

Teachers’ Perceptions of Integrated Physical Activity in the Classroom with Walkabouts

Priscila Candial; Spyridoula Vazou, Iowa State University

Movement integration involves infusing physical activity (PA) into normal classroom time, either as activity break or in integration with academic subjects. Even though there is an increased interest in exploring factors that may facilitate teacher’s implementation of movement integration, research exploring teacher’s perceptions about integrated PA is limited. Learning more about facilitators and barriers on the implementation of integrated PA programs could have multiple advantages, including directly facilitating learning, increasing intrinsic motivation for the educational process, as well as further allay concerns that the time spent on PA in the classroom is time taken away from academics. The purpose of this study was to explore teacher’s experiences from the implementation of the “Walkabouts”, a web-based program that integrates 7–10 minutes of PA with math and language arts in the academic classroom from preschool to second grade. A total of 388 elementary classroom teachers completed an online survey about their experience with the Walkabouts. Teachers identified teaching, reinforcing or assessing academic concepts as the main reasons for using the Walkabouts (selected by 72% of sample). Further, Walkabouts were highly valued by the teachers as important for the students to facilitate their learning, stay focused, improve their classroom behavior, and their cognitive performance. Meaningfully designed PA programs integrated with academic concepts, like Walkabouts, could defeat the impression among school staff that movement and learning are pitched against each other in an antagonistic relation.

The Effect of Exercise Training on Brain Structure and Function in Older Adults: A Systematic Review of Randomized Control Trials

Feng-Tzu Chen, National Taiwan Normal University; Fang-Cih Siao, National Taiwan Normal University; Tzu-Yu Yang, National Taiwan Normal University; Lin Chi, Minnan Normal University; Yu-Kai Chang, National Taiwan Normal University

Accumulating evidence suggests that exercise training is associated with the improvement of brain health, yet previous literatures remain insufficient in detailing and summarizing why exercise training applying the FITT-VP principle (i.e. Frequency, Intensity, Type, Time, Value, and Progression) facilitates improved brain structure and function. To determine whether exercise training is consequential to cognitive and brain improvement outcomes, we conducted a systematic review investigating the relationship between exercise training and brain structure and function, in order to further understand the neurophysiological mechanisms underlying the effects of PA training in older adults. The PubMed and Scopus were searched from inception to November 2019, and study quality was assessed using the Cochrane risk-of-bias tool. Twenty-five randomized controlled trials were included (10 studies, 40% for structure magnetic resonance imaging outcomes; 3 studies, 12% for event-related potential/ERP outcomes; 12 studies, 48% for functional magnetic resonance imaging outcomes). The proportion of older adults who agreed/strongly agreed they would feel supported by their institution after SRC was higher among those with higher intention to report symptoms (PR = 1.46, 95% CI = 1.05–2.02, p = 0.03) and higher perceived control over reporting symptoms (PR = 1.62, 95% CI = 0.99–2.64, p = 0.05). Conclusion: Student-athletes with higher intention to report and perceived control over reporting SRC symptoms may also perceive their institution as more supportive. Findings may inform future interventions targeting institutional support as a way to improve concussion disclosure and outcomes. Funding source: This study was funded by an NCAA-DOD Mind Matters Research Challenge Award.
imaging outcomes). The results from the present systematic review showed that exercise training, which participants engaged in three to four times per week for 12–24 weeks, with a moderate to hard intensity, and lasting for durations of 30–60 minutes per session, showed the most beneficial outcomes. This systematic review supported that older adults involved in exercise training may generally derive benefits to brain health, as reflected in intervention-induced changes in brain volumes and activation, but such benefits are dependent upon the dose of the exercise intervention. Importantly, current evidence remains limited in relation to applied exercise prescriptions (e.g., value and progression), and future research is needed that can clarify the effects of exercise training on brain-related outcomes in older adults.

Response Inhibition to Physical Inactivity Stimuli in an Affective Go/No-Go Task

Boris Cheval, University of Geneva; Marcos Daou, Coastal Carolina University; Daniel Cabral, Auburn University; Mariane Bacelar, Auburn University; Juliana Parma, Coastal Carolina University; Cyril Forestier, University of Grenoble Alpes; Dan Orsholits, University of Geneva; David Sander, University of Geneva; Matthieu Boisgontier, Vancouver Community College; Matthew Miller, Auburn University

Recent evidence suggests humans have an automatic attraction to effort minimization. Yet, how this attraction is associated with response inhibition is still unclear. Here, we used affective go/no-go tasks to capture inhibitory control in response to stimuli depicting physical activity versus physical inactivity in 59 healthy young individuals. Higher commission errors (i.e., failure to refrain a response to a “no-go” stimulus) were used as a measure for inhibitory control, whereas slower reaction times to go toward a “go” stimulus were used as an index of attentional bias. Based on the energetic cost minimization theory, we hypothesized that participants would exhibit higher commission errors and show slower reactions when responding to physical inactivity, compared with physical activity, stimuli. As expected, mixed effects models showed that participants exhibited higher commission errors (odds ratio = 1.59, 95% CI = 1.18 to 2.16, \( p = .003 \)) and showed slower reaction times (\( \beta = 26.4, 95\% \text{CI} = 11.0 \) to 41.7, \( p = .001 \)) when responding to stimuli depicting physical inactivity compared with physical activity. These results suggest that physical inactivity stimuli might attract attention and require high response inhibition. This study lends support for the hypothesis that an attraction to effort minimization might affect attention and inhibitory function processes in the presence of stimuli related to this minimization.


Linda N. Chukwurah; Leapetswe Malete, Michigan State University

The saying that sport is the great equalizer has its foundation on access and equity that generally characterizes sports. However, this view of sports is not always a reality, as demonstrated by persistent gender inequality in global sports. The inequality is a much bigger challenge in developing countries like Nigeria. It has profound effects on athletes’ psyche, performance, and career trajectories. Therefore, investigating the nature, sources and impact of gender inequalities in sports remains highly relevant today. This study examined gender equality in media coverage and welfare of Nigerian national teams within the context of the Africa Agenda 2063 and Nigerian sport policy. Twenty female soccer and track and field athletes and five coaches participated in in-depth structured interviews. Data was handled using thematic analysis. Participants reported significant pay gaps of close to 80% between male and female national team athletes in the same sport. Significant disparities were also reported in camping, travel conditions, recognition, and other welfare issues. Similar disparities were also found on TV, print, and electronic media coverage of male and female sport and individual. Overall, female athletes are perceived to be inferior, and many quit the sport or take other nationalities to continue competing at the highest level. The result show that minimal progress has been made to achieve gender equality in Nigerian sport despite the policy aspiration stated in the African Union Agenda 2063 and the Nigeria sport policy. The findings have implications for gender equity in global sports. Governing bodies must demonstrate commitment to eliminating gender inequality in sport and ensure strong alignments between policy and practice. More investigations on the nature, sources, constraints and strategies to foster gender equity in global sports are needed.

Development of the Youth Coaching Effectiveness Scale

Kyran Clements; John Mills; Paul Freeman, University of Essex

Determining the effectiveness of sport coaches’ behaviors is particularly important for research investigating athlete development within youth sport. A review of the coaching effectiveness literature was conducted, and discussions were held with professional coaches as part of a pilot study investigating the influence of coaching effectiveness on youth academy footballers. Following this, it was concluded that the current measure of coaching effectiveness did not fully encapsulate all coach behaviors deemed effective in producing positive developmental outcomes in youth athletes. Elements such as developing physical conditioning, coach self-reflection, understanding athlete needs, and providing intellectually stimulating challenges were highlighted as important factors both by professional coaches and within the literature. Building on existing measures (e.g., Coaching Efficacy Scale [CES; Feltz et al., 1999], CES II-High School Teams [Myers et al., 2008] Differentiated Transformational Leadership Inventory-Youth Sport [Vella et al., 2012], and Self Reflection and Insight Scale [Grant et al., 2002]), an integrated 44-item measure of youth athletes’ perceptions of coaching effectiveness was developed. Data were collected from 290 youth athletes (mean age = 15.42, SD = 1.49 years) across 16 sports. Confirmatory factor analyses tested the plausibility of three theoretically relevant factor structures (i.e., unidimensional, lower-order only, and higher and lower-order factors). Fit indices supported both a higher-order factor model, involving superordinate factors of professional, interpersonal, and intrapersonal knowledge and behaviors (\( \chi^2 (894, N = 290) = 1821, p < .001 \) [TLI = .88, CFI = .89, RMSEA = .06 [90% CI = .06 to .06], SRMR = .05] and a nine-factor lower-order model (\( \chi^2 (866, N = 290) = 1718, p < .001 \) [TLI = .89, CFI = .90, RMSEA = .06 [90% CI = .05 to .06], SRMR = .04). When comparing the fit indices of the models, a more optimal fit was provided by the nine-factor model. Further validation is required before it is advisable to use within youth coaching contexts.

A Longitudinal Examination of the Influence of Coaching Effectiveness on Youth Academy Footballers

Kyran Clements; John Mills, University of Essex

Coaches are influential in guiding athlete development. It is, therefore, important to understand what it means to be an “effective coach”. A pilot study was conducted, aiming to investigate youth academy football players’ perceptions of coaching effectiveness on the four coaching efficacy domains (i.e., motivation, technique, game strategy, and character-building) as predictors of their competence, confidence, connection, and character across a nine-month season. Academy football scholars (n = 65; mean age = 16.4, SD = 0.5 years) from three football teams completed surveys at three time points during the 2018/2019 competitive season. General linear mixed model analyses, controlling for time and team,
revealed that players’ perceptions of their coach’s ability to motivate ($\beta = 0.04, SE = 0.10, p = 0.66$), improve technique ($\beta = 0.17, SE = 0.09, p = 0.06$), and build character ($\beta = 0.14, SE = 0.08, p = 0.11$) positively predicted players’ perceived competence. Perceived coaching ability to motivate ($\beta = 0.07, SE = 0.11, p = 0.52$) and improve technical skill ($\beta = 0.04, SE = 0.10, p = 0.66$) positively predicted levels of reported confidence. Player perceptions of their coach’s ability to motivate ($\beta = 0.48, SE = 0.12, p < 0.01$), improve technique ($\beta = 0.32, SE = 0.11, p < 0.01$), and build character ($\beta = 0.09, SE = 0.10, p = 0.38$) were also positive predictors of players’ connection to their coach. The coach’s perceived ability to influence game strategy ($\beta = 0.23, SE = 0.15, p = 0.13$) and improve technique ($\beta = 0.06, SE = 0.12, p = 0.65$) were also positive predictors of player-reported character. Surprisingly, player perceptions of their coach’s game strategy effectiveness had a negative effect upon player-reported competence ($\beta = -0.07, SE = 0.11, p = 0.53$), confidence ($\beta = -0.04, SE = 0.12, p = 0.73$), and coach connection ($\beta = -0.39, SE = 0.14, p < 0.01$). In conclusion, academy football players’ perceptions of their coach may have important implications for players’ developmental outcomes.

Effects of a Five-Week Imagery Intervention on Strength Training
Sean M. Cochran, Christopher A. Aiken, Phillip G. Post, Jack I. Sampson, Tatiana A. Zhuravleva, Cameron N. Munger, Joseph M. Berning, New Mexico State University

Imagery has been found to enhance physical performance on a variety of motor tasks (Weinberg, 2008). However, little research has focused on the effects of imagery training on strength tasks. Thus, the purpose of the present study was to investigate the effects of a 5-week imagery intervention on a strength task. Thirty-seven participants performed a pre-test using a Biodex. The pre-test assessed peak torque of the right quadriceps and hamstrings (isokinetic and isotonic). Following pre-testing all participants performed 30 trials of an isokinetic extension/flexion while being video recorded from a first-person perspective. Participants were then randomly assigned to a mental imagery (MI), physical practice (PP), or control (C) group. During the training phase participants engaged in their intervention three times per week for five weeks totaling 15 training sessions. During each training session the MI group was seated on the Biodex and imagined themselves performing the strength task 30 times while watching their individualized video. PP group performed 30 trials of the strength task on the Biodex while the C group played Tetris during their 15 minute training sessions. Following training individuals performed a post-test which consisted of the same isokinetic and isotonic tasks completed during pre-testing. Peak torque changes from pre-test to post-test were analyzed using separate one-way ANOVAs for the quadriceps and hamstrings for both the isometric and isotonic tasks. Results revealed significantly greater peak force in the quadriceps during the isokinetic movement for PP compared to MI and CC ($p < 0.05$). Additionally, both PP and MI produced significantly greater peak force during the isometric contraction with the quadriceps than CC ($p < .05$), no significant differences were observed between MI and PP groups ($p > .05$). No significant differences were observed between groups for the hamstrings ($p > .05$). While not as effective as physical practice, these results demonstrate the effectiveness of imagery training to increase strength performance.

Physical Activity at University: Examining the Social (Exerciser) Identity and Exercise Attendance Relationship
Pete Coffce, University of Stirling; Meredith Schertzinger, University of St Andrews

Physical activity prevents non-communicable diseases and promotes healthy aging. However, one in four adults and three in four adolescents (11–17 years of age) do not adhere to physical activity recommendations set by the World Health Organization (2018). A target population for exercise interventions is university students, as researchers demonstrate that university students can significantly decrease their exercise engagement upon entering university (Guthold, Stevens, Riley, & Bull, 2018; Racette, Deusinger, Strube, Highstein, & Deusinger, 2005, 2008; Wengreen & Moncur, 2009). Moreover, researchers note that habits created in university can remain into adulthood (Sawyer, Alifi, Bearinger, Blakemore, Dick, Ezeh, & Patton, 2012). The purpose of this study was to examine, amongst first-year university students, the relationship between social (exerciser) identity and levels of exercise attendance together with exploring underpinning mechanisms. A sample of 194 first-year university students were recruited through convenience sampling. In a cross-sectional design, participants completed measures of social (exerciser) identity (Four Item Social Identity Scale; Postmes, Haslam, & Jans, 2013), exercise benefits and barriers (Exercise Benefits/Barriers Scale; Schrist, Walker, & Pender, 1987), exercise attendance, and cognitive appraisal (Cognitive Appraisal Scale; Gomes, Faria, & Gonçalves, 2013). Results demonstrated that, over and above the effect of pre-university exercise attendance, social (exerciser) identity was significantly positively associated with university exercise attendance. Mediation analyses identified a significant indirect effect between social (exerciser) identity and exercise attendance via perceived benefits, challenge perceptions (primary appraisal), and coping resources (secondary appraisal). These exploratory results present a pathway for intervention to increase exercise attendance amongst university students.

The Yoga Experience: A Qualitative Study Exploring Middle-Aged Women’s Perceptions of Yoga
Anne Cox, Washington State University; Jennifer Brunet, University of Ottawa; Amanda McMahon, Washington State University; Jenson Price, University of Ottawa

Background: Middle-aged women face intersecting challenges that may impact their body, mind, and health. The effect of aging can be challenging because it can reduce physical, psychological, and social functioning; therefore, efforts are needed to mitigate the aging effect. Yoga, a movement-based mind-body practice, may benefit women, but we need to understand whether yoga promotes positive experiences that can counter the aging effect during middle age. Thus, we explored how middle-aged women see yoga affecting their body, mind, and health in this qualitative study. Methods: Women ($M_{age} = 56.5$ yrs, $SD = 6.5$, range = 45–65 years of age), who self-identified as a beginner ($n = 10$) or an experienced ($n = 12$) yoga participant, were interviewed. An interview guide was used to explore participants’ experiences with yoga, including their perceptions about how yoga affects their body, mind, and health. Interviews were audio-recorded, lasted between 33–56 minutes, and were transcribed verbatim. Data were analyzed using inductive thematic analysis. Results: Both beginner and expert participants described several ways yoga affected their body, mind, and health, which are organized into three main themes. First, a supportive environment is key, which captured aspects of the instructor, other yoga members, and the studio that lead to positive or negative experiences. Second, yoga promotes self-care and health, which captured health benefits (e.g., lower stress), behaviors initiated due to yoga (e.g., hydrating), and helpful strategies learned through yoga (e.g., breathing). Third, the power of the mind-body experience, which captured participants’ critiques of their aging bodies and how yoga helped reduce self-criticism and develop self-confidence. Conclusions: Middle-aged women generally feel that yoga positively affects their body, mind, and health. However, they have preferences that should be considered to ensure yoga programs/classes address their needs and bring benefits.
Examining the Effects of Mindfulness-Based Yoga Instruction on Positive Embodiment and Affective Responses

Anne Cox, Washington State University; Sarah Ullrich-French, Washington State University; Catherine Cook-Cottone, State University of New York at Buffalo; Tracy Tyfka, The Ohio State University; Dianne Neumark-Sztainer, University of Minnesota; Veronica Garcia, Washington State University; Abigail Culver, Washington State University

Empirical evidence generally provides support for yoga as part of prevention and treatment for eating disorders through its positive impact on positive embodiment and experience of positive core affect. Yet, specific mechanisms of change related to the delivery of yoga have yet to be explicated. It is theorized that there may be specific instructional strategies that uniquely support positive embodiment and positive affect. We examined the effect of teaching a single yoga class using mindfulness-based instruction compared to appearance-based and neutral instruction on embodiment (i.e., state body surveillance, state body appreciation, pleasure during yoga) and changes in affect from before to after class. Female participants ($N = 62$; $M_{age} = 23.89$, $SD = 6.86$) were randomly assigned to a yoga class that emphasized: being mindfully present in one’s body, changing one’s appearance, or simply getting into the yoga poses. ANOVAs revealed significantly higher body surveillance ($\eta^2_p = .10$) and lower forecasted pleasure ($\eta^2_p = .21$) in the appearance class compared to the other two classes. Participants in the mindfulness class experienced greater improvement in affect ($\eta^2_p = .08$) from before to after class and higher remembered pleasure during the yoga class ($\eta^2_p = .19$) compared to those in the appearance class. Emphasizing changes to appearance in yoga instruction may place participants at risk for less positive affect and less positive experiences of embodiment compared to mindfulness-based or even neutral yoga instruction.

How Do I Look? The Impact of Body Awareness and Self-Objectification on Motor Performance in Women

Elizabeth Cox; April Karlinsky; Joseph Manzone; Timothy N. Welsh; Catherine M. Sabiston, University of Toronto

Drawing on tenets of self-objectification theory, women and girls internalize a focus on their body’s appearance rather than its functional attributes. Although self-objectification promotes constrained and ineffective motor performance in girls, it is unknown how body awareness and self-objectification impact motor performance in women. The present study examined the impact of body awareness and self-objectification on performance in women. It was hypothesized that greater body awareness would predict reduced performance during a visual-motor aiming task, and this relation would be mediated by self-objectification. Women ($N = 80$, $M_{age} = 20.6 \pm 3.1$ years) completed the state Self-Objectification Questionnaire. To prime awareness of the body, participants were assigned athletic clothing to wear for the duration of the study, had their picture taken, weight, height, and waist circumference measured, and completed a body size distortion task. Participants then completed a visual-motor aiming task while sitting beside a full-length mirror. Their behaviour was video-recorded. For each participant, number of clothing adjustments and self-views in the mirror were coded and summed, and mean body distortion score was calculated. Z-scores were calculated and summed to create a composite body awareness measure (CBA). Mean and standard deviation ($SD$) of reaction time ($RT$) were calculated across aiming task trials. Based on the linear regression models, CBA was significantly related to $SD$ of $RT$ ($\beta = 0.006$, CI: 0.002, 0.010, $p = 0.002$), whereby increased CBA predicted increased $SD$ of $RT$. The indirect effect of self-objectification was $\beta = -0.001$, CI: -0.002, 0.000, $p = 0.054$. These results suggest women’s body awareness and perception of their body as an object rather than as an effective instrument may lead to inefficient motor performance. Over time, this relatively inefficient performance could deter participation in physical activity. More work is needed to explore this possible link between body awareness, motor performance and physical activity. Funding source: SSHRC, NSERC.

Exploring the Impact of High versus Low Prevalence Messages on Norm Perceptions and Physical Activity Patterns During the Transition to University

Alyson Crozier, University of South Australia

Messages to promote individuals to be active sometimes include information about the prevalence of sufficiently (or insufficiently) active individuals. This type of prevalence information reflects the descriptive norm (DN), as highlighted in the focus theory of normative conduct (Cialdini et al., 1990). Indeed, informing people that most individuals are active (high DN) has led to increased physical activity in adults (Priebe & Spink, 2014). However, it is less clear how messages identifying that few are active (low DN) influences physical activity. Research in nutrition has shown detrimental effects of low DN messages on fruit and vegetable intake (Stok et al., 2013). Therefore, the purpose of this study was to examine the influence of high and low DN messages on individuals’ norm perceptions and physical activity engagement. Using online surveys, first-year students ($n = 160$) self-reported their DN perceptions and physical activity levels at the beginning of their first semester and four weeks later. At the end of the first survey, participants were randomly assigned to read one of three physical activity messages: a high DN, a low DN, or a control message. At follow-up, repeated measures ANOVA showed a difference between groups on DN perceptions [$F(2, 157) = 3.01$, $p = .05$], but none for physical activity levels [$F(2, 157) = 1.37$, $p = .25$]. Post-hoc analyses indicated that although groups had similar DN perceptions at baseline ($p > .05$), those in the high DN condition reported higher DN perceptions than the other two conditions at follow-up ($p < .01$). In regards to physical activity, a main effect of time was found [$F(1, 157) = 11.56$, $p < .01$], such that all university students decreased their physical activity. Results suggest that high DN messages may impact students’ normative perceptions positively, though this did not translate to behavior. A low DN message led to similar physical activity as a high DN or control message, suggesting that normative messages were not effective at motivating first-year university students to maintain their physical activity levels.

An Examination of the Relationships Between Social Capital, Physical Activity and Mental Health Among First-Year University Students in Australia

Alyson Crozier, University of South Australia; Katja Siecken, Medical School Hamburg; Insa Backhaus, Sapienza Universita di Roma

University students’ mental health can have a significant impact on their academic performance and retention. One factor that may influence a students’ mental health is their social capital, which includes their social networks (behavioral dimension) and feelings of trust and mutual support with others (cognitive dimension; Kawachi et al., 2008). Further, physical activity has a variety of mental health benefits, and it is not uncommon to be active with others. As such, physical activity may be associated with one’s social capital. Despite the potential link, limited research has explored the relationship between social capital, physical activity, and mental health. The purpose of the current study was to examine the relationships between students’ social capital, physical activity, and mental health during the transition to university. First-year Australian university students ($N = 322$) completed an online survey assessing self-reported physical activity, social capital (behavior and cognitive dimensions), and...
perceived stress and depression. Alarminghly, the majority of students reported clinically relevant depressive symptoms (61%) and moderate degrees of stress (63%). Linear regression analyses identified that physical activity positively predicted the behavioral dimension ($\beta = 1.07, p < .05$), but not the cognitive dimension ($\beta = -.34, p > .05$), of social capital. Further, the behavioral dimension of social capital was negatively related to depressive symptoms ($\beta = -.60, p < .05$). Results suggest that physical activity, social capital, and depressive symptoms are linked. Participating in physical activity impacts individuals’ social networks, potentially by increasing the number of groups one is a part of. As having greater social capital also was found to be a protective factor against depressive symptoms, physical activity may be an important avenue for intervention in university students to increase students’ social capital, and subsequently decrease depression symptoms.

**Older Adult’s Perception of the Use of Peer Support in Exercise Settings: A Qualitative Study**

Matthieu Dagenais; Alexandra Bula; Kimberley Gammage, Brock University

The physical and psychological benefits or exercise are known, although rates in Canadian older adults remain poor. One approach to enhancing exercise among older adults is through the use of peer mentors. This study investigates older adults’ perceptions of the use of peer mentors in exercise settings. Five in-person, semi-structured focus groups, each consisting of four to six members from a senior’s exercise program, were conducted. A total of 28 participants, 20 (71%) female and 8 (29%) male, took part in this qualitative study. The age of participants ranged from 61–83 years. Participants identified many positive and negative aspects of peer mentors. Peer mentors were identified as a motivator, and additional support systems holding participants accountable to engage in exercise. However, participants expressed concern regarding their peers’ lack of expertise in exercise settings, the creation of time constraints, and loss of scheduling freedom. Age and gender characteristics were considered less important compared to having similar life experiences for peer mentors, suggesting that student volunteers/staff may serve as peer mentors as long as they share similar experiences. Among the five groups, only one group viewed peer mentorship as an addition they would consider implementing into their workout routine. Findings suggest that participants are more inclined to seek peer mentorship if they have limited experience with exercise. Participants in this study expressed they would appreciate peer support in a diversity of forms, including providing information through research presentations and opportunities, fitness testing, and assisting with teaching new exercises.

**The Importance of the Motivating Style of Board Members and Coaches for Athletes’ Functioning in Sports Clubs: Study of a Trick-Down Effect**

Tom De Clerck; Annick Willem; Leen Haerens, Ghent University

Aim: Against the backdrop of high drop-out rates in sports club, we focus on the motivating role of the leaders of sports clubs, i.e., board members and coaches. Specifically, we investigate how the motivating styles of board members and coaches relate to athletes’ satisfaction and frustration of their basic psychological needs, and in turn athletes’ feelings about leaving the sports club. To this end, we rely on Self-Determination Theory Literature overview. A considerable amount of SDT research has related the motivating style of coaches to satisfaction of athletes’ basic psychological needs for autonomy, relatedness, and competence, and in turn positive athlete outcomes; and the demotivating style of coaches to frustration of athletes’ basic psychological needs, and in turn negative athlete outcomes. Yet, it is assumed, but not empirically investigated, that leaders in the sports club (i.e., board members) can also directly influence athletes’ feelings within the context of management-related situations at the sports club, or indirectly via the coaches’ (de)motivating style (i.e., trickle-down effect). Method: In order to investigate the relationships among the variables in our study, structural equation modeling is used to analyze data from at least 250 athletes out of a convenience sample of 30 Flemish sports clubs. Data from 194 athletes out of 28 sports clubs are currently gathered and data gathering is currently ongoing. Results: Preliminary analyses indicate a direct relationship of the board members’ motivating style to athletes’ need satisfaction, and the board members’ demotivating style to athletes’ need frustration. Furthermore, analyses reveal that a board members’ (de)motivating style indirectly influences athletes’ feelings about leaving the sports club through the coaches’ (de) motivating style and athletes’ need satisfaction. Conclusion: Results indicate that, despite the organizational distance, the sports clubs’ board members have a direct or an indirect (via the coaches) influence on athletes’ feelings about leaving the sports club.

**Self-Efficacy and Motivation Towards Physical Activity in a Mexican Community**

Manuel De La Cruz; Kathryn Valenzuela; Andres Castro-Zamora; Norma Angelica Borbon-Castro; Luis Alberto Durazo; Hector Duarte-Felix, Universidad Estatal de Sonora

Physical activity (PA) is associated with health benefits, but despite this, low levels of PA have been shown in Mexico. Motivation and self-efficacy (SE) are two constructs that have been related to the practice of PA. Self-Determination Theory (SDT) postulates that behaviors toward PA can be performed for autonomous motivation (AM), that is, because people consider it is interesting or enjoyable (Deci & Ryan, 1985) or for controlled motivation (CM), when people are involved in an activity to satisfy external demands or to receive rewards (Deci & Ryan, 2000). In addition, SE refers to confidence in one’s ability to perform specific behaviors such as PA. It is because of the above that, SDT and SE helps to explain coherently why people participate in certain healthy behaviors. The aim of this study was to examine the relationship between SE and the types of motivation towards physical activity in 664 adults (49.5 % males, 50.5 % females) between the ages of 18 and 65 ($M = 32.73, SD = 12.76$) from Sonora state (Mexico) of which, 66.6 % perform PA. Self-Efficacy for Exercise Questionnaire and Treatment Self-Regulation Questionnaire were used. T-test and structural equation modeling (SEM) were conducted to examine the theory based pathways from SE via CM and Amotivation (A) to PA. The results confirmed the reliability of the questionnaires. The t-test indicated that SE ($t = 32.16, p < .01$), AM ($t = 7.17, p < .001$), CM ($t = -5.81, p < .01$) and A ($t = 5.04, p < .01$) were significantly different for those who perform PA than those who don’t. Besides, SEM analysis showed an adequate fit of the data ($\chi^2 (164) = 524.03, p < .01; \chi^2/df = 3.19, CFI = .98, NFI = .97, RMSEA = .07$). Significant relationships were found from AE to AM ($\beta = .54$), to CM ($\beta = -.50$) and to A ($\beta = -.59$). In conclusion, when people have high levels of self-efficacy they will have a more autonomous motivation, on the contrary, they will have low levels of controlled motivation and amotivation towards physical activity.

**Free Communications: Verbal and Posters S74**

**Girls with More Gender-Stereotyped Attitudes Have Less Perceived Movement Competence: An Argument for a Psychosocial Approach to Movement Skills Programs**

India M. Dechrai, Deakin University; Lisa Hanna, Deakin University; Philip J. Morgan, University of Newcastle; Emiliano Mazzoli, Deakin University; Myles D. Young, University of Newcastle; Jacqueline New,
University of Newcastle; Emma R. Pollock, University of Newcastle; Stevie-Lee Kennedy, University of Newcastle; Lisa M. Barnett, Deakin University

Background: Eccles et al.’s expectancy-value model suggests gender identity is internalized from a young age via socializing influences. The aim was to determine if girls’ gender-stereotyped attitudes and beliefs were associated with their perceived movement skill competence (PMSC). We hypothesized that girls with higher gendered attitudes and beliefs would have lower PMSC. Methods: In 2019, 69 Australian girls (M_{age} = 8.85 yrs, SD = 1.69) were recruited. The Pictorial Scale of Perceived Movement Skill Competence was used to assess perception of competence in object control/locomotor skills and active play. Gender-stereotyped attitudes and beliefs were assessed using the Children’s Occupation, Activity and Trait–Attitude and Personal Measure (COAT). Items within the COAT are categorized as either stereotypically feminine (e.g. occupation–florist), masculine (e.g. activity–fishing), or neutral (e.g. trait–creative). To determine attitudes, girls were asked whether ‘only male’, ‘only female’, or ‘both’ should do/have certain occupations/activities/traits. To determine beliefs, girls rated how much they would like to do/have each of the occupations/activities/trait using a 4-point scale. Both tools were administered via one-on-one interviews with researchers. Correlations were used to calculate associations, followed by age-adjusted general linear models, which investigated associations between gender variables and PMSC in girls. Results: There were medium, negative significant correlations between gender-stereotyped attitudes for overall PMSC (rs = −.35), and object control skills (rs = −.37) and a small negative correlation for active play skills (rs = −.24). No other association were significant. Similar associations were observed in the models. Discussion: Targeting girls’ PMSC may benefit from a psychosocial approach, particularly addressing stereotypical gendered social norms.

Pathways to Excellence in Alpine Skiing: A Comparison Between Elite United States and Austrian Ski Racers

Brady S. DeCouto, University of Utah; Rhiannon L. Cowan, University of Utah; Bradley Fawver, University of Utah; Erich Müller, University of Salzburg; Lisa Steinl-Müller, University of Innsbruck; Birgit Pötschberger, University of Salzburg; Christian Raschner, University of Innsbruck; Keith R. Lohse, University of Utah; A. Mark Williams, University of Utah

Sociocultural factors are believed to shape an athlete’s development in sport. Yet, few cross-cultural studies exist contrasting athlete development in similarly competitive countries with distinct models of talent identification, funding, and sport prominence. We examined developmental and psychological differences between Austrian and United States (U.S.) alpine ski racers. A battery of practice history and psychological measures was administered to adolescent alpine ski racers (M_{age} = 16.27 + 1.66) from the U.S. (n = 169, women = 88) and Austria (n = 209, women = 104). Performance data were collected from an international FIS point database. Austrians began training and skiing competitively at a younger age (p < .001), while U.S. skiers played more other sports during development (p < .001). U.S. skiers accumulated significantly more practice hours over their career compared to Austrians (p < .001), and this effect was largely driven by a practice advantage for U.S. women over their Austrian counterparts (p = .004). Austrians demonstrated greater mental toughness (p = .004) and less burnout (p = .007) compared to U.S. skiers, while U.S. women reported higher scores for perfectionism (i.e., parental pressure, organization, p = .006). Perfectionistic strivings (i.e., personal standards, organization) were significantly associated with better performance in only the U.S. sample (p = .027). Austria’s trend for earlier engagement and specialization aligns with their national recognition of alpine skiing as the primary sport, which may contribute to positive psychological outcomes by creating a supporting environment for participation. Alternatively, U.S. skiers’ inclination towards sport diversification and increased practice time may uniquely impact dispositions necessary for elite performance (i.e., perfectionism). However, findings highlight a concerning trend for greater burnout and parental pressure in U.S. compared to Austrian skiers that may be influenced by national sport structure and sociological factors (e.g., gender stigmas in sport).

Physical Activity as a Depression Treatment: Post-Secondary Mental Health Care Providers’ Physical Activity Prescription Practices and Beliefs

Melissa deJonge, University of Toronto; Ashley Stirling, University of Toronto; Brendan Stubbs, King’s College London; Catherine Sabiston, University of Toronto

Post-secondary student mental health is recognized as a growing crisis. Consequently, mental health treatment strategies mandate a need for coordinated, collaborative, and diverse approaches. Physical activity (PA) is an evidence-based alternative or adjunctive therapy to common depression treatment approaches (e.g., pharmacological and cognitive). Yet, little is known about post-secondary mental health care providers’ (MHCP) PA prescription practices and beliefs. To further understand PA prescription for depression, MHCPs employed across Canadian campuses (N = 88, M_{age} = 43.09, SD = 10.12 years, 81% female) completed a cross-sectional self-report questionnaire guided by the theoretical domains framework (TDF). Based on descriptive statistics and bivariate Pearson correlations, MHCPs identified PA as an effective (86%) and acceptable (82%) depression treatment. Respondents reported prescribing PA always (13%), most of the time (34%), sometimes (33%), occasionally (11%), and never (9%). PA prescription practices were significantly (p < .05) moderately correlated with perceived PA prescription knowledge (r = .34; 95% CI = .14, .51), skills (r = .37; CI = .17, .54), social professional role and identity (r = .48; CI = .30, .63), beliefs about consequences (r = .36; CI = .16, .53), and behavioral regulation (r = .47; CI = .28, .62), and strongly correlated with beliefs about capabilities (r = .50; CI = .32, .64), intentions (r = .58; CI = .42, .70), memory attention and decision processes (r = .62; CI = .47, .73), and emotion (r = .50; CI = .32, .64). MHCPs reported they would definitely (66%) and possibly (31%) participate in further training and training preferences included topics on the best type of PA (55%), how to assess the student’s suitability for PA (57%), how to get and maintain motivation in people with depression (56%), and linking students with community/campus PA programs (26%). These results have implications for informing the development of evidence-based resources and interventions to improve post-secondary MHCPs PA prescription practices.

Youth Sport Coach Reports of Emotional Intelligence, Coaching Efficacy, and Teammate Bullying Behavior

Anthony G. Delli Paoli, Rutgers University; Jordan A. Blazo, Louisiana Tech University

Youth sport coaches play an important role in the management of youth athlete behavior. The Conceptual Model of Coach Efficacy (Felz et al., 1999) has been extensively applied to better understand coach influence on athlete behavior (Boardley, 2017). Coach characteristics such as emotional intelligence serve as an antecedent to coach efficacy beliefs that facilitate prosocial and mitigate antisocial behavior among young athletes. Greater emotional intelligence and coaching efficacy may enhance a coach’s ability to detect antisocial behaviors, deter them, and guide personal development of youth athletes. Of the antisocial behaviors studied in sport, victimization has received little attention. Victimization is repeatedly receiving any unwanted aggressive behaviors by peers that involve a
power imbalance (CDC, 2014). Victimization can be physical, social, verbal, or damage to personal property and is associated with maladaptive developmental outcomes (Troop-Gordon, 2017). The purpose of this study was to assess the links among coach reported emotional intelligence, efficacy beliefs, and teammate victimization behavior. Youth sport coaches ($N = 191$, $M_{age} = 44.1 \pm 8.3$) completed established measures of study variables. Mediation analyses showed emotional intelligence positively predicted all five coach efficacy beliefs and negatively predicted verbal victimization. No evidence of mediation was found for any of the coach efficacy beliefs to explain the emotional intelligence with verbal victimization association. Results showed that more emotionally intelligent coaches report fewer instances of peer verbal victimization and that coach efficacy beliefs appear to be unrelated to reporting peer victimization on youth sport teams. Emotional intelligence remains an important antecedent to coaching efficacy beliefs with direct effects on teammate antisocial behavior. Practical implications for youth sport coaches include educating the importance of emotional intelligence to facilitate greater coaching efficacy and deter teammate victimization.

**Coach Reports of Peer Victimization in Youth Sport**

*Anthony G. Delli Paoli, Rutgers University; Jordan A. Blazo, Louisiana Tech University*

A majority of aggressive behaviors experienced by youth athletes is committed by peers (Vertommen et al., 2017). One such aggressive behavior linked to maladjustment and internalizing problems is peer victimization (Troop-Gordon, 2017). Peer victimization research often relies on youth self-report, yet independent reporters (e.g., adults) may provide additional insight on the occurrence of such behaviors (CDC, 2014). Accordingly, the purpose of this study was to explore prevalence data on physical, social, verbal, and damage to property types of victimization that occur in youth sport. Moreover, differences related to their chosen pathway. Analyses of the participation pathway groups (i.e., early specialization, late specialization, and continued multi-sport) indicated that these groups possessed mostly similar beliefs, expectations, and outcomes related to their sport pathway experiences; however, athletes who tended to hold more favorable perceptions of specialization and favored a “primary” sport much more than other sport options were more likely to adopt specialized pathways. Implications of these findings underscore the importance of accounting for the influence of context and competitive climate in understanding youth athletes’ selected sport pathways and subsequent experiences, and the results from the initial exploration of this proposed ecological framework can serve as a hypothesis-generating mechanism for future research.

**The Impact of Movement Factors on Mental Health During the Transition to Parenthood**

*Alison Divine, University of Leeds; Chris Blanchard, Dalhousie University; P. J. Naylor, University of Victoria; Danielle Symons Downs, Pennsylvania State University; Ryan Rhodes, University of Victoria*

The transition to parenthood involves major physical and psychological adjustments. The aim of this study was to examine how movement behaviors (sleep, physical activity) are associated with resulting mental health changes in the transition to early parenthood. Nonparents (51 dyads, $n = 102$) and new parents (70 dyads, $n = 140$) participated in a 12-month longitudinal study. Measures were taken at baseline, 6, and 12 months. Sleep (self-report), and physical activity (measured using accelerometers), as well as life satisfaction using the Satisfaction With Life Scale, and mental health using the 12-item Short Form Health Survey were measured at all time-points. A dyadic growth curve analysis assessed change in mental health over time. A multi-group path analysis was used to determine which factors were associated with mental health in parenthesis. The dyadic growth curve model showed that women had a significant increase in mental health over time (non-parents, slope $= 2.43$, $p = .008$; new parents, slope $= 3.25$, $p = .015$) with no change in men. Critical ratios difference testing from the multi-group path analysis indicated that there were significant differences between non-parents and parents for the relationships between mental health and life satisfaction at baseline (new parents, $\beta = -.243$, $p = .003$; non-parents, $\beta = .157$, $p = .099$) as well as mental health and amount of sleep at 6 months (new parents, $\beta = .273$, $p < .001$; non-parents, $\beta = -.037$, $p = .660$). Over 12 months, subjective mental health increased in a similar manner for parents and non-parents, however findings indicate that life satisfaction was associated with mental health differentially across the transition to parenthood. Life satisfaction was negatively related to mental health during pregnancy but positively related to mental health six months after the child was born for men and women. This relationship is not seen in couples without children. Further research is needed to understand factors that contribute the life satisfaction in new parents to promote positive mental health during the transition to parenthood. Funding source: Diabetes Canada.
Influence of Sport Participation on Mental Health and Physical Health in Adolescents From Rural, Low-Income Families
Sarah Beth Dolinger; Robyn Feiss; Melissa Pangelinan, Auburn University

Sport participation in adolescence has been associated with better physical health during adolescence and into adulthood. Further, adolescent sport participation is inversely associated with mental health problems (e.g., depressive and anxiety symptoms). However, few studies have been conducted in rural, low-income populations that may be at elevated risk for physical and mental health disparities. The purpose of this study was to examine the relationship between sport participation and physical health and mental health in high school students from rural, low-income backgrounds. Data were collected from 10th and 11th grade students through Wellness Fairs conducted at four Title I high schools in Alabama. A total of 253 adolescents (104 males, 134 females, 15 sex not reported) participated in the study. Students completed the PROMIS Psychological Stress Experiences, PROMIS Pediatric Depressive Symptoms, PROMIS Pediatric Anxiety, and PROMIS Physical Activity questionnaires. Students also completed the FITNESSGRAM® physical fitness testing (body composition, BMI, resting heart rate, blood pressure, muscular strength and endurance (push-ups, curl-ups), and aerobic capacity (PACER)). Physical activity, but not sports participation, was associated with mental health measures (e.g., anxiety, depressive, and physical stress symptoms). However, sport participation was associated with improved physical health measures (e.g., body fat percentage, blood pressure, resting heart rate, curl-ups, push-ups, and PACER test), and athletes reported being more physically active than non-athletes. Additional demographic influences on mental and physical health, physical activity, and sport participation will be discussed. This study is unique in that physical fitness testing was conducted as a supplement to self-report physical activity measures. Further, the results indicate other factors (e.g., nutritional intake, anxiety/stress, sports pressure, team or coach-athlete dynamics) may influence the relationship between sport participation and physical and mental health in adolescents.

Developing an Organizational Mission Statement in Youth Sport: Utilizing Mad Libs as a Novel Approach
Travis Dorsch, Utah State University; Amand Hardiman, Utah State University; Matthew Vierimaa, Acadia University

Decades of research highlights the potential for youth to experience positive developmental outcomes through sport. This process is influenced by their interactions with other persons, as well as the aims and values of their sport organizations. In an effort to guide the design and delivery of sport, organizations often utilize mission statements. In youth sport, these can be used as “road maps” to guide the behavior of the many persons who interact within an organization. In most cases, mission statements are constructed by administrators and implemented using a top-down approach. In the present study, we utilized a novel technique and relied on the perspectives of multiple stakeholders to craft a mission statement for an elite youth volleyball club on the east coast of the United States. Prior to the competitive season, a subset of club administrators (n = 3) head coaches (n = 5), athletes (n = 10), and parents (n = 9) participated in Mad Libs, a phrasal word game in which individuals are asked to fill in missing words in a prescribed story template. In our modified Mad Libs activity, key mission-relevant words were left blank, and beneath each blank was a prompt such as “noun (what the club should provide)”, “verb (what the club should do)”, or “adjective (what kind of partnerships the club should build).” This approach was preferred to asking stakeholders to draft a mission statement from scratch because it provided a common rubric to facilitate the synthesis of participants’ perceptions of the club’s values and aims. Participants completed stories individually, and responses were synthesized using content analysis. Relatively high convergence existed across stakeholders as to the key components of an effective volleyball club. A three-sentence mission statement was crafted and shared at a preseason meeting, and subsequently modified by club administrators. Importantly, this study highlights a novel technique, informed by a range of stakeholder perceptions and experiences that can be used to craft an organizational mission statement in the context of youth sport. Funding source: Virginia Elite Volleyball Club.

Cultivating Efficacy Beliefs About a Personal Trainer’s Ability to Help: Are Current Strategies Effective?
Alison Ede, Robin Acosta-Daniel, Long Beach State University

Bandura (1997) proposed that when individuals feel that they do not have the knowledge or other resources to achieve their goals on their own, they turn to proxy-agents who are more qualified to help. In exercise, fitness professionals can aid in actions such as planning and structuring a workout, allowing the exerciser to focus their energy elsewhere (Bray, Gyrscik, Culos-Reed, Dawson, & Martin, 2001). Thus, proxy efficacy in exercise can be conceptualized as confidence in a professional’s ability to help an exerciser perform exercise skills (Shields & Brawley, 2006). However, little is known about how proxy efficacy beliefs develop, particularly when individuals are choosing a proxy-agent. Therefore, the purpose of this two-part study was to examine: a) existing content of online personal trainer biographies, and b) how that content influences proxy efficacy beliefs. First, in a content analysis of 600 personal trainer biographies, the most common information provided were certifications (76.8%), training philosophy (44.5%), training focus (45.3%), personality traits (33.3%), and personal information (32.3%). In the second pilot study, using information from study 1, four different fictional personal training biographies were developed: three efficacy-enhancing biographies (male, female, and gender-neutral) and one basic, non-efficacy enhancing biography. Forty participants randomly viewed one of the four messages and filled out an online questionnaire assessing proxy efficacy beliefs and importance of trainer characteristics. No significant differences in proxy efficacy were found between the four groups (p = .694). Trustworthiness received the highest ratings for importance in a trainer biography (M = 4.52, SD = 0.77), and passionate, the most common word in the content analysis of study 1, received the second-lowest ratings (M = 3.93, SD = 1.06). Results suggest that the current information used to market personal trainers may not be effective in influencing a potential client’s confidence in the proxy-agent.

Under Pressure: Understanding the Stressors Experienced by NCAA Division I Head and Assistant Coaches
Kimberly Faszczykiewski, Appalachian State University; Sara Powell, Missouri State University; Nick Stevens, Appalachian State University; Anthony Cangas, Appalachian State University

Research has suggested that the coaching position is a performing position, resulting in an immense amount of stress. The stress of coaching stems from a number of sources including team performance and work-life balance. There is little research on coaches themselves, as the existing body of research primarily concerns the impact of coaches on athlete performance. Furthermore, the limited coaching research that exists focuses on examining the perceived stressors of head coaches. The present study aimed to gain a better understanding of the relationship of stressors experienced by head and assistant coaches. NCAA Division I head coaches and assistant coaches from multiple sports with varying levels of coaching experience took part in semi-structured interviews that were transcribed.
An Investigation into Hazardous Drinking Behaviors and Coach Influence on Drinking in Canadian Student-Athletes

Siobhan Fitzpatrick; Janine Othuis, University of New Brunswick

Research suggests that American student-athletes are at heightened risk for hazardous alcohol consumption more so than the general student population. No current studies, however, have investigated this trend in Canadian student-athletes, whose athletic and academic environments are very different from those in the US. Moreover, there is a dearth of research examining the impact of coaches’ alcohol-related behaviors. Thus, this study sought to investigate the rate of problem drinking in Canadian athletes as compared to non-athletes, and whether coach normative influences, coach drinking policies, and the quality of athlete-coach relationship impacted student-athlete drinking. Participants included 584 undergraduates (179 athletes, 365 non-athletes) who completed online self-report measures that assessed drinking behaviors and, among athletes, coach factors. A series of one-way between subjects ANOVAs revealed that Canadian student-athletes demonstrated significantly higher alcohol-related problems than non-athletes, but no differences in alcohol consumption or binge drinking were identified. Hierarchical regression analyses revealed that coach normative influences significantly predicted weekly alcohol consumption and binge drinking, but not alcohol-related problems. Coach alcohol policies and the coach-athlete relationship did not predict alcohol outcomes. Findings are among the first to investigate hazardous alcohol consumption and coach influence on drinking in Canadian student-athletes. Results suggest that student-athletes are an at-risk group for alcohol-related problems, and that student-athlete drinking behaviors are influenced by perceptions of their coach’s attitude towards drinking. Future research should continue to investigate variables that may mitigate hazardous alcohol consumption within the student-athlete population in an effort to reduce their risk of alcohol-related problems. Funding source: Canadian SSHRC Master’s Graduate Student Grant.

The 2 × 2 Model of Pressure to be Perfect and the Development of Perfectionism in Youth Sport

Daniel Fleming, Utah State University; Daniel Madigan, York St John University; Sarah Mallinson-Howard, York St John University

Perfectionism is a multidimensional personality characteristic comprised of exceedingly high personal standards and overly critical self-evaluations and has often been associated with negative outcomes such as anxiety, burnout, and depression. In youth sport, parents and coaches have been linked to the development of perfectionism in young athletes. However, whether and how combinations of parent and coach pressure may contribute to the development of perfectionism in young athletes remains unknown. To address this gap, our aim was to introduce and test a new model—the 2 × 2 model of pressure to be perfect—to illustrate important social influences in the development of perfectionism in youth sport. This model differentiates four within-person combinations of pressure: (1) pure coach pressure (high coach pressure/low parental pressure), (2) pure parental pressure (low coach pressure/high parental pressure), (3) mixed pressure (high coach pressure/high parental pressure), and (4) no pressure (low coach pressure/low parental pressure). Athletes (N = 210; M age = 14.68 years) who were active participants in a variety of sports including track and field, soccer, and rowing completed measures of perfectionistic strivings, perfectionistic concerns, coach pressure to be perfect, and parental pressure to be perfect. The 2 × 2 model was tested using moderated hierarchical regression and simple slopes analyses. Mixed perfectionism emerged as the most important predictor of both perfectionistic strivings (parent pressure β = .27, p < .001; coach pressure N.S.) and perfectionistic concerns (parent pressure β = .27, p < .001; coach pressure β = .17, p < .05). There was also a significant interaction between the two (β = .15, p < .05). Findings provide initial evidence for the utility of the 2 × 2 model of pressure to be perfect in youth sport and highlight the importance of considering the combinations of coach and parental pressure in athletes’ development of perfectionism.
Investigating the Relationships Between Cognitive Control Exertion, Attentional Focus and Physical Performance

Ashley Flemington, McMaster University; Sara Svoboda, Loughborough University; Denver Brown, University of Toronto; Jeffery Graham, McMaster University; Chris Englert, University of Bern; Steven Bray, McMaster University

Fatigue is a major barrier to many important life pursuits including performing physically-demanding tasks. Several studies show poorer performance and increased perceived exertion during physical tasks when people are mentally fatigued. Other studies show mental fatigue is associated with an internal focus of attention, which could heighten perceived effort and discomfort when performing physically-demanding tasks. The purpose of this study was to investigate effects of mental fatigue (MF) and attentional focus on performance and perceived exertion (RPE) during a muscular endurance task. Undergraduate students (N = 50) completed two endurance handgrip squeezes separated by either a demanding cognitive task (incongruent Stroop) designed to induce a state of mental fatigue or a low cognitive demand control task (documentary viewing). Prior to the second handgrip, attentional focus was manipulated using task instructions to prompt either an internal or external focus. Manipulation checks confirmed a significant effect on MF (p < .001); however, the attentional focus manipulation was not effective (p = .293). Results showed no differences between conditions on handgrip task performance (p = .209, partial eta^2 = .09). Analyses proceeded to investigate patterns of attentional focus and RPE using 2 (MF) × 2 (trial) × 3 (0%, 50%, 100% iso-times within trial) ANOVAs. A significant 3-way interaction for attentional focus (p = .006, partial eta^2 = .202) was decomposed to show greater internal focus on trial 2 compared to trial 1 in the high MF condition at 0% and 50% iso-times (p = .011, partial eta^2 = .242 and p = .002, partial eta^2 = .344, respectively). A significant 3-way interaction for RPE (p = .027, partial eta^2 = .146) showed significantly higher RPE in the low MF condition at 50% and 100% iso-times (p = .009, partial eta^2 = .252, p = .001, partial eta^2 = .347, respectively). Mental fatigue has effects on both attentional focus and perceived exertion; however, these relationships appear to be complex and require further investigation.

Does Negative Self-Talk Impair Performance in a Stand-Up Paddling Obstacle Course?

Marie Ottlie Frenkel; Friederike Uhlenbrock; Laura Giessing, Heidelberg University

Self-talk represents an effective and frequently used psychological performance enhancement tool (Andersen, 2009) with promising benefits in various sporting domains (Hatzigeorgiadis, Zourbanos, Galanis, & Theodorakis, 2011). The relationship between negative self-talk and sports performance, however, remains understudied with contradicting results suggesting a negative or null effect on performance. To fill this gap, the present study investigated the influence of individual, negative self-talk on sports performance in a stand-up paddling obstacle course in a sample of N = 20 German sports science students using a within-subject experimental design. Moreover, the influence of dispositional self-control, intrinsic motivation, and heart rate variability (HRV) on this relationship were being investigated and integrated in the context of the neurovisceral integration model (Thayer, Hansen, Saus-Rose, & Johnsen, 2009). Performance was expected to decrease in the negative self-talk condition, however, buffered by dispositional self-control and HRV. Intrinsic motivation was used as a manipulation check. Contradicting hypotheses, results revealed no significant decrease in performance in the negative self-talk condition. In addition, only non-significant associations between self-control, intrinsic motivation, HRV and sports performance were detected apart from a significant negative correlation between dispositional self-control, and baseline RMSSD which is considered a surprising finding. Multiple regression analyses identified none of these variables to be a significant predictor of performance. Methodological, conceptual, and theoretical issues possibly responsible for the null findings are discussed and integrated in the current state of research. Finally, implications for future research are given. Funding source: Heidelberg University, Field of Focus 4.

Performing Under Stress: Interaction Effects of Physical and Emotional Stress on Shooting Performance of Paintball Players

Marie Ottlie Frenkel, Heidelberg University; Laura Giessing, Heidelberg University; Sebastian Egger-Lampfl, AIT Austrian Institute of Technology GmbH; Marie Staller, University of Applied Sciences for Police and Public Administration in North Rhine-Westphalia; Henning Plessner, Heidelberg University

In sports, police service, and military, actors are required to exert peak performance in cognitive and perceptual motor tasks under risky circumstances that are both psychologically and physically challenging. Those situations, that are often characterized by a threat to physical integrity, trigger psychophysiological stress reactions which can impair motor performance (Nieuwenhuis, & Oudejans, 2017; Giessing, Frenkel, Zinner, Rummel, Nieuwenhuis, Kasperk et al, 2019). To date, laboratory studies only investigated the effects of stress and physical load on the performance in perceptual-motor and cognitive tasks separately. Hence, the present study examines the interaction effects of both factors on shooting performance in a standardized paintball game situation. Sixteen male paintball league players underwent a standardized game situation that included various cognitive and perceptual-motor tasks (e.g., shooting on static and dynamic targets, fine-motor reloading of the gun) in two conditions, “low stress” (LS) and “high stress” (HS). In the HS condition, a confederate opponent shot back at the participant using paint balls. Physical stress is manipulated as a between-subject factor through a physical exertion task (Wingate test) before entering the game situation. Physiological (heart rate variability) and psychological (anxiety, mental effort) variables were measured repeatedly before and after the game situation. Behavioral measures of performance are captured for all tasks in the obstacle course. Both low and high stress scenarios elicited comparable increases in anxiety and mental effort with paintball players under high physical stress reporting more anxiety and mental effort. 2 × 2 ANOVAs revealed no significant main or interaction effects for the performance parameters, except that all paintball players hit the dynamic target faster in the high stress game situation. Surprisingly, the results show that physical load/stress increase anxiety and mental effort in psychologically challenging situations, without further impairing performance. Funding source: European Union’s Horizon 2020 Research and Innovation Programme (Grant Agreement No 833672).

Concentricity: The Development of Team Culture in an Elite Sport Team Environment

Jeff Frykholm, University of Minnesota

A growing sentiment in team sport contexts is that the culture underlying winning teams may be more important to success than talent or experience. Despite acknowledgement of the importance of culture on elite sports team performance, the understanding of stimulants that create cultural norms remains underdeveloped, particularly in the realm of competitive youth sports. This study details a six-month exploration of a highly performing high school boys’ soccer team. It elaborates the nature and development of shared understandings among team members regarding team values,
mission, and goals, as well as the roles adopted by coaches and players as creators and “keepers” of both the “macro-“ and “micro-cultures” that defined the team community. In the spirit of ethnographic research, qualitative methods of analysis were used to generate themes and concepts from the data record that provided insight to the questions of interest. Implications of this research include the introduction of an explanatory theory of cultural development in sport teams—one that acknowledges and explores both the existence, and the subsequent interaction, of well-defined, sub-cultures within broader team contexts.

Tone it Down or Tune it Out? The Effect of Instructor Cues on Body Image Outcomes in Older Adults During a Group Exercise Class
Sarah Galway; Nicole Last; Kimberley Gammage, Brock University
Within a group exercise setting, many factors can influence body image, including instructors and the cues that they use to motivate participants. For example, previous studies have reported that appearance-focused (versus health/functionality) cues during an exercise class led to poor body image outcomes post-exercise in university students; however, no study has examined the impact of these cues in older adults. Therefore, the purpose of the present study was to examine the impact of appearance versus functionality-focused cues used by an instructor on state body image in older adults. One hundred and seven men and women over the age of 60 took part in two visits. During visit one, participants completed demographic and trait body image questionnaires and had anthropometric measures taken. For visit two, participants were randomly assigned to an appearance or functionality-focused exercise class. In the appearance-focused class, the instructor’s cues emphasized the exercises as a way to alter the body’s appearance (e.g., weight loss), whereas in the functionality-focused class, cues focused on exercise as a way to improve function and health (e.g., completing daily activities). Participants completed state measures of body image immediately before and after participating in the exercise class. ANCOVA’s were conducted for each state body image measure (body appreciation, functional appreciation, body satisfaction with appearance and functionality, self-objectification, and social physique anxiety) controlling for state body image pre-class and appropriate demographic variables. Contrary to our hypotheses, no significant differences were found between conditions on any post-class body image measures (all p’s > .05). Findings from the present study support correlational and qualitative findings that age may act as a protective factor to poor body image experiences and expand experimental evidence to an exercise setting. Future studies should continue to experimentally examine psychological outcomes of acute exercise in older adults. Funding source: Student support from Ontario Graduate Scholarship and Social Sciences and Humanities Research Council.

Young Adults’ Weekly Variations of Moderate Physical Activity: Relations with Control Beliefs and Feelings of Shame
Alex Garn, Louisiana State University; Kelly Simonton, University of Memphis
Objective: Despite comprehensive benefits associated with regular physical activity (PA), many adults fail to meet recommended guidelines. Evidence suggests that major declines in PA occur in the early stages of adulthood as individuals typically gain greater independence from caregivers. Grounded in control-value theory of achievement emotions, this study investigated how self-evaluation processes including control beliefs and feelings of shame contributed to young adults’ weekly PA. Method: Young adults (N=71; M_age = 21.25; 55% male/45% female) reported moderate PA, control beliefs, and shame for five consecutive weeks. Latent growth curve models examined intra-individual trajectories of PA. Control beliefs, feelings of shame, and sex were added as covariates in order to explain inter-individual differences in intra-individual trajectories of PA. Results: The linear growth model for PA fit data better than an intercept-only model and equally as well as the quadratic and latent-basis models. The predicted level of PA at week 1 was 40 minutes of moderate PA approximately three days per week, with the average rate of change staying stable in the following four weeks. There were clear inter-individual differences (i.e., heterogeneity) in initial reports of PA and intra-individual trajectories. Adding covariates produced an adequate fitting model (e.g., CFI = .904; RMSEA = .075). Time specific control beliefs (β = .38 to .51) were positively related and feelings of shame (β = .13 to −.24) were negatively related to weekly changes in PA. Sex was not related to the latent intercept or slope. Conclusion: Control-value theory assumes that both motivational beliefs and emotions play important roles in shaping behavior. Our findings supported these assumptions, revealing that young adults’ control beliefs and shame (i.e. self-evaluation processes) toward PA contributed to weekly fluctuations of moderate intensity PA engagement. These findings highlight the need for self-evaluation strategies that increase agency and reduce self-consciousness in PA contexts and interventions.

Impact of a Physical Education-Based Behavioral Skill Training Program on Cognitive Antecedents and Exercise and Sport Behavior Among Adolescents
Markus Gerber; Robyn Cody; Jan-Niklas Krepke; Manuel Coinbra, University of Basel
School-based physical education has been associated with a multitude of potential learning outcomes. Representatives of a public health perspective suggest that promoting physical activity in and outside the context of school is an important endeavor. While the importance of self-regulatory skill training to improve (motor) learning is well documented, the promotion of behavioral skills to foster physically active lifestyles constitutes a rather neglected area in physical education research. Therefore, the purpose of this study was to examine whether a standardized behavior skill training program has the potential to positively impact on adolescents’ self-reported sport/exercise participation, as well as cognitive antecedents involved in the regulation of sport/exercise behavior. The study was designed as a cluster randomized controlled trial. A sample of 143 secondary school students (50% girls, aged 14–18 years) attending academic high schools in German-speaking Switzerland was assigned class-wise to the intervention (behavioral skill training) and control conditions (conventional physical education lessons). Data was assessed prior to and after completion of the 7-week intervention, which was composed of four 20-min lessons and two reflection phases. All outcomes were assessed via self-reports. Repeated measures ANCOVA were used to test the hypotheses. The results showed that compared to a control condition, the intervention program resulted in significant improvements with regard to introjected motivation, coping planning, and self-efficacy. The intervention also had a positive impact on adolescents’ self-reported sport/exercise behavior. Based on these findings, we conclude that behavioral skill training as part of compulsory physical education has the potential to improve cognitive antecedents of sport/exercise behavior and to foster adolescents’ sport/exercise participation. Enhancing behavioral skills might be one way in which school physical education can contribute to the creation of more physically active lifestyles among adolescents.

Relationships Between Sleep Quality, Sleep Hygiene, and Psychological Distress in University Student-Athletes
Chris Gladney; Matthew Marini; Philip Sullivan, Brock University
Insufficient sleep has a detrimental effect on an individual’s mental health, physical health, and well-being. Amongst the general adult population,
poor sleep quantity and sleep quality has been a prominent issue (Gilmour et al., 2013). Post-secondary students and student-athletes are part of a vulnerable population that experiences insufficient sleep and poor sleep quality. Therefore, student-athletes may experience damaging effects to their psychological health and overall well-being. In order to promote better sleep, Peach, Gaultney and Grey (2016) suggested improving sleep hygiene at the onset of sleep. Sleep hygiene is comprised of four domains, arousal-related behaviors, sleep scheduling and timing, eating/drinking behaviors, and sleep environment. Lastella et al. (2015) stated that an increased emphasis on sleep hygiene education will help improve levels of sleep quality. Among the post-secondary population, there are few studies that have examined sleep quality, sleep hygiene, and psychological distress together. The present study examined if sleep quality mediated the relationship between sleep quality and psychological distress in varsity athletes. Ninety-four university student-athletes completed the Kessler Psychological Distress Scale, Pittsburgh Sleep Quality Index, and Sleep Hygiene Practice Scale (Buyess et al., 1989; Kessler et al., 2002; Lin, Cheng, Yang, & Hsu, 2007). A mediation model was used to examine the relationships among the variables. Results showed that there was a direct inverse relationship between both psychological distress and sleep hygiene ($β = −0.451$), and psychological distress and sleep quality ($β = −0.417$). Furthermore, the relationship between sleep quality and psychological distress was significantly reduced when sleep hygiene was added to the model (95% CI: $−0.546, −0.079$), showing that sleep hygiene mediates the relationship between sleep quality and psychological distress. These results have many potential implications for sleep and well-being interventions for this population.

**Elementary Physical Education Students’ Climate Perceptions Predict Their Orientations and Competence**

**Karynn Glover; E. Whitney; G. Moore, Wayne State University**

Around the age of 12, youth begin to adopt both task and ego goal orientations based off previous experiences such as their perceptions of motivational climates (Nicholls, 1989). Further, motivational climates and goal orientations are related to students’ perceived competence. Sixth grade students ($N = 250$, 54% male/46% female) completed a survey including their perceptions of the motivational climate, goal orientations, and competence in their Physical Education class. The students were in classes of 25 that were split into groups of approximately eight, each with a member of the research team who read the survey items to the students and clarified any of the items for the students. A path analysis was conducted in lavaan to examine how student sex moderated the students’ competence being predicted directly by their perceptions of the caring, task- and ego-involving climates and indirectly through their task and ego goal orientations. The final model partially supported the hypotheses. The students’ perceptions of the climate as task-involving significantly predicted their task goal orientation and accounted for 42% and 44% of variance for males and females, respectively. The students’ ego goal orientation was significantly predicted by their perception of the ego-involving climate, accounting for 17% and 13% of variance for males and females, respectively. Females’ perceived competence was significantly predicted by their task goal orientation and accounted for 28% variance. However, 43% of males’ perceived competence variance was accounted for by their task orientation and task-involving climate perceptions. Thus, the perception of the task-involving climate directly predicted males’ perceived competence; whereas, for females’ perceived competence, their perceptions of the task-involving climate only had an indirect effect by increasing their task goal orientation. The results of this study suggest that P.E. teachers should strive to create a task-involving climate, as it can lead to higher reports of perceived competence through students’ adoption of a task orientation.

Funding source: Carol M. White PEP Grant.

**The Moderating Role of Narcissism Between Social Loafoing and Intermittent Running Performance in Soccer Players**

**Recep Gorgulu, Bursa Uludag University**

In performance domains such as sport, individuals high in narcissism excel when opportunities for personal glory are evident. However, when no such opportunity exists, the differential effect of narcissism is less known. Despite, narcissists’ beliefs that they are exceptional performers; this may contribute to conflicts within a team setting. Conflicts within a team often lead to a decrease in team functioning and may cause social loafing. Therefore, the present study aimed to explore the moderating role of narcissism on social loafing during an intermittent running performance. Thirty-six male football players ($M_{age} = 21.65; SD = 1.70$) completed self-report measures of the Narcissistic Personality Inventory -16 (Ames, Rose & Anderson, 2006). All participants were physically active and free of cardiovascular, metabolic, and orthopedic limitations for the past six months. Participants’ psychophysiological measures such as heart rate, heart rate variability, and body mass indexes were obtained before and during the experiment. All participants twice performed an intermittent yo-yo running test in teams of three: once when identifiability was low (team condition); and once when identifiability was high (individual condition). Judd, Kenny, and McClelland’s (2001) regression procedure was used to test within-subject moderation and results revealed that narcissists’ performance significantly decreased from individual to team conditions, whereas others displayed no such performance differences. Regressing the performance difference, $Y_d$ (i.e., $Y_I − Y_d$), on narcissism yielded $\hat{Y}_d = −4.40 + .92 N_{d}$. The slope for narcissism was significantly different from zero, $t_{(35)} = 2.96, p = .004$. This significant Narcissism × Performance interaction shows that narcissistic experienced significantly greater decreases in performance from high- to low-identifiability performance conditions. These data demonstrate that individuals high in narcissism performed better when there was a chance for glory, which provides a sound basis foundation for future studies on an intermittent type of team sports.

**Conformity or Projection? Prospective Associations Between Team Drinking Norms and Students’ Alcohol use Frequency Within Club Sports Teams**

**Scott Graupensperger, University of Washington; Michael Panza, Pennsylvania State University; M. Blair Evans, Pennsylvania State University**

Student-athletes’ decisions to engage in alcohol use often align with perceptions of teammates’ attitudes and behaviors (i.e., social norms). However, researchers debate the direction of this link, proposing contradicting pathways of conformity (i.e., perceived social norms predict one’s alcohol use) and projection (i.e., one’s alcohol use predicts perceptions of norms). We tested these competing models using a longitudinal sample of 1,054 college students (61% female) nested within 35 college club sport teams. At three timepoints across a single school year, participants reported frequency of alcohol use and perceptions of descriptive and injunctive drinking norms for teammates. Random intercepts cross-lagged panel modeling was employed to estimate prospective within-person associations—accounting for stable trait-like between-person associations—to better determine directionality. At the between-person level, perceptions of both descriptive and injunctive team drinking norms were related to students’ alcohol use frequency. Regarding within-person effects for descriptive drinking norms, models revealed strong contemporaneous associations between descriptive norms and alcohol use frequency within each time point, but no prospective associations (i.e., neither conformity, nor projection). Whereas results regarding injunctive drinking norms also demonstrated similar contemporaneous associations with alcohol use, injunctive norms predicted alcohol use at later timepoints—which signifies conformity to team...
norms. The current findings are somewhat contrary to previous research that has reported reciprocal relationships between social norms and alcohol use behavior. We attribute these differences to contrasting approaches to model behavior. These findings further elucidate the mechanisms of social norms, and provide valuable evidence to advance norm-based strategies to reduce harm. Funding source: National Institute for Alcohol Abuse and Alcoholism (F31 AA027685); NASPSPA Graduate Student Research Grant.

How Much Alcohol Does My Team Drink? Consensus Emergence Modeling of Perceived and Actual Drinking Norms in College Club Sport Teams

Scott Graupensperger, University of Washington; Michael Panza, Pennsylvania State University; M. Blair Evans, Pennsylvania State University

Student-athletes often engage in greater alcohol use than non-sport-playing students. Prior evidence from college students indeed reveals that individuals’ alcohol use behavior often aligns with the norms of groups to which they belong. However, individuals’ perceptions of what is ‘normative’ are idiosyncratic, and college students tend to misperceive how accepting peers are of alcohol use (i.e., injunctive norms) and how much peers actually drink (i.e., descriptive norms). We conducted the current study with college club sport teams with the expectation that small groups to which they belong. However, individuals that have reported reciprocal relationships between social norms and alcohol use behavior. We attribute these differences to contrasting approaches to model behavior. These findings further elucidate the mechanisms of social norms, and provide valuable evidence to advance norm-based strategies to reduce harm. Funding source: National Institute for Alcohol Abuse and Alcoholism (F31 AA027685); NASPSPA Graduate Student Research Grant.

Measuring Psychological Need Frustration in Physical Activity: Instrument Modification and Preliminary Results

Katie Gunnell, Carleton University; Jennifer Brunet, University of Ottawa; Catherine Sabiston, University of Toronto; Mathieu Bélanger, Université de Sherbrooke

Background: Researchers have developed new operationalizations of psychological need frustration that are distinct from low scores on measures of psychological need satisfaction. We are unaware of a questionnaire to assess adolescents’ psychological need frustration in the context of physical activity (PA). Purpose: We developed and examined the factor structure of adolescents’ responses to a psychological need frustration in PA self-report questionnaire. Methods: Items were drawn from existing situational (e.g., physical education) and general questionnaires of psychological need frustration and modified to be age-appropriate and reflect the PA context. Theoretical Experts (N=6) evaluated the content validity of the items and feedback informed modifications. Adolescents (N=349; M_{age}=15.93; SD.=.73; 57.6% girls) from the Monitoring Activities of Teenagers to Comprehend their Habits study completed the 13-item questionnaire in English or French. Responses were analyzed using a series of factor analytic models to determine the best factor structure. Results: Experts rated item clarity (Mx>4.46; SDs<.48) and representation (Mx=3.67; SDs<.32) above the midpoint of the 5-point scales. Confirmatory factor analysis and exploratory structural equation models indicated problems with high correlations (r=.80-.92) between competence, autonomy, and relatedness frustration latent factors. A confirmatory bifactor model provided the best statistical fit (CF=98, RSMEA=.04 [.02,.06]) and was the most interpretable model considering theory. Conclusion: The 13-item questionnaire was best represented as 3 specific factors (i.e., competence, autonomy, and relatedness frustration) and 1 global factor (i.e., overall psychological need frustration). High interfactor correlations and the presence of a global factor suggest the need for instrument modification and theoretical refinement. Specifically, removing aspects of relatedness frustration is challenging when measuring competence and autonomy frustration given the definitions of competence and autonomy frustration refer to ‘others’. Funding source: Social Sciences and Humanities Research Council and Sport Canada through the joint Sport Participation Research Initiative and by the New Brunswick Health Research Foundation.

The Impact of Athlete Culture and Coach Connections on Athlete Help-Seeking Intentions

Christine Habeeb, East Carolina University; Stacy Warner, East Carolina University; David Walsh, University of Houston

Research continues to demonstrate that athletes fear being stigmatized for seeking help with mental health issues (Delenardo & Terrion, 2014). Athletes who are more willing to seek help, however, will experience better adjustment and fewer emotional and behavioral problems (Fallon & Bowles, 2001). Despite coaches being identified as the strongest social asset for encouraging help-seeking, more information is needed on how the culture and relationships coaches create with athletes will impact athletes’ intentions to seek help. The current study’s purpose was to examine the extent to which athlete culture and coach connections (two factors empirically grounded in a qualitative phase of a larger study) predict athlete help-seeking. Athletes (N=474) completed an online survey on athlete culture (i.e., business-like, toughness), coach connections, and intentions to seek help from athletic administrators, other athletes, significant others, and mental health professionals. Results indicated that athletes were descriptively less likely to seek help from athletic administrators compared to other athletes, significant others, and mental health professionals. ANOVAs revealed that males reported significantly higher levels of toughness and coach connections compared to females. Freshmen reported significantly lower levels of business-like, and significantly higher levels of coach connections and intentions to seek help from athletic administrators compared to sophomores, juniors, and seniors. A path analysis revealed that coach connections predicted more help-seeking from athletic administrators (b=.25, p<.001) and other athletes (b=.17, p<.001). Business-like predicted less help-seeking from athletic administrators (b=-.31, p<.001), but more help-seeking from personal relationships (b=.42, p<.001). Results indicate the key factors that will encourage athlete help-seeking include coaches that focus on cultivating relationships with their athletes and minimizing a business-like, results-driven culture. Funding source: American Athletic Conference.
An Investigation of Self-Efficacy and Other-Efficacy on Collective Efficacy and Performance in an Interdependent Team Rope-Pulling Task

Christine Habeeb, East Carolina University; Patrick Rider, East Carolina University; Ross Murray, University of Toronto; James Merritt, East Carolina University; Rachel Grantham, East Carolina University

This study’s purpose was to examine the relative effects of self-efficacy and other-efficacy on collective efficacy and performance during an interdependent task. Twenty unacquainted male pairs participated in four practice trials, each requiring pulling a rope as hard as possible for 5 seconds with the partner. In line with Dunlop, Beaty, and Beauchamp (2011), self- and other-efficacy were manipulated, immediately following the practice trials, through the provision of randomly allocated bogus feedback from one of four conditions: (A) both persons performed well, (B) the participant performed poorly and the partner performed well, (C) the participant performed well and the partner performed poorly, or (D) both persons performed poorly. Participants then reported their collective efficacy (CE) using a 0–100 scale and performed in four competition trials of the same pulling task, alternating in the front and back pulling positions each trial. Force performance was measured using a dynamometer attached to the rope. Force data were averaged for the two trials associated with the participant pulling in the front position and then percent change in force, from the practice to competition trials, was calculated. Results indicated that the manipulation was effective whereby levels of self- and other-efficacy were reported in the expected direction for each condition. In condition A, participants reported the highest levels of CE (M = 92.9) and had an average 15.9% force increase. In conditions B and D, participants reported a similar level of CE (M = 83.8, 83.2, respectively), but participants in condition B had the lowest force increase (M = 11.9%) while participants in condition D had the highest force increase (M = 23.4%) across all conditions. Finally, participants in condition C, reported the lowest levels of CE (M = 75) across all conditions, but a similar force increase (M = 12.4%) as participants in condition B. In conclusion, personal and partner performance uniquely inform CE, and may help explain what motivates individual performance within teams.

Linking Competition Related Emotions with Conventional and Unaccustomed Coping Strategies Among Elite Student-Athletes

John Elvis Hagan Jnr., University of Cape Coast; Yavra Kloboito, University of Cape Coast; Medina Srem-Sai, University of Cape Coast; Pollmann Dietmar, Bielefeld University; Thomas Schack, Bielefeld University

Given that elite athletes experience a wide range of different emotions (e.g., happiness, anxiety, anger, and dejection) within any sporting environment, it is surprising that researchers have paid limited attention to these varied emotional experiences and diverse coping strategies during competition. This study was set out to investigate the impact of religious coping, as opposed to conventional psychological skills, to ascertain whether these coping approaches would influence athletes’ emotional reactions. Using a descriptive cross-sectional survey design, self-reported emotions, spiritual/religious coping, and psychological skills were measured with the Sport Emotion Questionnaire (SEQ), Test of Performance Strategies (TOPS), and Brief-Religious Coping Scale (Brief RCOPE) after 300 selected athletes were conveniently chosen. A factorial, 2 × 3 × 3 MANCOVA after controlling for age revealed no significant interactions on between-subject factors (gender, status, religion) across all the coping dimensions. However, significant main effects were realized for experience and religion on only anger, anxiety as well as dejection, though self-talk and negative religious coping were exhibited. Based on the multiple regression analyses, religion was identified as the most significant predictor of anger, anxiety, and dejection whereas competitive status appeared to be the most associated variable for self-talk and negative religious coping. Self-talk, together with unaccustomed negative religious/spiritual coping, may discriminate between athletes’ varied emotions during competition, especially among elite performers who are religiously inclined. These findings relate dysfunctional coping strategies to maladaptive emotions. Hence, identifying factors that may best predict athletes’ negative emotional experiences during competitive engagements is critical towards the development of appropriate psychological intervention framework for athletes’ improved performance and psychological well-being.

NCAA Student Athletes’ Valuation of Experienced Symptoms: A Missing Link Between Concussion Symptomology and Reporting Behavior?

Joshua A. Hansen, F. Edward Hebert School of Medicine; Travis E. Dorsch, Utah State University; Breanna E. Studenka, Utah State University

Sport-related concussions are receiving an increasing amount of attention from both scientists and health-care practitioners. It is estimated that more than 3.8 million sport-related concussions occur annually in the United States alone, and some studies suggest that up to 43% of these go unreported and untreated (Harmon et al., 2013; Torres et al., 2013). In our study, student-athletes from a sampling of 127 NCAA institutions completed an online survey to assess the influence of race, ethnicity, gender, and socioeconomic factors on the reporting of sub-concussive and concussive events, as well as the concussion symptoms they had experienced in sport. The survey also included questions designed to gauge student-athletes’ general knowledge of and attitudes about concussions, and to determine any discrepancies between ideal and actual behavior when faced with hypothetical situations involving concussion-like symptoms. Results suggest that sport category (limited-contact, contact, or collision), participation in football, and sport division (I, II, or III) had the most significant effects on symptom reporting, sub-concussive event reporting, and concussion reporting behavior, while gender, ethnicity, and parental levels of education and/or income did not. Interestingly, an athlete’s own valuation of concussion symptoms also influenced attitudes toward reporting and report behavior.

Organizational Effectiveness in Youth Sport: Lessons Learned From a Year-Long Intervention with an Elite Volleyball Club in the United States

Amand Hardiman, Utah State University; Matthew Vierimaa, Acadia University; Travis E. Dorsch, Utah State University

Sport research highlights the potential for youth to experience positive and/or negative developmental outcomes as a result of their participation. The extent to which these outcomes are achieved is influenced by young athletes’ regular interactions with other persons and contexts. Sport organizations represent one context where the interactions of multiple persons have the potential to influence and be influenced by an athlete’s behaviors, attitudes, experiences, and outcomes. Using an integrated model of the youth sport system (Dorsch et al., in review), the present study was designed to assess the organizational effectiveness of an elite youth volleyball club in the United States. The study was commissioned by the club, whose administrators were dissatisfied with its organizational culture. Club administrators (n = 5), coaches (n = 13), parents (n = 71), and athletes (n = 80) completed established measures of organizational effectiveness and cohesion, coaching leadership, parent support and pressure, parent-child warmth and conflict, and athlete leadership and social capital development. To gain further insight into stakeholder experiences of the
Mental Fatigue Alters Anticipated Effort and Subjective Valuations of Exercising to Predict Choice to Exercise or Not
Sheereen Harris; Nilina Mohabir; Steven R. Bray, McMaster University

Current physical activity (PA) recommendations suggest adults attain at least 150 minutes of moderate-to-vigorous intensity PA (MVPA) each week. Despite the majority of adults having intentions to engage in regular PA, less than 20% are currently meeting these guidelines. The disconnect between one’s intended behavior and actual behavior may be influenced, in part, by episodic shifts in motivation for engaging in PA that occur in response to fatigue and other feeling states throughout the day. For example, previous research showed young adults who were mentally fatigued had inflated perceived cost valuations of exercising; which, in turn, predicted their likelihood of choosing to engage in a sedentary task versus an exercise task. The present study extended that work by examining mental fatigue, anticipated effort of exercise, and benefit vs. cost valuations as potential mediators affecting choice between exercise and sedentary behaviors. Participants (N=84) completed either a 10-minute, cognitively-demanding, Stroop task or a non-demanding control task before choosing to engage in either a 20-minute self-paced MVPA task or a 20-minute sedentary task. Participants rated their mental fatigue, perceived effort, and benefits vs. costs of the MVPA task before and after the experimental manipulation. Mediation analysis revealed a significant indirect effect of group on exercise choice (95% C.I. =−.64 to −.06), with the cognitively-demanding task leading to higher mental fatigue, greater anticipated effort, and reductions in benefit vs. cost valuations of MVPA, which predicted sedentary vs. exercise task choice. Results also showed that benefit vs. cost scores decreased following the low cognitive demand task (p = .02, partial eta² = .13), suggesting that fatigue alone is not responsible for changes in subjective valuations and choice. Findings highlight the complexities of decision-making and emphasize the importance of a more holistic understanding of the phenomenology and consequences of engaging in cognitive tasks and how feeling states affect motivation and choice.

The Challenges, Opportunities, and Strategies of Community-Based Sport Positive Youth Development Research
Dorian Hayden; Michael Mignano; Leapetse Malete, Michigan State University

The field of sport and exercise psychology has seen growth in opportunities related to positive youth development (PYD) community-based sport and physical activity programs in underserved communities (Whitley et al., 2014). Underserved communities are identified as areas with a “shortage of personal services for residents, including economic, cultural, and linguistic barriers influencing their health and well-being” (Health Resources and Services Administration, 2011). With this growth in opportunities, researchers have also increasingly examined the impact of PYD sport and physical activity programs in underserved areas. However, many research projects related to the efficacy of such community and school-based programs in these populations have encountered several key challenges. Some of these challenges include gaining consent/assent, building trust, attrition, sociocultural competence, attrition, control groups, sport type offering, and several more (Whitley et al., 2014). In this presentation, we will describe our experiences conducting a mixed-methods evaluation study in a community-based PYD sport program, First Tee Golf In Schools, in an underserved school community. The opportunities, challenges, potential solutions, and overall importance of conducting research in underserved communities will be summarized. Our primary goal is to continue the discussion emphasized by Knight et al. (2009) and others by presenting transparent methods, acknowledging mistakes, and reducing the perceived “sanitized view of the research process” (Baum, 1998, p. 112). By presenting our experiences, we hope to provide future researchers with solutions and ideas when posed with the numerous challenges of conducting PYD sport and physical activity projects in underserved communities. Funding source: Michigan State University – Alliance for African Partnership.

Influence of Type and Level of Stress on Decision-Making in Sport: A Between-Persons Investigation
Teri J. Hepler, University of Wisconsin-La Crosse; Matt Andre, George Mason University

The purpose of this study was to examine the influence of type of stress (i.e., mental, physical), level of stress (i.e., low, high), and the interaction of type × level of stress (i.e., low mental, high mental, low physical, high physical) on decision outcomes (i.e., speed, accuracy, confidence) in sport. One hundred undergraduate students were randomly assigned to one of five stress conditions: control/no stress, low mental stress, high mental stress, low physical stress, and high physical stress. Mental stress was induced by mental serial subtraction and a color word task. Physical stress required running on a treadmill. Stress level was also manipulated to create low and high stress tasks. Each participant was exposed to approximately 15 minutes of stress. Immediately following stress exposure, participants performed 12 decision-making trials. In each decision trial, participants watched a video depicting an offensive situation in basketball and had to decide what the player with the ball should do next. Decision quality was rated by three college basketball coaches and used a 6-point Likert scale (0 = not at all acceptable, 5 = best possible). Decision speed was measured by the computer. Evidence from psychophysiological stress measures suggested that participants experienced significant amounts of stress in the various conditions and that the high stress conditions were in fact more stressful than the low stress tasks. Results revealed that stress level was the most influential factor, whereas there were no significant main effects for stress type or a type × level interaction on any of the variables of interest. Specifically, participants in the low stress conditions made faster decisions (M = 4851.9 ms), and were more confident in those decisions (M = 8.86), than were participants in the high stress conditions (speed: M = 5728.9 ms, p = .018; confidence: M = 8.38, p = .028)). Results of the current study, which contrast somewhat with previous research, suggest that stress level, not type, has the biggest impact on decision outcomes.

Influence of Type and Level of Stress on Decision-Making in Sport: A Within-Persons Investigation
Teri J. Hepler, University of Wisconsin-La Crosse; Matt Andre, George Mason University

The aim of this study was to investigate the influence of type of stress (i.e., mental, physical), level of stress (i.e., low, high), and the interaction of
type × level of stress (i.e., low mental, high mental, low physical, high physical) on decision quality, speed, and confidence. Across two different sessions, 42 undergraduate students completed each of the five stress conditions: control/no stress, low mental stress, high mental stress, low physical stress, and high physical stress. For the mental stress conditions, participants performed serial subtraction and a color word task. Physical stress involved running on a treadmill at various intensities. Stress level was also manipulated to create low and high stress tasks. Participants performed a stress condition for approximately 15 minutes and then immediately completed 12 decision-making trials. In each decision trial, participants watched a video of an offensive situation in basketball and had to decide what the player with the ball should do next. Decision quality was based on expert ratings and used a 6-point Likert scale (0 = not at all acceptable, 5 = best possible). Decision speed was measured by a computer. Evidence from psychophysiological stress measures (e.g., cortisol, visual analog scale) indicated the stress manipulations were successful at creating desired stress conditions. According to results, participants made better, faster decisions when performing under low stress (quality M = 3.58; speed M = 4981.64) as compared to high stress (quality M = 3.39; speed M = 5744.49). There was a significant type × level interaction on decision confidence, with participants expressing more confidence when making decisions under high physical stress than they were in decisions made under low physical stress (p = .001). Level of stress did not affect decision confidence for the mental stress tasks (p = .984). Results suggest that stress level plays an important role in decision-making in sport.

Behavioral Outcomes of the Personal Trainer-Client Relationship: A Tripartite Efficacy Examination

Christopher Hill, California State University, San Bernardino; Deborah Felz, Michigan State University; Alan Smith, Michigan State University; Nicholas Myers, Michigan State University

Individuals who struggle with engaging in regular physical activity or exercise might enlist the help of a personal trainer to help their exercise motivation. There is currently very little knowledge about the motivational consequences and behavioral outcomes of working with a personal trainer. The purpose of this study was to examine the tripartite efficacy model with clients who are working with personal trainers and to shed light on the behavioral outcomes of the personal trainer-client relationship. Adults (N = 301; Mage = 46.82 years, SD = 11.54 years; 61.5% female) who engage in exercise under the guidance of a personal trainer completed a survey at two time points. At the first timepoint, self-efficacy beliefs, other-efficacy beliefs, and relation inferred self-efficacy beliefs (RISE) were measured. One week later, participants were asked to complete a questionnaire about their perceived in-session effort and their moderate to vigorous physical activity (MVPA). Path analysis was conducted with RISE and other-efficacy as predictors of self-efficacy and all forms of efficacy beliefs as predictors of in-session effort and MVPA. Other-efficacy (β = .40) and RISE (β = .34) were significant predictors of self-efficacy, explaining 33% of the variance in self-efficacy. All efficacy beliefs in the tested model did not significantly predict MVPA but self-efficacy (β = .13) and other-efficacy (β = .23) were significant predictors of in-session effort (R² = .10). These findings build on previous tripartite efficacy model findings that underpin the importance of other-efficacy and RISE in building self-efficacy in the social milieu. Overall, this study also supports the notion that other-efficacy beliefs can foster higher levels of effort whenever a client views their personal trainer as an effective professional in an exercise setting. Future work can extend this study by including objective assessment of physical activity, by incorporating in-session effort measures like heart rate, or measuring perceived effort during training sessions. Funding source: Michigan State University College of Education Dissertation Completion Fellowship.

Effects of Aerobic Exercise on Cognition in Adults 3 Months or More Post-Stroke: A Meta-Analysis

Simon Holzapfel, Arizona State University; Michaela Mitchell, Arizona State University; Jessica Jones, Northern Arizona University; Mary Catherine Lockmiller, Northern Arizona University; Pamela Bosch, Northern Arizona University

Background: There is limited conclusive data on both pharmacological and holistic treatment options to improve cognition in adults after stroke. In particular, there is lacking evidence for cognitive rehabilitation in the subacute and chronic phases when cognitive impairment may be more salient. Objective: In this meta-analytic review, our primary objective was to determine the cognitive effects of aerobic exercise on post-stroke adults in the post-acute phases. Secondary objectives were to investigate the differential effects of aerobic exercise on sub-domains of cognitive function. Methods: Data were extracted from PubMed (MEDLINE), CINAHL, Embase, PsycINFO, and Scopus. Intervention effects were represented by Hedges’ g and combined into pooled effect sizes using random effects models. Heterogeneity was evaluated using the Chi-squared (Q) and I² statistics. Results: Six studies met inclusion criteria, representing data from 212 participants. The primary analysis produced a positive overall effect of aerobic exercise on cognition (Hedges’ g [95% confidence interval] = 0.59 [0.016-1.031]). Effects were significantly different from zero for aerobic interventions combined with other interventions (Hedges’ g [CI] = 0.90 [0.43 to 1.38]), but not for aerobic interventions alone (p = 0.40). In specific subdomains, positive effects were found for global cognitive function (Hedges’ g [CI] = 1.17 [0.40 to 1.94]) but not for attention and processing speed (p = 0.08), executive function (p = 0.84), and working memory (p = 0.17). Conclusions: Our analysis does not support the efficacy of aerobic exercise alone to improve cognitive function during the post-acute phases after stroke. The generalization of the beneficial effects of exercise on post-stroke cognitive function is premature and unwarranted. Further research is needed to determine the efficacy of aerobic training on cognitive function, specifically during the post-acute periods.

“Athlete” or “Exerciser”? The Influence of Identity on Physical Activity Preferences and Behavior

Briana Hubbard; Kathleen S. Wilson; Lenny D. Wiersma; Koren L. Fisher, California State University, Fullerton

Individual preferences have been described as important for participating in physical activity (Burke, Carron, & Eys, 2006). Preferences appear to vary across age, gender, settings, and modalities (Burton, Khan & Brown, 2012). One factor yet to receive attention relative to preferences is identity. While identities such as exercise and athletic identity have been linked to physical activity (Rhodes, Kaushal, & Quinlan, 2016), they have yet to be related to preferences. The purpose of this study was to examine the relationship of identity (athletic and exercise) to sport- and exercise-related preferences and behavior. University students (N = 191; age M = 22.2, SD = 3.2; 47% women) completed an online, cross-sectional survey about their identity, preferences, and physical activity behavior. The survey included the Athletic Identity Measurement Scale (AIMS; Brewer, 1993), Exercise Identity Scale (Anderson & Cychosz, 1994), Minnesota Lifetime Physical Activity Questionnaire (Montoye et al., 1996), and a preferences questionnaire created specifically for the current study. Multiple regression analyses were performed to predict exercise-related preferences and behavior as well as sport-related preferences and behavior. Exercise identity and athletic identity (three subscales: social identity, exclusivity, negative affectivity) were included as predictors in each model. The regression models were significant for exercise-related preferences.
(F = 2.5, p = .046; R^2 = .05), sport-related preferences (F = 14.0, p < .001; R^2 = .24), and yearly engagement in exercise-related behavior (F = 7.4, p < .001; R^2 = .12) but not yearly participation in sport-related behavior (F = 1.4, p = .224; R^2 = .009). Exercise identity was positively associated with exercise-related preferences (p = .006) and behavior (p < .001). Athletic identity (social identity & negative affectivity) was positively related to sport-related preferences (p = .002). The results suggest that individuals engage in and prefer physical activities that are congruent with their identity and have implications for tailoring programs to individuals.

**Maintenance Motives for Physical Activity Among Older Adults: A Systematic Review and Meta-Analysis**

Mary Katherine Huffman; Jason Brian Reed; Theresa Kathleen Carpenter; Steve Amtrieault, Purdue University

Objective: Maintenance of physical activity (PA) is vital for healthy aging. The purpose of this systematic review was to examine if the theorized motives of self-determination, enjoyment, identity, and satisfaction are related to PA maintenance in older adults and to explore whether the predictive capability of these four motives varies according to age, gender, health status, and/or maintenance context (i.e., self-initiated maintenance vs. maintenance beyond program termination). Methods: Studies that investigated PA maintenance with a sample mean age ≥ 55 years were included. Five electronic databases (e.g., PubMed, PsycINFO, and ProQuest Dissertations and Theses) were searched, resulting in 24,386 records, and 16 studies (k) were included in the review. When the number of studies was ≥ 5 for a given motive, a summary effect size (r) was calculated using the inverse-variance method under the random-effects model assumption. Results: There were 11 studies investigating self-determination, and it was found to be positively associated with PA maintenance [r = 0.18 (95% CI: 0.10, 0.26); k = 9]. The effect was stronger for those studies with a sample mean age > 64 (r = 0.33; k = 4) compared to studies with a sample mean age ≤ 64 (r = 0.12; k = 5). However, this observation may be confounded with publication bias, as all smallest sample size studies also had a sample mean age > 64 years. The percentage of females in the study sample did not influence the findings, and too few studies were available to explore variation in this effect according to health status and maintenance context. Few studies were included that investigated enjoyment (k = 4), satisfaction (k = 3), and identity (k = 1), which precludes any summary judgement for these three motives. Conclusions: There is a positive relationship between self-determination and PA maintenance for older adults. Additional research is needed to understand the effect of enjoyment, satisfaction, and identity on older adults’ PA over time. PROSPERO Registration Number: CRD42018088161.

**Acute Effects of Short Duration Walking on Executive Function in Patients with Chronic Kidney Disease**

Jasmin Hutchinson, Springfield College; Laurie Cournoyer, Springfield Public Schools; Samuel Headley, Springfield College

The purpose of this study was to determine the acute effect of a 6-min walk on executive function in a sample of 42 patients (55% male, 45% female; age 60.2 ± 9.2 years; BMI 34.5 ± 7.8) with stage 3 & 4 kidney disease. Participants were randomly assigned to either a walking or seated control group and completed the Victoria Stroop test (VST; Spreen & Strauss, 1998) immediately prior to and following a self-paced 6-min walk (intervention group) or a 6-min period of seated rest (control group). The VST is a timed test that requires short-term memory, attention, task switching, and response inhibition and is considered to be a valid and reliable measure of executive function (Troyer et al., 2006). The VST has three parts: naming the color of dots (control task), of neutral words (training task), and of color words printed in contrasting colors (interference task). The interference task requires the individual to inhibit an automatic reading response and to produce a more effortful color-naming response. An interference score is determined by calculating the extra time required to name colors in the interference task in comparison to the time required to name colors in the control (dots) task. VST interference score was compared using a 2 (time) × 2 (group) mixed factorial ANOVA. A significant time × group interaction was found (F = 4.24, p = .046, η^2_p = .096). VST performance significantly improved (i.e. task interference score decreased) in the walking group, but not in the control group. These results suggest that a short bout of acute exercise has short-term benefits for executive function in adults with chronic kidney disease. This effect is consistent with past literature describing a beneficial effect of acute exercise on cognitive performance (e.g., Tomporowski, 2003); however, this is the first study to provide evidence of this effect in patients with CKD. Future studies should seek to replicate this finding, and consider the effect of different exercise durations, intensities, and modalities. Longitudinal research designs would be particularly valuable.

**The Role of Parents in Facilitating Life Skills Development in Competitive Youth Sport**

Helene Jørgensen; Colin J. Deal; Nicholas L. Holt, University of Alberta

Life skills development through sport is a complex process that occurs across different learning contexts and is influenced by multiple social agents. An influential, yet understudied, group of social agents is parents (Harwood, Knight, & Thrower, 2019). The purpose of this study was to examine the role of parents in facilitating life skills development in competitive youth sport. Individual semi-structured interviews were conducted with 44 participants. The sample was comprised of 24 athletes between the ages of 12 and 16 (14 female, 10 male, M_age = 14.3 years, SD = 1.25) who competed in a variety of youth sports at a provincial level or higher, and the parent most involved in their sport participation (13 mothers, 7 fathers, M_age = 46.8 years, SD = 4.63). Interviews were transcribed verbatim and data were subjected to Braun and Clarke’s (2006) semantic thematic analysis procedure. Our findings suggested that high, and consistent, parental involvement and expectations across two learning contexts (i.e., home and sport) facilitated life skill development. Furthermore, it appeared that children learned life skills from their parents in a variety of ways within these contexts, some of which we coded as ‘indirect’ teaching and learning (e.g., parent role modeling). Other ‘direct’ teaching and learning was also reported (e.g., parents creating a checklist for sport equipment required for practice). The results of this study provide insight into the broader dynamics of family life as it relates to sport participation and life skills development. In the future, it may be useful to examine relationships between parenting styles and life skills outcomes, which could produce knowledge that informs parent education and support initiatives in youth sport. Funding source: Human Performance Fund Grant 2019-2020.

**Evaluation of Mind Fit: A Community-Based Exercise and Mental Wellness Intervention for Adolescents**

Mahabir Kandola, University of British Columbia; Erica Lau, Centre for Hip Health and Mobility; Peter Crocker, University of British Columbia; Guy Faulkner, University of British Columbia

The worldwide prevalence of poor mental health among children and youth is increasing, and those experiencing low mood are less likely to participate in physical activity (PA) than their peers. Community-based PA interventions can provide a low-cost, easily accessible solution to improve mental and physical health, but how do we deliver interventions at scale? In...
partnership with YMCA, Mind Fit is a community-based PA intervention which combines 1-hour of mental wellness discussions and 1-hour of PA in a group setting once a week for 8 weeks. The purpose of this study is to evaluate Mind Fit and examine program implementation and effectiveness over 2 years. Youth (13–18 years; N = 60) completed baseline, post-program, 3-month follow-up surveys, and telephone interviews including measures of PA, mental health (PHQ-9, GAD-7), motivation, and program experiences. Telephone interviews were conducted with Mind Fit coordinators and instructors to assess program implementation and collect qualitative feedback. Statistical analyses included descriptive statistics, paired samples t-tests, and ANOVA to examine differences pre- and post-intervention. Six teenagers dropped out and 75% of the remaining teenagers completed more than half of all sessions across seven sites. Depression and anxiety symptomatology decreased from baseline (M = 10.9, SD = 6.1; M = 10.2, SD = 4.6) to post (M = 8.4, SD = 5.6; M = 7.6, SD = 4.5) and 3-month follow-up (M = 7.6, SD = 4.8; M = 7.1, SD = 4.7). Self-reported PA remained constant, on average, over the duration of the program and follow-up. From interviews, teens expressed high satisfaction and enjoyment. Staff believed the program was effective but experienced implementation challenges such as limited availability of recreational space and low recruitment. Mind Fit has demonstrated potential to improve mental health outcomes and was well-received by youth. Staff are optimistic of the program effectiveness however, improved PA curriculum, greater collaboration opportunities among instructors, and improved recruitment strategies are required in the future.

Students in Undergraduate Kinesiology Course Define Disability
Winston Kennedy; Samuel Logan; Joseline Raja; Samantha Noregaard; Kathleen Bogart, Oregon State University

Disability has been defined in a variety of ways. The way in which individuals choose to define disability is important because the language used influences expectations and interactions with people with disabilities. Many undergraduate students in kinesiology aspire to be leaders in fitness, physical education, medicine, physical therapy, occupational therapy, dentistry, and nursing and will work closely with people with disabilities on a daily basis. Therefore, it is important to understand how kinesiology students define disability as it may provide insight into present or future interactions with people with disabilities in physical activity contexts. The purpose of this study is to conduct a quantitative content analysis of kinesiology students’ responses about how they defined disability. Method: 382 undergraduate kinesiology students (205 Female; Mean age 21.3 years, SD = 2.3) were enrolled in a motor behavior course at a public university in the United States. Students answered the question “According to your own personal opinion, how would you define disability?”. A quantitative content analysis approach was used to analyze responses. Inter-rater reliability was assessed during the coding process (Cohens Kappa agreement >.8). Results: 13 themes emerged and included Difficulty (disability is a difficult experience), Participation (disability is identified around participation in activities and society in general), Norm-Comparative (comparing disability to a standard norm). These themes occurred in 84%, 69%, and 42% of responses respectively. Conclusion: These results highlight similarities in students’ definition of disability. There is no one objective definition of disability, but this study shows that there are consistent themes that are present across definitions that may provide insight into this group’s potential interactions with people with disabilities. Future studies should aim to understand how health professionals define disability, which could help begin to outline if there is a shift in how disability is defined from a student to a professional. Funding source: The primary author acknowledges the contents of this manuscript were developed under a grant from the US Department of Education (H325D160023 [PI Yun/MacDonald]). However, the contents do not necessarily represent the policy of the US Department of Education, and you should not assume endorsement by the Federal Government.

A Mixed-Methods Multiple Case Study of Informal Roles in Two University Basketball Teams
Jeemin Kim, University of Toronto; Taylor Coleman, Wilfrid Laurier University; Michael Godfrey, Wilfrid Laurier University; Matthew Viermaa, Acadia University; Mark Eys, Wilfrid Laurier University

Roles, defined as a set of behavioral expectations held for each member, are an important structural aspect of sport teams. Previous research suggested that roles that naturally arise such as team comedians, mentors, and distracters (i.e., informal roles) can impact sport team functioning. The current case study aimed to highlight the key factors that influence informal role emergence in sport teams. A total of 27 athletes from one female and one male university basketball team participated. Three types of data were collected: (a) questionnaires were administered four times during the sport season to assess athlete personality and informal role occupancy, (b) athlete behaviors during a game session for each team were objectively coded, and (c) end-of-season qualitative interviews were conducted with one team to garner in-depth perspectives. For analysis, athletes occupying different types of informal roles (positive vs. negative, task vs. social) were compared in terms of their demographics, personality, and behavior patterns to search for similarities and differences. The interviews were thematically analyzed to further identify relevant factors involved in this process. The results suggested that those who occupied positive task (e.g., verbal leader) and/or social (e.g., comedian) informal roles tended to have higher tenure and playing status, in comparison to those who occupied no informal roles or negative informal roles (e.g., distracter). Those who occupied social-oriented roles displayed higher extraversion (M = 3.96) and behavioral activity, whereas those who occupied only task-oriented roles displayed lower extraversion (M = 2.28) and activity. The interview results identified several person-related (e.g., work ethic) and contextual (e.g., role void) factors that influenced informal role emergence. Overall, informal role emergence appears to involve a complex interaction of various factors. The results were integrated to propose a conceptual model that offers a foundation for future research in this area. Funding source: NASPSA Graduate Student Research Grant; Doctoral Award from the Social Sciences and Humanities Research Council (SSHRC) of Canada.

New Insight into Why We Run a Track Counterclockwise: Frontal EEG Asymmetry and ERP Analyses
Jingu Kim; Yujin Kim; Sechang Kwon, Kyungpook National University

Previous research has attempted to explain why we run around the track counterclockwise (CCW), not clockwise (CW), using varying theories including historical, biological, or biomechanical facts, providing little neurophysiological evidence on what underlies the CCW running tendency with relevance to brain activity. In this study, two experiments were administered to investigate the differences in electrical activity of the brain involved in CCW versus CW running. In experiment 1, 36 participants were randomized to either a CCW motor imagery (MI) group or a CW MI group. They were instructed to start MI when presented with a dynamic counterclockwise (CCW), not clockwise (CW), using varying theories including historical, biological, or biomechanical facts, providing little neurophysiological evidence on what underlies the CCW running tendency with relevance to brain activity. In this study, two experiments were administered to investigate the differences in electrical activity of the brain involved in CCW versus CW running. In experiment 1, 36 participants were randomized to either a CCW motor imagery (MI) group or a CW MI group. They were instructed to start MI when presented with a dynamic image showing the first-person view of running a curved track in either direction for 2 minutes. EEG was recorded during MI and at rest, and frontal EEG alpha asymmetry was analyzed. In experiment 2, 54 participants were randomized to an arrow, still image, or dynamic image group, depending on types of stimulus to be presented for cueing the direction of MI. Each participant completed a total of 200 MI trials for 10 seconds each across 4 blocks, which included half CCW and half CW conditions. N2 and
P3 ERPs were obtained at the frontal, central, and parietal regions. In the analysis of frontal EEG alpha asymmetry, relatively greater left frontal activity was observed in the CCW group, while the CW group exhibited greater right frontal activity, which can be interpreted in association with motivational and affective states of the participants during MI. The differences in ERPs only emerged during MI with the dynamic image, with MI in CCW direction involving greater N2 amplitudes compared to CW at the left frontal, central, and parietal regions. The learning-related signature of N2 may indicate that participants are more skilled at running CCW than CW as a result of repetition. Overall, the neurophysiological data found in this study suggest that running CCW may evoke more comfortable and positive emotions compared to running CW in a track. In a following study, the neural mechanism of the turning bias has been further investigated using fMRI. Funding source: This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2016S1A5A2A01023896).

Thriving in Youth Sport: Investigating the Motivation, Intention to Continue, Well-Being, and Goal Progress
Keita Kinoshita, University of Ottawa; Eric MacIntosh, University of Ottawa; Shintaro Sato, Waseda University

Participation in sport has well-documented physical, psychological and social benefits that can lead to the development of healthy behaviors; however, sport participation rates have been declining, particularly among youths (Statistics Canada, 2019). Scholars have recently suggested that thriving, defined as the concurrent experience of learning and vitality, may offer insight into the problem as it is a positive predictor of salient outcomes such as retention, well-being, and performance (e.g., Porath, Spreitzer, Gibson, & Garnett, 2012). Thus, the purpose of the present study is to examine if thriving would influence important outcomes for youth athletes (i.e., intention to continue, well-being, and goal progress). To do so, the Self-Determination Theory was utilized (i.e., Hedonic/Eudaimonic motives: HM/EM and basic psychological need satisfaction: BPNS). One hundred and ninety-six youth sport participants answered an online survey (Mage = 15.41). Data analysis was conducted by using the path analysis with maximum likelihood estimation to investigate the hypothesized model. The proposed model showed a good fit to the data ($\chi^2$/df = 2.42; CFI = .99; TLI = .95; RMSEA = .09; SRMR = .03). The results showed that hedonic and eudaimonic motives were significantly related to intention (HM: $\beta$ = .01; EM: $\beta$ = .03), well-being (HM: $\beta$ = .01; EM: $\beta$ = .02), and goal progress (HM: $\beta$ = .02; EM: $\beta$ = .05) through both BPNS and thriving (HM/EM → BPNS (Mediator$_1$) → Thriving (Mediator$_2$) → Intention/well-being/Goal progress). The study revealed that both HM and EM are indirectly related to not only intention to continue sport but also athletic well-being and goal progress through BPNS and thriving. Hence, the findings suggest that thriving is an important predictor of athletes’ intention to continue, athletic well-being, and goal progress, which can be enhanced by greater BPNS. Therefore, education to increase HM and EM is imperative for youth athletes to improve the salient outcomes. The research will present the mechanism underlying the experience of thriving in youth athletes.

A Buffering Effect of Mental Toughness on the Link Between Youth Athletes’ Basic Psychological Need Thwarting and Thriving
Keita Kinoshita, University of Ottawa; Eric MacIntosh, University of Ottawa; Shintaro Sato, Waseda University

Basic psychological needs (BPNS; Ryan & Deci, 2000) are the concept that helps clarify the psychological mechanism to reach outcomes (e.g., thriving or depleting). Although researchers claim that the low BPN satisfaction and BPN thwarting differently explain outcome variables (Costa, Ntoumanis, & Bartholomew, 2015), recent review studies focused only on BPN satisfaction and the outcomes (Cerasoli, Nicklin, & Nassreluggawi, 2016). When BPNs are undermined or thwarted, people should be less likely to thrive. As mental toughness (MT) can reduce the negative effects of stressors, MT may buffer the negative effect of maladaptive motivation (e.g., Gucciardi, 2016). The purpose of the present study was to investigate the buffering effect of MT on the negative links between BPN thwarting and important outcomes for youth athletes (e.g., thriving, intention to continue sport, well-being, and goal progress). One hundred eighty-eight Canadian youth athletes (Mage = 15.51) completed a survey consisting of 46 items questions. Mediation and moderated-mediation analyses were conducted to test our hypotheses. The results demonstrated some significant moderating effects of MT on the indirect links between BPN thwarting and intention/well-being/goal progress through thriving. The negative impacts of BPN thwarting on the outcomes were not significant for youths with high MT. Concomitantly, the results showed the athletes with low MT were more vulnerable to the negative effects of BPN thwarting on three outcomes through thriving. Finally, for the two models in which intention and well-being are the outcomes, the direct links with BPN thwarting were still significant in the models, suggesting that BPN thwarting was a significant negative predictor of the two outcomes (i.e., intention and well-being) regardless of the level of MT. Hence, the findings demonstrate the buffering effect of MT for the negative effects of BPN thwarting on youth sport outcomes.

Rural/Remote First Nations Athletes and University Sport in Manitoba: Strategies for Overcoming the Obstacles
Nickolas Kosmenko; Joanne Halas; Leisha Strachan, University of Manitoba

TRC Call to Action 90(ii) calls for “An elite athlete development program for Aboriginal athletes” (p. 10). University sport may be a pathway to elite levels by providing access to state-of-the-art facilities, expert coaches, athletic therapists, nutritionists, and sport psychologists. However, there are many barriers to sport and university for First Nations athletes. Some sport-related barriers include lack of infrastructure on reserves, geographic distance of reserves from facilities and experts, funding challenges, racism, and acculturation challenges (Blodgett et al., 2014; Canadian Heritage, 2005). Some university-related barriers include cultural exclusion (Kirkness & Barnhardt, 1991), lack of career counseling on some reserves, and lack of outreach by universities to reserves (Preston, 2008). Better understanding of these barriers, including solutions for change, may inform schools and sport programs seeking to promote sport participation among First Nations people, like Manitoba. Following an Indigenous Research Paradigm and using an ecological systems approach involving interviews with First Nations athletes and their coaches and teachers, this research explored factors influencing university sport participation among First Nations athletes from rural and remote communities in Manitoba. Preliminary results suggest family/community support is important in athlete development, and that First Nations athletes in university must often be proactive in finding financial and academic support. Results also highlight the importance of coaches who are either knowledgeable of, or willing to learn about First Nations cultures. These results confirm previous research and provide increased support for initiatives addressing Call to Action 90(ii). Funding source: University of Manitoba Graduate Fellowship; Manitoba Graduate Scholarship; Social Sciences and Humanities Research Council CGSM; Vanier Canada Graduate Scholarship; Sport Canada Research Initiative; CD Howe Memorial Fellowship.
Extensive research has supported the positive effects of music on exercise performance. Music during exercise heightens arousal and increases the valence of exercisers’ affect. Furthermore, musical stimuli delay the attentional shift from external to internal attention which occurs as exercise intensity increases. However, the extant literature does not examine the effect of music stimuli’s timing during exercise. Therefore, this experimental study tested the effects of music timing on rating of perceived exertion (RPE), attention, and affective response during aerobic exercise. Researchers randomly assigned 41 undergraduate kinesiology students from a Southeastern university to either a control condition (i.e., no music) or one of two experimental groups. The first experimental condition presented music to participants throughout the duration of exercise. The second experimental condition delayed music stimuli onset until participants reached or exceeded RPE 11. Both experimental groups listened to a self-selected, high tempo (over 120 bpm) playlist. All participants completed the Balke and Ware treadmill exercise test, consisting of a steady pace walk on a gradually increasing incline, until voluntary exhaustion. Participants RPE and attention were recorded every minute during exercise, and affect was measured before and after participation. To control for differential voluntary dropout times, RPE and attention scores were converted into five time points plus baseline. There was a significant interaction of group and time point, \( p < .05, \eta^2 = .09 \), such that both experimental music groups had lower RPE later in the exercise than the control group. There was no significant effect of group or group by time point interaction for attention or affective response. These findings provide partial support for the impact of music on affective response during exercise. Delaying the onset of music stimuli until RPE increases beyond light activity could provide novel distraction as exercise intensity increases compared to constant music exposure.

Adults Want to Play Too: Social Play Versus Group Training for Exercise Enjoyment and Adherence: Preliminary Data From a Randomized-Controlled Trial
Matthew A. Ladwig; Christopher N. Sciamanna, Pennsylvania State University

Few adults in the United States obtain sufficient physical activity (PA) despite having knowledge of the associated health benefits. One potentially important barrier to PA is that many people do not experience the behavior as pleasant and enjoyable. With these barriers in mind, in 2016, we designed a novel social sport program, known as PlayFit. PlayFit consists of several sport games (e.g., Ultimate Frisbee, Handball, Kickball, Netball, and Soccer) modified to be easier to play, non-contact, and for fun as opposed to competition (e.g., we do not keep score). Some of the unique modifications include smaller playing areas, lightweight balls and Frisbees, lack of goalkeepers, and randomly choosing teams. We were subsequently funded (R61/33HL142679) to conduct a pragmatic randomized-controlled trial (RCT) designed to test the impact of PlayFit versus traditional General Exercise on exercise enjoyment and program adherence. Here we present the protocol and preliminary data from this ongoing RCT. Currently, 176 participants \( (\text{n}_{\text{male}} = 137, \text{n}_{\text{female}} = 39, M_{\text{age}} = 40.5 \pm 6.9, M_{\text{BMI}} = 33.1 \pm 7.5) \) from four sites across central Pennsylvania have been randomized out of a 360 participant goal. Overall, adherence to the three times weekly program for both PlayFit and Group Exercise has been poor (i.e., around 15–20%), despite program satisfaction among attenders being good (i.e., 3.5 out of 5) and the likelihood of recommending the program to a friend high (i.e., 8 out of 10). In this presentation, we will discuss modifications to recruitment for our second cohort, as well as lessons learned while administering a large-scale pragmatic RCT among sedentary, overweight-to-obese adults. Funding source: National Institutes of Health (NIH) – National Heart, Lung, and Blood Institute (NHLBI).

Development and Dissemination of Physical Activity Messages for Parent Support for Children With and Without Disabilities: A Systematic Scoping Review
Victoria Laroocca, York University; Amanda McKinnon, York University; Kelly Arbour-Nicitopoulos, University of Toronto; Jennifer Tomasone, Queen’s University; Amy Latimer-Cheung, Queen’s University; Rebecca Bassett-Gunter, York University

Background: Parent support has been identified as a major determinant of physical activity (PA) participation among children, including children with disabilities (CWD). There is no known systematic synthesis of evidence to inform the development and dissemination of motivational messages targeting parent support for PA. A synthesis can aid in identifying optimal strategies to inform organizations on effective message development and dissemination for all parents and identify unique considerations for parents of CWD. Objective: This study used systematic scoping methodologies to identify literature regarding: a) optimal content to include in PA messages targeting parents and b) strategies that will optimize the message dissemination. The review also seeks to identify unique considerations regarding messages targeting parents of CWD. Methods: Guided by Lavis and colleagues’ (2003) Framework for Knowledge Transfer, peer-reviewed and grey literature searches, and expert consultations were conducted. Articles published in English between 2000–2019 were included for review if they included information regarding: (a) PA messages/promotion, (b) PA message development strategies, and/or (c) dissemination strategies. Results: A total of 3,998 records were searched and 33 articles were eligible for examination. Seven themes were identified that can aid organizations wishing to target parents: a) Message Framing, b) Message Awareness, c) Dissemination Preferences*, d) Attitudes Toward Child PA*, e) Barriers To Supporting Child PA*, f) Psychosocial Antecedents To Parent PA Support*, and g) Use Of Marketing Strategies. Unique considerations for messages targeting parents of CWD were identified within the themes marked with an asterisk. Conclusions: In line with the Framework for Knowledge Transfer, these results can provide information regarding message development and dissemination for organizations wishing to target parent support through evidence-based practices, especially for organizations wishing to be more inclusive of parents with CWD. Funding source: SSHRC.

Coach Autonomy Support and Need Satisfaction/Thwarting: A Comparison of Youth and Masters Swimming Contexts
Heather K. Larson, University of Alberta; Bradley W. Young, University of Ottawa; Tara-Leigh F. McHugh, University of Alberta; Wendy M. Rodgers, University of Alberta

The importance of autonomy support in sport environments has been well-established, but little is known about how adult sportspersons’ perceptions of coach autonomy support (CAS) relate to psychological need satisfaction or thwarting (Hoffmann, Young, Rathwell & Callary, 2019). Nor has any work queried whether these relations differ between adult and youth sport cohorts. The purpose of this study was to compare CAS and need satisfaction/thwarting in two contexts: youth swimming and masters swimming. Participants completed surveys measuring a variety of psychological variables, including autonomy support and the satisfaction and thwarting of autonomy, competence, and relatedness. The sample included 205 masters swimmers \( (M_{\text{age}} = 44.4, \text{range} = 18–85 \text{ years}; 60\% \text{ women}, 40\% \text{ men}) \).
is a consistent correlate of children’s PA. Children’s perception of PAP has gained relatively little attention given that it is hypothesized to mediate the relationship between PAP and child PA outcomes. The purpose of this study was to qualitatively examine 7–10-year-old children’s perspectives on PAP practices and how they relate to their motivational regulation of PA. Altogether 79 children, 7–10 years of age, participated in 19 semi-structured focus group interviews. Transcribed data were analyzed using qualitative theory-guided content analysis and by utilizing ATLAS.ti software. Using frameworks of parenting dimensions and the Self-Determination Theory (SDT), we found that children’s perceptions of high responsiveness and low demandingness in PAP, and the corresponding elements of parenting defined in the SDT, autonomy support, involvement, and structure, were associated with satisfaction of all three psychological basic needs—autonomy, competence, and relatedness. In contrast, perceptions of high demandingness and low responsiveness in PAP (i.e. coercive parental control) were associated with dissatisfaction of autonomy need. However, perceptions of high demandingness and high responsiveness in PAP, specifically perceptions of parental expectations and facilitation of PA in association with co-participation in PA or consideration of the child’s PA interests, were associated with satisfaction of competence need. The findings suggest that based on interviews with 7–10-year-old children, it is possible to identify theory-guided PAP practices which associate with psychological need (dis)satisfaction, and can be thus expected to enhance or inhibit autonomous motivational regulation of PA. The study contributes especially to understanding of parental demand in the PAP since different forms of parental demand inness with differing motivational outcomes were uniquely identified from children’s perceptions. Funding source: Finnish Ministry of Education and Culture (OKM/59/626/2017) and Finnish Cultural Foundation (00170607).

Can We Take a Closer Look at This? Challenging Dominant Developmental Models with Visual Representations of Youth Sport Participation Data

Heather K. Larson, University of Alberta; Bradley W. Young, University of Ottawa; Tara-Leigh F. McHugh, University of Alberta; Wendy M. Rodgers, University of Alberta

Models of sport participation and athletic development propose specific patterns of youth sport involvement that lead to favorable outcomes, such as elite performance and long-term participation (e.g., Côté & Fraser-Thomas, 2016). Correlational work linking youth activity with later adult participation suggests patterns may be less coherent than conveyed in such models (Larson, Young, McHugh & Rodgers, 2019). This study aimed to visually represent the pattern of youth participation from age 6 to 12. Data were from a large study of 265 swimmers (M_age = 13.8, r = 12–17 years; 60% girls). Parents reported on children’s sport backgrounds, including total number of sports, type of sports, season length, and weekly hours, starting at age 6. Swimmers were from two contexts, summer (i.e., brief season) and winter club (year-round investments), to encompass a range of participation characteristics. We organized data with Excel to illustrate color-coded patterning over time, sorted by gender, swim context, and main sport. Descriptive values supported the visual representations. Though all participants were swimming at time of data collection, their sport backgrounds were extremely variable. There was remarkable variability in sampling (0 to 5+ sports), from the earliest ages, evidence of decreasing and increasing sampling, and late entry. A “one sport” pattern was weakly represented throughout. The largest gender differences were seen at age 9 (boys sampled more) and age 12 (girls sampled more). Summer swimmers consistently sampled more than winter peers. Those reporting a main sport other than swimming also had consistently greater sampling. We saw remarkable heterogeneity of participation, surprising sampling contrary to dialogue on early sport specialization (Côté & Fraser-Thomas, 2016), and patterns that are not easily aligned with predominant developmental models. Results suggest current models (e.g., Sport for Life, 2019) are oversimplified.

“It’s Compulsory But it’s Still Pretty Nice”: Young Children’s Views on Physical Activity Parenting and the Associated Motivational Regulation

Arto Laukkonen; Arja Sääkslahti; Kaisa Aunola, University of Jyväskylä

Physical activity parenting (PAP), i.e., concrete behavioral strategies employed by parents to influence their children’s physical activity (PA),
Relationships Between Social Support, Exercise Barrier Self-Efficacy and Intentions to be Active for Inactive and Active SCI Ambulators

Sarah Lawrason; Kathleen Martin Ginis, University of British Columbia

Individuals with spinal cord injury (SCI) who walk (i.e., SCI ambulators) participate in less leisure-time physical activity (LTPA) than individuals with SCI who use wheelchairs. SCI ambulators also have lower exercise barrier self-efficacy (BSE; i.e., confidence in overcoming barriers to exercise) than wheelchair-users. Both intentions to be active and BSE predict LTPA, but the relationship between BSE and intentions is unknown. The purpose of this study was to explore the relationships between BSE, social support, and intentions among inactive and active SCI ambulators; and to measure the mean duration of moderate-vigorous LTPA. A secondary analysis of the Study of Health and Activity in People with SCI data was conducted. The Physical Activity Recall Assessment for People with SCI was used to collect LTPA data. Questionnaires assessing LTPA intentions, social support, and BSE were administered. Descriptive statistics revealed that across 92 SCI ambulators (72% male; 47% tetraplegic), 49% did not participate in any LTPA (inactive group). Among active participants, the mean duration of moderate-heavy LTPA was 12.08 mins/day (SD = 14.36). Multiple regression analyses revealed that for the inactive group, social support (β = .36, p = .007) and BSE for time (β = .42, p = .002) significantly predicted intentions, F(2,41) = 12.45, R² = .38, p < .001. For the active group, only BSE for fatigue (β = .56, p < .001) significantly predicted intentions, F(1,45) = 20.52, R² = .31, p < .001. Different types of BSE predicted intentions to be active for the inactive and active groups. Researchers and interventionists should consider developing and tailoring behavioral exercise interventions to address different types of BSE depending on whether SCI ambulators are active or inactive. For instance, inactive SCI ambulators may benefit from increased social support and strategies to increase time to be active, whereas active SCI ambulators may benefit from strategies to reduce fatigue.

Exploring the Effects of Acute Exercise on Activities of Daily Living Among Older Adults

Jean-Charles Lebeau; Sasa Vann; Thomas Gretton; Taylor Gabler; Alyssa Fuller, Ball State University

The effects of both acute and chronic exercise on cognitive functioning are now well established (Chang, Labban, Gatin, & Etnier, 2012; Kramer & Colcombe, 2018; Sprague et al., 2019). However, the research on the effects of acute aerobic exercise on cognitive functioning among healthy older adults is relatively scarce and relies primarily on laboratory measures of executive functions (Chu, Chen, Hung, & Chang, 2015; Hyodo et al., 2012). Hence, it is unknown how the benefits of acute exercise on cognitive functions transfer to the sort of dynamic cognitive functioning in everyday life (Etnier, 2012; Sprague et al., 2019). The goal of this study was to address this gap by investigating the effect of acute exercise on two activities of daily living relevant to the older population: preparing a pill organizer and maintaining postural balance in functional tasks. Sixty-five healthy older adults (M_age = 77.93, SD = 8.95) were randomly allocated to a 15 min moderate intensity cycling exercise or video control. Before and after the exercise or video, participants were tested on their cognitive functioning via the Stroop test. They also performed the Berg Balance Scale for functional balance and were asked to prepare a pill organizer based on a prescription. No significant time by condition interaction effect emerged for the Stroop test and the pill organizer task. However, some significant effects were observed for functional balance (p = .02). These results suggest that even one bout of exercise can improve balance among older adults, thus offering the potential for preventing falls for this population. Additionally, the positive effects of exercise on functional balance may appear in the absence of improvements in executive functions as measured by the Stroop test. The results of this study are discussed in light of the challenges associated with transferring results from laboratory tests to more ecologically valid tasks.

Acceptability of Aerobic Exercise as an Adjunct to Repetitive Transcranial Magnetic Neurostimulation for Treatment-Resistant Depression

Jacqueline S. Lee, University of British Columbia

Background: Repetitive transcranial magnetic stimulation (rTMS) is an alternative therapy for patients with depression who fail to respond to standard pharmacotherapy and psychotherapy. Aerobic exercise is another treatment approach for depression which promotes a broad range of adaptations in the brain. rTMS combined with aerobic exercise may have synergistic benefits for the treatment of depression. This study is the first to assess the acceptability of adding exercise to rTMS treatment for depression. Methods: This study employed a cross-sectional approach. Patients receiving rTMS treatment were asked to complete a web-based survey. Acceptability was assessed based on a series of questions regarding their preferences for an exercise program while receiving rTMS and willingness to participate in a hypothetical exercise intervention consisting of 30 minutes of moderate-intensity treadmill exercise, 3 times per week, for the full 6 weeks of rTMS treatment. Results: 38 patients (9 male, 28 female) with major depressive disorder completed the web-based survey. Acceptability was assessed based on a series of questions regarding their preferences for an exercise program while receiving rTMS and willingness to participate in a hypothetical exercise intervention consisting of 30 minutes of moderate-intensity treadmill exercise, 3 times per week, for the full 6 weeks of rTMS treatment. Most patients were in the maintenance phase of their treatment (74%, n = 28) with self-reported length of rTMS treatment ranging from 3 weeks to 6 years. The majority of patients were willing to participate in an exercise intervention for the full 6 weeks of rTMS treatment (73%). Given the choice of performing the exercise bout one to five days per week (Monday to Friday), most patients indicated a preference for doing exercise three or more days out of the week (68%). On a 7-point Likert scale from strongly disagree to strongly agree, the majority of patients agreed (72%) or strongly agreed they would participate in the hypothetical exercise intervention. Conclusion: The majority of patients perceived aerobic exercise to be an acceptable adjunct to rTMS treatment. These results will be used to design a sequential study examining the efficacy and acceptability of a combined rTMS and aerobic exercise intervention in patients with depression.

Effectiveness of the Fun for Wellness Online Behavioral Intervention to Promote Well-Being in Adults with Obesity: A Theory-Based Intervention

Seungmin Lee, Michigan State University; Adam McMahon, University of Miami; Isaac Prilleltensky, University of Miami; Nicholas D. Myers, Michigan State University; Samantha Dietz, University of Miami; Ora Prilleltensky, University of Miami; Karin A. Pfeiffer, Michigan State University; André G. Bateman, Michigan State University; Almamee M. Brincks, Michigan State University

Fun For Wellness (FFW) is a self-efficacy theory-based online behavioral intervention developed to promote growth in well-being and physical activity by providing capability-enhancing learning opportunities to participants. Behavioral intervention studies can be placed on a continuum, with a progression from efficacy trials (i.e., under controlled conditions) to effectiveness trials (i.e., under relatively uncontrolled conditions).
Evidence has been provided for the efficacy of FFW to promote well-being actions in adults in a relatively controlled setting. The objective of this study was to evaluate the effectiveness of FFW to increase well-being actions in adults with obesity in the United States of America (USA) in a relatively uncontrolled setting. The data described in this study were collected within a more broadly focused trial: the Well-Being and Physical Activity Study (ClinicalTrials.gov, identifier: NCT03194854). The study design was a large-scale, prospective, double-blind, parallel group randomized controlled trial. Participants were recruited through an online panel recruitment company. Data collection occurred at three time points: baseline, 30 days, and 60 days after baseline. Participants (N = 667) who were assigned to the FFW group (nFFW = 331) were provided with 30 days of 24 hr access to the online intervention. A path model was fit to the data. There was evidence for a positive indirect effect of FFW on both community and psychological well-being actions at 60 days after baseline through community (β = .028) and psychological (β = .017) well-being actions self-efficacy at 30 days after baseline, respectively. There was evidence for a positive direct effect of FFW on both community and psychological well-being actions at 60 days after baseline (p = .023, d = 0.19) and occupational (p = .036, d = 0.18) well-being actions at 60 days after baseline. Results from this study provided some initial evidence for both the effectiveness of, and possible revision to, the FFW intervention for increasing well-being actions in adults with obesity in the USA. Funding source: Funding for this study was provided by the Erwin and Barbara Mautner Charitable Foundation through the Erwin and Barbara Mautner Endowed Chair in Community Well-Being at the University of Miami.

Predicting Future Sitting in the Office Using an Augmented Reasoned Action Approach Theory

Alexander Lithopoulos, University of Victoria; Navin Kaushal, Indiana University; Mark Beauchamp, University of British Columbia; Mark Conner, University of Leeds; Gert-Jan de Bruin, University of Amsterdam; Amy Latimer-Cheung, Queen’s University; Ryan Rhodes, University of Victoria

Background: Despite the adverse health effects, people sit for long periods at work. It is therefore important to reduce the amount of time people spend being sedentary while in the workplace. Psychological behavioral theories that aim to predict sedentary behavior can inform future interventions; however, the development and testing of theories in the sedentary behavior domain is in its infancy. Thus, the objectives of this study were to explore predictors of (a) intentions to take active breaks at work and (b) average hours of sitting per day at work using a reasoned action approach (Fishbein & Ajzen, 2010), augmented with habit included to account for more automatic processes. Method: This study used data from an RCT, the groups were collapsed, and group assignment was controlled for statistically. An online longitudinal survey design was used (baseline, 4 weeks, 8 weeks, and 12 weeks post-baseline), and 116 full-time office employees from a variety of organizations who sat for more than 5.5 hours per day at work began the study (Mage = 43.07, SD = 10.95; 57.8% female). The psychological variables examined were injunctive and descriptive norms, affective and instrumental attitudes (predicting intentions), intentions and habit (predicting sitting), and self-efficacy and control (predicting intentions and sitting). Results: Baseline variables did not predict intentions or sitting at week 4. Week 4 instrumental attitude (β = .32) and self-efficacy (β = .31) predicted intentions at week 8, and week 4 self-efficacy (β = -.25) and control (β = .22) predicted sitting at week 8. Week 8 instrumental attitude (β = .23) and descriptive norms (β = .50) predicted intentions at week 12, and week 8 intentions (β = .34) predicted week 12 sitting. Discussion: No variable consistently predicted sitting behavior, although instrumental attitude was related to intentions to take active breaks in 2/3 tests. Although the longitudinal design increased the study’s rigor, predictive ability was likely attenuated. Funding source: Social Sciences and Humanities Research Council of Canada.

Staying Cool Under the Heat: Examination of Neural Efficiency in Firefighter Officers During Incident Command Simulation

Calvin Lu, University of Maryland, College Park; Xinhong Jin, Shanghai University of Sport; Hyuk Oh, University of Maryland, College Park; Andrew Ginsberg, University of Maryland, College Park; Kyle Pietro, University of Maryland, College Park; Bradley Hatfield, University of Maryland, College Park

Theories in sport psychology have advanced our understanding of the differences between expert and novice practitioners. Through psychophysiological measures, changes in cortical activity can be used to differentiate between high and low skill levels. While employing virtual reality, incident command fire simulations can be a tool to assess the readiness of firefighter officers in leadership roles. Purpose: To examine the psychophysiological and performance differences between high-ranking officers (chiefs) and young officers (lieutenants) during an incident command fire simulation. Methods: Fourteen participants (lieutenants = 10, chiefs = 4) were recruited for the study. Participants performed two conditions (Easy & Hard). During each condition, electroencephalography (EEG) and electrocardiography (ECG) measures were recorded, task performance was scored by an expert rater, and subjective questionnaires (i.e., NASA TLX) were collected after each condition. Results: A two-way ANOVA comparison on performance scores yielded a main effect on Group (F(1, 13) = 31.6105, p < 0.001). The chiefs scored higher compared to the lieutenants. A five-way ANOVA on EEG measures on theta power yielded a main effect on Group (F(1, 13) = 34.667, p < 0.001). The chiefs exhibited lower theta power compared to the lieutenants. Conclusion: Utilizing virtual reality, it is possible to capture psychophysiological data while officers perform as incident commander. While both groups were able to complete the incident command simulation successfully, the chiefs performed at a higher level. Additionally, the EEG measures of the chiefs reflect lower mental workload and less cortical activation. Collectively the higher performance and lower brain activation imply greater neural efficiency in meeting the challenge, likely based on the greater experience of the chiefs. The psychophysiological profile of higher-ranking officers can serve as benchmark measures in assessing the readiness of young officers for future promotions.

What’s a Coach to do? Exploring Coaches’ Perceptions of Body Image in Girls’ Sport

Kristen Lucibello, University of Toronto; David Kacznowska-Wilks, University of Toronto; Alyona Koulanova, University of Toronto; Eva Pila, Western University; Allison Sandmeyer-Graves, Canadian Association for the Advancement of Women and Sport; Drew Maginn, Ontario Physical and Health Education Association; Catherine Sabiston, University of Toronto

Adolescent girl athletes report that body image concerns negatively impact experiences and engagement in sport. Based on theoretical tenets and empirical evidence from an athlete’s perspective, coaches are a prominent source within the interpersonal sport context that can influence an athlete’s body image. However, the coach’s perspective on how their role as a coach and a stakeholder in the broader sport environment impacts athletes’ body image is not understood. The purpose of the present study was to explore coaches’ perceptions of how various aspects of the sport context influence girls’ body image. Coaches of non-aesthetic girls sports teams (N = 13; 62% male, 38% female; 4–25 years coaching experience; 46% elite teams) participated in 1-on-1 interviews. Based on inductive thematic analysis,
four themes were generated from the data: (a) body image as the ‘elephant’ on the field (i.e., the unspoken nature of body image despite visible manifestations), (b) agents of body image messaging in sport (i.e., parents, coaches, media), (c) skill over appearance (i.e., coaches focusing on athletes’ skill and competence), and (d) systemic strategies. Coaches identified body image concerns in their athletes and believed it was their responsibility as a coach to mitigate such concerns. However, many coaches felt unprepared to discuss and handle body image concerns, and suggested broader-scale changes to increase support. Throughout the interviews, coaches also endorsed a simplified perception of body image, whereby body image was dependent on appearance, body shape, and weight. Collectively, these findings underscore the importance of providing coaches with adequate training and resources on body image, in order to improve the sport experiences of girl athletes. Funding source: Social Sciences and Humanities Research Council Insight Grant [126138].

Masters Athletes’ Perceptions on the Roles of Applied Sport Psychology for Performance and Lifestyle Enhancement

Tyler Makepeace; Bradley W. Young, University of Ottawa

With the growth of Masters sport (adults 35+), greater resources are needed to support a quality adult sport experience (Young & Callary, 2018). However, the use of mental skills and applied psychological strategies as supports to Masters Athletes (MAs) remains underdeveloped (Makepeace & Young, 2019). This study explored Canadian MAs’ views regarding their applications of sport psychology in relation to their sport experiences. Semi-structured interviews with eight MAs (M_{age} = 51, range = 38–62; 3 males, 5 females) representing 12 sports (10 individual, 2 team) explored how they used sport psychology to enhance performance, experience, and sport adherence. Data were thematically analyzed (Braun & Clarke, 2006) inductively using Weinberg and Gould’s (2015) traditional mental skills catalogue, and deductively. Deductive results demonstrated the benefits, situations, and techniques for goal-setting, imagery, arousal regulation, concentration, and self-confidence. MAs commonly used each mental skill to enhance performance and to obtain a competitive advantage. Inductive results revealed non-traditional themes for applied skills and strategies to support MAs’ pursuit of regular sporting activity. MAs used personal prioritizing strategies, including “cognitively justifying”, “framing sport as an outlet”, and “embodying the authentic self”, and social strategies, including “cultivating supportive relationships”, “negotiations with significant others”, “social signaling”, and “obligations to training mates”. MAs also used strategies to fit sport in (“twinning”; “scheduling/structuring”; and “managing commitment”) and to manage age-related concerns (“mindfulness” and “compensation”). Overall, MAs described both traditional and non-traditional applications for sport psychology, with non-traditional results showing novel and age-nuanced themes enacted to uniquely sustain the adult sporting lifestyle. Results suggest nuances for how applied sport psychology might better support adult sportspersons and implicate the delivery of resources and services.

An Exploration of Goal Orientation in NCAA Championship Endurance Sport Athletes in Repeat Attempts

Derek Marr, Northern Michigan University

In this qualitative exploratory research, seven NCAA champions who won individual titles from between 2016–2019 in the endurance sports of Nordic skiing, cross-country running and track and field were interviewed about their experience leading up to, during and between their individual NCAA championship(s) and their title defense(s). Participants were both successful and unsuccessful in their title defense. The interviews lasted between 43 minutes and 96 minutes. The interview schedule was designed to obtain rich, descriptive accounts of the participants experience with specific probing questions to ensure data related to motivation, and goal orientation for both the initial NCAA title event as well as the subsequent NCAA title defense(s). The interviews were transcribed, themed, and coded. The researchers used an interpretive phenomenological design which enabled a comparison to Goal Achievement Theory (Duda, 1992 & 2001) to determine if this theoretical framework is consistent with the participants’ experience. This allowed for a comparison to explore if there was a change in participants from task to ego orientation or ego to task from initial NCAA title to the title defense. In addition, a sub-component of the theory, avoidance versus approach achievement goals were explored to see if they could have impacted the success of the title defense. This research is important for anyone interested in changes in goal orientation over time and for those that are working with individuals or teams that are attempting to defend a championship performance. Funding source: Northern Michigan University – Internal Grant.

Utilizing Variable and Person-Centered Analyses to Investigate the Passion-Perfectionism Relationship in Adolescent Athletes

Eric Martin, Boise State University; Thelma Horn, Miami University

Passion, or a strong inclination toward an activity that an individual likes, finds important, and invests time and energy in, can manifest in one of two ways; as harmonious or obsessive passion. Typically, research has indicated that harmonious passion leads to more adaptive outcomes than obsessive passion. One construct that might be related to passion is perfectionism. Various scholars believe that perfectionism, depending on the type one holds, can be either adaptive or maladaptive. Few studies have investigated this relationship, and when they have done so researchers have looked at general perfectionism instead of sport-specific perfectionism. Further, when researchers have investigated the passion-perfectionism relationship, they have explored how one construct related to another (i.e., variable-centered). Although this investigation is useful in understanding how variables are related, it does not provide an understanding of how complex constructs manifest in participants (i.e., participant-centered) which can be beneficial in understanding real-world implications. Therefore, the purpose of this study was to investigate the relationship between sport passion and sport perfectionism in a group of 243 adolescent athletes (M_{age} = 16.64; SD = 63) from both a variable- and person-centered perspective. Overall, athletes had high levels of harmonious passion and moderate levels of obsessive passion. In terms of their perfectionism, athletes perceived high levels of personal standards, organization, and coach pressure and lower levels of concern over mistakes, doubts about actions, and parental pressure. When investigating the variable-centered relationship, harmonious passion was positively related to adaptive forms of perfectionism while obsessive passion was positively related to maladaptive forms of perfectionism. From a participant-centered lens, various relationships appeared that indicate that harmonious passion may buffer some of the negative effects of high obsessive passion. Future directions and implications of the findings will be discussed.

Measuring Heart Rate of Snowboard Jumpers Just Prior to the Activity is Not Assured of Yielding the Strongest Correlation with Observed Performance

Seiji Matsumura; Ken Watanabe; Naoki Saijo; Yuuki Ooishi; Makio Kashino, NTT Communication Science Laboratories

Estele athletes achieve superior performance under high pressure in competitive situations. Although several studies have investigated the relationship between the performance and physiological state of athletes in different skills, it is still unclear when that state is the most strongly
correlated with best performance. This study examines the relationship between heart rate (HR) and competition performance. Thirteen expert snowboarders (12 males and 1 female) participated in an experiment consisting of a jumping competition on an indoor ski slope. HR was measured 10 minutes and 1 minute prior to the activity. Each snowboarder attempted two jumps in practice, qualifying and final sessions. Jump performance was scored by three professional judges. The results showed that HRs were significantly higher in the qualifying and final sessions than in the practice session. The HR 1 minute before the jump was also significantly higher than HR 10 minutes before the jump in all sessions. The 1 and 10 minute HRs were correlated with the score. Intriguingly, the 10 minute HR yielded a higher Pearson’s correlation coefficient than the 1 minute HR, indicating that it was a better indicator of the score. Additionally, the difference between the 1 and 10 minute HR was not correlated with the score, implying that any increase in the HR just before the activity would be irrelevant to final performance. From these results, we propose that, with regard to optimizing the physiological state for best performance, the physiological state should be measured some period in advance of the activity. The state immediately prior to the activity might not be directly related to final performance. Funding source: JST CREST (JPMJCR14E4).

Exploring Individualized Consideration of Athletes in Coaching Practice
Alysha Matthews; Karl Erickson, Michigan State University

Coaching literature has linked coach behaviors and positive youth development outcomes (Fraser-Thomas, Côté & Deakin, 2005), specifically when implementing transformational leadership (TFL) behaviors to foster athlete development (Price & Weiss, 2011). Individualized consideration (IC), an aspect of TFL, is exemplified by leaders showing care through supporting their followers’ individual needs (Turnidge & Côté, 2018). Though TFL has had a positive impact on youth sports, a more thorough investigation of IC is warranted to define IC in action as well as determine what coaching behaviors would be categorized as IC (e.g., communication, technical assessment). The purpose of the current study was to explore youth sport coaches’ experience with the process of IC and the varying implications for each individual they coach. Qualitative interviews were conducted with 10 male minor hockey coaches whose teams consisted of 9–13 year old male athletes. A three-step coding process (Nalepa, 2018) was used to create meaning units and inductively analyze the data for themes. Findings illustrated that coaches demonstrate an understanding of and use IC through gathering information about their athletes (e.g., observing), assessing their needs (e.g., developmental, emotional), using actions to support IC (e.g., develop rapport, tailor messages), and working towards outcomes of IC (e.g., appropriate developmental pathway). This exploratory design found that minor hockey coaches understand and are practicing IC in their context. Therefore, implications surrounded the roles of youth sport researchers, organizations and coach education programs in supporting minor hockey coaches.

A Season-Long Examination of Changes in Athletes’ Skill Level and Purposeful Practice and Their Interplay with Self-Regulated Learning
Lindsay McCardle, University of Ottawa; York University; Bradley W. Young, University of Ottawa; Sharleen Hoar, Canadian Sport Institute Pacific; Joseph Baker, York University

Self-regulated learning (SRL), or self-processes related to goal-oriented learning practices, are important for talent development (McCardle, Young & Baker, 2017). Although SRL competencies have distinguished skill levels, no work has examined the interplay between SRL and skill, and between SRL and practice amounts, over time. We examined (1) whether there were individual differences in change in skill over a season and whether SRL predicted individual change; and (2) whether there were individual differences in amount of change in practice over a season and whether SRL predicted such change. Sixty individual-sport athletes completed the SRL-Sport Practice survey (McCardle, Young, & Baker, 2018) at season’s start. At three subsequent points, they reported ‘skill level’, a variable derived from ordinal skill (ranging from city to international level) and estimations of competitive successes; ‘time in purposeful practice’ (PP; Tedesqui, McCardle, Bartulovic & Young, 2018), and season phase. In a latent growth model pertaining to skill level, athletes increased their skill over the season (α = .15, p < .001). There were individual differences in the intercept, or mean skill level (α² = 2.11, p = .001), but not in slope (α² = .008, p = .38) meaning all athletes increased their skill at the same rate. Next, we added age (covariate) and SRL to a model as predictors of the intercept. These additions did not improve model fit, meaning differences between athletes for SRL did not contribute to skill level. In a latent growth model for PP, the mean practice time was 238 min/week, but slope did not indicate significant increases in PP over the season (p = .18). Neither the intercept nor the slope demonstrated significant variances (ps > .80) suggesting athletes of varying skill levels reported similar PP amounts and between-athlete differences were not implicated in PP changes. We consider conceptual, design, and assessment explanations for surprising and null results and interrogate the suitability of our variables for skill level and practice quantities. Funding source: The current study was funded by Insight Grants from the Social Sciences and Humanities Research Council of Canada.

Me or We? The Effect of Team and Individual Sports Activity on Executive Functioning
Alexander McKenzie, University of Windsor

Executive function (EF) is an umbrella term for a set of mental skills that develop across childhood and adolescence, enabling us to accomplish tasks and goals (Bhandari, 2015), particularly in sport-specific settings (Best, 2010). There is limited research examining the processes by which open and closed motor skill sports optimize EFs. The present study analyzed the effects of motor sequencing (i.e., open motor skill) and repetitive movement (i.e., closed motor skill) in individual and team sports and their influence on EFs. Forty university students (17 Male, 23 Female) aged 17–29 (M = 20.47, SD = 2.75) were randomly assigned to a team and individual sport-specific intervention focused on either repetitive or variable sequential motor skills. To assess EF pre- and post-intervention, a cognitive battery was administered to measure working memory, cognitive flexibility, and planning and problem solving; all of which are fundamental EFs (Diamond & Lee, 2011). It was predicted that participants in the variable motor sequencing and team condition would yield superior EF performance. The results suggested a significant interaction effect of gender and type of sport (team/individual) on EF measures, as females and males performed significantly different on a team relative to those in the individual conditions. For performance on intervention, an overall main effect of type of sport was found, such that participants in the team conditions finished faster on the sports task than those in the individual conditions. There was also a significant main effect of gender, as males generally outperformed female participants. These findings have implications for optimizing athletic and EF performance between genders, as well as between types of sport.
Antecedents to High School Strength and Conditioning Coaches’ Task-Involving Climate Development

Keith McShan; E. Whitney G. Moore, Wayne State University

Strength and conditioning coaches (SCC) play a large role on athletes’ sport experience. However, little achievement goal theory-based research has been done in the strength and conditioning realm. Achievement goal theory postulates athletes’ motivation is affected by the motivational climate created by their coach. Therefore, understanding antecedents to coaches’ motivational climate development is important. High school SCC were surveyed because of the potentially high influence they have in their athletes’ physical activity engagement as adults. It was hypothesized the coaches’ goal orientation and coaching efficacy would predict their transformational leadership, which in turn would predict the motivational climate they reported developing. High school SCC attending a National Strength and Conditioning Association Conference (N = 60) and completed a survey measuring their goal orientations, coaching efficacy, transformational leadership, and motivational climate development. All measures had good reliability except ego-involving climate (α = .58). A fully indirect effects path model for the goal orientations and coaching efficacy predicting the motivational climates through transformational leadership in lava. This hypothesized model was not supported (p = .03). The direct effect of task goal orientation predicting task-involving climate needed to be added. The final model included task goal orientation and coaching efficacy significantly predicting transformational leadership behaviors, which in turn significantly predicted task-involving climate with task goal orientation. Ego-involving climate was not significantly predicted by any variables, and the ego goal orientation did not significantly predict any variables. Coaches’ transformational leadership behaviors were dependent upon their efficacy and task orientation. Coaches’ self-reported task-involving climate promotion was dependent upon their transformational leadership behaviors and their task orientation. Coaches’ task orientation directly and indirectly predicts their task-involving climate promotion.

Comparison of High-Intensity Interval Training Exercise Modalities on Executive Function

Caroline C. Meadows; Eric S. Drollette, University of North Carolina, Greensboro

Acute aerobic high intensity interval training (HIIT) has demonstrated positive effects on inhibitory control in young adults. However, the evidence is not well established regarding the combination of HIIT aerobic and resistance training in accordance with underlying neural mechanisms following acute exercise. The aim of the present investigation was to examine the after effects of HIIT-aerobic and HIIT-aerobic resistance on following acute exercise. The aim of the present investigation was to examine the after effects of HIIT-aerobic and HIIT-aerobic resistance in accordance with underlying neural mechanisms. HIIT were surveyed because of the potentially high influence they have in their athletes’ physical activity engagement as adults. It was hypothesized the coaches’ goal orientation and coaching efficacy would predict their transformational leadership, which in turn would predict the motivational climate they reported developing. High school SCC were surveyed because of the potentially high influence they have in their athletes’ physical activity engagement as adults. It was hypothesized the coaches’ goal orientation and coaching efficacy would predict their transformational leadership, which in turn would predict the motivational climate they reported developing. High school SCC attending a National Strength and Conditioning Association Conference (N = 60) and completed a survey measuring their goal orientations, coaching efficacy, transformational leadership, and motivational climate development. All measures had good reliability except ego-involving climate (α = .58). A fully indirect effects path model for the goal orientations and coaching efficacy predicting the motivational climates through transformational leadership in lava. This hypothesized model was not supported (p = .03). The direct effect of task goal orientation predicting task-involving climate needed to be added. The final model included task goal orientation and coaching efficacy significantly predicting transformational leadership behaviors, which in turn significantly predicted task-involving climate with task goal orientation. Ego-involving climate was not significantly predicted by any variables, and the ego goal orientation did not significantly predict any variables. Coaches’ transformational leadership behaviors were dependent upon their efficacy and task orientation. Coaches’ self-reported task-involving climate promotion was dependent upon their transformational leadership behaviors and their task orientation. Coaches’ task orientation directly and indirectly predicts their task-involving climate promotion.

Cross-Domain Social Relationships, Self-Perceptions, and Identity Among Collegiate Student-Athletes

Dana Mefford, Texas State University; Tanner McGee, Caldwell High School; Lindsay Kipp, Texas State University

Social identity theory states that leadership emerges from a leader’s ability to understand and influence a group’s shared identity, which can impact individual outcomes. One aspect of leadership is the development of cross-domain relationships (CDRs; knowing athletes on and off the field). The study purpose was to explore associations among college student-athletes’ CDRs with coaches and teammates, identity, and self-perceptions. A second purpose was to explore academic year differences on study variables. Participants, 107 Division 1 student-athletes (75 females; M = 19.8 years-old, SD = 1.3), completed a survey to assess (a) CDRs with head coaches, assistant coaches, and teammates, (b) self-perceptions (scholastic competence, athletic competence, global self-worth, and social acceptance), and (c) academic and athletic identity. Three MANOVAs tested for differences on each set of variables by academic year. There was a significant difference (p < .05) between academic years on CDRs. Seniors reported higher CDRs with head coaches than sophomores, freshman reported higher CDRs with assistant coaches than sophomores, and seniors reported higher CDR’s with assistant coaches than sophomores and juniors. Lower CDR’s perceived by sophomores may signal that coaches tend to be more engaged with freshmen and seniors. Regression analyses tested whether (a) CDRs with head coaches, assistant coaches, and teammates predicted each self-perception variable, and (b) self-perceptions predicted academic and athletic identity. Greater CDR’s with teammates significantly predicted greater social acceptance, self-worth, and scholastic competence (p < .05). Athletic competence was a significant positive predictor of athletic identity, and scholastic competence was a significant positive predictor of academic identity (p < .05). Results suggest the importance of facilitating CDRs with teammates to promote multidimensional self-perceptions among collegiate athletes. In turn, higher perceived ability in academics and athletics may contribute to athletes’ identity in those domains.

The Association of Coach and Peer Motivational Climate Perceptions with Athlete Engagement in Youth Athletes

Kathleen T. Mellano, Springfield College; Alan L. Smith, Michigan State University

The quality of young people’s athletic experiences is linked to their social relationships. Assessing athlete interactions with coaches and peers concurrently can offer valuable insight into these experiences and how the youth sport system operates. One way this can be achieved is by examining athlete perceptions of coach- and peer-created value structures that define criteria for success and failure. Distinct coach and peer motivational climates operate within a team (Vazou et al., 2005), but little is known about the salience of these climate perceptions when considered together (Ntoumanis et al., 2007). The purpose of this study was to 1) identify motivational climate profiles based on adolescent athletes’ perceptions of both coaches and peers, and 2) examine potential profile group differences on markers of athlete engagement. Adolescent female volleyball players (N = 255; M age = 15.5 years, SD = 1.3) completed established survey measures of motivational climate, engagement, effort, and intention to continue sport involvement. Cluster analysis of the motivational climate variables yielded four profiles: 1) Coach and Peer Low Task/High Ego, 2) Peer Low Task, 3) Coach High Ego, Peer High Task, and 4) Coach and Peer High Task/Low Ego. Profile groups differed significantly on the set of engagement variables (Pillai’s trace = 0.19, F(21,726) = 2.45, p < 0.001, ηp² = 0.07). Athletes in profiles characterized by low task perceptions had
lower scores on engagement variables than those in other profiles, and those in the profile with high task and low ego coach and peer climate perceptions showed the opposite. Those in the coach high ego and peer high task climate profile had the second highest scores on engagement variables. These findings suggest that high peer task-involving climate perceptions may protect athletes from lower quality athletic experiences. The contributions of multiple agents must be considered in order to better understand the youth sport system and its potential consequences for athletes.

P3b as an Electroencephalographic Index of Automatic Associations of Exercise-Related Images

Matthew Miller, Auburn University; Mariane Bacelar, Auburn University; Robyn Feiss, Auburn University; Marcos Daou, Coastal Carolina University; Brandon Alderman, Rutgers University; Panteleimon Ekkekakis, Iowa State University

Objective: Interest in automatic, positive or negative, associations of exercise and physical activity as potential contributors to behavioral tendencies is rising. However, the measurement of these associations presents a challenge, since the reliability and validity of behavioral tests (despite their widespread usage) is unsatisfactory by most accounts. As a possible alternative, an electroencephalographic (EEG) index (i.e., P3b amplitude) was examined in the present study. Design: We used a mixed-factor design, with one group of insufficiently and one group of sufficiently physically active participants being compared across different experimental conditions. Methods: Thirty-seven insufficiently and thirty-six sufficiently active participants viewed exercise-related images presented within series of negative, neutral, or positive images and rated all images as negative (unpleasant) or positive (pleasant) while EEG recordings were obtained. The amplitude of the P3b component of the EEG-derived event-related potential, time-locked to the onset of exercise images in each context (series), was extracted as the dependent variable. Results: Insufficiently active participants rated the exercise-related images as neutral-to-positive, whereas sufficiently active participants rated the images as positive. However, all participants exhibited the smallest P3b amplitude when the images were presented in the neutral context, suggesting that the images were registering as neutral. Conclusion: Exercise-related images may evoke neutral automatic associations, but these associations may differ from how individuals reflectively rate the same images. P3b amplitude may be useful in detecting such discrepancies although, in the present study, it could not differentiate insufficiently physically active participants from sufficiently active ones.

Survival of the Fittest? II: The Role of Biological Factors and Participant Motivation throughout a Varsity Cross-Country Season

Eva Monsma, University of South Carolina; Hayes Bennett, University of South Carolina; Megan Buning, Augusta University; Heather Elliott, University of South Carolina

This study aimed to uncover interacting biological and psychological characteristics of male and female varsity cross-country runners. Male (n = 4) and female (n = 4) runners with estimated prototypical physique (PPT) and non-prototypical physique (NPTP) were purposefully selected. Measured anthropometric characteristics were used to derive BMI percentiles, somatotype and maturity status for each group, confirming physique differences. Psychological skills were assessed prior to, and after the season using the TOPS while the CSAI-2R was used to assess pre-race perceptions across four races throughout the season and associated with race times and placement. Data on these biological and psychological variables were used to frame results of an end of season semi-structured interview regarding participants’ reflections of physical and psychological factors associated with their performance over the season. A deductive approach was used to code the data for TOPS strategies and CSAI-2R scales. All nine strategies were represented, but activation and attentional control were combined as were imagery, relaxation, and automaticity. Through inductive analysis of physical explanations of performance factors themes of (a) Biological growth and maturation, (b) Sleep, nutrition, and hydration, and (c) Physical training emerged. Both PPT and NPTP participants accurately described their derived characteristics when attributing their physical characteristics to their performance. Inductive analyses of reasons for participating in cross country revealed the following themes: 1) Team’s reputation, 2) Social agents and community, 3) Personal growth and exercise and 4) Fun and enjoyment which paralleled aspects of Self-Determination Theory. These findings inform practitioners about distinguishing features of adolescent athletes matching the elite athlete physical profile and these not meeting that profile with the utility of tailoring training plans that enable participant satisfaction for sheer intrinsic reasons and those also connected to elite performance training.

Sink or Swim? A Survival Analysis of Sport Cessation in Australian Youth Swimmers According to Socio-Demographic and Competition-Level Characteristics

Kyle Moulds, The University of Sydney; Shaun Abbott, The University of Sydney; Johan Pion, HAN University of Applied Sciences Nijmegen; Mark Heathcote, Swimming New South Wales Ltd; Cecilia Brophy-Williams, Swimming New South Wales Ltd; Stephen Cobley, The University of Sydney

Introduction: Youth sport participation can have multiple health and psycho-social health benefits (Eime et al., 2013). However, research identifies a substantial proportion of youth will withdraw from sport participation before adolescence (Cobley & Till, 2017). Within an Australian swimming context, various factors are associated with high cessation rates, such as an early age performance emphasis. However, multiple factors could be influential. This study examined longitudinal retention/
dropout trends in youth swimmers, with the influence of socio-demographics considered. Additionally, within a sub-sample, the influence of competition level was examined alongside existing variables. Methods: Participants were N = 17,161 male and female registered New South Wales (NSW) swimmers (10–15 years). To identify cessation trends, Kaplan-Meier (1958) survival analyses, supplemented with Cox (1972) regression were used on annual participation data. Procedures were repeated when examining the influence of competition level in the sub-sample (N = 1,822). Results: Kaplan-Meier analysis identified median sustained participation rates was four years (95% CI = 3.93, 4.06), with 15.9% maintaining participation over 10 years. Cox regressions identified age was influential (p < 0.001), with a 184.9% higher Hazard Rate (HR) for 10 versus 15 year-olds. Residential proximity to NSW cities was influential (p < 0.001), with urban swimmers reporting a 24.8% higher dropout (HR) rate than rural swimmers. Sex and relative age did not influence sport cessation. In the sub-sample, median sustained participation was four years (95% CI = 3.7, 4.2), with 27.6% maintaining ten years of participation. Level of competition was influential (p < 0.001), with a 60.3% higher HR associated with lower competition-levels (i.e., club/district v national). Conclusion: Survival analyses identified generally shorter-term sustained swimmer involvement. Age of registration, city proximity, and competition-level influenced dropout rates, highlighting implications for regional and national swimming provision.

Reducing Anxiety and Depression in University Students: Effects of a Campus Wide Exercise Intervention
Irene L. Muir; Krista J. Munroe-Chandler; Todd M. Loughead; Chad A. Sutherland, University of Windsor

University students face multiple adversities (e.g., missing home, lack of support) that heighten their psychological distress. As a result of the prevalence of anxiety and depressive symptoms among university students, and the demands placed on counseling services, additional mental health services are warranted across university campuses. The purpose of the current study was to examine the impact of a six-week exercise intervention on university students’ depression and anxiety. Low risk students (N = 49, M_age = 23.08, SD = 4.96), referred by campus counselors, completed the exercise intervention. Participants engaged in individual workout sessions, supervised by a personal trainer, twice per week (45 minutes each). Each session included a warm-up, cardiovascular fitness activity, whole body resistance exercises, flexibility training, and a cool-down. Participants also attended weekly meetings (30 minutes each) with a health and wellness coach to discuss various strategies to overcoming barriers to exercise (e.g., positive self-talk, social support, time management). The Mental Health Inventory-38 (Veit & Ware, 1983) was administered pre and post intervention to assess changes in mental health. Paired samples t-test found a significant decrease in depression scores from pre (M = 12.26, SD = 3.49) to post (M = 10.95, SD = 4.26) intervention (p = 0.01). Similarly, anxiety scores significantly decreased from pre (M = 32.11, SD = 8.26) to post (M = 27.26, SD = 8.29) intervention (p = 0.00). Given such findings, exercise seems to serve as a coping mechanism to reduce symptoms of psychological distress. Thus, the importance of disseminating the current findings to academic stakeholders will be discussed. Funding source: University of Windsor Office of Student Experience.

Relationships Among Executive Functioning, Future Time Perspective, Identity and Physical Activity Self-Regulation Among Low-Active Middle-Aged Adults
Sean Mullen, University of Illinois; John Adamek, University of Illinois; Madhura Phansikar, University of Illinois; Imani Canton, University of Illinois; William Massey, Oregon State University

Lack of time is an often-cited reason for low physical activity participation, yet data revealed that Americans average over five hours daily of discretionary time. Future time perspective (FTP: belief one has more or less time to spend in life) may distort perceptions of time. Similarly, FTP and future exerciser identity (i.e., viewing exercise as part of one’s future self-image) may influence one’s exercise self-efficacy, goal-setting priorities and time management, and in turn, physical activity engagement. Evidence also suggests executive functioning (e.g., inhibition, memory) plays a role in modulating physical activity self-regulation. The purpose of this study was to test the hypothesis that inhibition control (assessed via Stroop task) and working memory (assessed via Sternberg) are associated with future-related perceptions, and that FTP plays a role in future exerciser identity, exercise self-efficacy, physical activity self-regulation, and leisure-time exercise (LTE). Participants were derived from a sample of 366 low-active, middle-aged adults (M_age = 49.36; 50.3% women) who were enrolled in two nearly identically designed studies (N = 133, N = 233). Covariance modeling was conducted using a mostly saturated model. Specifically, LTE was regressed on all previously identified variables, age, gender, and education. Additional direct and indirect effect paths were tested. Model-to-data fit (χ^2 = 2.05(df = 2), p = .36; CFI = 1.00; RMSEA = .01; SRMR.01) was adequate and hypotheses were partially supported. Inhibition had an indirect effect (β = .02, p = .03) on LTE via future exerciser identity; the effect of working memory on goal-setting was not statistically significant (β = .07, p = .08). The indirect effect of FTP on LTE via future exerciser identity was β = .02 (p = .06). Inhibition control, future exerciser identity, goal-setting, and education all had direct effects (p < 0.05) on LTE (R^2 = .16). Findings from this study highlight potentially important roles of executive functioning, and general and domain-specific perceptions of time in modulating physical activity engagement.

Exploring the Relationship Between Levels of Sport Participation and Anxiety in Canadian High School Students
Jessica Murphy, Brock University; Karen A. Patte, Brock University; Philip Sullivan, Brock University; Scott T. Leatherdale, University of Waterloo

An umbrella study by Dale et al., (2019) reports an unclear relationship between sport participation and anxiety levels in children and youth. As such, further research exploring the relationship between anxiety and physical activity involvement in this population is needed (Dale et al., 2019; Biddle et al., 2019). The purpose of this cross-sectional investigation was to explore the relationship between sport participation and anxiety, by sex, in a large cohort of youth. A total of 66,902 Canadian high school students (33,425 female and 33,477 male) completed the Generalized Anxiety Disorder–7 item (GAD-7) scale in year 7 (2018/2019) of the COMPASS Study. A multi-level analysis, nested by school, was performed to determine the effect of CSS participation on GAD scores; average vigorous physical activity per day was entered as a covariate to control for levels of physical activity. Analysis revealed a three-way interaction between sex, participation in CSS, and participation in OSS. In females who participated in CSS, average physical activity per day was a significant negative covariate for GAD-7 scores. In both males [F(1, 1738.57) = 32.03, p < 0.001] and females [F(1,1161.34) = 8.35, p < 0.01], those students who were involved in CSS and OSS had lower GAD-7 scores than those who were only involved in CSS. Furthermore, in both males [F(1, 1643.31) = 147.09, p < 0.001] and females [F(1,705.53) = 63.30, p < 0.001], GAD-7 scores were lower in those students who were not participating in CSS but were involved in OSS. These results suggest that there is an additive positive effect of sport participation on symptoms of generalized anxiety in Canadian high school students. Interestingly, it appears that average vigorous physical activity per day has a negative effect on generalized anxiety levels in females participating in CSS. It is...
possible that characteristics of specific schools may impact the effect of sport participation on anxiety. Future research will examine these relationships longitudinally.

**Sport Team Participation Patterns Between Adolescence and Young Adulthood: Associations with Mental Health**

Ross Murray, University of Toronto; Catherine Sabiston, University of Toronto; Isabelle Dore, University of Montreal; Mathieu Bélanger, University of Moncton; Jennifer O’Loughlin, University of Montreal

The social interaction and sense of belongingness adolescents experience through participating on sport teams is important for developing social identity. However, sport team participation decreases throughout adolescence and sharp declines are noted in the transition to young adulthood. As such, individuals are at risk of losing an important part of their social identity, which can influence mental health. The purpose of this study was to examine the associations between sport team participation patterns (i.e., non-participation, engagement, disengagement, or continuation) during the life transition between adolescence and young adulthood and mental health outcomes. Using data from the NDT prospective longitudinal study, we examined whether adolescents (N = 617) participated on a sport team at any of four different time points during their final year of high school (M_age = 16.84), and again at one time point during young adulthood (M_age = 20.39). We also assessed sport team participation and mental health (i.e., depressive symptoms, anxiety, stress, and coping) at young adulthood. Controlling for age, sex, socio-economic status, physical activity, and baseline mental health, a one-way MANCOVA revealed that different sport team participation patterns were significantly associated with mental health outcomes in young adulthood, Pillai’s Trace = .08, F(12, 1557) = 3.38, p < .001. Follow up one-way ANOVAs were all significant. Tukey HSD comparisons revealed that, compared to individuals who continued sport team participation, individuals who never engaged in sport teams reported worse mental health scores in all four outcomes (all ps < .01). Further, compared to individuals who maintained sport team participation, those who stopped team sport after high school reported higher levels of stress (p < .01). These findings provide preliminary evidence that changes in sport team participation are associated with mental health outcomes. Further research is needed to confirm the direction of causality and whether these differences are due to changes in social identity.

**Facilitating Physical Literacy Within the Framework of Meaningful Physical Education**

Autumn Nedoly; Douglas Gleddie; Tara-Leigh McHugh, University of Alberta

Background/Introduction: Several researchers have identified confusion between the theoretical and practical understandings of physical literacy. In our previous work exploring perspectives of physical literacy with Indigenous peoples, there was noticeable overlap between how the participants described physical literacy and the goals of the Meaningful Physical Education (MPE) framework, which is a framework for teaching physical education presented by Beni and colleagues (2018). Such findings highlight the need to theoretically consider how these two concepts are positioned in relation to each other. Purpose: The purpose of this supplementary secondary analysis was to explore findings from a physical literacy-related study with Indigenous people through the framework of MPE. Participants: Eleven Indigenous educators, coaches, and youth mentors participated as collaborators in this study. Methods: Data was generated through one-on-one and sharing circle interviews, and transcripts were analyzed using a three-phase process of content analysis. Results: Drawing comparisons between three of the components of MPE and the understandings of physical literacy described by collaborators, our findings are represented by three themes: a) social interactions and relational support, b) personally relevant learning and being mindful of teachings, and c) fun and youth-centered approaches. Discussion: Findings from this research suggest that the MPE framework may be a useful tool for facilitating physical literacy experiences amongst Indigenous youth. Many programs focused on developing physical literacy tend to emphasize the physical aspect of the concept (i.e., physical competence). Perhaps by using an MPE framework Indigenous youth will have a greater opportunity to develop all aspects of physical literacy including the affective, cognitive, and physical domains.

“20,000 Leagues Under the Sea”: Sleep, Cognitive Performance, and Self-Reported Recovery Status During a 67-Day Military Submarine Mission

Arne Nieuwenhuys, University of Auckland; Jonas Dora, Radboud University; Melanie Knufinke, Philips Experience Design; Debby Beckers, Radboud University; Gerard Rietjens, Royal Netherlands Army; Pieter Helmhoat, Royal Netherlands Army

Military submariners often spend long periods at sea–working shifts, isolated from their natural environments, facing a wide range of work-related and psychosocial stressors, and with limited options to engage in physical activity. Despite growing understanding of the physical and psychological demands of prolonged submarine missions, robust insight into the temporal development of psychophysiological load effects during missions, thus far, remains unreported. Employing a field-based monitoring paradigm, the current study examined day-to-day fluctuations in actigraphy-based sleep recordings, cognitive performance (10-minute psychomotor vigilance test; PVT), and self-reported recovery status (work-related fatigue, vigour, affect, and rumination), among 14 submariners throughout an actual 67-day military mission. Mission averages reflected suboptimal sleep that was of short overall duration (5:46 ± 1:29 hours per 24-hour day) and relatively low efficiency (82.5 ± 9.9 %); moderate levels of self-reported recovery status during both on- and off-shift hours (n.s.); and suboptimal levels of cognitive performance (PVT response time = 283 ± 35 ms; response errors = 5.3 ± 4.8). Whilst self-reported recovery status remained stable across mission days (all bs < .01, SEs < .03), small but consistent day-to-day increases in sleep onset latency (47%; b = 0.09, SE = .04) and PVT response time (16%; b = 0.66, SE = .24) accumulated to reflect meaningful deterioration across the entire 67 days of the mission – with potential to significantly affect submariner health and operational performance. Future work is required to corroborate the current findings, firmly establish underlying causes, and make evidence-based suggestions for interventions to improve and uphold submariners’ health and performance.

**Determine the Effects of a School-Based Physical Activity Intervention on the Attitudes and Practices Towards Physical Activity in Adolescents**

Olalekan Osifeko; Rowena Naidoo, University of KwaZulu-Natal

Background: Nigerian adolescents are physically inactive and unable to enjoy the health benefits of exercise, due to the lack of PA promotion during PE classes. This study aimed to determine the effects of a school-based physical activity intervention on the attitudes and practices towards physical activity in adolescents. Study design and methods: This study employed a mixed-methods approach, including an intact group and action research designs. A purposive sample of 1200 students was recruited in twenty-four junior secondary schools, Lagos State East senatorial district,
Nigeria. Students completed the Attitudes and Practices of PA for Adolescents (Q-APPAA) questionnaire pre- and post-intervention. A PE teacher from each school participated in the teacher-training intervention ($n = 24$) and participated in focus group discussions pre- and post-intervention. Results: There was a significant difference in students’ perception of PA promotion post-intervention, $t(181) = -21.350$, $p < 0.05$. Students’ increased willingness to participate in PA was significant. Post-intervention results showed significant changes in attitude and practice towards PA promotion ($p < 0.05$) in the average number of sports and games participated that are more attractive to each student during PE classes. Teachers reported that the intervention improved their teaching methodologies and practices and those students were motivated to participate in PE classes. Conclusion: The teacher training intervention improved the attitudes and practices regarding PA participation in adolescents. Increased participation of students in PE classes, together with adequately trained teachers to deliver PE classes, has the potential to promote healthier lifestyles among students and to decrease the sedentary behaviour.

Refocusing Imagery Interventions: Reconciling Motor Imagery and Attentional Focus to Improve Basketball Free Throw Shooting

Gene Ouellette; Kyle Milley, Mount Allison University

There is much interest in developing efficacious imagery interventions to improve sport performance. However, the current literature has not fully examined how attentional focus may be manipulated within imagery to improve outcomes, despite previous research that has shown an external attentional focus to be more beneficial to motor performance outcomes than an internal focus of attention. The present study integrated mindfulness and flow into a modified imagery script designed to promote an external focus of attention (EFA) during a free throw shooting task. This approach was termed EFA-driven imagery and was tested here relative to alternate coaching that prioritized an internal focus of attention (IFA) through an emphasis on technique. Twenty-five male and female university basketball players completed both conditions one week apart in a completely counterbalanced within-subject design. Free throw shooting performance was hypothesized to improve more within the EFA-driven imagery condition than with IFA-oriented coaching of technique. Repeated measures ANOVA results confirmed that the EFA-driven imagery condition resulted in greater performance across trials than did the IFA-technique condition. Results are especially noteworthy considering the short term nature of the imagery intervention (a single session) which may match real-life time constraints within sport; yet, the precise underlying mechanisms responsible for the improved performance remain elusive. Avenues for future research are offered to better understand attentional processes during imagery, with the end goal of maximizing the efficiency and effectiveness of motor imagery interventions. Highlights: Imagery can be optimized by incorporating what is known from research on focus of attention; an external focus of attention can be utilized to enhance motor imagery interventions

Communication Profiles and Motivational Experiences of Athletes

Christine E. Pacewicz, Saginaw Valley State University; Alan L. Smith, Michigan State University

Communication among teammates takes various forms and produces exchange of information that can influence motivational experiences in sport (e.g., burnout, engagement, enjoyment, and satisfaction). The purpose of this study was to examine: (a) how various profiles of communication processes are expressed by individuals, (b) if team identity and sex predict profile membership, and (c) if these profiles are motivationally salient in sport. Collegiate track and field athletes ($N = 219$; $M_{age} = 20.2$ years, $SD = 1.4$) completed established measures of communication processes, team identity, and motivational experiences in sport. Analyses were conducted in Mplus to examine communication profiles, predictors of profile membership, and profile differences in perceptions of motivational experiences. Three profiles with distinct patterns of communication processes were found and labeled as the Less Effective, the Supportive, and the Functional Communicators. Greater perceptions of team identity predicted higher probability of membership in the Supportive Communicators profile ($p < 0.001$). Men had a higher probability of membership in the Functional Communicators profile than in the Supportive (OR 2.69, $p = 0.01$) and Less Effective (OR 2.36, $p = 0.01$) Communicators profiles, respectively. The Less Effective Communicators had greater perceptions of burnout ($p < 0.01$) and lower perceptions of engagement ($p < 0.01$ and $p < 0.05$), satisfaction ($p < 0.001$ and $p = 0.001$), and enjoyment ($p < 0.001$ and $p < 0.05$) than those in the Supportive and Functional Communicators profiles. Supportive Communicators had greater satisfaction ($p < 0.001$) and enjoyment ($p < 0.001$) than the Functional Communicators. Results indicate that the collective expression of communication processes with teammates differentially links with motivational experiences in sport. Also, greater team identity associates with the most motivationally adaptive communication profile. Future work should examine how communication profiles might evolve and shape changes in athletes’ motivational experiences across a season.

Exploring Flourishing Among Canadian Football League Players

Kurtis Pankow; Nicholas L. Holt, University of Alberta

The purpose of this study was to examine flourishing among Canadian Football League (CFL) players. Flourishing is the positive dimension of mental health that includes emotional, psychological, and social well-being (Keyes, 2002). Participants were five current CFL players, with between 1 and 9 years of CFL experience ($M = 4$, $SD = 3$). Participants completed individual semi-structured interviews ($M$ length = 44 minutes, $SD = 9$). Following a thematic analysis, we identified seven themes that contributed to flourishing, which were organized around a social ecological perspective ranging from the individual to broader system-level factors. At an individual level, participants reported that their attitudes (e.g., staying positive, appreciating their opportunity) and behaviors (e.g., engaging in non-football activities, setting and reaching realistic performance goals) played a role in their flourishing. At a microsystem level, themes were categorized as either contextual or relational factors. Contextual factors such as the participants’ residence (e.g., proximity of residence to restaurants and groceries, having a kitchen) and transportation (e.g., access to a car, being within a short walk of activities) were reported as important factors for flourishing. Interpersonal factors included football-related (e.g., friendships with teammates, mutual respect with coaches), or external (e.g., remaining connected with parents and friends, positive relationships with romantic partners). With the context of the CFL club, respectful relationships with the team staff were important. At the broader league level, participants said that some league policies (e.g., mandated bye weeks and the off-season, enforced maximum work hours per day) promoted player flourishing. However, players believed that the league culture of short term contracts (typically two years or less) were a barrier to flourishing. Overall this research provides a novel look at factors that contribute to flourishing among CFL players and may inform future league and team policies. Funding source: Mitacs (IT14825).

The Effect of Distinct Settings and Types of Exercise Images on the Automatic Processing of Non-Exercisers

Juliana Parma; Victoria Zona; Mariane Bacelar; Daniel Cabral; Matthew W. Miller, Auburn University

The Effect of Distinct Settings and Types of Exercise Images on the Automatic Processing of Non-Exercisers
Physical inactivity is one of the main risk factors for non-communicable diseases. Thus, mass-reach campaigns are usually developed to encourage sedentary people to undertake an active life. These campaigns often use exercise images, and recent work suggests the type of exercise (gym-based vs. sport-based) and setting of exercise (indoors vs. outdoors) depicted in the images affects reflective affective evaluations of the images. However, other recent work indicates reflective and automatic affective evaluations of exercise images differ. Given the important role of automatic processing in the adoption of active behavior, we investigated non-exercisers’ automatic evaluations of exercise images as a function of the exercise type and setting depicted in the images. We used an affective oddball paradigm in which participants were presented with series of negative, neutral, or positive images among which one of four types of exercise images was presented: indoor/gym-type; indoor/sport-type; outdoor/gym-type; and outdoor/sport-type. We obtained participants’ reflective ratings of the images, and the amplitude of the P3b component of participants’ electroencephalography (EEG)-derived event-related potentials evoked by the exercise images served to assess participants’ automatic evaluations. Results revealed that exercise images were reflectively rated as neutral/positive, and this rating did not depend on image setting or type. Regarding automatic evaluations of exercise images, those set outdoors and those depicting gym-type exercise elicited greater P3b amplitude than those set indoors and those depicting sport-type exercise, respectively. Yet, these effects were not moderated by whether the exercise images were presented in a series of neutral, negative, or positive images, suggesting that differences in how the exercise images were automatically evaluated were not related to affect, but just to the magnitude of cognitive processing. Thus, exercise images may be automatically processed to differing extents based on the setting and type of exercise depicted in the images.

**Soccer Mom or Softball Dad No More: Exploring the Transition Out of the Sport Parent Role**

**Julie Partridge; Kristiana Feerer; Lindsey Leatherman; Emma Brazeau, Southern Illinois University Carbondale**

Leaving sport may be a significant stressor for athletes and may lead to anxiety, depression, and coping difficulties, particularly for those with high levels of athletic identity (Wippert & Wippert, 2008; 2010). However, while the impact of athletic retirement on athletes has been frequently studied, less is known about the experience of a parent whose child is transitioning from sport. Existing research has indicated that parent-child sport socialization can have a significant impact on the child’s sport experience and competence beliefs (Babkes & Weiss, 1999; Wuerth et al., 2004). Research has also identified the reciprocal nature of sport socialization between parents and children (i.e., child-to-parent socialization; Dorsch, Smith, & McDonough, 2008), and parents have been found to both gain interest, and engage in behaviors surrounding sport, based upon their child’s participation (Weiss & Hayashi, 1995). Lally and Kerr (2008) conducted interviews with parents of female former elite gymnasts (retired 3–5 years) and found that this experience resulted in both impacts to familial relationships (i.e., parent-parent, parent-child, parent-peer), and the possibility of lingering parental doubts in terms of their choices pertaining to their child, coaches, and family. Limited research, however, has examined the effects of athlete retirement on parents with a non-elite sample. The purpose of the current study was to explore the experience of parents whose children who had competed at either the high school or collegiate level and had recently (i.e., within the previous competitive year) left the sport role either voluntarily or involuntarily. Semi-structured interviews were recorded, transcribed verbatim and content was inductively analyzed. Both fathers and mothers were recruited. Resulting themes include Social Impact, Changes to Family Dynamics, and Connection to Sport, and indicate that the transition out of the sport parent role is a complex and significant process. These results and implications for future research will be discussed.

**A Recess Without(Out) Adults: Using Qualitative Research Methods to Examine Common Problems and Potential Solutions to School-Based Recess**

**Deanna Perez; Jannelle Thalken; Alex Szarabajko; Laura Neilson; William Massey, Oregon State University**

Over the past decade, considerable attention has been paid to the implications of school-based recess on childhood development. Emerging data suggests that decision makers must consider the quality of recess in addition to children’s access to this environment (Massey et al., 2020). In an effort to develop solutions to increasing the quality of children’s experience at recess, the purpose of the current study was to document common problems observed during elementary school recess and the conditions in which these problems emerged. Data were collected from 112 recess sessions in 25 schools located in three distinct geographical regions (Midwest, Northwest, Southwest portions of the United States). The Great Recess Framework-Observational Tool (GRF-OT; Massey et al., 2018) measures the following factors: (1) safety and structure of the recess environment, (2) student behaviors on the playground, (3) adult supervision and engagement, (4) transitions, and (5) physical activity patterns. The GRF-OT was used to guide observations and detailed field notes. Following data collection an inductive content analysis was conducted to examine patterns in the raw data (Tashakkori & Tashakkori, 2010). Analyses revealed that poorly designed and maintained recess spaces contribute to common safety issues observed during recess. Moreover, a combination of insufficient space planning and maintenance, lack of play equipment and game availability, and limited adult involvement on the playground reinforced social hierarchies that led to exclusionary practices. While recess is often deemed a child-led portion of the school day, results highlighted the important, and often forgotten, role adults play in recess. Specifically, adults have the resources to design play spaces, ensure the availability of adequate equipment, maintain and upkeep spaces and equipment, and reinforce rules and norms of behavior. Findings will be presented within the context of practical solutions schools and policy makers can adopt to mitigate issues observed during recess. Funding source: SD Bechtel Jr. Foundation; Playworks Education Energized.

**Individuals with Strong Intentions and Low Trait Self-Control Benefit Most From a Physical Activity Planning Intervention**

**Ines Pfeffer, Medical School Hamburg**

People often fail to translate their physical activity intentions into action. Generating action and coping plans increases the likelihood of behavior enactment (Hagger & Luszczynska, 2014). However, it is unclear for whom planning interventions are most effective. It was hypothesized that planning can compensate for poor trait self-control (general tendency to exert self-control across diverse situations and contexts). Therefore, the role of trait self-control for translating action and coping planning into behavior was examined. A randomized controlled trial with two points of measurement (t1 and t2) was conducted. One hundred and ninety-four students (71.7% women; M_age = 22.71 years, SD_age = 2.53) filled in standardized questionnaires measuring age, sex, physical activity behavior, action and coping planning (control variables), as well as intention and trait self-control (moderators). Subsequently, participants either received a planning intervention or a control intervention (t1). Action and coping planning as well as physical activity behavior (dependent variable) were assessed again at t2 (1 week later). The planning intervention group (compared to the control group) significantly increased action and coping.
planning as well as physical activity behavior between t1 and t2. A regression analysis revealed that the group, intention (t1) and action planning (t2) directly predicted behavior at t2. Furthermore, a significant three-way interaction among Coping Planning (t2) × Intention × Trait Self-Control on physical activity behavior was observed: the association between coping planning and behavior was strongest for participants with high intentions and low trait self-control. Planning seems to be an effective self-regulatory technique, particularly for people with low trait self-control. Action planning (but not coping planning) directly predicted behavior while coping planning notably helps people with strong intentions and low trait self-control to overcome barriers and obstacles and to act more in line with their intentions.

Organizational Systems in Sport and Their Impact on Athlete Development and Mental Health
Zoe A. Poucher, University of Toronto; Katherine A. Tamminen, University of Toronto; Christopher R. D. Wagstaff, University of Portsmouth

Background: Sport organizations have consistently been noted to be pivotal to the success and failure of their athletes, with a substantial body of research pointing to factors, such as team culture, that support and hinder performance and wellbeing in performance environments (Wagstaff, 2017; 2019). Purpose: The purpose of this project was to explore stakeholders’ perceptions of how high-performance sport organizations support the personal development of athletes. Methods: Semi-structured interviews were conducted with 18 key stakeholders (14 men, M = 36 years old) from the United Kingdom’s elite sport system. Stakeholders were employed by Sport England, the English Institute of Sport, and Sport Northern Ireland. Based on the purposes of this study, thematic analysis was used to analyze the data. Results: Stakeholders described nine different mechanisms of support for elite athletes including: performance lifestyle advice, sport psychology, financial assistance, sport medicine, physiotherapy, performance analysis, nutrition, strength and conditioning, and physiology; participants emphasized the importance of the first three for promoting athlete development (AD). Several stakeholders observed that despite the extensive support available to athletes, the prevalence of a performance narrative (i.e., pursuit of medals) has led to an environment that discourages holistic AD. Discussion: Despite extensive available support, it was noted that many athletes do not engage with the support they have access to. As such, sport organizations should consider developing alternate strategies for engaging athletes in some disciplines of science and medicine support. Additionally, employing full-time sport psychologists, who also work as performance lifestyle advisors, within funded sports offers a valuable opportunity to enhance holistic AD support. Sport organizations should also look to support the well-being of their staff who may then be able to more effectively support their athletes. Funding source: Mitacs Globalink Award.

Self-Perceptions Among Adolescent and Young Adult Cancer Survivors Who Participated in a Physical Activity Trial: A Qualitative Study
Jenson Price, University of Ottawa; Amanda Wurz, University of Calgary; Jennifer Brunet, University of Ottawa

Background: Adolescent and young adult cancer survivors (AYAs) report negative side effects that can be attenuated by physical activity (PA). The mechanisms underpinning the benefits of PA remain relatively unexplored. The Exercise and Self-Esteem Model (EXSEM) proposes physical and psychological processes that may be implicated. In this qualitative study, we explored physical and psychological processes among AYAs who participated in a PA trial to better understand how PA benefits AYAs. Methods: We interviewed 16 AYAs who participated in a two-arm randomized controlled trial comparing a 12-week PA intervention to a wait-list control group. Semi-structured interviews were conducted pre- and post-intervention. Questions and probes were designed to bring participants’ attention to different processes within and outside the EXSEM. We analyzed data thematically using a deductive-inductive approach. Results: Participants’ experiences were organized into four main themes. First, self-esteem evolves throughout the cancer journey, which reflected the profound negative and positive changes in self-esteem participants experienced across social, emotional, and physical domains in the wake of cancer. Second, negative physical self-perceptions motivates PA, which captured how physical changes experienced guided participants’ desire to engage in PA. Third, past PA affects PA confidence, which described how previous PA experiences impacted participants’ evaluation of their confidence to overcome PA barriers and engage in PA. Fourth, positive self-perceptions develop from engaging in a PA intervention, which for participants in the intervention group captured enhanced appraisals of their functioning, appearance, and abilities post-intervention. Conclusion: PA interventions may help AYAs address negative self-perceptions, and in turn help them feel more confidence to engage in PA. Further, findings suggest there may be other processes beyond the primarily physical processes in the EXSEM influencing AYAs’ wellbeing in the context of PA.

The Potential of Telehealth Interventions for Health Behaviour Change Among Rural-Living Young Adult Cancer Survivors
Jenson Price; Jennifer Brunet, University of Ottawa

Background: Physical activity (PA) participation and fruit and vegetable (FV) consumption are generally low. Certain populations have difficulties accessing programs that aim to increase these behaviors. We drew on Self-Determination Theory and behavior change literature to develop a 12-week synchronous, real-time telehealth intervention to increase PA participation and FV consumption among rural-living young adult cancer survivors (YAs). We conducted a single-arm, mixed methods pilot trial to assess (1) intervention and trial methods feasibility and (2) intervention acceptability. Methods: Rural-living YAs met with a health coach for 60 minutes/week for 12 weeks using live, interactive telecommunications technology. Feasibility was assessed by tracking rates of recruitment, enrollment, attrition, retention, adherence, and missing data. Acceptability was assessed during post-intervention semi-structured interviews. Results: Over a 1-year period, 18 young adults self-referred, 9 were eligible and provided consent, and 2 dropped out (retention = 74%; attrition = 22%). Intervention adherence was 95%. There was <10% missing data and all participants completed the interview. Intervention acceptability was summarized into five themes: (1) 12 weeks facilitates initial behavior change, (2) real-time communication encourages a positive relationship with a health coach, (3) a distance-based delivery method promotes access, (4) key techniques for behavior maintenance post-intervention, and (5) minor changes may enhance other participants’ experiences. Conclusions: Certain methods require modifications to enhance trial feasibility; however, the 12-week behavior change intervention that employed audio-video communication technologies was well received by rural-living YAs. Future interventions should be delivered using synchronous (or real-time) technologies rather than asynchronous (or store-and-forward) technology, whilst integrating booster sessions after the formal intervention is over.

The Relationship of Fitness Self-Conscious Emotions With Enthusiastic and Constrained Commitment: Examining the Moderating Role of Athletic Competence
Elizabeth Pritchard, The University of British Columbia; Catherine Sabiston, University of Toronto; Guy Faulkner, The University of British Columbia
Sport participation can be beneficial for adolescent athletes; however, female sport participation tends to decrease significantly during adolescence. A commonly cited reason for dropout is issues surrounding body image, including body-related self-conscious emotions (pride, shame, guilt, envy, and embarrassment). Specifically, fitness focused body-related self-conscious emotions (FSCE) are associated with sport commitment, but research has not differentiated between the two subtypes of sport commitment (enthusiastic and constrained). Self-conscious emotions are elicited in response to self and socially encouraged standards, so it is important to understand how FSCE influence enthusiastic and constrained commitment. Additionally, preliminary research has suggested that high levels of perceived athletic competence (PAC) may buffer the impact of negative FSCE on sport outcomes, such as commitment. Thus, this study examined the relationship between FSCE and the two subtypes of sport commitment, as well as the moderating effect of PAC on this relationship. Based on a sample of adolescent female athletes (n = 106, M_age = 14.8), all negative FSCE (shame, guilt, envy, and embarrassment) were positively related to constrained commitment and negatively related to enthusiastic commitment. Positive FSCE (authentic and hubristic pride) showed the opposite pattern of relationships. Results of the multiple regression analyses indicated that negative FSCE predicted constrained commitment ($R^2 = .18$), whereas positive FSCE predicted enthusiastic commitment ($R^2 = .20$). PAC was significantly correlated with enthusiastic commitment, but there was no evidence of moderation. These findings suggest that FSCE are related to both subtypes of sport commitment, thus this research provides further evidence of the important contribution of body-related self-conscious emotions in predicting sport outcomes. Funding source: Social Sciences and Humanities Research Council.

**The Influence of Sleep and Physical Activity on Psychological Health and Health Behaviors in First-Year College Students**

*Erica Rauff; Michael Spinetta, Seattle University*

Background: Physical activity (PA) and sleep have been positively associated with psychological health and engagement in health behaviors. However, limited research has examined PA, sleep, psychological well-being, and health behaviors in first-year college students. Purpose: This study examined the influence of PA and sleep duration on stress, anxiety, body esteem, depression, and alcohol use in a sample of first-year college students. Methods: First-year college students (N = 105, 16% male, 84% female) completed validated measures. Students were categorized as meeting PA guidelines (52%) or not meeting PA guidelines (48%) and meeting sleep recommendations (68%) or not meeting sleep recommendations (32%). Two separate MANCOVA’s with Bonferroni correction controlling for sex were conducted for PA and sleep groups to examine group differences in psychological health and health behaviors. Results: A significant multivariate effect was observed for PA groups (WL = 0.82, $F(6, 98) = 3.5$, $p < 0.01$); students meeting PA guidelines reported significantly higher alcohol consumption ($M = 3.6$ drinks) compared to students not meeting PA guidelines ($M = 2.5$ drinks). A second significant multivariate effect was observed for sleep groups (WL = 0.81, $F(6, 97) = 3.6$, $p < 0.01$); students meeting sleep recommendations reported significantly greater body esteem ($M = 116.4$), significantly less stress ($M = 19.1$), anxiety ($M = 45.5$), and consumed significantly less alcohol ($M = 2.8$ drinks) compared to students not meeting sleep recommendations ($Ms = 104.6, 21.8, 50.9$, and $3.8$ respectively). Conclusion: These exploratory analyses suggest that students who engage in prosocial behaviors such as PA may also be more likely to engage in negative health behaviors such as binge drinking. However, students who are meeting sleep recommendations appear to have a more positive psychological profile and engage in less binge drinking. Thus, it is important to consider key health behaviors to target in first-year college students that will positively influence both their psychological health and health behaviors.

**Sex Differences in Cognitive and Neuropsychiatric Functioning in Former Athletes**

*Christopher K. Rhea, University of North Carolina at Greensboro; Jeffrey D. Labban, University of North Carolina at Greensboro; Michael L. Alosaic, Boston University; Robert A. Stern, Boston University; Donna M. Duffy, University of North Carolina at Greensboro*

Sport-related repetitive head impacts (RHI) are postulated to cause later-life consequences in cognitive and neuropsychiatric functioning. The Longitudinal Examination to Gather Evidence of Neurodegenerative Disease (LEGEND) Study enrolled retired athletes (N = 794) to determine the extent to which later-life consequences are associated with sport-related RHI. Assessments of executive function, depression, apathy, and cognition were included. Parallel to the LEGEND Study, there has been increased interest in differential responses between males and females after RHI, for which females have increased concussion rates, symptom severity, and symptom duration in the acute response to RHI. However, the extent to which these sex differences persist as a chronic response to RHI is unknown. To address this question, LEGEND data were split between males (N = 714) and females (N = 80), as well as sport type (collision vs. non-collision sports). F tests were used to calculate effect sizes between groups (small effect = 0.1, moderate effect = 0.25, large effect = 0.4). When comparing female collision sport athletes to male collision sport athletes, a moderate effect was observed for the depression scale ($F = 0.22$), such that females (25.8 ± 11.7) reported higher levels of depression than males (19.6 ± 14.0). When comparing female collision (C) sport athletes to females who competed in non-collision (NC) sports, moderate effects were observed for the behavioral regulation ($C = 63.2 ± 11.9$; $NC = 58.2 ± 12.3$; $F = 0.20$) and depression ($C = 25.8 ± 11.7$; $NC = 19.7 ± 11.5$; $F = 0.27$) scales, and small-to-moderate effects were observed for metacognition ($C = 63.0 ± 11.7$; $NC = 59.7 ± 13.2$; $F = 0.13$) and global executive composite ($C = 64.1 ± 12.4$; $NC = 59.8 ± 13.0$; $F = 0.17$) scales. In all cases, females playing collision sports reported worse outcomes compared to females playing non-collision sports. These data suggest that sex differences in cognitive and neuropsychiatric functioning after sport-related RHI persist into later-life and that playing collision sports may further exacerbate these consequences.

**Exercise Schema and Motivational Regulation of College Students: A Latent Profile Analysis**

*Stephen Samendinger, SUNY-Farmingdale; Christopher Hill, California State University, San Bernardino*

To further understand the complex psychological processes involved with motivating health behavior, we sought to examine how one’s exercise schema may align with self-determined exercise motivation regulations. Cognitive schema serve as identity-bound cognitive structures derived from past experiences that organize and guide the processing of domain-specific information related to one’s conception of self. Schema automatically motivates identity-relevant behavior in a manner consistent with an identity. The degree of identity assimilation in exercise settings likely occurs from engaging in rewarding and fulfilling exercise-based experiences. The degree of identity assimilation or internalization will influence one’s behavioral regulation on a continuum ranging from amotivation to extrinsic (controlling) to intrinsic (autonomous and self-rewarding). Few studies have examined patterns of motivation regulations that may be
associated with exercise schema. To identify unique clusters of exercise schema and associated motivation regulations, we conducted a latent profile analysis on responses from 427 college-aged adults to an exercise self-schema measure (using both schema identification and schema strength) and five exercise regulation survey subscales (external, injected, identified, integrated, intrinsic). A three-class latent profile model fit this data best considering both the fit indices and theoretical implications. Profile 1 response patterns indicated that exercise was not self-descriptive but was important to self-image, while exercise regulation responses suggest these individuals sit on the threshold of autonomous regulation (non-exercise schematics). Profile 2 scored low on schema identification and importance and all exercise regulation scale items (aschematics). Profile 3 persons were high in exercise schema self-description and importance, as well as autonomous forms of motivation (exercise schematics). Future research may examine the stability of these profiles and methods to operationalize schema-regulation profiles to enhance exercise behavior.

Motivation Alone Does Not Contribute to the Benefits of Imagery Training on Strength Performance
Jack J. Sampson; Tatiana A. Zhuravleva; Sean M. Cochran; Phillip G. Post; Christopher A. Aiken, New Mexico State University
Research has suggested that imagery training may enhance motivation or self-efficacy which plays a role in improved performance (Munroe et al., 2000; Slimani & Cheour, 2016). However, there is still relatively little research examining the effects of imagery on motivation. Thus, the purpose of the study was to investigate the effects of imagery on motivation to perform a strength task. Participants (n = 37) completed an adapted Intrinsic Motivation Inventory (IMI; McAuley et al., 1989) following pre-testing that assessed peak torque of the right quadriceps and hamstrings. Participants were then randomly assigned to different interventions; physical practice (PP), mental imagery (MI), or Control (C). During the training phase participants engaged in their selected intervention three times a week for five weeks totaling 15 training sessions. PP group performed 30 maximal effort extensions and flexion on the Biodex, the MI group performed 30 imagined trials of the task, while C group played Tetris for 15 minutes. Following the training intervention participants performed a post-test which was the same as pre-testing. After completing the post-test participants filled out the IMI and a post-experiment questionnaire. Results revealed that the three groups did not significantly differ on the IMI for any subscale: Interest/Enjoyment, Perceived Competence, or Effort/Importance (p > .05). The groups also did not increase in any subscale from pre- to post-testing. In the exit questionnaire participants were asked to rank how beneficial their training was in improving their leg extension and flexion performance. PP rated their training intervention as being more beneficial than the participants in the MI or C groups (p < .001), while participants in the MI group rated their selected training as more advantageous than participants in the C group (p < .05). These results suggest that motivation alone does not contribute to the benefit of utilizing imagery as a training mechanism even when participants believe that imagery training is beneficial to their strength performance.

Resistance Exercise in Men with Symptoms of Muscle Dysmorphia: A Qualitative Inquiry
Nick SantaBarbara; Miguel Blacutt; Miranda Lampke; Joseph Ciccolo, Columbia University
Introduction: Excessive resistance exercise (i.e., weight lifting; RE) is the primary symptom of muscle dysmorphia (MD), a pathological pursuit of increasing muscle size that affects mainly men. Most of the MD research has focused on identifying correlates of MD with less work having focused on RE factors that may reinforce the behavior. Purpose: To explore RE factors that may reinforce RE behavior. Methods: Semi-structured interviews were conducted with 21 men with MD symptoms. Interviews were conducted following participation in a larger study that evaluated the acute effects of moderate vs. high-intensity RE. Data were de-identified, recorded, transcribed verbatim, and then reviewed by the authors to enable refinement and increase rigor. Thematic techniques were used for content analyses of the open-ended questions, which were chosen to allow for flexibility and probing. An inductive approach was used allowing themes to be derived from the data. Responses were first grouped into sub themes and then into higher-order themes. Results: 865 responses were grouped into 49 initial sub themes and then 4 higher-order themes. 1) Participants noted greater body satisfaction and a psychological addiction to the temporary muscle swelling (described as the “muscle pump”) and break down following high-intensity RE, despite the increased physical exertion and muscle pain and discomfort. 2) Deviations from the normal RE routine were accompanied by anxiety, restlessness, and perceptions that one’s body is gaining fat and losing muscle. 3) Motivations for RE included lack of confidence, insecurity, body dissatisfaction, social acceptance, respect, and perceived weak will. 4) Participants would always be dissatisfied with their bodies regardless of whether their predetermined, objective goals were met. Conclusions: The perceived benefits of, and motivations for, high-intensity RE appear to influence continued usage, despite the accompanied pain and discomfort. Future studies that explore other RE factors that may reinforce the behavior are needed. Funding source: Teachers College, Columbia University Dissertation Fellowship Grant.

Factors Implicated in Olympic-Level Athlete Well-Being
Jeffrey Sauvé; Joseph O’Rourke; Mark Beauchamp, The University of British Columbia
The intense psychological, physical, and competition demands of Olympic-level sport create a unique array of factors that can influence athlete well-being. This qualitative study examined the perceptions of recently retired Canadian Olympians in relation to factors they believe contributed to, or impaired, their well-being over the course of their elite sport careers. Twelve recently retired Canadian Olympic athletes (eight women and four men; Mage = 33.42, SD = 2.78), from a variety of winter and summer sports served as participants in the study. Participants were categorized as recently retired if they competed in the category of athlete at one or more Olympic Games since 2010. For the study, Olympians participated in individual semi-structured interviews, each of which was transcribed verbatim and subject to thematic analysis. An interpretivist approach underpinned this study. The results revealed nine lower-order themes that were subsumed within three higher-order themes. These included interpersonal (i.e., coach-athlete relations, support team, training environment), organizational (i.e., finances, planning, communication), and intra-individual (i.e., results-focused mindset, identification with elite sport norms, feelings of isolation versus connectivity) factors that participants felt contributed to, or undermined, their well-being during their elite sport careers. When taken together, the results of this study point to both the complexity of factors that potentially contribute towards, or thwart, Olympic-level athlete well-being, as well as unique insights into interpersonal, organizational, and intra-individual factors that are worthy of more scrutinized investigation (e.g., participants identified sport psychologists, hired by their National Sport Federations, as both contributing to but also unintentionally thwarting athlete well-being). Implications for future research, applied practice, and National Sport Federation governance are discussed.
How do Passionate Sports Fans Respond to Championship Victories? A Look at Savoring and Dampening

Benjamin Schellenberg, University of Manitoba; Jérémie Verner-Filion, Université du Québec en Outaouais; Patrick Gaudreau, University of Ottawa

A particularly enjoyable part of being a sports fan is when one’s favorite team wins a championship. But fans do not all respond to championship victories in the same way. One broad way of responding to positive events, such as championship victories, is to engage in savoring and attempt to maintain, enhance, or prolong good feelings. However, another way of responding to positive events is to engage in dampening and attempt to suppress positive emotions. In this research, we wondered if certain psychological characteristics of sports fans are associated with savoring and dampening responses. Specifically, we relied on the dualistic model of passion (Vallerand, 2015) and tested if savoring and dampening were predicted by the extent to which passion for being a sports fan is harmonious or obsessive. We recruited two samples of sports fans: Fans of Liverpool F.C. (n = 299), within 2 days of Liverpool F.C. winning the 2019 UEFA champions league, and fans of the Winnipeg Blue Bombers (n = 334), within 10 days of the Blue Bombers winning the 2019 Grey Cup championship game. Both samples of fans completed online surveys assessing harmonious passion, obsessive passion, the positivity of the victory, and the extent to which they engaged in savoring and dampening after the win. In both samples, we found that harmonious passion was positively related to savoring the championship victory, and that obsessive passion was positively related to both savoring and dampening. These results mean that harmonious passion in fans is associated with trying to make the most of championship victories by attempting to prolong or enhance positive emotions, whereas obsessive passion in fans is associated with a more conflicted response that involves both savoring and dampening. This research contributes to our knowledge of how passionate people regulate their emotions following positive events, and suggests savoring and dampening as potential mechanisms that might help explain why harmonious passion tends to predict greater well-being than obsessive passion. Funding source: Social Sciences and Humanities Research Council of Canada.

A Content Analysis of Empirical Literature on Sport Coach Education Programs Around the World, 2010–2019

Majidullah Shaikh, University of Ottawa; Tanya Forneris, The University of British Columbia

Trauma-informed treatment has demonstrated strong effectiveness in reducing trauma-related symptomology in youth (e.g., cognitive and emotional dysregulation, impairments in social relatedness). However, little research has explored the effectiveness of this treatment in non-healthcare contexts like youth sport. The purpose of this study was to examine the influence of trauma-informed sport programming on psychosocial processes and outcomes (i.e. basic needs support, basic needs satisfaction, and well-being) for youth participants. Three sites hosted weekly 1–2 hour trauma-informed sport sessions over the course of six seasons (each season = 6–10 weeks, 10–25 youth per season). A mixed-methods approach was used, in which self-reported data were collected from youth participants aged 8–12 (N = 218; 61% male, 39% female; M_age = 9.12, SD = 1.26), and individual interviews with youth were conducted to understand their program experiences, perceptions of their interactions and relationships with staff, and their experiences of psychosocial development and skills. Descriptive and multivariate statistics were conducted to examine the magnitude of youth’s ratings on each measure and pre-post changes. Qualitative data were analyzed using deductive-inductive thematic analysis (Braun, Clarke, & Weate, 2016). The quantitative results indicated that, on average, self-reported ratings of well-being trended upward from the pre- to post-assessment each season. As well, self-reported ratings of basic needs support and satisfaction were generally positive, however perceptions of autonomy support and satisfaction were scored relatively lower than perceptions of competence and relatedness. Four themes were generated from the qualitative results to represent the psychosocial experiences and outcomes that youth constructed from their participation: (a) I feel accepted, (b) I made friends, (c) I learned sport skills, and (d) I learned life skills. Implications are shared on how trauma-informed sport can help reach a broader population of trauma-exposed youth in the contexts they engage in.

Culture and Emotion in Paralympic Swimming Medalists

Erin Snapp; Jeffrey Martin; Franziska Loetzner, Wayne State University

The purpose of the present study was to examine if cultural identity was related to the emotional experiences of Paralympic swimmers’ upon
winning medals at the 2016 Paralympic Games. Paralympic athletes’ countries were scored on Hofstede’s (2011) six cultural dimensions and athletes who won medals had their facial expressions analyzed to determine levels of basic emotions (i.e., happiness, sadness, anger, surprise, disgust, fear, and neutral) based on Ekman’s (1993) neuro-cultural theory of emotion. After controlling for medal won, and time and place expectations, we found that happiness was negatively associated with long/short term orientation (r = −0.313, p < 0.004) and positively linked to indulgence/restraint (r = 0.210, p < 0.06). The emotion of neutral was positively associated with power distance (r = 0.239, p < 0.032) and long term/short term orientation (r = 0.290, p < 0.009) while being negatively linked to indulgence (r = −0.276, p < 0.013). Based on an abductive theory of the scientific method (Haig, 2005; 2008) we formed plausible explanations for our findings and conclude, given our study is the first of its nature, that researchers should continue this line of inquiry.

Do Not Smile. Efficacy of Emotional Regulation on Self-Control Among Student-Athletes
Jessie Stapleton, University of North Florida; Michael Nolan, Missouri Baptist University

According to The Strength Model of Self-Control, self-control is a global, trainable resource. It is well-established that self-control is positively related to academic achievement and physical performance. Student-athletes may benefit from self-control training as they are continuously challenged to exhibit cognitive self-control in the classroom and physical self-control during competition. As such, emotional regulation may be a novel approach to training self-control among student-athletes. The purpose of this randomized, controlled trial was to test the efficacy of emotional regulation on self-control among student-athletes. A group of 47 collegiate baseball student-athletes (Mage = 20.78, SD = 1.38) completed a battery of baseline questionnaires, performed a self-control task (i.e., plank until failure), and were randomized into experimental and control groups. The experimental group watched comedy segments while asked to stifl all emotional responses for 30 minutes twice per week for four weeks. After the fourth intervention week, both groups completed the same questionnaires and self-control task. A series of paired t-tests were conducted to analyze within and between group differences. There were no significant differences between group plank times at baseline (t(43) = −1.02, p = .31) nor post-test (t(40) = −1.24, p = .22). The control group significantly decreased in plank times from baseline to post-test (t(19) = 3.19, p < .01, but the intervention group did not significantly decrease (t(21) = 2.10, p = .05. These results suggest student-athletes who participated in emotional regulation training maintained their self-control better than student-athletes who did not participate in emotional regulation training. Emotional regulation may be a viable self-control training strategy to avoid declines in self-control over an academic semester and sport season for optimal performance in both contexts.

Congruence of Athlete Self-Efficacy and Coach Estimation of Athlete Self-Efficacy: Personal and Relational Impacts
Sarah Stephen, Florida State University; Christine Habeeb, East Carolina University; Calum Arthur, University of Edinburgh

Training and competition decision-making often involve coaches’ estimations of their athletes’ confidence (Jackson & Beauchamp, 2010). Research suggests accurate estimations, or high coach-athlete congruence, can result in higher athlete satisfaction and performance (Chelladurai, 2007). Coaches, however, are not always accurate in their assessments and misestimation of an athlete’s self-efficacy can result in inter- and intra-personal consequences. Unfortunately, the relevance of the congruence hypothesis (Reimer & Toon, 2001) for relational efficacy beliefs that exist in coach-athlete dyads has not been explicitly tested. The purpose of this study was to assess the extent to which congruence, of athlete self-efficacy and coach estimation of athlete self-efficacy (CEASE), is predictive of dimensions of coach-athlete interconnectedness. Data were obtained from 71 British coach-athlete dyads from a range of individual sports regarding athlete self-efficacy, CEASE, and coach-athlete interconnectedness (i.e., closeness, commitment, and complementarity). Polynomial regression analyses were conducted to determine if athlete self-efficacy, CEASE, and congruence (of athlete self-efficacy and CEASE) predicted athletes’ and coaches’ individual perceptions of closeness, commitment, and complementarity. Interactions were then depicted in 3D surface response plotting. Results suggest that congruence (of athlete self-efficacy and CEASE) was significant in predicting athletes’, but not coaches’, perceptions of closeness, commitment, and complementarity. CEASE, regardless of athlete self-efficacy and congruence with athlete self-efficacy, was significant in predicting coaches’ perceptions of closeness, commitment, and complementarity. Results support that coach-athlete congruence can be a significant factor in determining athlete perceptions and overall success of the coach-athlete relationship, which provides an exciting grounding for future research.

Preliminary Findings from a Pilot Pragmatic Trial Examining the Real-World Effectiveness of a Functional Movement mHealth Application
Matthew Stork; Sara McCreary; Ethan Bell; Mary Jung, University of British Columbia

Background: There are thousands of mobile applications (apps) available for download that are geared towards health and fitness, yet limited research has evaluated the real-world effectiveness of such apps. The movr app is unique in that it is designed to enhance physical functioning and physical activity by prescribing functional movement training based on individualized movement assessments. Movr’s influence on adherence to physical activity (PA) behaviour, aerobic fitness, and perceptions of physical functioning has not yet been established empirically. Purpose: To examine the real-world impact of Movr on PA behaviour, aerobic fitness (VO₂max), and perceptions of physical functioning. Method: Twenty-four physically active adults (15 women, 9 men; 25 ± 6 yrs) completed an 8-week pilot pragmatic trial whereby they were randomly assigned to either 8-week pilot pragmatic trial whereby they were randomly assigned to either 8 weeks of use of the movr app (n = 12) or 8 weeks waitlist control (n = 12). Measures of PA, VO₂max, and satisfaction with physical functioning were collected at baseline and 8-week follow-up. Results: PA significantly decreased from pre- to post-intervention (M = 3399.5 to 2264.1 MET-min/week, p < .05) for those in the control group, but not for those in the movr group (M = 3351.2 to 3382.0 MET-min/week, p > .05). RM ANOVA revealed a significant time by group interaction (p < .05), with participants in the control group decreasing their VO₂max over time (M = 43.1 to 41.8 ml/ kg/min), while those in the movr group increasing their VO₂max over time (M = 39.9 to 40.6 ml/kg/min). Finally, satisfaction with flexibility and overall physical functioning significantly improved for those in the movr group (Mflex = 3.4 to 4.1; Moverall = 15.8 to 17.3, ps < .05), but not for those in the control group (Mflex = 3.5 to 3.8; Moverall = 16.5 to 16.8, ps > .05). Conclusion: This preliminary pilot data illustrates the potential for the movr app to promote maintenance of physical activity and aerobic fitness levels, while enhancing perceptions of physical functioning among physically active adults. Funding source: Mitacs and lululemon athletica.

Attention-Related Coaching Behaviors and Their Impact on Perceptions of a Caring Climate
Cheryl Stuntz; Zoe Barnhart, St. Lawrence University
As an effective method to extend positive results from exercise training studies and should be further explored.

Toward the Development of a Coding Framework to Analyze Parent-Athlete Interactions and Communication in Youth Sport

Katherine Tamminen; Sina Azimi; James Bissett, University of Toronto

Parents have been described as socializers of youth athletes’ sport experiences, and parents’ behaviors, values, and attitudes can affect athletes’ enjoyment and motivation to participate in sports. However, there is limited research examining the process of communication between parents and athletes. Therefore, the purpose of the present study was to develop a coding framework to analyze interactions between parents and youth athletes. The first stage in developing the coding framework involved a literature review of published articles that examined parent-athlete interactions and communication in sport. These articles (N = 46) were deductively analyzed to extract key themes and behaviors identified as important for parent-athlete interactions. The second stage consisted of an inductive analysis of video recorded interactions between parent-athlete dyads in a naturalistic setting (i.e., the car ride to and from sport practices and competitions); these videos were reviewed to identify additional behaviors and actions to include in the coding framework. The Verbal Codes in the resulting coding framework included: 1) Performance Feedback (e.g., praise, criticism, areas for improvement); 2) Expressions of Confidence; 3) Questions (e.g., questions inviting descriptions, reflection, and elaboration); 4) Statements (e.g., advice, expressions of concern or expectations, statement of fact or opinion, agreement or disagreement); and 5) Non-sport related statements. Non-Verbal Codes include: 1) Silence; 2) Music (turning on radio or using headphones); 3) Gaze; 4) Head Position (e.g., turning toward/away from partner, and nodding); 5) Eye Contact; 6) Laughing & Smiling; 7) Physical Movements (e.g., affectionate physical contact, and facepalm). The coding framework can be used to code and analyze parent-athlete communication patterns to identify interactions that promote various outcomes among parents and athletes, including autonomy support, parenting styles, parent-athlete relationship perceptions, athletes’ cognitive and emotional development, and the development of coping skills. Funding source: Province of Ontario Ministry of Research and Innovation: Early Researcher Award.

The Relationship Between Recess Quality, Recess Time, and Body Mass Index Among Elementary School Children

Janelle Thalken, Oregon State University; Alexandra Szarabajko, Oregon State University; Laura Neilson, Oregon State University; Brian Dauenhuauer, University of Northern Colorado; Megan Stellino, University of Northern Colorado; William Massey, Oregon State University

There has been increasing attention on research and policy related to school-based recess and the corresponding benefits for children; however, time allotted for recess remains low. From a public health perspective, this limitation is concerning because recess provides one of few opportunities for physical activity during the school day. Further, obesity prevalence among elementary-aged children is still approximately 18% (U.S. Department of Health and Human Services, 2017). The purpose of the current study was to examine the relationship between recess quality, recess time, and body mass index (BMI) in a sample of low-income elementary school students. Data were collected at 26 schools across four distinct regions of the United States (West Coast, Mountain West, Midwest, and South). Schools ranged from 31.6% to 98.2% economically disadvantaged (M = 78.53; SD = 17.95). Recess quality was measured by trained observers using the Great Recess Framework-Observational Tool (Massey et al., 2018) at 124 recess sessions, with at least two observation days per recess.

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at each school. Recess time was measured using the School Physical Activity Policy Assessment and was classified into three different time categories, less than 20 minutes per day, 21–30 minutes per day, and more than 30 minutes per day. BMI was measured by height and weight assessments completed on children who were randomly selected from each of the third and fifth grade classrooms (n = 468; M = 19.83; SD = 4.48). BMI was calculated using the measured height and weight scores, and then translated to z-scores, percentiles, and age-adjusted BMI category. Two-level regression models were conducted in Mplus (v. 8.2; Muthén & Muthén, 2018). Recess time significantly predicted student BMI scores (b = −7.04, p = .027) when controlling for key covariates (e.g. school district, age, and gender). There was no relationship found between the quality of the recess environment and BMI scores. These findings suggest that time spent at recess is important for elementary-age children and their physical health. Funding source: SD Bechtel Jr. Foundation.

Perfectionism and Drive for Muscularity as Predictors of Body Dissatisfaction and Substance Related Attitudes and Use

Burgandy Thiessen; Chantal Arpin-Cribbie; Morgan Miller; Megan Bolt, Laurentian University

Although substance use has appeared to be prevalent in sport, relatively little information has been provided as to why athletes engage in such behaviors. Despite the growing effort to provide drug testing and education against doping, evidence has shown that usage rates have actually increased (e.g., Muwonge, Zayuga, & Kabenge, 2015). Research has also shown that athletes higher in perfectionism may be more likely to engage in substance use behaviors as an effort to enhance physical appearance and performance (e.g., Bahrami, Yousefi, Kaviani, & Ariapooran, 2014; Zucchetti, Candela, & Villosio, 2015). In this study, we examine attitudes towards substance use as well as actual usage of substances as consequences from athletes and non-athletes who suffer from body dissatisfaction and who are higher in perfectionistic traits and higher in drive for muscularity. The results of this study will help determine which individuals are more at risk for substance use behaviors which could ultimately lead to building new prevention strategies that could provide assistance in decreasing this growing epidemic.

The Face of Affect and Exertion: Automated Facial Action Analysis to Decode the Flow of Experience During Exercise

Sinika Timme, University of Potsdam

Increasing evidence suggests affective experience during exercise influences future exercise behavior. The analysis of the affective responses to exercise has so far relied on self-reports and statistical analyses based on aggregated individual data (e.g. repeated-measures. The present study tested an alternative approach: utilizing machine-learning powered automated facial action analysis, continuous facial variations were recorded and classified into facial action metrics. The resulting longitudinal data were analyzed with multilevel regression analysis, considering the variability of individual trajectories. One hundred and thirty-two individuals (M = 21.58 years, SD = 2.93; 53 women) followed an incremental cycle ergometer protocol until volitional exhaustion, while their faces were video-recorded. Thirty-four facial landmarks were continuously monitored and an algorithm (iMotions Affindex) applied a set of rules based on psychological theories and statistical procedures. In addition, affective valence (Feeling Scale) and perceived exertion (RPE) were verbally reported every two minutes. The intraclass correlation showed that 33% of the variance in affective valence was due to inter-individual variability. Observed facial actions were indicative of reported feelings. Jaw drop was uniquely associated with RPE (b = 0.02, p < .01), whereas nose wrinkle was uniquely associated with affective valence (b = −0.09, p < .01). Mouth open was associated with both RPE (b = 0.03, p < .01) and affective valence (b = −0.02, p < .01). These findings underline the importance of considering individual differences in exercise response trajectories and demonstrate that reported feeling states covary with unique facial actions that occur during exercise. Taken together, this study provides evidence and further statistical approaches to support future research endeavors to examine exercise-affect by recording facial actions, which also entails practical implications by providing observable facial variations to monitor the affective state of exercisers without interrupting the person’s experience.

Physical Activity, Chronic Pain and Subjective Wellbeing Among Individuals with Spinal Cord Injury: A Systematic Scoping Review

Kendra Todd; Sarah Lawrason; Robert Shaw; Derrick Wirtz; Kathleen Martin Ginis, University of British Columbia

Introduction: Individuals with spinal cord injury (SCI) experience higher levels of chronic pain, and poorer subjective wellbeing (SWB) compared with able-bodied individuals. Research has demonstrated that leisure-time physical activity (LTPA) participation may lead to changes in chronic pain and SWB for persons with SCI. However, the characteristics of LTPA (i.e., frequency, intensity, time, and type) required to elicit positive changes are not yet known. The objective of this scoping review was to systematically catalogue extant studies that evaluated the effect of LTPA on chronic pain and SWB for persons with SCI. Methods: MEDLINE, EMBASE, PsyCINFO, CINAHL, Web of Science, and SportDiscus were searched for articles that investigated the effects of LTPA on chronic pain and SWB for persons with SCI. A total of 3494 articles were screened by two independent coders. Sixteen published articles, consisting of 12 original studies, met the review inclusion criteria. Results: Four different patterns of findings emerged regarding changes in chronic pain and SWB outcomes. The majority of articles (n = 12) reported decreased chronic pain, and improved SWB following LTPA. LTPA characteristics varied greatly, although exercise was the most commonly prescribed type of LTPA (n = 12). Only three articles categorized pain according to the International SCI Pain Classification tool. Conclusions: Most reviewed studies reported that LTPA may reduce chronic pain, and improve SWB for persons with SCI. The results of this review could inform future research targeting the development of non-pharmaceutical treatments for chronic pain and SWB among persons with SCI. Further research is needed to identify mechanisms that explain the effects of LTPA on chronic pain and SWB among persons with SCI, in order to determine specific characteristics of LTPA that may lead to the greatest improvements in these constructs. Funding source: Social Sciences and Humanities Research Council; Work Safe BC.

Burnout in Youth Competitive Swimmers: Evidence for the Influence of Athletic Competence and Athletic Identity on Youth Athlete Burnout

Myriam Tremblay, University of Calgary/University of British Columbia; David Paskevich, University of Calgary

The purpose of this cross-sectional study was to determine how athletic identity and competence are related to burnout symptoms in youth competitive swimmers. Most of the research knowledge surrounding burnout relies on older adolescent and adult populations; however, little research evidence exists for how burnout manifests in youth athletes younger than 14 years of age. Competitive youth swimmers aged 10–14 (N = 104) from two high performance swim clubs in Canada were recruited via convenience sampling with 65 youth participants partaking in this study. Participants completed three questionnaires, the Athlete
Burnout Questionnaire (ABQ), Athletic Identity Measurement Scale (AIMS) and the Self-Perception Profile for Children and/or the Self-Perception Profile for Adolescents (dependent on participant age). Hierarchical multiple regression analysis revealed statistically significant relationships between the burnout dimensions of reduced sense of accomplishment ($\beta = -0.374$) and sport devaluation ($\beta = -0.327$) with athletic competence when controlling for the covariate variables of age, sex and experience. A similar relationship was found between reduced sense of accomplishment with the self-identity subscale of AIMS ($\beta = 0.297$) and sport devaluation with the exclusivity subscale of AIMS ($\beta = 0.333$) also when controlling for the covariate variables of age, sex, and experience. No statistically significant differences between sex and burnout, athletic competence and athletic identity were observed. The results of this study support the previous literature surrounding youth athlete burnout and adds to the breadth of evidence for youth athlete burnout. This study suggests that athletic competence is related to a lower prevalence of burnout while athletic identity is associated with higher levels of burnout symptoms in youth competitive swimmers. The results of this study are of particular importance as very little previous research has investigated the relationship between youth athlete burnout and athletic identity and athletic competence in a Canadian cohort.

The Physical Activity Intention-Behavior Gap: Do Perceived Behavioral Control and Social Ecological Barriers Play a Moderating Effect?
Joan Úbeda-Colomer, The University of British Columbia; José Devis-Devis, Universitat de València; Kathleen Martin Ginis, The University of British Columbia

Introduction: Although intention has been widely demonstrated to predict physical activity (PA) behavior, the intention-PA association is generally weak. This lack of correspondence has been called the ‘intention-behavior gap’ and suggests that other external factors influence PA engagement. Such external influences could be especially relevant for people with disabilities, since this population experiences a wide range of social and environmental barriers to PA. Purpose: The aim of the present project is to explore whether perceived behavioral control (PBC) and social ecological barriers (SEB) moderate the association between intention and moderate-to-vigorous physical activity (MVPA) in university students with physical disabilities ($N = 662$). Method: Participants completed self-administered measures of intention, PBC and SEB. A multiple regression model was tested in two steps to predict MVPA. Intention, PBC and SEB were introduced in Step 1 as independent variables, while the intention $\times$ PBC and the intention $\times$ SEB interactions were introduced in Step 2. Results: Although students reported a high intention to exercise ($M = 5.13$ out of 7, $SD = 1.98$), 62.5% were not meeting the minimum recommendations of 600 MET-min/week of MVPA. In Step 1, lower intention to exercise ($\beta = 116.51, p = 0.01$), lower PBC ($\beta = 249.73, p < 0.01$) and greater SEB ($\beta = -268.55, p < 0.01$) were associated with lower MVPA. In Step 2, PBC ($\beta = 89.52, p < 0.01$) and SEB ($\beta = -87.34, p = 0.04$) moderated the association between intention and MVPA, while main effects were not significant. The intention-behavior relationship was strongest for students reporting high PBC and low SEB, and weakest for those with low PBC and high SEB. Conclusions: Intention is necessary but not sufficient for university students with physical disabilities to engage in MVPA, since PBC and SEB play a significant moderating role. PA-enhancing interventions among this population would benefit from bridging the intention-behavior gap by increasing PBC and minimizing SEB.

State Mindfulness Scale for Physical Activity 2: Expanded Acceptance Content
Sarah Ullrich-French; Anne Cox; Christopher Huong, Washington State University

The State Mindfulness Scale for Physical Activity (SMS-PA) assesses state experiences of being mindful during physical activity. Qualities of awareness, attention, and openness to the physical experience and the psychological experience are captured with 12 items. The scale is best supported by a bi-factor structure of either a general state mindfulness score or two independent scores of mindfulness of mind and body. Initial evidence showed that mindfulness positively associates with state intrinsic motivation/engagement, health and mood reasons to exercise, intrinsic motivation for physical activity, and negatively associates with body surveillance. However, the mindfulness qualities of acceptance, non-judgement, and non-reactivity are not well captured in the SMS-PA. Acceptance may be a particularly powerful mechanism that explains the positive effects of mindfulness. Therefore, the purpose of this study was to expand the SMS-PA to include acceptance and non-judgment items. A panel of researchers created an item pool to capture acceptance, non-judgement, and non-reactivity. Young adults who just participated a fitness class completed a brief survey including the SMS-PA with the additional items, core affect, remembered and forecasted affect, state body appreciation, state body surveillance, state anxiety, and intrinsic motivation for exercise and trait mindfulness. Exploratory factor analysis on the original SMS-PA items and new items was used with a random split of half the sample. A four-factor solution was supported. The second half of the sample was used to test the four-factor structure with a confirmatory factory analysis. The model fit was acceptable (CFI = .97, TLI = .96; RMSEA = .09) and all items loaded significantly ($p < .001$) on hypothesized factors. Awareness of physical and acceptance of physical and mental experience associated ($p < .01$) positively with affect variables, state and trait intrinsic motivation, body appreciation, and trait mindfulness and negatively with state anxiety and body surveillance. Initial evidence supports SMS-PA2 use.

The Impact of Cognitive Fatigue on Motivation to Exert Physical Effort
Sven van As, Radboud University; Debby Beckers, Radboud University; Harm Veling, Radboud University; Sabine Geurts, Radboud University; Masud Husain, University of Oxford

In the last decade, multiple studies have shown a negative impact of cognitive fatigue on physical performance. However, the precise mechanisms through which this effect occurs remain unclear. Multiple well-established theories assume that cognitive fatigue is accompanied by a reduced willingness to exert effort. Despite its strong theoretical foundations, this motivational account has never been thoroughly tested. Supported by recent theorizing, we expected that cognitive fatigue causes an increased weighting of effort-costs, resulting in a reduced willingness to exert physical effort. In the current experimental study, an effort-based decision paradigm was employed to test these assumptions. Following a counterbalanced cross-over design, participants visited the lab on three occasions. Lab visits were separated by 48 hours and scheduled on the exact same time of day. On each visit, participants underwent one of the three experimental manipulations, which either induced cognitive fatigue (i.e., 2-back task), physical fatigue (i.e., handgrip exercise), or served as control condition (i.e., documentary watching). Following the manipulations, participants performed an effort-based decision task in which they decided for 125 offers whether they were willing to exert the required level of physical effort to obtain a specific reward. Required physical effort levels were operationalized as percentage of maximum voluntary contraction of the hand while rewards were represented as apples to be gathered. Initial multi-level analyses of 20 participants suggest that physical-, but not cognitive fatigue, causes an increased weighting of physical effort-costs. These findings imply that instead of motivational changes, alternative processes might explain the impact of cognitive fatigue on physical performance. The study is currently being replicated and extended.
Findings of both studies will provide important insights into the mechanism through which cognitive fatigue affects physical performance.

Understanding Exercise-Related Barriers, Facilitators, and Needs of Hard to Reach Female Cancer Survivors

Madison Vani; Catherine Sabiston; Jenna Smith-Turchyn, University of Toronto

Despite the reported benefits of exercise for cancer survivors, less than 30% of cancer survivors engage in regular exercise. Due to low participation rates, researchers have examined exercise barriers and describe physical side effects and a lack of knowledge as the main barriers to exercise participation. These barriers are likely intensified for cancer survivors who are part of hard to reach groups, yet there remains a paucity of information assessing barriers for cancer survivors who are young adults (18–39 years of age), are living in rural or remote communities, or are living in areas of low socioeconomic status. The purpose of this study was to explore the barriers, facilitators, and exercise needs of hard to reach female cancer survivors. Hard to reach female cancer survivors (N = 24; Mage = 48.7 years) participated in semi-structured interviews. The interviews were audio-recorded and transcribed verbatim. Two researchers independently coded the transcripts and the coded data was aggregated into nodes and grouped into meaningful units based on identified patterns. Based on the descriptive analysis, five categories were created. Hard to reach female cancer survivors described a lack of accessible (e.g., location, cost) and appropriate (e.g., age-appropriate, cancer-specific) exercise programs in their communities. A lack of support, personal factors (e.g., physical and psychological side effects), and a lack of detailed exercise information were also reported as barriers. Hard to reach cancer survivors suggested strategies to overcome barriers and facilitate exercise engagement. For example, they identified a need for varied programming formats (e.g., online, individualized, flexible timing, no-cost) and clear and accessible survivor-specific exercise information. The present findings highlight a need for the development of accessible and appropriate exercise programming for all cancer survivors. The development of these exercise programs can help improve and maintain exercise engagement for hard to reach female cancer survivors. Funding source: Canadian Institute of Health Research (CIHR) Fellowship.

International Adaptation and Scale-Up of a Sports-Based Mental Health Program: Ahead of the Game

Stewart Vella, University of Wollongong; Owen Brigstock-Barron, November; Jason Heard, November; Tracy Herd, November; Shannon Nix, November; Barbara Snelgrove, November; Christian Swann, Southern Cross University

Ahead of the Game is a multi-component sports-based program aimed at promoting early intervention, help-seeking, and resilience among adolescent males. The Ahead of the Game program is comprised of four distinct components and a club-based messaging campaign. For adolescent males, two components target: 1) mental health literacy, intentions to seek and provide help, and 2) resilience. A mental health literacy program for parents, and a coach education program to assist in supporting athletes’ psychological needs are also included. A large controlled trial showed that the program led to increases in depression and anxiety literacy, intentions to seek help from formal sources, resilience, and wellbeing. This presentation will report on the international adaptation and scale up of the Ahead of the Game program from Australia to Canada and the UK. Formative research which included 10 focus groups of various stakeholders (i.e., athletes, parents, and coaches) and extensive user experience testing were utilized to tailor the program for international markets, and were also used to inform content modifications. Pre-post designs were used to assess the effectiveness of pilot programs and screen for any potential negative outcomes. One-on-one interviews were used with key implementation partners (e.g., program managers and deliverers) to assess the barriers and facilitators to implementation. Overall, human- and data-driven opportunities were taken to tailor the program to local contexts thereby making it engaging and relatable for participants in each market. Using a human centered design approach, we were able to implement these adaptations with minimal changes to program content. The international versions of the program appeared to be comparably effective to the original program. Implementation was difficult, with implementation problems consistent across Australia, Canada, and the UK. In conclusion, widespread adaptation and scale-up of mental health programs in non-elite sports is feasible. Particular attention should be paid to tailoring and implementation. Funding source: Movember.

The Relationship Between Pupils’ Psychological Factors and Mark In Physical Education

Ruben Vist Hagen; Monika Haga; Håvard Lorås; Hermundur Sigmundsson, Norwegian University of Science and Technology

The aim of this study was to explore the relationship between psychological factors and mark in physical education. Two-hundred pupils (89 boys, 111 girls) from lower secondary school, aged between 12–16 years old, participated by answering previously validated questionnaires addressing psychological variables such as grit, mindset, self-perception, situational motivation, and gender at one time point. Marks where collected at the end of school year. The results of this study showed a weak to moderate correlation between several of the variables to that of mark. Our main analysis found that the regression model explained about one third of the variance in mark, and that the self-perception domains scholastic competence, athletic competence and physical appearance acted as unique predictors. No gender differences were found. Overall, the results highlight the importance of positive self-perceptions in several domains in relation to mark in PE, and may help provide guidance for teachers on what individual characteristics they should help foster and develop for pupils’ achievement. Funding source: Employed as a Doctoral research fellow at the Norwegian University of Science and Technology, Department of Teacher Education.

Military Veterans’ Experiences of a Social Identity Informed Sport Program

Katrina J. Waldhauser; Mark R. Beauchamp, University of British Columbia

On completion of active service, military veterans are at increased risk of mental health deficits that include heightened levels of depression, combat-related PTSD, as well as suicide. Veterans who transition out of the military often face substantive challenges during their move to civilian life, which include identifying appropriate opportunities for employment, supporting their respective families, and developing high-quality social connections within their civilian lives more generally. The importance of social connectivity, in particular, has recently been highlighted as an important mechanism that can facilitate improved mental health and quality of life among veterans, and represents a viable target for intervention. The purpose of the study was to examine military veterans’ experiences of Purpose After Service through Sport (PASS) which is a sport-based program underpinned by the tenets of social identity theory. We recruited 11 participants (Mage = 38.72, SD = 7.46; Myears of service = 13.95, SD = 8.03), and using semi-structured interviews and thematic analysis, we identified several aspects of the program that participants...
experienced and considered important. These included a sense of shared (military) identity, physical and mental health benefits, as well as increased awareness of opportunities (e.g., employment, education/training, and veterans services). Participants also commented on salient structural features of the program that supported their involvement, as well as suggestions for program refinement. The study provides evidence for the feasibility and acceptability of the PASS program as well as insight into veterans’ experiences of this initiative. Future research should examine the efficacy/effectiveness of the PASS program to support effective transitions and quality of life outcomes among military veterans using causal (e.g., randomized trial) research designs. Funding source: Social Sciences and Humanities Research Council – Explore Grant.

Understanding How Central Nodes Establish Positions of Influence in Coach Social Networks

Lauren Walker, Elon University

Coaches serve as a critical stakeholder in ensuring positive performance and psychosocial outcomes in sport. As such, understanding how they adopt coaching knowledge, attitudes and behaviors is critical. One area that has been understudied is peer-to-peer social networks and how these networks shape the spread of coaching knowledge and behavior (Walker, Thomas, & Driska, 2018). Due to this scarcity of research, a mixed method study was conducted to: (a) map the structure of advice-giving social networks in two USA Swimming regional networks (LSCs), (b) clarify the types of information shared, and (c) understand how the most central members of these networks established their influence. This third purpose, understanding central nodes influence, was approached using semi-structured interviews with ten coaches: the most influential member of each LSC, and several members of their network (both staff and non-staff) who cited them as a good source of coaching knowledge. Interviews were analyzed using a hierarchical content analysis to identify and organize lower and higher-level themes from the data. Results reflected three higher-order themes of “influence:” 1) region-specific and overall coaching experience, 2) personal characteristics attributed to the central node, and 3) tangible actions that contributed to the credibility of their knowledge. Lower-order themes of interest included: the importance of approachability (i.e., being friendly, agreeable, honest/direct, not being protective of knowledge), being a life-long learner, and building reciprocal relationships, which may make social network relationships distinctive from more formalized mentor relationships. Lower order themes reflected a high congruity between what “advice-seeking” coaches and central node coaches felt contributed to establishing a central role in this knowledge-seeking network. This knowledge can help researchers and NGBs to identify these influential leaders in the coaching community, engaging them more meaningfully in the spread of quality knowledge that improves awareness of opportunities (e.g., employment, education/training, and veterans services). Participants also commented on salient structural features of the program that supported their involvement, as well as suggestions for program refinement. The study provides evidence for the feasibility and acceptability of the PASS program as well as insight into veterans’ experiences of this initiative. Future research should examine the efficacy/effectiveness of the PASS program to support effective transitions and quality of life outcomes among military veterans using causal (e.g., randomized trial) research designs. Funding source: Social Sciences and Humanities Research Council – Explore Grant.

Effects of Acute Exercise Volume on Meta-Cognition in Middle-Aged and Older Adults

Chun-Chih Wang, National Taiwan University; Chien-Heng Chu, National Taiwan Normal University; Jing-Yi Ai, National Taiwan Normal University; Kao-Teng Yang, National Taiwan Sport University; Yu-Kai Chang, National Taiwan Normal University

The world’s aged population is rapidly growing. The majority of the aging population experiences gradually the effects of cognitive decline and brain decay. Aging-related cognitive decline can be prevented or delayed by exercise in older adults. While the positive effects of acute exercise on certain aspects of cognitive function have been identified, the effects of such improvements on meta-cognition is still unclear. In addition, the FITT-VP principle that was proposed by the ACSM is worth considering, relative to concerns about establishing exercise prescriptions, and components of intensity, duration, and volume are required for assessing the effects of acute exercise programs, specifically. The purpose of the present study was to examine the effects of acute exercise on meta-cognition from an exercise volume perspective. Thirty healthy, middle-aged and older adults were recruited. Participants were instructed to complete four treatment sessions on separate days in a counterbalanced order, including (a) reading control, (b) vigorous intensity for 16 minutes, (c) moderate intensity for 30 minutes, and (d) low intensity for 40 minutes. Tower of London test was performed after each treatment. The results revealed that the total correct scores, total move scores, planning-solving times, total execution times, and time violation scores improved across all exercise conditions, relative to those of the control condition. No differences in the total initial times and rule violation scores were found among the four conditions. Our findings suggest that the positive effects of acute aerobic exercise on multiple aspects of executive functions were ascertained by a Tower of London test in middle-aged and older adults. The cognitive benefits from the acute exercise that involves different intensities and durations are similar, given that the volume of the exercise is maintained. More research regarding the relationships between acute exercise volume and various types of conditions, and the mechanisms of the exercise volume on cognitive functions, are encouraged.

Motivation and Behavior of Parental Involvement in Competitive Sports: Moderating Effects of Perceived Stress

Ting Wen Wang, Feng Chia University

The purpose of this study was to examine the moderating effects of perceived stress on the motivation and behavior of parental involvement. Participants were parents who regularly participated in the athletic curriculum of their children, including 218 fathers and 422 mothers (Mage = 42.01; SD = 4.74). We used the regression analysis to test the moderating effect, the results showed that the motivation of parental involvement and perceived stress could explain 29% of parental involvement behavior, F(6, 631) = 43.56, p < .001. After controlling the main effect, parental involvement motivation and perceived stress can increase by 3% on parental involvement behavior, F (5, 626) = 5.40, p < .001. It shows that parental perceived stress has a moderating effect on the parental involvement motivation and behavior. Further analysis of the five dimensions of parental involvement motivation showed: “Pursuing Remuneration × Perceptual Stress”, “Self-verification × Perceptual Stress” and “Sports Achievement Expectation × Perceptual Stress” has a significant effect for parental involvement behavior. On the other hand, the “Untrusted psychology × Perceptual Stress” and “Sports value × Perceptual Stress” has no significant effect for parental involvement behavior. The conclusions and future recommendations based on the findings were as follows: (a) parents are advised to find effective ways to relieve pressure in their children’s sports participation; (b) give children and coaches more space and trust in their training; (c) do not place expectations of performance on children in competitive sports; (d) keep normal expectations for children’s athletic performance. Let children grow up in the best competitive sports environment and obtain a positive development on their physical, psychological and social levels. Funding source: Ministry of Science and Technology, R.O.C.
Coaches’ Impact on Youth Athletes’ Intentions to Continue Sport Participation: The Mediational Influence of the Coach-Athlete Relationship

Meredith Wekesser, Michigan State University; Brandonn Harris, Georgia Southern University; Jody Langdon, Georgia Southern University; Charles Wilson Jr., Georgia Southern University

About 70% of youth athletes drop out of sport by age 13. Self-Determination Theory has been utilized to investigate athletes’ motivations for behaviors including sport persistence (i.e., continuation) and suggests that the coach can be an influence on such motivations. Basic need fulfillment via interpersonal coaching behaviors, the coach-athlete relationship (CAR), and intentions to continue sport participation have been examined independently and in various combinations and directions, but these variables have not been examined collectively in this manner. The purpose of this study was to determine if CAR quality mediates the relationship between interpersonal coaching behaviors and intentions to continue sport participation. Surveys were administered to 148 athletes, ages 11 to 16, from organized sports teams. No significant indirect effects of mediation could be established. Significant positive relationships were found among supportive coach behaviors and CAR quality as well as CAR quality and intentions. Negative relationships were demonstrated among thwarting coach behaviors and CAR quality. A significant linear regression was found that predicted intentions based on competence-supportive coaching behaviors ($F(1,146) = 18.855, p < .001, \text{adjusted } R^2 = .108$). Results support that coaches’ competence-supportive behaviors can positively impact CAR quality and intentions to continue sport participation in youth athletes.

Examining Optimal Predictability as a Candidate Basic Psychological Need in the Context of Exercise

Colin M. Wierts; Edward Kroc; Mark R. Beauchamp, University of British Columbia

Studying the three psychological needs (competence, autonomy, and relatedness) within Self-Determination Theory (SDT; Ryan & Deci, 2017) has played an important role in understanding exercise related well-being. In recent years, there have been calls to examine other candidate psychological needs, beyond those subsumed within SDT (Sheldon, 2011). Dweck (2017), for example, proposed that optimal predictability – the need to understand and predict events in one’s world – is one such basic psychological need. In this study, we examined whether optimal predictability prospectively explains unique variance in well-being, when considered alongside the three psychological needs conceptualized within SDT, in the context of exercise. The need for optimal predictability was assessed by asking participants to predict positive affective and health outcomes that may result if they were to exercise the following day. A convenience sample of community adults ($N = 252$; $M_{age} = 30.96$ years; $65.10\%$ female) completed online questionnaires of their need satisfaction at baseline, and exercise related well-being (subjective vitality, positive affect, and negative affect) four weeks later. Three separate regression analyses were conducted for each well-being variable, with the five predictors (prediction of affect, affect, prediction of health, three SDT needs) included in each regression model. Participants’ prediction of affective outcomes ($\beta = .29, p < .01$) and competence ($\beta = .18, p < .05$) were prospectively associated with subjective vitality. Participants’ prediction of positive affective outcomes ($\beta = .45, p < .01$) was the only significant prospective correlate of positive affect. Finally, autonomy ($\beta = -.17, p < .05$) was the only significant negative prospective correlate of negative affect. The results of this study suggest that participants’ prediction of positive affective outcomes during exercise is prospectively related to measures of exercise-related well-being (subjective vitality, positive affect) above and beyond that of the three psychological needs subsumed within SDT. Funding source: Social Sciences and Humanities Research Council of Canada (SSHRC) – CGS Doctoral Award.

Parent-Initiated Motivational Climate and Young Child Enjoyment in Year-Round Swimming

Rachel Williams, East Carolina University; Dlugonski Deirdre, University of Kentucky; Christine Habeeb, East Carolina University; Thomas Raedeke, East Carolina University; Katrina DuBose, East Carolina University

Many factors potentially influence a young athlete’s sport enjoyment (Mollerlokken, Loras, & Pedersen, 2017). Social agents, such as parents, explain a large part of the variance in youth sport experiences (Chan, Lonsdale, & Fung, 2012). While research suggests the environment created by parents impacts athlete sport experiences (Curran, Hill, Hall, & Jowett, 2013), it is unknown if this is true for young children in the early stages of sport participation (5–12 years of age). The purposes of this study were to: 1) to determine the reasons parents enroll their children in year-round competitive swimming, and 2) to examine the relationship between parent-initiated (PI) motivational climate and child’s swim enjoyment. Thirty parent-child dyads were recruited from registered USA Swimming club teams. Parents completed questionnaires to measure child swim history, parent motives for year-round swim team enrollment, and PI motivational climate. Children completed a questionnaire assessing swim team enjoyment and commitment. Overall, the primary reason parents enrolled their child in year-round swimming is for fitness benefits. Both a PI learning climate ($r = .41$, $p < .01$) and success-without-effort performance climate ($r = .36$, $p < .05$) were positively associated with child enjoyment. A PI was positively associated with child enjoyment. A PI learning mastery climate was positively associated with the following year-round swimming enrollment motives: fitness ($r = .32$, $p < .05$), skill/mastery ($r = .46$, $p < .01$), fun/excitement ($r = .44$, $p < .01$). A PI success-without-effort performance climate was negatively associated with enrolling a child because of fun/excitement ($r = -.33$, $p < .05$) and positively associated with ego/competitiveness ($r = .33$, $p < .05$). In summary, the main reason parents enroll their child in year-round swimming is for the fitness benefits of the activity. Further, a PI motivational climate can predict young-child enjoyment in year-round swimming participation.

I Know You Think I Can: Examining the Tripartite View of Efficacy in Parent and Child Dyads

Kathleen S. Wilson; Nikki Saberi, California State University, Fullerton

Self-efficacy has been identified as one of the key correlates of physical activity behavior in both adults and children. The tripartite model of efficacy (Lent & Lopez, 2002) has been examined in a variety of physical activity contexts including coach-athlete, therapist-client, teacher-student, and athlete-athlete. Parents have been identified as playing a key role in their child’s physical activity behavior. However, the relational efficacies within the parent-child relationship have received less attention in the literature. The purpose of this study was to explore the associations between children’s self-efficacy with relational-inferred self-efficacy perceptions (RISE beliefs), parents’ belief in their child (other efficacy) and parental support. Parent-child dyads ($N = 26$) completed a background questionnaire that was part of a larger study. Children aged 8–12 years old ($M_{age} = 9.9$ years; $65\%$ female) completed a measure of self-efficacy (confidence in their own ability to be active), RISE beliefs (belief in the level of confidence that their parent has in them) and parental support. Parents (92% mothers) completed a measure of other efficacy (confidence
in child’s ability to be active). Correlations and regression analyses were performed. In one multiple regression, child’s self-efficacy was related to their own RISE beliefs and other efficacy (parents’ belief in child). A second regression was performed predicting RISE beliefs with other efficacy and parental support. Child’s self-efficacy ($R^2 = .48$, $p = .001$) was only related to RISE beliefs ($b = .046, p < .001$). RISE beliefs ($R^2 = .11$ $p = .270$) were not related to other efficacy or parental support. These findings support the tripartite model in that there was a relationship between children’s self-efficacy and RISE beliefs. As this study may have lacked power to detect factors related to RISE beliefs, future research should continue to examine factors that relate children’s beliefs of their parents’ confidence in themselves given its relationship with children’s self-efficacy.

Examining the Relationship Between Age and Self-Reported Capabilities for Self-Regulated Learning During Practice in Competitive Junior Athletes

Stuart G. Wilson, University of Ottawa; Bradley W. Young, University of Ottawa; Lindsay McCardle, University of Ottawa & York University; Sharleen Hoar, Canadian Sport Institute Pacific; Joseph Baker, York University

Self-regulated learning (SRL) in sport involves metacognitive and motivational regulation in the pursuit of enhanced practice effectiveness (McCardle, Young, & Baker, 2017). Self-reported SRL capabilities are associated with skill level among senior athletes, but findings have been mixed among juniors (McCardle, Young, & Baker, 2018). While age has been identified as a significant predictor of SRL in education research (Zimmerman & Martinez-Pons, 1990), it has not been specifically addressed in sport. This study examined the relationship between SRL scores and age among competitive junior athletes. Responses for the Self-Regulated Learning for Sport Practice survey (SRL-SP; McCardle et al., 2018) were collected from a mixed sport sample of 138 North American athletes, aged 13–17 ($M = 15.09$, $SD = 1.38$). The sample was mostly female (69%), identified primarily as team sport athletes (72%), and ranged in skill level from city/regional up to international competition. Separate initial correlations between age and each of the five SRL subscales (i.e., planning, checking, evaluating/reflecting, self-efficacy for challenge, and effort) were non-significant (all $rs < .11$; all $ps > .21$), except for evaluating/reflecting ($r = .18$; $p = .04$). SRL scores showed consistent trends, but non-significant (all $ps > .07$) differences by sex. Using SPSS PROCESS macro, the effect of age on SRL score was separately examined for each of the five SRL-SP subscales, as moderated by sex, after controlling for skill level. Age did not predict SRL score on any of the subscales (all $ps > .54$) after controlling for skill and considering the influence of sex. Further, none of the age by sex interactions were significant (all $ps > .64$). Based on this sample, there is no reason to suggest distinguishing by age and sex when examining SRL capabilities among teenage athletes. Our results contrast with existing literature on age and sex differences, and we discuss possible contextual, measurement and methodological explanations for the discrepancy. Funding source: This research was supported by Insight Grants from the Social Sciences and Humanities Research Council of Canada.

“Parents’ Perspectives on Child Youth Development Within the Junior Lifeguard Program”

Danielle Wong; Megan Babkes Stellino, University of Northern Colorado

Youth sport and physical activity participation can provide benefits to the children involved. Youth sport programs are designed to make a connection between skill development and attitudes (Petitpas, Cornelius, Raalte & Jones, 2005). Parents support their children’s engagement in specific activities because they potentially provide a salient context for their children to develop essential, transferable skills (Dunn, Kinney & Hofferth, 2003). The Junior Lifeguard Program is a nationwide youth program that aims to expand outreach and ocean safety education to children and by association, to their families. Junior lifeguards learn how to interpret the dynamic ocean currents, properly administer First Aid and Cardiopulmonary Resuscitation (CPR), and perform physical tasks including buoy swims and simulated rescues. Though the Junior Lifeguard Programs seem to yield benefits for participants, little research has been done to investigate parents’ understanding of the program and why they promote their children’s participation. Fifteen parents ($n = 15$; 93% mothers) of youth ($n = 29$; 37.9% female; 44.8% male; 17.2% gender not noted) participated in a mixed methods, preliminary study. The survey gathered information about their values associated with their children’s participation in the program. The open-ended items assessed parent perceptions of the program. Parents felt 93.9% of the program’s curriculum benefited their children’s mental and physical development; 88.1% of parents believed the program provided multiple opportunities for their child to learn ocean safety; and 100% reported being ‘proud’ Junior Lifeguard parents. Open-ended responses indicated parents were supportive of their children’s participation in the program. Results are discussed in relation to the positive youth development and sport parent socialization literature. These preliminary findings further encourage systematic continuation of this line of research to help understand, develop, and increase accessibility for similar programs, and decrease the number of annual drownings in coastal regions. Funding source: United States Lifesaving Association.

Differential Effects of Psychological Skills Training on How Athletes Cope with Stressful Competitive Situations, Evidenced by Frontal EEG Asymmetry

Minjung Woo, University of Ulsan

The mechanism by which different types of psychological skills training (cognitive and physiological training) affects the psychological and motivational systems of athletes in stressful competitive situations was examined using a neurophysiological approach. Thirty-one college soccer players (20.06 ± 1.31 years old) were randomly divided into a physiological training group (8), cognitive training group (8), and control group (15). A psychological skills training program of three group training sessions and three individual counseling sessions for six weeks was conducted. The physiological training included self-discovery, relaxation, exploring chief complaint, relaxation training, and practical application. The cognitive training comprised cognitive restructuring, self-talk, cognitive self-discovery, rational belief system, and application of self-talk. The Frontal EEG Asymmetry Score (FAS) was calculated to examine the effectiveness of the training. The participants’ psychological states and brain activity were measured in stress conditions; pre-post values were compared. The groups exhibited no pre-post differences in intrinsic motivation, athletic coping skills, and sports anxiety at rest. However, anxiety and stress measured in the stress conditions decreased after the training in both training groups; no difference was observed in the control group. Analysis of frontal asymmetry revealed the FAS of the physiological training group decreased in the negative (−) direction, while that of the cognitive training group increased in the positive (+) direction after training. While physiological training appears to induce the withdrawal motivation system so as to avoid stressful situations, cognitive training employs a more active approach by reducing withdrawal motivation. Funding source: This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2016S1A5A8019015).
The Impact of Gender on Athlete Burnout and Associated Factors in Men and Women Playing Gaelic Games
Siobhan Woods; Simon Dunne; Pamela Gallagher, Dublin City University

A recent review of the literature on athlete burnout in team-sports found that female athletes are substantially under-represented. As such, we have a limited understanding of female team-sport athletes’ experience of burnout and associated factors. The aim of this research was to explore the impact of gender on burnout and associated factors in Gaelic games players. Gaelic games are traditional Irish team-sports, which are played across the globe at different levels, often with significant demands on players. Data were collected via an online questionnaire, including demographic questions, the Athlete Burnout Questionnaire, Perceived Stress Scale, Sport Commitment Questionnaire, and Perceived Motivational Climate in Sport Questionnaire (PMCSQ). Any adult Gaelic games player was eligible for participation. Players were recruited via social media and email contact with clubs. The questionnaire was completed by 370 players; 178 males and 192 females. No significant differences were found between male and female athletes on burnout dimensions [physical/emotional exhaustion (PEE), reduced sense of accomplishment, sport devaluation], PMCSQ, number of hours committed to sport or teams represented. However, female athletes reported significantly higher scores on stress (M = 29.58, SD = 0.48), perceived loss of investment (Md = 4.0) and informational social support (Md = 3.8) than males (M = 27.49, SD = 6.66; Md = 3.8; Md = 3.6). 84% of females felt their gender impacted their playing experience; 94% reported a negative impact. 15.7% of male players felt their gender impacted their playing experience; 96% reported a positive impact. Players who reported a gender impact scored significantly higher on PEE. These results suggest that, while male and female Gaelic games players face similar demands, female players experience greater stress, and feel their gender negatively impacts their sporting experience. The findings highlight the importance of female representation in burnout research, while also pointing to a need to address the inequity of support across male and female games. Funding source: This research is funded by Dublin City University School of Nursing and Human Sciences Supervision Enhancement Fund.

Comparing the Impact of Multiple Factors Across the Three Dimensions of Athlete Burnout
Siobhan Woods; Simon Dunne; Pamela Gallagher, Dublin City University

Athlete burnout is a multi-dimensional syndrome encompassing physical and emotional exhaustion (PEE), reduced sense of accomplishment (RSA) and sport devaluation (SD). Although burnout has been linked to a number of different variables, limited research exists comparing the impact of variables across the burnout dimensions. The aim of this study was to examine burnout in Gaelic games players, and to compare the impact of a range of variables on PEE, RSA and SD. Data were collected via an online questionnaire, including demographic variables (DVs), the Athlete Burnout Questionnaire, Perceived Stress Scale (PSS), Sport Motivation Scale (SMS), Sport Commitment Questionnaire (SCQ), and Perceived Motivational Climate (PMC) in Sport Questionnaire. Any adult Gaelic games player was eligible for participation. Players were recruited via social media and email contact with clubs. The questionnaire was completed by 370 players. Regression analyses revealed that SCQ variables constrained commitment, other priorities and quantity of perceived investments (24.3%) accounted for the most variance in PEE, followed by stress (18.4%), amotivation (16.3%), DVs (12.1%), and PMC (11.9%). In contrast, amotivation (39.5%) accounted for the most variance in RSA scores, followed by a range of SCQ variables (enjoyment, valuable opportunities, social support, enthusiastic commitment, constrained commitment, other priorities; 38.6%), PMC (22.3%), stress (10.3%), and DVs (9%). Finally, SCQ variables, enjoyment, desire to excel, enthusiastic commitment, constrained commitment and other priorities (66%), also accounted for the most variance in SD, followed by intrinsic and extrinsic regulation (61.8%), PMC (29.5%), DVs (10.5%), and stress (7%). These results demonstrate that key burnout correlates have a differential impact on the burnout dimensions, thus highlighting the importance of taking a multi-dimensional approach in the assessment of athlete burnout. Identifying the most influential variables for each dimension can allow us to develop targeted intervention and prevention plans. Funding source: This research is funded by the Dublin City University School of Nursing and Human Sciences Supervision Enhancement Fund.

Running to Quit? Exploring Predictors of Attendance in an Exercise and Smoking Cessation Intervention
Kelly Wunderlich; Carly Priebe; Mark Beauchamp; Gay Faulkner, University of British Columbia

Run to Quit (RTQ) is a national smoking cessation and learn to run program with promising cessation and physical activity outcomes. However, attrition was high with only 41.1% of participants completing the program. Determining predictors of attendance could help to improve attendance and program effectiveness in future iterations. Given that the program was offered in a group setting, the purposes of this study were to explore predictors of attendance, and examine whether including group-related variables added to the prediction of attendance beyond individual variables. Blocked multiple regression analysis was used, with mean substitution for missing data (n = 335). Individual predictors included age (middle aged vs. younger adults; older adults vs. younger adults), gender, home ownership, quit self-efficacy, week 1 nicotine dependence (FTND) and MVPA. Group-level predictors included cohesion subscales (attraction to group-task, attraction to group-social (ATG-S), group integration-task, group integration-social), and average transformational leadership (TL) of the coach, belonging, perceived similarity, and group size (control variable). Both individual and group predictors were significant and adding group-related variables explained an additional 4.5% of the variance. Overall, the final model explained 9.2% of the variance (adjusted $R^2 = .092, F(15,319) = 3.27, p < .01$), with being an older adult ($ß = .14, p = .03$), male ($ß = -.12, p = .03$), lower FTND ($ß = -.15, p < .01$), lower MVPA ($ß = -.12, p = .03$), higher ATG-S ($ß = .19, p = .01$), higher belonging ($ß = .19, p < .01$), and lower TL ($ß = -.16, p = .02$) significantly predicting attendance. This model explained a modest amount of variance suggesting that there are additional factors that predict attendance and further exploration is needed. Future RTQ programs may benefit from focusing on modifiable factors such as coach training to support the development of group cohesion and a sense of belonging. Funding source: We acknowledge the support of the Canadian Institutes of Health Research (CIHR). The program was supported by the Public Health Agency of Canada.

Development and Initial Validation of the Coaching Athlete Purpose Scale (CAPS)
Mariya Yukhymenko; Wade Gilbert; Jenelle Gilbert; John McMillen, California State University, Fresno

Coaching purpose defines why coaches do what they do, reflects coaches’ fundamental reasons for being a coach, and represents their motivations for coaching. Quality coaching means teaching life skills and valuable life lessons through sports with the ultimate purpose of the holistic development of athletes and their overall health and wellbeing. Using the United States Olympic and Paralympic Committee Quality Coaching Framework, the purpose of the present study was to develop and validate a scale designed to measure coaching purpose related to the athlete outcomes of competence, confidence, connection, and character. Following the review of literature,
items were developed and subjected to content validation. As a result, a set of 51 items was finalized for pilot testing with a sample of coaches. Participants \(N=517\) were NCAA coaches in the Division III institutions who were recruited by emailing the link to the online survey with an invitation to participate in the survey. The analyses focused on examining validity and reliability of the items and optimizing the length of the scale. A five-factor interpretable solution was suggested by the results of a series of exploratory factor analysis, which were titled as coaching purpose related to the development of sport-specific competence, sport-general competence, confidence, connection, and character. During the series of exploratory factor analysis, the length of the scale was optimized by removing 23 items because of insufficient loadings on the primary factor or high loadings on the secondary factor. Items within each factor were also examined for conceptual sense (i.e., redundancy, clarity), resulting in removal of five items. The five-factors explained a total of 56.9% of the variance. Factor loadings were all above .50. Reliability estimates ranged from .79 to .87. The significance of the proposed work is that the newly developed scale could be considered as a valuable tool for practitioners and researchers to aid in quality coaching and holistic athlete development.

Social Factors and Physical Activity in Older Adults: Identifying Predictors Using Baseline Data From the Canadian Longitudinal Study on Aging

Chantelle Zimmer; Meghan McDonough, University of Calgary

Introduction: Fewer than 20% of older adults accumulate sufficient physical activity (PA) to achieve health benefits central to successful aging. Social relationships and social participation are thought to influence PA in older adults, suggesting that they may be important mechanisms underlying PA promotion and intervention. However, limited research has examined these associations. The purpose of this study was to determine which social factors significantly predicted PA in this population. Method: Self-report data from the Canadian Longitudinal Study on Aging was used to examine associations among 21,491 adults aged 65 and older. Multiple regression was performed with 9 social factors as predictor variables and PA as the outcome variable, while controlling for demographic and health factors (e.g., age, BMI, general health). Results: All predictor variables were positively and significantly \(p < .05\) correlated with PA, except frequency of online communication with family and friends. The regression model with all predictor variables was significant \(R^2 = .20, p < .001\). Total social network size \(β = .07\), frequency of contact with social network members \(β = .03\), frequency of social participation in community-related activities \(β = .07\), and affectionate support \(β = .03\) were positively and significantly associated with PA. Frequency of online communication with family and friends, emotional/informational support, and positive social interaction were not significant predictors in the model. There were suppression effects on the coefficients for being in a domestic partnership (bivariate \(r = .14, \text{multivariate model } β = -.03\)) and tangible support (bivariate \(r = .09, \text{multivariate model } β = -.02\)) therefore their effects were considered possibly positive, but inconclusive. Conclusion: Social factors that indicated whether older adults had other people present in their life and interacted with them significantly predicted PA. However, of the social support functions included in this model, only affectionate support predicted unique variance in PA. Funding source: Canadian Institutes of Health Research, Brenda Strafford Centre on Aging, O'Brien Institute for Public Health.