exercise time increased, SD acceleration and mean velocity of postural control in the medial lateral (ML) direction increased for IF. As moderate intensity exercise increased, mean velocity and mean acceleration in the ML direction increased for IF. As light exercise increased, TSK scores decreased and SF-36 (General Health and Social Functioning) increased for IF. These data suggest that physical activity outside of a balance training intervention may offset some of the known detrimental effects of an IF during balance training.

Individual Differences of Variance Restructuring When Acquiring a Kettlebell Swing Motor Task in Young Adults

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Initial acquisition of a motor skill might demand exploration of possible degrees of freedom (dof) followed by exploitation of preferred task solutions. The control strategy for this exploration followed by exploitation is unknown. Two major control strategies are plausible, covariation across dof (CoV) or reducing variation of the dof to which the task goal is most sensitive (InV). Both control strategies have been found in young adults dependent upon task constraints. This study aimed to characterize the control strategy employed to structure the variance of body segments (dof) based on their influence on the vertical COM position (task goal) during the acquisition of a kettlebell swing. Twelve young adults (7F/5M, 22.62 (2.04) years) participated. Subjects watched a video that modeled and provided instructions, but received no verbal cues or feedback. We evaluated two conditions: no practice (NP), 3 sets of 20 kettlebell swings, and short-term practice (SP), 3 sets of 20 kettlebell swings following 4 practice days of 5 sets of 20 kettlebell swings. A Vicon motion capture system collected kinematic data. A modified uncontrolled manifold analysis partitioned segment angle variance across cycles as either affecting the vertical COM position or not. Then individual variance was removed to evaluate the degree of CoV and the remaining variance was considered InV. Our results suggest there was not a single strategy employed when acquiring the kettlebell swing. The majority (8/12) demonstrated an InV strategy for both NP and SP, others a CoV strategy (2/12) for both NP and SP, and some shifted from CoV to InV (2/12) from NP to SP. The majority of subjects implementing an InV strategy might suggest a tendency to focus on the dof (i.e. body segment) that has the greatest impact on the task goal and reduce its variance. More work is necessary to qualify if one strategy is more representative of skilled performance and whether practice design could be tailored to these individual differences. Funding source: University of Dayton Research Institute Seed Grant.

Categorizing and Distinguishing Perceptual-Cognitive Skills in Interceptive Sport Athletes

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Recent advancements in technology allow accessible assessments of an athlete's ability to process information and make decisions, what have been termed perceptual-cognitive (PC) skills. However, there is ambiguity, uncertainty and a lack of organization concerning the type of skills which distinguish elite athletes from their less-elite counterparts. To determine the importance of various PC skills for different athlete groups, operational definitions of these skills are needed, along with defined measurement standards and protocols. The present study classified skills into four broad categories: fundamental visual skills; low-level visual skills; high-level visual/attentional skills; and cognitive skills. After determining the types of skills encompassed within these categories, including domain specific skills and more domain general skills, the study comprehensively reviewed studies containing elite and less elite or novice group comparisons. This first phase focused on interceptive skill athletes, such as those involved in baseball or tennis, where PC skills play a critical role. There was considerable discrepancy in research evidence differentiating between athletes based on fundamental and low-level visual skills, such as dynamic visual acuity and colour/contrast sensitivity. High-level visual/attentional skills; including attention location, typically assessed through eye gaze measures, have consistently demonstrated expert-novice response pattern differences and superior expert performance. Most cognitive skills (anticipation, memory & knowledge, and decision-making) have overwhelming evidence supporting expert-novice differences in sport-specific tasks, yet research evidence regarding general executive function differences mostly fail to distinguish across skill groups, although the evidence is relatively mixed. This review aims to identify gaps and controversies in PC skill research and ultimately orient practitioners and researchers towards distinguishable skills and methods to assess and train. Funding source: NSERC (Hodges, Spering) and Own The Podium (Hodges).

Measures of Gait Variability Are Not Sensitive to Aging

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Gait variability is suggested to be associated with the age-related decline in locomotor ability and increased fall risk in older adults. Differences in gait variability between the old and young have been quantified using linear and nonlinear techniques, promoting their use for identifying poor locomotor patterns. However, little is known about how measures of gait variability change across the lifespan. The purpose of this work was to investigate age-related changes in linear and nonlinear measures of gait variability. Thirty-two adults (23-71 years) walked for 6 minutes at their preferred speed during which stride time, stride length, knee angle, and pelvis motion were recorded. Linear gait variability analysis included standard deviation and coefficient of variation of stride time and stride length. Nonlinear analyses included sample entropy and detrended fluctuation analysis of stride time, stride length, and correlation dimension and local dynamic stability of pelvis motion and knee angle. Of the variability measures, linear regression analyses showed age to be significantly predictive of only coefficient of variation of stride length (r^2=.09) and sample entropy of stride time (r^2=.12). Age was best predicting preferred gait speed (r^2=.21). Additional linear regression analyses used gait speed as a predictor variable for measures of gait variability, revealing gait speed to better predict and predict more measures of gait variability. Gait speed was significantly predictive of coefficient of variation of stride length (r^2=.32), sample entropy of stride time (r^2=.50), correlation dimension of the pelvis motion (r^2=.24) and knee angle (r^2=.32), and local dynamic stability of pelvis motion (r^2=.08). Thus, while there is a decline in walking speed across the adult lifespan, measures of variability are not especially sensitive to age itself. Future work should consider adjusting for differences in gait speed across ages to understand the changes in locomotor variability that are due to factors other than gait speed.

In Search of Motor Memory Consolidation Processes Underlying Wakeful Post-Training Interventions: A Review

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Following training, novel motor memory is initially fragile before consolidation processes render the memory stabilized into long-term memory. Of

the two types of time-dependent consolidation processes that occur following training, those associated with sleep have attracted the most attention at the cost of consideration for processes that occur in the post-training wakeful period. Notably, a range of interventions have been shown to provide wakeful motor memory including exercise, cognitive task performance and mindfulness meditation for which several questions remain unaddressed. For example, it is not known whether wakeful consolidation interventions are unique or share common features in how they support memory consolidation. To gain some perspective on this issue, we reviewed wakeful interventions for motor memory consolidation. While a range of means have been proposed to explain consolidation from wakeful interventions including exercise-specific increases in physiological arousal and neurotrophic factors levels and meditation-related increases in striatal dopamine, our review revealed overlapping descriptions of consolidation mechanisms associated with attention. As goal-oriented tasks, wakeful interventions share the requirement of increased attention control to maintain task performance. This suggests that states of increased attention control following training might be important for learning outcomes. Distinct from the role of attention during skill training, consolidation would not require attention control to be skill-specific. There is some discrepancy with this view as it has been shown that states of reduced attention demand, including that associated with mind-wandering or default mode states, following training might better serve memory consolidation. This review has highlighted that while attention control might represent a unifying set of processes by which wakeful interventions provide memory consolidation, these processes remain poorly described and lack empirical evaluation.

Kinematic Predictors of Standing Long Jump Distance in Novice Performers

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The standing long jump (SLJ) is often used to assess physical fitness and athletic abilities in various age groups. Several studies have suggested that SLJ performance is determined by a variety of kinematic factors and is positively influenced by use of external focus (EF) cueing compared to internal focus (IF) cueing. Fewer studies, however, have looked at the effects of cueing on the underlying factors that may lead to improved jump performance. The aim of this study was to examine the effects of cueing on projection angle (PA) at take-off and peak lower extremity (LE) joint angles in the CM phase as they relate to SLJ distance in novice performers. Thirty-one participants with no formal training in the SLJ performed seven jumps in a randomized order (no cue=1, IF=3, and EF=3). Jump distance was measured in centimeters (cm). Internal LE joint angles were measured using 3D motion capture. PA was calculated as the angle between the shank and horizontal, immediately after take-off. Statistical analysis included one-way repeated measures ANOVAs and forward linear regressions. P-values<0.05 were considered significant. As expected, the EF cue led to significantly greater jump distance compared to the IF and no cue conditions. The EF cue also significantly led to a more optimal PA (45.5±6°), which predicted about 17-22% of jump distance in the IF and no cue conditions. IF and EF cues significantly reduced peak ankle dorsiflexion (DF) and knee flexion angles compared to no cue. Peak ankle DF had a significant, negative, moderate relationship with jump distance and was identified as a significant predictor of jump distance in all jump conditions (R2=28-33%). These results suggest that cueing, EF cues in particular, leads to better SLJ performance due in part to a more optimal PA at take-off and reduced peak ankle DF and knee flexion in the countermovement phase. However, a significant percentage of jump distance has yet to be accounted for when considering other kinematic factors (e.g. joint velocity), kinetic factors, and/or muscular contributions to the SLJ.

The Effect of Implicit Learning on Motor Performance Under Psychological Pressure: A Meta-Analysis

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Reinvestment theory predicts that motor skills learned implicitly should be less susceptible to deterioration under psychological pressure (i.e., choking) than skills learned more explicitly. In this meta-analysis, we investigated that prediction. A systematic search was conducted for articles that had participants learn a motor skill implicitly relative to a comparison group and had both groups perform the skill under low- and high-pressure conditions. Ten studies with a median of 9 participants/group met the inclusion criteria. Results revealed that participants who learned a motor skill implicitly performed better under a high-pressure condition than a low-pressure condition (Hedges' g_{av} = -1.06, 95% lower CI = -1.75, upper CI = -0.37), whereas participants in the comparison group performed similarly between conditions (Hedges' g_{av} = 0.18, 95% lower CI = -0.25, upper CI = 0.62). For the implicit learning group, funnel plot visual inspection showed an asymmetrical distribution and a significant negative relationship between effect size and precision was found. In conclusion, results confirm reinvestment theory's prediction that implicit motor learning benefits performance under pressure, but the benefit is due to implicit learning improving performance under pressure rather than preventing choking. Furthermore, this effect might be distorted by bias and driven by underpowered studies.

Individualized COgnitive and Motor Learning for the Elderly (ICOME): A Guiding Framework for Enhancing Motor Learning Performance

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In the near future, elder adults aged >65 will make up more than 50% of the population in developed countries. It is therefore increasingly important that elder adults maintain the ability to retain and relearn motor functions as this can facilitate an active quality of life for increased health and wellbeing. Current health systems typically rely on a 'one-size-fits all' for motor learning due to limited resources despite wide-ranging differences in physiology, cognitive and motor capacities in the ageing population. We hypothesize that, compared to generic programs, increased benefits are possible when implementing an individualized learning approach, which we call Individualized COgnitive and Motor learning for the Elderly (ICOME). Firstly, to unpack motor sequence learning and related phenomenon such as motor chunks and concatenation, we outline how ICOME is grounded in prominent theoretical sequence learning models like the *Cognitive framework for Sequential Motor Behavior* (Verwey et al., 2015). Cognitive control is an important consideration that generic programs often fail to consider, which we think meditation as a cognitive practice can offer additional enhancement benefits. To monitor changes in cognitive control, we review the use of event-related synchronization/desynchronization (ERS/ERD), a form of frequency decomposition in electroencephalography during motor sequence learning. We specifically target changes in Alpha bandwidth (μ/ mu) of 8 – 13 Hz and Beta bandwidth of 15 – 30 Hz in the ERS/ERD, that are most relevant for changes in cortical activity over the motor cortices during sequence execution. Lastly, we unify the topics with modelling predictions across behavioral and cortical measures to test the effectiveness of the ICOME approach. For example, we predict that using the ICOME approach will result in greater reductions of Beta ERD (pre and post movement) across learning modelled against reaction time reductions, compared to using a generic motor learning approach. Funding source: This