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Motor Control Moderate the Relationship Between Implicit Learning and Motor Ability in Children With Autism Spectrum Disorders

Bo Shen, Wayne State University; Liangsan Dong, Central China Normal University; Yanli Pang, Central China Normal University; Patricia Lasutschinkow, Eastern Michigan University; Jiayou Shen, University of Michigan; Jin Bo, Eastern Michigan University

Difficulty with implicit learning plays an important role in symptomology of Autism Spectrum Disorder (ASD). The findings in the motor learning literature, however, have been controversial. Additionally, how the learning impact motor deficits in ASD remains largely unknown. This study evaluated implicit sequence learning and its relationship with motor ability in children with and without ASD. Twelve children with clinical diagnosis of ASD and 16 age- and gender-matched controls performed a classic serial reaction time task (SRT), a retention task, and two explicit awareness tasks. Their motor ability was measured with the Movement Assessment Battery for Children (MABC). Significant learning differences between children with and without ASD were only found in retention ($t_{(26)} = 2.09$, $p < 0.05$) but not at the end of SRT. Neither SRT learning nor retention outcomes were correlated with MABC-2, although SRT baseline response time (RT) was associated with MABC (r =-0.43, $p < 0.05$). We further conducted exploratory moderation analyses with *baseline RT* as the moderator (M), *SRT retention* as the independent variable (X), and *MABC* as the outcome variable (Y) to test how the motor control impact the relationship between implicit learning and motor ability in both children with and without ASD. The model's explanatory power significantly increased with additional interaction term ($\Delta R^2 = 0.15$, $F = 4.61$, $p < .05$): children with faster RT had significant relationship between implicit learning and motor ability ($t = 1.97$, $p = .05$) whereas those with slower RT did not show any relationships. We argue that children with ASD may have more difficulties in consolidation rather than learning per se. Consistent and fine-tuned movements are fundamental for optimal learning and should be weighted more for future intervention in children with ASD.

Gait Variability in the Assessment and Tracking of Fall Risk in Older Adults

Ben Sidaway, Husson University

Two studies were conducted to examine the ability of measures of gait variability to assess the fall risk of healthy community dwelling older adults and then to determine whether dynamic balance training can improve those measures of gait variability. In the first study, gait parameters of 50 community dwelling older adults (65-95 yrs.) were recorded as they walked freely on a computerized mat. Participants also completed the Narrow Path Walking Test (NPWT) on the mat. The number of falls 6 months prior and 6 months post testing was recorded. Gait velocity did not differ between older adults who had fallen (F) in the previous 6 months and those who had not fallen (NF). No differences between F and NF were found for step length and step time but the NF group had significantly lower coefficient of variation (CV) in these gait parameters than the F group. Prior history of falls was significantly correlated with step length CV and step time CV. Analysis of the NPWT also found significant differences in step length and step time CV between the F and NF groups. In the second study, 13 older adults (65-90 yrs.) participated in a training study in which they attempted to walk along a series of 6 m beams of decreasing width (18, 15, 12, 9, 6 cm). Participants practiced beam walking for 20 minutes twice a week for 4 weeks. Before training, at the completion of training, and one week following training gait parameters were recorded on a computerized mat. All participants showed improvement in beam walking performance with practice. The balance training significantly increased self-selected gait velocity (0.78 m/sec to 0.88 m/sec) and step length (44.6 cm to 48.2 cm). Step length CV decreased significantly with training (13% to 8.7%) as did stride width CV (51% to 31%), and step time CV (7.3% to 5.5%). Taken together these studies indicate that measures of gait variability may be useful in identifying relatively healthy older adults at risk of falling and that dynamic balance training can reduce gait variability and potentially therefore, the risk of falls in older adults. Funding source: Husson University Research Fund.

Autonomy Supportive, Externally Focused Instructions Improve Children's Motor Learning in Physical Education

Thomas Simpson, Edge Hill University; Mitchell Finlay, Edge Hill University; Paul Ellison, Edge Hill University; Evelyn Carnegie, Edge Hill University; Victoria Riding, Preesall Fleetwood's Charity Primary school; David Marchant, Edge Hill University

Practice conditions that facilitate an external focus (EF) of attention and support learner autonomy (AS) have been shown to improve motor performance and learning. However, research has yet to examine how the delivery of EF instructions impacts motor learning (i.e., via autonomy supportive or controlling instructions). Therefore, the present study examined the effects of delivering EF instructions via autonomy supportive vs controlling instructional language. Twenty-four novice participants (10.30 ± 0.52yrs) practiced a land-based curling task under AS-EF (EF instructions delivered via supportive language), AC-EF (EF instructions delivered via controlling language) or control conditions (EF instructions-only) before completing a same-day retention and transfer test (non-dominant hand). Participants were required to push a curling-stone from 5m towards a bullseye target. An EF was promoted by instructing participants to "slide the stone smoothly to the centre of the target". Task instructions included autonomy-supportive (i.e., provide choice or hints for successful task completion which could be adopted or rejected by the participant) or controlling language (i.e., prescribed how best for the participant to successfully complete the task) for the AS-EF and AC-EF groups respectively. Motor performance was measured via a points-based accuracy score (Max score = 10) and positive affect was measured post-practice on a 200-point continuous scale. ANOVA revealed the AS-EF group (Mean = 3.68 ± 2.00) outperformed the AC-EF (Mean = 1.23 ± 1.09; $p = .002$) and control (Mean = 1.52 ± 1.07; $p = .007$) groups on the retention test and reported higher positive affect after practice. The findings support predictions of the OPTIMAL theory and further evidence that EF and AS factors have additive effects on children's motor learning. Moreover, results suggest that the detrimental effects of controlling instructional language can be offset by an EF, indicating that positive motivational interventions facilitate an optimal focus of attention through goal-action coupling mechanisms.

Functional Variability Increases With a Distal External Focus

Harjiv Singh, University of Nevada, Las Vegas; Hui-Ting Shih, University of Nevada, Las Vegas; Elmar Kal, Brunel University; Tim Bennett, Leeds Beckett University; Gabriele Wulf, University of Nevada, Las Vegas

A recent meta-analysis on attentional focus (Chua, Jimenez-Diaz, Lewthwaite, Kim, & Wulf, 2021) showed that focusing on an intended movement effect that is farther away from the body (i.e., distal external focus) results in performance benefits relative to focusing on an effect in greater proximity to the body (i.e., proximal external focus) or the body itself (i.e., internal focus). The present study examined whether this distance effect was associated with differences in functional variability. Skilled volleyball players ($n = 20$) performed sixty overhand volleyball serves to a target. Using a within-participants design, an internal focus ("Focus on your hand"), proximal external focus ("Focus on contacting the middle of the ball"), and

distal external focus ("Focus on hitting the bullseye) were compared. The distal focus condition resulted in significantly higher accuracy scores than did the proximal and internal focus conditions. To examine whether this was a result of increased functional variability, 3D kinematic data were collected by a 12-camera VICON motion capture system, and the uncontrolled manifold analysis (UCM) was used. Shoulder, elbow, and wrist joint angles served as elemental variables whereas the magnitude and angle of ball velocity was calculated as the performance variable. In line with our hypothesis, functional variability was greatest in the distal focus condition as shown by a significant increase in V_{UCM} (performance-stabilizing variance) and significant decrease in V_{ORT} (performance-destabilizing variance) compared to the proximal and internal focus conditions. These findings suggest that a distal external focus on the task goal enhances movement outcomes by optimizing compensatory coordination of body parts.

Determining Fall Risk in Older Adults: A Novel Balance Task With a Cost-Effective, Portable Phone App

Ruth Stout, University of North Carolina at Greensboro; Lauren Higgins, University of North Carolina at Greensboro; Christopher Rhea, University of North Carolina at Greensboro; Louisa Raisbeck, University of North Carolina at Greensboro

Research shows that falls are more common after age 65, which can result in injury, loss of independence, and mortality. Clinical fall assessments are typically not administered until a fall occurs, eliminating intervention. This study aims to identify balance tests that may indicate higher fall risk for older adults; by comparing them with younger adults when performing a novel balance test. A smartphone app was developed to measure the temporal and spatial characteristics of the right leg during a stepping in place task. The test is cost effective, and is easy to administer. It was hypothesized that mean stride time and variability would be less in younger adults but that they would demonstrate greater excursion and height (thigh ROM, mean peak flexion) for each stride. Ninety-nine younger adults (18-30 years) were recruited in a multi-site project, and compared with 19 older adults from 65-90 years (78±6.01) who reported that they had not experienced a fall in the previous 12 months. Participants stepped to a timing cue delivered by the phone app for ten seconds, followed by an additional 60s at that recalled pace while shaking the head, challenging the vestibular system. Three trials were completed, and averaged for each variable. A multi-level model was conducted to compare the effects of group on spatial variables (thigh ROM, mean peak flexion, SD of peak flexion, COV of peak flexion) and temporal variables (mean stride time, SD stride time, COV stride time). There were no group differences for steps. The younger group was coded 0, and the older group 1. A significant effect of group was observed for stride time COV ($\beta = 2.634$, $p < .001$), thigh ROM ($\beta = 36.298$, $p < .001$), mean peak flexion ($\beta = 40.32$, $p < .001$), and COV of peak flexion ($\beta = 7.782$, $p < .001$) There are group differences captured by the phone suggesting that older adults sacrificed the ROM of the thigh to keep the pace. We conclude that better clearance of the legs in stepping could help mitigate fall risk, and is supported in literature of stair climbing and obstacle clearance. Funding source: NIH/National Institute on Aging Grant 1R15AG053866.

How Similar is Immersive Virtual reality to the Real-world? A Pilot Cross-Over Design on Upper Limb Kinematics

Andrew Strick, University of Tennessee, Knoxville; Logan Markwell, University of Tennessee, Knoxville; Kaileigh Ester, University of Tennessee, Knoxville; Jared Porter, University of Tennessee, Knoxville

Previous research has demonstrated motor learning benefits when using virtual reality (VR) practice environments that simulate replicate real-world (RW) tasks/contexts have demonstrated motor learning benefits in a RW context. Numerous studies have examined how varying aspects of VR affect motor performance. However, understanding the degree to which the biomechanical fidelity can differ in VR compared to the RW is warranted. The purpose of this pilot study was to determine if upper limb joint kinematics differences exist between VR and RW practice for a dart throwing. Kinematic data were obtained using 12-camera 3D motion capture system (Vicon Nexus Motion Analysis Inc., UK). Two male participants performed 130 dart throws in a single practice session in a cross-over design of 5 conditions: pre-test, RW practice, mid-test, VR practice, post-test. A total of 50 dart throws were performed in each practice phase and 10 dart throws were performed during the pre-test, mid-test, and post-test (the first 9 of which were recorded in each condition). A cross-over design was implemented between the RW and VR practice conditions to minimize possible order effects. Dependent measures taken were minimum and maximum elbow angle, elbow angular velocity, and wrist linear velocity. Data were analyzed using 5 one-way ANOVAs. The results of the ANOVAs indicated that there was a significant effect between conditions for only elbow angular velocity and wrist linear velocity. Post-hoc Scheffe tests revealed statistically significant differences in elbow angular and wrist linear velocity from VR practice compared to all other conditions. Specifically, these results showed elbow angular and wrist linear velocity were significantly lower in VR compared to RW. The results of this study indicate dart throwing practice in immersive VR has significantly different upper limb joint kinematics compared to RW, which could limit the transfer between VR to RW tasks. This finding should be taken under consideration for the implications it may have on transfer of learning from VR to RW.

The Influence of Spectators on NBA Free Throw Shooting Performance

Andrew Strick, University of Tennessee, Knoxville; Logan Markwell, University of Tennessee, Knoxville; Harjiv Singh, University of Nevada, Las Vegas; Jared Porter, University of Tennessee, Knoxville

Previous research demonstrated a significant increase in free throw shooting accuracy as the National Basketball Association (NBA) finished the 2019/2020 season inside the NBA bubble without spectators. Interestingly, the average free throw shooting percentage in the NBA has been 75% for nearly five decades. However, during the 2019/2020 season without spectators, the free throw percentage significantly increased to 79%. Two regular NBA seasons have now been played with spectators present since the 2019/2020 spectator-free NBA bubble season. The current study examined differences in free throw percentage between the 2019/2020 COVID-bubble season played without spectators and the most recent two NBA seasons played with spectators. This study also examined differences in free throw percentages between home and away games to understand if a possible home-field advantage contributed to this increased free throw percentage phenomenon. Chi-square tests of independence were used to test for significant differences in the percentage of free throws made. Analyses revealed free throw shooting percentages during the 2020 and 2021 NBA seasons (with spectators) were significantly lower compared to the spectator-free season. While the free throw shooting percentage increased to 79% directly following the removal of spectators, the free throw shooting percentage decreased back to the average (i.e., ~75%) that has been observed for the last fifty years during the 2020 and 2021 spectator-filled NBA seasons. Moreover, the analyses found no differences in free throw percentages between home and away games. Given that no differences were found between home and away free throw shooting percentages, home-field advantage does not appear to have an influence on the increase in free throw shooting accuracy inside the NBA bubble. Thus, the differences in free throw performance are likely due to factors