

Deconstructing Occupational Performance: Investigating the Impact of a Visual-Spatial Attention Intervention on Motor and Subsystem Performance

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The purpose of this research is to investigate the effects of NeuroTracker (NT) 3D multiple object-tracking (3D-MOT) visual-spatial attention training on motor and other subsystem performance in children diagnosed with neurodevelopmental disorders (NDs), and specifically developmental coordination disorder (DCD). Children diagnosed with NDs have limited participation in physical, educational, social, and leisure domains, which negatively impacts their quality of life (Dahan-Oliel et al., 2012; Masse et al., 2013), and in DCD this has been linked to psychosocial disorders including depression (Lingam et al., 2012). Towards the goal of increased participation, it is important to consider the attentional capacity required for dual-task performance (Stephens et al., 2018), and understanding how attentional deficits impact subsystems can help clinicians develop targeted interventions. Tullo et al. (2018) found that children diagnosed with NDs were able to participate in 3D-MOT training with good tolerance. Current standard intervention for DCD addresses motor deficits (Preston et al., 2017; Thornton et al., 2016) but does not target possible underlying deficits of the attention system. A testing and intervention paradigm was developed and refined across a series of pilot studies. Studies 1 and 2 were experimental randomized controlled trials. Healthy young adults were recruited from Touro College (Study 1: $n = 19$ ages 22-30, $M = 53\%$, Study 2: $n = 41$, ages 21-34, $M = 41\%$). Following these trials, a single-subject case study was completed in which this protocol was applied to a child (12 years, female) with a neurodevelopmental diagnosis (dyslexia), who was recruited as a sample of convenience. All three studies incorporated a pre-test/post-test design, and 8-10 NT training intervention sessions were provided. Study 1: (8 NT sessions) Outcome measures included Star Excursion Balance Test (SEBT) (Gribble, Hertel, & Plisky, 2012), and spatiotemporal measures of gait as assessed on the GaitRite (Graser, Letsch, & van Hedel, 2016). The experimental group showed greater improvements on the SEBT as compared to the control group. Study 2: (10 NT sessions) Outcome measures included SEBT, Stroop test (Golden & Freshwater, 2002), and a novel gait outcome measure to assess dual task performance (attention +walking) on the GaitRite (Bensinger-Brody, 2015). The experimental group demonstrated improvements on the SEBT, and within group differences on the Stroop. Across groups, velocity, step length and stride length varied between each gait condition in the gait/attention task, indicating a successful perturbation to a well-practiced task. Study 3: (10 NT sessions) Outcome measures included SEBT, gait/attention task on GaitRite, Stroop test, Movement Assessment Battery for Children, 2nd Edition (MABC-2) (Henderson, Sugden, & Barnett, 2007), Test of Visual Perceptual Skills (TVPS) (Gardner & Frauwirth, 2017), and visual convergence testing (Ventura, Balcer, & Galetta, 2014). Post intervention, the participant demonstrated clinically significant improvements on the TVPS, MABC-2 (balance subtest), and on the Stroop (color-word subscore). Additional, but non clinically significant improvements were found for performance on the other Stroop subscores, spatiotemporal variables of gait, and visual convergence. Collective findings support the hypothesis that training the attention system will drive improved performance across multiple functional domains. NT 3D-MOT training is a safe, feasible, and potentially useful intervention to improve subskill performance for enhanced occupational engagement in children diagnosed with NDs. Future research will be discussed.

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