Bimanual skill acquisition during combined bimanual training and transcranial direct current stimulation in pediatric unilateral cerebral palsy

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Background

Bimanual skills are an important aspect of everyday hand use. Children with unilateral cerebral palsy (UCP), producing weakness on one side of the body, benefit from bimanual training to achieve goals requiring use of both hands[1, 2]. Transcranial direct current stimulation (tDCS) may be a complementary intervention to bimanual training to enhance motor learning and neuroplasticity. The direct effects of tDCS on bimanual skill acquisition have not been examined in children with UCP. Thus, the objectives of this study were to measure changes in performance, specifically the timing, of a novel bimanual skill before, during, and after a combined tDCS and bimanual motor training intervention.

Methods

Eight children and young adults (mean age=12.3±4.0 yrs) with UCP, and without contraindications to non-invasive brain stimulation or other medical interventions, participated. This was an open-label study consisting of multiple baseline assessments (Pre1-Pre4), followed by a 10 day intervention (D1-D10) and immediate post-intervention assessment (Post). The intervention included 20 minutes of 1.5 mA cathodal contralesional tDCS concurrently with 120 minutes of bimanual motor training focused on individual goal achievement. Bimanual skill acquisition was examined using a novel, modified Speed Stack task[3], which requires assembly of plastic cups using both hands in a pre-specified pattern.

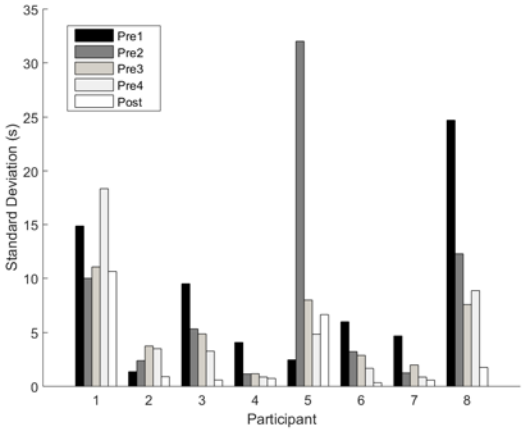

Fig 1. Individual performance variability on speed stacking task across all assessment periods. Participants showed the smallest variability at Post (open bars).

Results

Change in completion time from Pre4 to Post ranged from -9.3-18.8s (μ=-2.2s, 95% CI=[-9.74, 5.35], p=0.51), with six of eight participants showing improvement. Variability in performance (Fig 1) was marginally significantly reduced from Pre4 to Post (μ=-2.5 s, 95% CI=[-5.31, 0.29], p=0.07). The average daily (D1-D10) improvement during the intervention was 0.3s (95% CI=[-2.79, 2.21], p=0.82).

Conclusions

Acquisition of bimanual skills is a key part of upper-extremity rehabilitation in UCP. Reduced variability, while not statistically significant in this sample, may be a functionally-relevant signal of improved bimanual performance. Comparing bimanual motor learning in larger groups of children with and without tDCS will help elucidate the role of brain stimulation to enhance learning of motor skills.

References

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