Moving to the beat: Examining the role of auditory perception in motor coordination abilities among children using a multimodal neuroimaging approach

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Background

Developmental coordination disorder (DCD) • Difficulties in learning and execution of motor skills + sensorimotor timing [1] • The precise perceptual timing is a prerequisite for motor coordination [2] • Unclear whether these difficulties arise from auditory perceptual or motor timing differences, or both [3]

Music-based interventions • Even passive listening to rhythmic auditory stimuli activates motor regions of the brain and leads to enhanced motor performance in adults with movement difficulties [4]

Research Questions:

1. Do children with DCD have auditory perceptual timing difficulties in addition to motor difficulties?
2. Can rhythmic auditory cues enhance motor coordination accuracy in children?
3. Are there differences in neural patterns between children with DCD compared to TD children?

Methods

Session #1 • Child: Standardized assessment of motor and cognitive abilities (MABC, KBIT, Digit Span) • Caregiver: Questionnaires

Session #2 1. Auditory perceptual tasks • Duration vs. rhythm discrimination 2. Motor tasks with/without auditory cues (EEG-fNIRS) • Paced vs. unpaced tapping (500/1000 ms) 3. Conscious and subconscious auditory-motor synchronization (EEG-fNIRS) • Continuous time-modulated intervals at 3%, 7%, and 20% of baseline interval (1250 ms)

Participants • Children 7 – 11 y. o. • Children with DCD (N=15), TD without music training (N=15), and TD children with extensive music training (> 2 years; N=15)

Future steps: Data analysis • Perceptual thresholds: An adaptive 2-up-1-down transformed-response procedure • Tapping: Synchronization error (SE) and inter-response interval (IRI)

• EEG-fNIRS preprocessing pipeline • EEG: Induced oscillatory neural activity, inter-trial phase coherence • fNIRS: Hemodynamic changes in the prefrontal / motor cortex

Predicted results & clinical relevance

Should the results support the hypotheses that (a) children with DCD have auditory perceptual differences (b) rhythmic auditory cues can enhance children’s ability to coordinate and synchronize their movements these findings will imply that auditory-motor interventions may confer additional benefit over motor training alone.

References


Holland Bloorview Kids Rehabilitation Hospital