 DOI: 10.3217/978-3-99161-050-2-108

Feasibility of Non-Invasive EEG Brain-Computer Interfaces in Neurologic Music Therapy for Attention Training in Children with Neuromotor Disorders

Si Long Jenny Tou[1,2*], **Susannah Van Damme**[1], **Andrea Lamont**[1], **Eunice Kang**[1], **Tom Chau**[1,2]
[1]*Holland Bloorview Kids Rehabilitation Hospital;* [2]*University of Toronto*
*150 Kilgour Rd, Toronto, ON, M4G1R8, Canada. E-mail: sl.tou@mail.utoronto.ca

Introduction: Neurologic Music Therapy (NMT) uses music-based interventions to enhance neurorehabilitation outcomes. Non-invasive EEG brain-computer interfaces (BCIs) have shown promise in clinical settings for recreational therapy in children with special needs [1]. In this study, we explore the feasibility of integrating BCIs with NMT for attention training in children with neuromotor disorders.

Material, Methods and Results: Three participants (ages 7–15) were each recruited for sixteen 45-minute sessions of BCI-NMT, alongside pre- and post-intervention attention assessments. To date, one participant has completed the study. Across all participants, 35 sessions have been conducted, with BCI data recorded in 33 sessions. Each session is facilitated by a certified music therapist and a BCI technician, and includes three NMT interventions using traditional musical instruments, followed by three BCI-NMT interventions. BCI activations were enabled by Mindset software [2] to control 1–2 switches that triggered prerecorded musical outputs. The BCIs were trained using three trials of each 5-second task of familiar mental imagery activities. All sessions were video recorded for subsequent analysis. No adverse events were reported during the study. All participants reported enjoyment with the BCI-NMT sessions and demonstrated high motivation for continued participation. One participant used a 32-channel BrainVision R-Net EEG headset throughout the study, while two others initially tried the R-Net but transitioned to the Emotiv Epoch X headset after reporting better comfort and tolerability. All participants consistently produced discernible brain signals for 1–2 active mental imagery tasks and rest, achieving 100% training accuracy across all sessions. With manual adjustments to the classification thresholds, all participants were able to use the BCI effectively for NMT activities during online tasks.

Figure 1: *Illustration of BCI-NMT setup. Music therapist tailored the intervention to the child's needs and provided musical cues for the child to follow. Mental imagery EEG was transmitted to Mindset then to switch musical outputs.*

Conclusion and Next Steps: This preliminary investigation demonstrates the feasibility of using non-invasive EEG BCIs for NMT in attention training for children with neuromotor disorders. Key to the success of these interventions were child-specific adaptations, including individualized headset selection, tailored control signals, task designs, and personalized music and instrument preferences. Future work will focus on annotating video recordings to evaluate real-time BCI accuracy and quantify attention-related outcomes across sessions. These findings aim to inform further development of BCI-enabled NMT for pediatric populations with neuromotor challenges.

Acknowledgments and Disclosures: We extend our gratitude to Ka Lun Tam and Jason Leung for their technical support and to our summer students Huda Jirreh, Melody Nguyen, Anusha Broekhuyse, and Ethan Dhanraj for their dedication to this project. This work was supported by the Kimel Family Pediatric Rehabilitation Scholarships.

References:

[1] Van Damme, S., Mumford, L., Johnson, A., & Chau, T. (2024). Case report: Novel use of clinical brain-computer interfaces in recreation programming for an autistic adolescent with co-occurring attention deficit hyperactivity disorder. *Frontiers in Human Neuroscience*, *18*, 1434792.

[2] Leung, J., & Chau, T. (2024). Mindset–a general purpose brain-computer interface system for end-users. *IEEE Access*.

 Published by Verlag der Technischen Universität Graz