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tDCS at home in children with acquired brain injury (hrtDCS-Attention): A dose-controlled clinical trial protocol

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Introduction

- Acquired brain injury describes any injury to the brain occurring since birth, where traumatic brain injury (TBI) is the most common injury¹
- By the age of 10, 16% of children will sustain at least one traumatic brain injury (TBI) requiring medical attention²
- Following mild TBI, 25-30% of children experience chronic problems³
- Attention problems are among most common cognitive symptoms after TBI⁴

Medications are associated with potential side-effects and stigma in childhood which limit compliance⁵

Daily tDCS is a non-pharmacological alternative which may improve cognition after ABI⁶

However, daily clinic visits can be burdensome for participants⁷

Home-based, remotely-supervised tDCS may provide a practical alternative to in-clinic tDCS⁷

Research questions

Is 10 consecutive weekday sessions of hrtDCS-Attention in children aged 8-18 years with ABI feasible?

Can hrtDCS-Attention improve attention, and does this persist at 1 and 4 weeks following tDCS?

Does hrtDCS-Attention cause significant changes in functional connectivity?

Does functional connectivity predict response to hrtDCS-Attention?

Outcomes

Feasibility

- Adherence to protocol
- Tolerability of tDCS
- Semi-structured interview

Neurocognitive

- Flanker RT (daily)
- Stop signal task RT (pre and post tDCS)

Behavioural

- Conners' 4 Parent (pre and post tDCS)

Neurophysiological

- EEG (pre and post tDCS)
- MRI (pre tDCS)

Study design

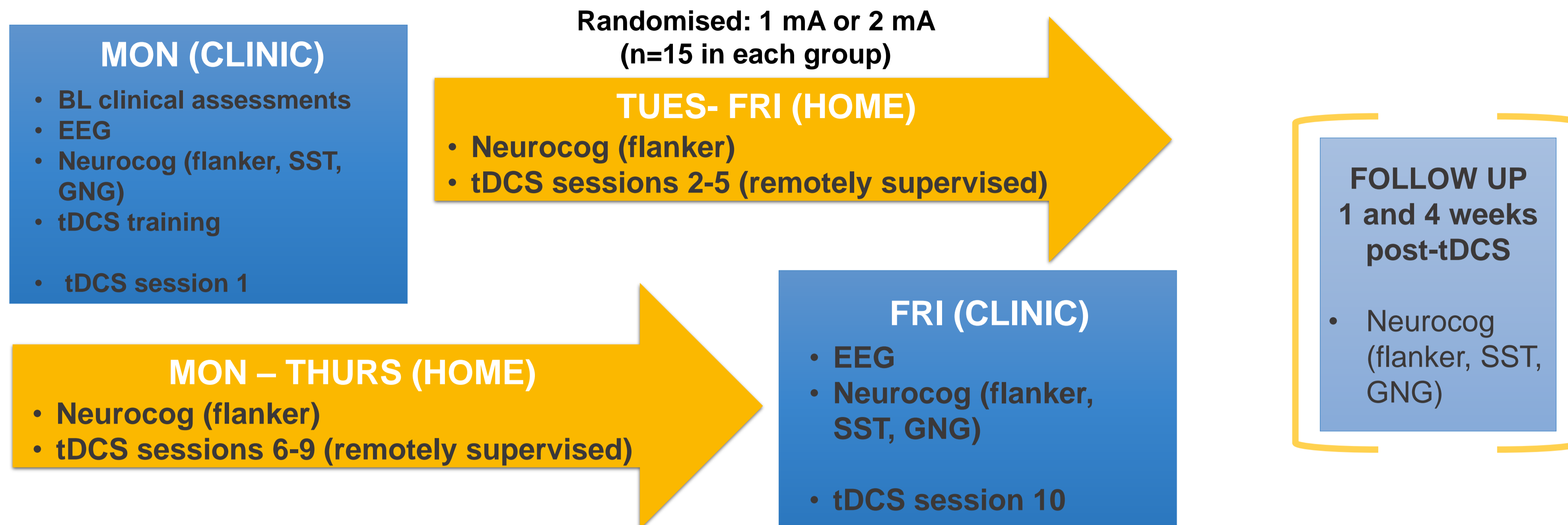


Figure 2: Home based protocol flow diagram. tDCS will be given for 10 consecutive weekdays during attention training, with a neurocognitive follow up at 1 and 4 weeks post-tDCS. BL, baseline; tDCS, transcranial direct current stimulation; SST, Stop Signal task; GNG, Go/No-Go task.

Safety data: tDCS pilot study in children with ABI

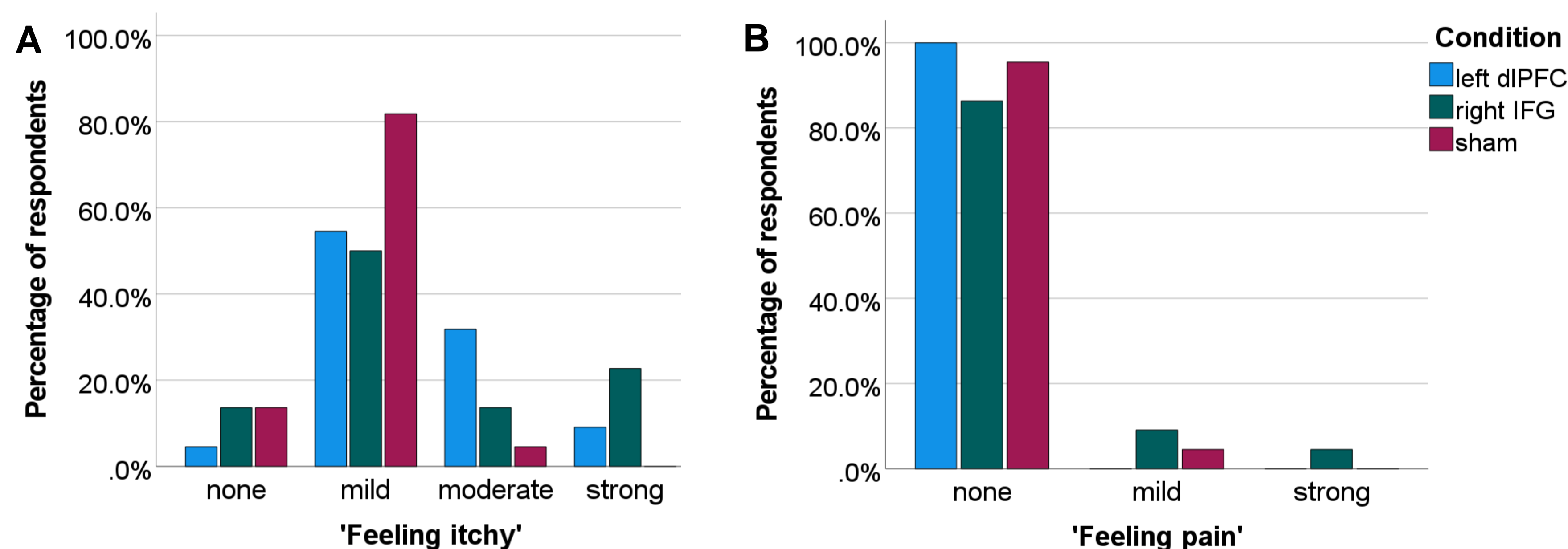


Figure 3: Established safety data from single session tDCS pilot study in children with ABI (n=15 ABI, n=15 HC). Each participant attended 3 x single sessions (dlPFC, rIFG, sham tDCS). (A) Responses for 'feeling itchy' on tDCS sensations questionnaire. (B) Responses for 'feeling pain' on tDCS sensations questionnaire. Data shown for ABI and HC participants combined (n=30).

Personalised tDCS cap: 'slip on and go'

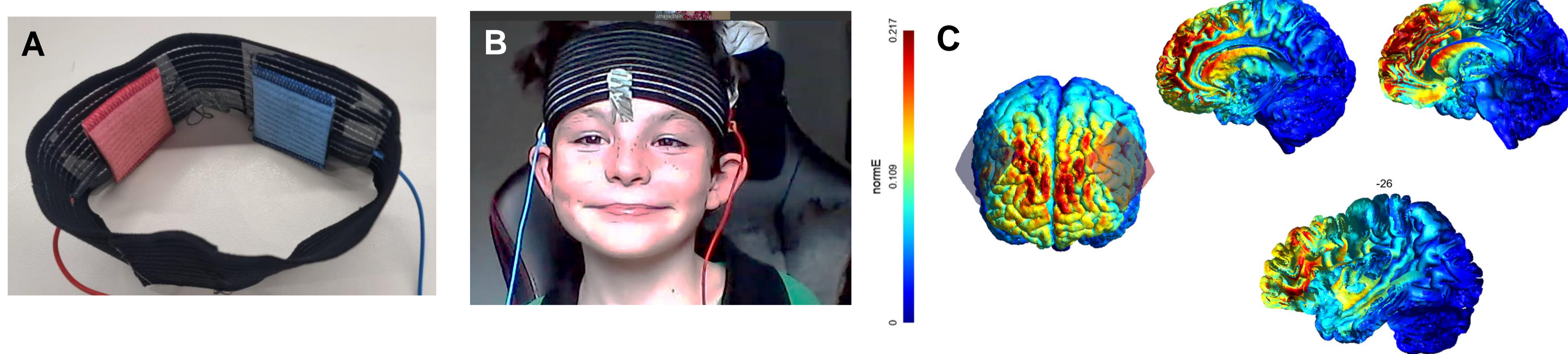


Figure 4: (A) Personalised headband for tDCS at home: design features Velcro-on sponges and adjustable headband sizes. (B) Zoom screenshot of participant wearing headband for tDCS session at home. (C) Current flow model for bifrontal dlPFC tDCS montage (modelled in child with TBI). normE represents electric field magnitude (V/m)

Gamified attention tasks: SST and GNG

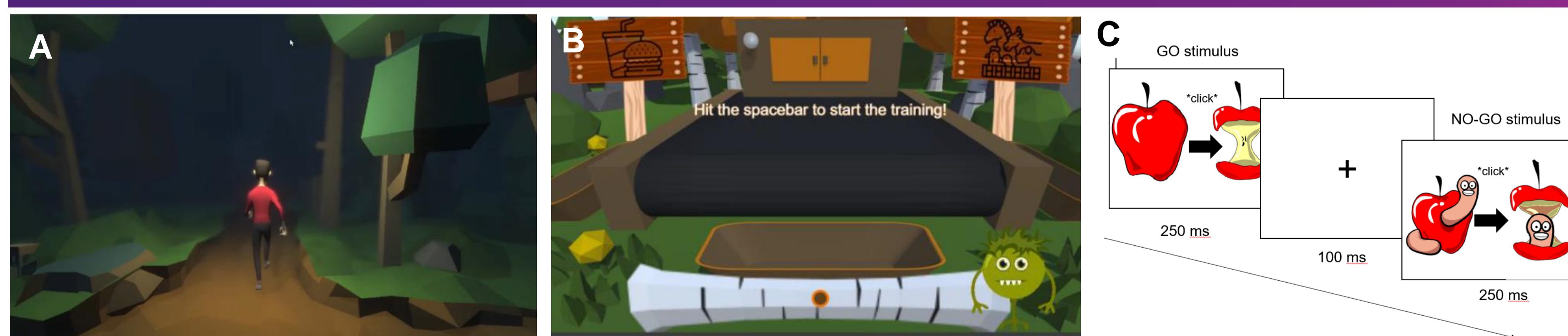


Figure 5: Gamified attention training played by participants during tDCS: (A) 'Fairy Game' Stop Signal Task designed by Friehs and Frings (2020)⁸. (B) 'Sorting' Stop Signal Task designed by Schroeder et al. 2021⁹. (C) Gamified Go/No-Go task developed by Young et al. 2014¹⁰

Conclusions and implications

- hrtDCS fills an existing gap in the use of tDCS to improve attention in the childhood acquired brain injury population
- Conducting tDCS from home may increase access to tDCS in this population, while maintaining tDCS safety and quality standards
- The use of neuroimaging promotes personalization of tDCS according to brain connectivity, allowing characterization of the variability of tDCS outcomes in the ABI population
- Our results will provide feasibility and preliminary efficacy data to inform a future randomised controlled trial investigating the efficacy of multi-day home-based tDCS to improve attention in children with ABI

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