

## **Integrating BCI, FES, and social media for Rehabilitation of Upper Extremity Motor Function in Youth**

Anna Bourgeois, Meghan Maiani, Araz Minhas, Brian Irvine, Ion Robu, Payton Shaw, Dejana Nikitovic, Zeanna Jadavji, Gregory Wilding, Nathan Brand, Mateo Ambrogiano, Emily Schrag, Nicole Romanow, Adam Kirton, Eli Kinney-Lang

### **Introduction:**

Perinatal stroke can lead to lifelong physical disabilities, but even small improvements in function can significantly increase quality of life. There is a window of opportunity after perinatal stroke to harness brain plasticity to improve outcomes.<sup>1</sup> However, current therapies are minimally effective, in part due to the boring, unengaging procedures required to achieve adequate repetitions that are not suited to children.<sup>1</sup> The combination of functional electrical stimulation and brain computer interface (FES/BCI) has been shown to be effective for adults with stroke<sup>2</sup> and hemiparesis and appears feasible in children.<sup>3</sup> We designed a novel FES/BCI system that uses social media to better engage youth, called “FlickTok”.

### **Methods and Results:**

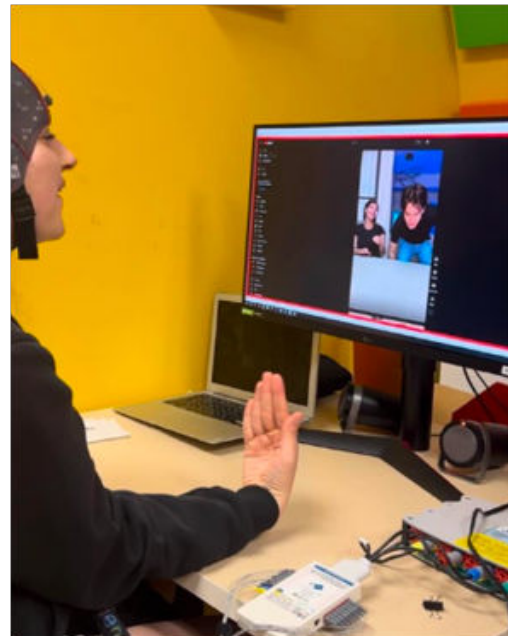
The research protocol was informed through engagement with three youth patient partners with lived experience who developed and tested FlickTok. Each participant is fitted with a 16 channel EEG gel headset. The BCI training consists of 20 trials of attempted movement and rest which is then classified using a binary Riemannian Geometry based motor imagery classifier. After training is complete, participants can independently swipe through videos that are coordinated with FES. Data collected includes Cohen's Kappa and motor assessments of passive and active range of motion and the box and blocks (BB) test. Participants complete qualitative interviews to obtain enjoyability metrics to further improve the system. To date, 7 participants have completed at least one session. Early results indicate technical feasibility and increased enjoyability. Initial qualitative interviews have explored functional improvements and methodological changes that should be implemented in future studies. The BB assessment improved by 29% and 45% respectively after 3 sessions of FlickTok in 2 participants.

### **Conclusion:**

Informed by users, simple EEG-based BCI can be integrated with FES and social media to perform upper extremity rehabilitation in youth with hemiparesis. This pilot trial will inform the design of future clinical trials required to evaluate efficacy.

### **References:**

1. Kirton, A. *et al.* Perinatal stroke: mapping and modulating developmental plasticity. *Nat Rev Neurol* **17**, 415–432 (2021).
2. Biasucci, A. *et al.* Brain-actuated functional electrical stimulation elicits lasting arm motor recovery after stroke. *Nature Communications* **9**, 2421 (2018).
3. Jadavji, Z., Kirton, A., Metzler, M. J. & Zewdie, E. BCI-activated electrical stimulation in children with perinatal stroke and hemiparesis: A pilot study. *Front Hum Neurosci* **17**, 1006242 (2023).



**Figure 1. Patient Partner using Flick Tok app**