You've got mail: using telehealth to improve dissemination of brain-computer interfaces (BCIs) for communication and control.

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Introduction: Despite successful independent home use of BCIs (e.g., [1,2], they remain largely unavailable to the people who need them most[3]. We are exploring the use of telehealth to introduce clinicians, patients, and their caregivers to BCI technology in the form of a simple one-target SSVEP-based BCI demonstration application. The goal is to encourage and facilitate adoption of an EEG-based BCI for important communication and control functions.

Materials, Methods, Results: Two people (S1, S2) with amyotrophic lateral sclerosis (ALS) (ALSFR[4] functional ratings of zero) and their caregivers [system operators (SO)] received information via telehealth, phone, and mail to ascertain interest and obtain informed consent for remote BCI training and support. S1 and SO1 were naive to BCI. S2 had tried a BCI in clinic and at home without success; SO2 had observed some sessions. System hardware was a laptop (ASUS A15, Windows 10), an USB amplifier (g-tec), and a cap (ECI, locations Fz, Cz, P3, Pz, P4, Po7, Po8, Oz). System software was BCI2000 (v3.6) and the SSVEP MusicBox (MB) (Psychtoolbox, MATLAB, MP3 audio files). The MB is a one-target BCI that provides visual and auditory feedback in proportion to amplitude of the steady state visual evoked potential (SSVEP) (Fig 1). Each pair (S and SO) received a hardware schema and a video of cap application and care. In telehealth visits (TV) 1 and 2, we: verified materials; supervised system assembly, cap application and care; and introduced the MB task. In TV3, the SO had applied the cap before the session began. We reviewed placement, gel application, and signal quality (e.g., ground and reference, artifacts, impedance). We then showed MB startup and carried out a full session (25 trials). SOs contacted us immediately before and after subsequent sessions. They asked questions, and we used TeamViewer software if necessary. S1 and S2 completed data collection for 3 and 5 sessions, respectively. Investigator-observed and independent sessions did not differ in signal quality (impedance) or in performance. Electrode impedances never exceeded 15 KOhms. S1 was subsequently successfully introduced to the P300-based BCI speller.

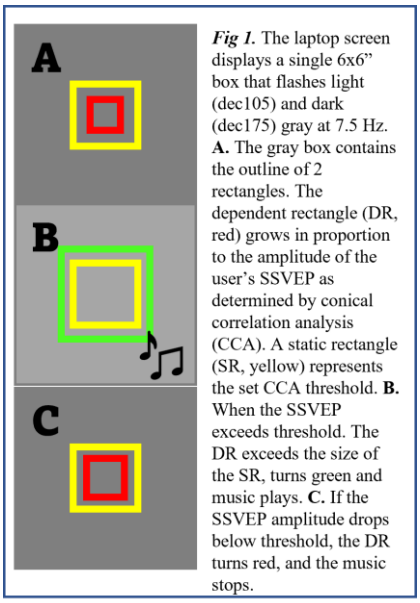

Fig 1. The laptop screen displays a single 6x6" box that flashes light (dec105) and dark (dec175) gray at 7.5 Hz. **A.** The gray box contains the outline of 2 rectangles. The dependent rectangle (DR, red) grows in proportion to the amplitude of the user's SSVEP as determined by conical correlation analysis (CCA). A static rectangle (SR, yellow) represents the set CCA threshold. **B.** When the SSVEP exceeds threshold. The DR exceeds the size of the SR, turns green and music plays. **C.** If the SSVEP amplitude drops below threshold, the DR turns red, and the music stops.

Discussion and Significance: Early and frequent exposure to high-tech augmentative and alternative communication (AAC) (e.g., a brain-computer interface (BCI)) can encourage and facilitate eventual adoption and productive use. The one-target MusicBox task and a telehealth format can introduce patients and their caregivers to BCI use. It may provide a gateway for BCI translation into standard clinical practice.

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