C.E.N.T.

Computer Enabled Neuroplasticity Treatment

COGNITIVE SCIENCE
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University of Helsinki introduces Neurofeedback to Finland. Finland is heavily invested in cutting-edge brain science, yet it has never before had dealings with neurofeedback (NFB), either in research or clinical practice. However research on ADHD in Finland has developed strongly (e.g. Helenius et al., 2011, Gumenyuk et al., 2004) and thus provides a good ground for the introduction of neurofeedback into Finland.

On par with more global estimates (Polanczyk et al., 2007), the prevalence of ADHD in Finnish 8-year-olds is estimated at 4% (DSM-III) (Almqvist 2004), while among Finnish 16-18 year olds it rises to 8.5% (DSM-IV) (Smalley et al., 2007). Indeed, given that in Finland medication therapy for ADHD is lowest among all Scandinavian countries (Zo ega et al., 2011), Finland's need for other treatments may be substantial.

The CENT project will conduct a study on the effects of NFB on adult ADHD within Finland. Research is being conducted by the Cognitive Science Unit at the Institute of Behavioural Sciences, Helsinki University, with NFB conducted by trained technicians supervised by qualified psychotherapists. Software is custom-built for the project, with games sourced from local companies.

STUDY DESIGN

The experiment aims to test the efficacy of neurofeedback for adults with either ADHD or ADD by randomized controlled clinical trial (RCT). The persistence of the treatment effects will also be tested with a follow-up study. Additionally we will study the neurological symptoms of adult ADHD/ADD using laboratory-grade EEG to examine the Event-Related Potentials (ERP) of patients as they perform attentional tasks, and analyse the patterns of hemispheric activity that characterise them. Both latter studies will use control groups of healthy non-ADHD/ADD subjects.

Figure 2. shows the study design, with tasks interrelated in timeline format. From summer 2011 the research, design and preparation work have been ongoing, ramping up in stages until the beginning of 2012. Thereafter, the study began in earnest:

Fig.1 EEG-based brain-computer interface

Research phase. Research was conducted into the disorder, prior NFB studies, and Brain-Computer Interface technology; using literature review and importantly, fact-finding in centres of NFB across Europe: Brainclinics in Nijmegen, Netherlands; Heckscher Klinikum in München and Niels Birbaumer's lab at University of Tübingen, both in Germany.
Design phase. In preparation for the study we obtained Ethical Approval from the Ethics Committee of Greater Helsinki region; recruited patients through clinical partners and targeted advertising campaigns; and screened and conducted intake measurements of the patients:
- Wechsler's short-form IQ,
- 128 channel Event-Related Potentials (ERP),
- Test Of Variables of Attention (TOVA) with EEG,
- Vigilance monitoring with EEG.

Piloting phase. NFB training for the assistants who were to administer the treatment was structured as a validation-test pilot study where each trainer also acted as a patient, learning the subjective experience of NFB.
Treatment phase Treatment is conducted in the clinics of partner MCC, with patients scheduled to attend on average 3 times per week. Treatment is ongoing. Every 10 sessions, patients report on their quality of life and sleep (using Q-LES-Q(SF) - Quality of Life Enjoyment and Satisfaction Questionnaire and PSQI - Pittsburgh Sleep Questionnaire). Exhibition of ADHD/ADD related symptoms and expectations on treatment outcome are also monitored (through ASRS - Adult ADHD Self-Report Scale and placebo questionnaire of Borkovec and Sibrava (2005).

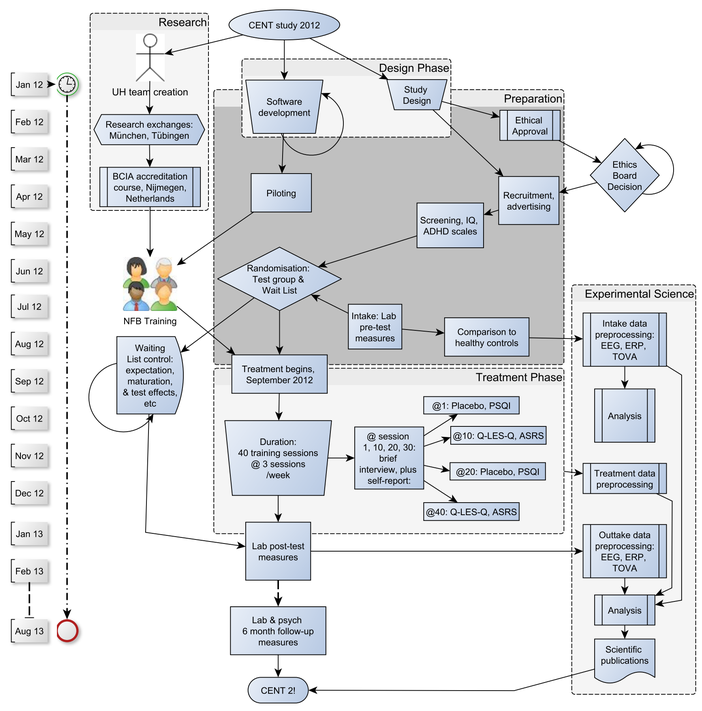

Fig.2 Timeline schematic of the Cent study.

HARDWARE

The study is using Neuroelectrics' Enobio system to feedback patient's EEG signals. Enobio is a wireless 4-channel active-electrode EEG amplifier, which can utilise wet or dry electrodes interchangeably. With dry electrodes, uncomfortable abrasive skin preparation and messy gel is not needed, so recording can start almost immediately after the subject is ready and electrochemical equilibrium is established.

Sampling rate: 250Hz
Frequency range: DC-125Hz
Common-Mode Rejection Ratio: 92dB
Signal-to-Noise Ratio: 83dB
Electrodes: active sintered Ag/AgCl
Amplifier noise: 0.5 μV
Driven-Right leg reference
Low-powered radio connection

SOFTWARE

A new software platform was developed by the Finnish company BLStream for the study, integrating OpenVibe platform's signal analysis capabilities with a graphical user interface designed for the project. The platform gives the researcher or clinician the option to use different neurofeedback protocols and activities, for example different games or auditory content. The program records relevant background information on the patient's state before each session and tracks the patient's progress as the treatment proceeds.

The program is designed for a dual-monitor setup, with separate monitors for the therapist and the patient. In principle it is possible for the patient and the therapist to be in different locations while training, thus enabling tele-neurofeedback.

The training itself is based on thresholds calculated from baseline measurements. Currently two NFB protocols are supported, theta-beta (the default option) and SMR; one of these is chosen by the trainer at the beginning of a session.

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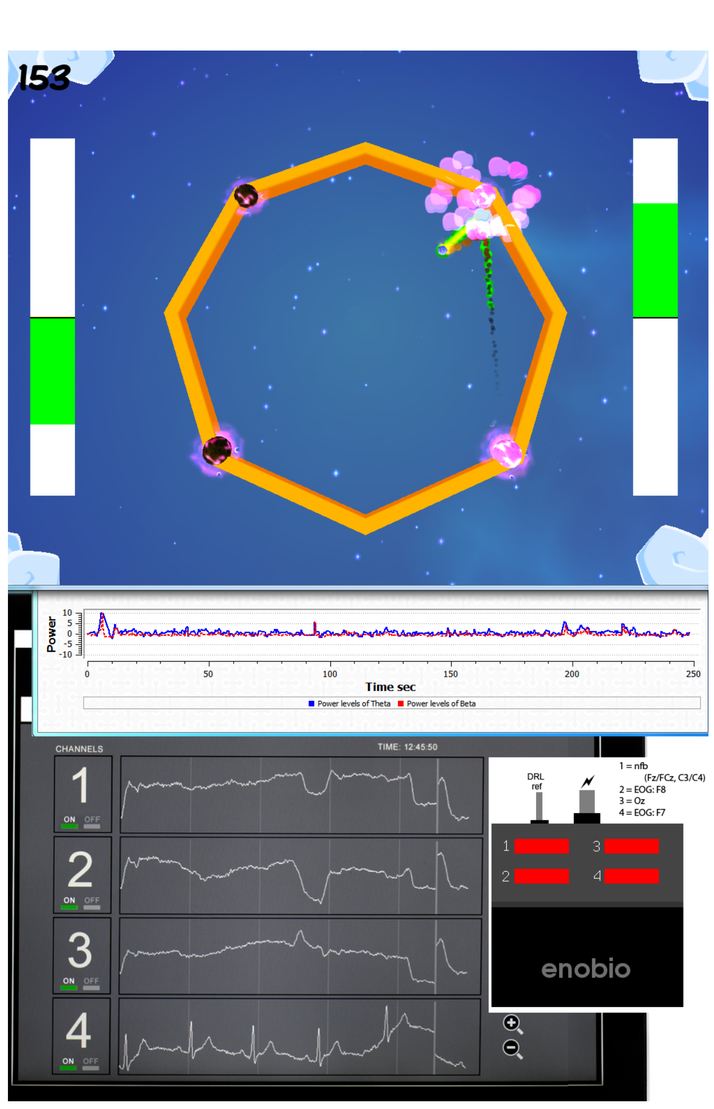

Fig.3 Screenshot of the software used in CENT

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