Co-Designing Neurofeedback Applications for Youth

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Abstract

Attentional challenges and anxiety are the most prevalent mental health issues among North American children and youth today. One non-pharmacological treatment method that has shown promising results is neurofeedback. Recent developments in personal electroencephalogram (EEG) technology have made these treatments more accessible than ever; however, few design guidelines for neurofeedback applications currently exist. This work builds on research using the existing neurofeedback application *Mind-Full*. We propose using co-design practices to redesign this system for urban youth, ages 13-15, with attentional challenges and/or anxiety. In this position paper, we provide an overview of the existing *Mind-Full* system, describe proposed co-design activities and evaluation methods, and conclude with a brief discussion.

Author Keywords

Co-design; neurofeedback; ADHD; brain-computer interfacing; youth.

ACM Classification Keywords
H.5.2. Information interfaces and presentation (e.g., HCI): User Interfaces: User-Centered Design

Introduction
Attentional challenges and anxiety are the most prevalent mental health issues among North American children and youth today [3]. These challenges are often associated with stress and can have negative impacts on individuals' self-esteem and well-being [2]. Consumer interest in non-pharmacological treatments is on the rise. One alternative treatment method that has shown promising results is neurofeedback [6]. Neurofeedback training involves using a brain-computer interface to practice control over one's brain state. Recent developments in personal electroencephalogram (EEG) technology have made these treatments more accessible than ever; however, few design guidelines for neurofeedback applications currently exist.

This work builds on research using the existing neurofeedback application *Mind-Full* [1]. We wish to redesign this system for urban youth, ages 13-15, with attentional challenges and anxiety. We propose using co-design practices to better understand this unique population's needs and interests. In the following position paper, we provide an overview of the existing system, describe proposed co-design activities and evaluation methods, and conclude with a brief discussion.

Mind-Full Neurofeedback System
Mind-Full is a mobile application developed by Dr. Alissa Antle at Simon Fraser University. Using a single-sensor, commercially available EEG-headset, *Mind-Full* provides real-time feedback on user's stress and attention levels and rewards them for achieving customizable thresholds. Children practice with the system for 3 10-minute long sessions per week, over a period of 14 weeks. Research suggests that by using *Mind-Full* in a controlled environment, users can improve their self-regulation skills over time [1].

Currently there are three versions of the *Mind-Full* system, each designed for a specific research context: 1) An urban school in Nepal; 2) An Aboriginal community in Canada; 3) An urban school district in Canada. These systems share the same core game functionality, but differ in appearance. Culturally relevant themes and imagery were selected in collaboration with representative community stakeholders. The intended users are children ages 5-11 who have experienced trauma or have attentional and/or anxiety issues.

Until now, there has been no *Mind-Full* application designed specifically for older children. Children's abilities and interests vary with age [5,10]. A system developed for, and tested on, a younger cohort may not be appropriate for a more mature group. Previous research with the *Mind-Full* system suggests that it can take over 18 sessions for neurofeedback treatments to have a lasting effect. As such, in order to encourage sustained use, it is important that the games are appealing and fun to use. Practicing neurofeedback with the existing systems are unlikely to maintain youths' attention for the duration of treatment – we must therefore revisit our initial design considerations with this population in mind.

Co-designing with youth

It has been established that children and youth can play an active role in the design of new technologies [4,7]. Druin describes the various roles children can perform as that of *user*, *tester*, *informant* and *design partner* [4]. For the purposes of this research, we believe it is important for youth to have an active role in the design process (ie: as *informant/design partner*). With this in mind, we propose running a series of four co-design sessions with a group of six youth with attentional challenges and/or anxiety in Fall 2017. Students will be recruited from a local school. The first two sessions focus on idea generation and design; and the final two sessions emphasize user experience and participant debriefing.

The first session begins with a form of contextual inquiry [4] in which researchers observe youth using their preferred mobile applications. This is followed by a discussion of what they like about these particular applications, and why. Meanwhile, researchers will make notes on a whiteboard to be referred to later. Next, participants and researchers take part in an idea elaboration session [4], brainstorming game ideas as a group.

During the second session, participants create low tech prototypes as a form of participatory design [4]. This involves sketching out the games and interactions that were brainstormed in the previous session. Proposed ideas are then discussed as a group, and ranked by participants using *dot voting (*colored stickers to indicate preferences) [8]. At the end of this session a single design would be selected based on a combination of vote preferences, and the feasibility of the design.

The paper prototype is then developed into an interactive prototype for the third session. This is presented to participants to perform user testing and gather further feedback. Any required changes are implemented prior to the final session, when the completed system is demonstrated to participants. A debriefing informs them of why certain choices were made, and the session concludes with a team reflection and evaluation of the design process [4].

Discussion

Co-design gives users a voice [9] and allows researchers to benefit from their lived experience and insight. Incorporating youth into the design process for Mind-Full will help create a better system. This paper represents work in progress which we hope to further develop through discussion at the *Analyzing Children's Contributions and Experiences in Co-Design Activities* workshop at Interaction Design and Children 2017.

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