Designing Data-Driven Interventions for Mental Health Care

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Abstract
This paper introduces the design of an assistive technology in a training program for cognitive and emotional control for adults with ADHD. We further address how patient-generated data (PGD) can support the interaction between patients and clinicians in this training process, and potentially increase the effect of the treatment.

Author Keywords
Affective interaction; patient-generated data; assistive technology; mental health care; ADHD; pervasive affective sensing.

ACM Classification Keywords
H.5.2 Human factors.

Introduction
This position paper addresses the introduction of ICT-support in evidence-based treatments in mental health care and how patient-generated data can be included in this process. The particular case that is presented deals with introducing assistive technology into non-pharmacological treatment of adults with ADHD.

There is a documented need for such treatment options as an alternative or supplement to existing pharmacological treatments [9], as well as a documented desire from patients for such alternatives

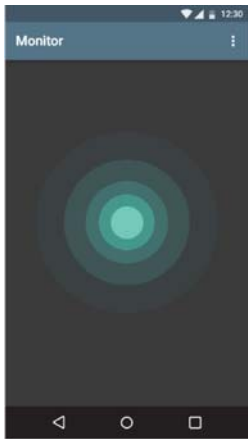

Figure 1: Colors visualizing changes in EDA, suggestive of affective states.

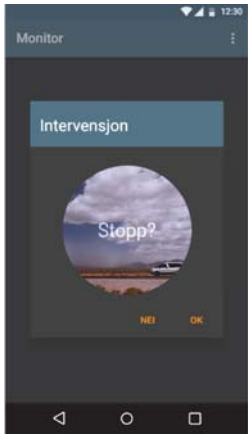

Figure 2: Intervention asking whether to stop. Note that our design supports personalization of "stop" word and imagery.

[13]. As ADHD is a neurodevelopmental disorder [1] where reduced cognitive and emotional control is assumed to be of central importance [2], there is a need for a long-term perspective that incorporates everyday activity. A skill-building approach was, therefore, chosen as the basis for the development of our treatment alternative [16].

Of particular relevance to the current work is the emphasis on learning a "Stop-technique" to allow for an assessment of ongoing behavior and emotions, and whether these are in line with current goals. As the addition of simple external cueing in the form of text messages has been shown to enhance the effect of such skill-training [16], we believe that a directed intervention guided by in-situ analysis of a person's state may prove even more beneficial.

Background and Related Work

Research on the design of technologies to support people with ADHD has historically received limited attention from the HCI community. Recently, efforts to produce a design framework and design principles for the design of such technologies have emerged [14]. Sonne et al. [14] present "automatically executing services based on in-situ analysis of context information" as one of several promising uses of assistive technology for people with ADHD. ParentGuardian [10] is another relevant example. Based on the tracking of Electrodermal Activity (EDA), it provides parents of children with ADHD with behavioral strategies to cope with stressful situations as they are detected by the system.

While showing great potential to support users through stressful events, such automatic affective sensing systems present certain challenges [3]. Due to the complex nature of emotions, incorrect detections of affective states seem inevitable [3]. Addressing the challenge of accurately detecting stress by tracking EDA, Sanches et al. [11] designed a stress management service for empowering users in interpreting their own affective states. Their design supports and enables interpretive flexibility by leaving the definition to the user [3], "empowering users to link the complexities of everyday life, subjective experiences, and body data into a non-reductionist whole" [11].

Designing Data-Driven Interventions

The design and HCI-research in our case are inspired by the perspective of affective interaction [3] and follow a research through design process. The approach used in our interdisciplinary project is to seek out possible ways to include assistive technology in well-documented treatments, and in the next round to study how such technologies can enhance the given treatment.

In our efforts to establish requirements and identify candidate technologies we have been inspired by Participatory design [4], and have established a user panel. Three adults with ADHD have, in a series of design-workshops, contributed as experts of their own conditions and needs. The views of these experts are meant to supplement the neuropsychological domain knowledge as the basis for design and innovation.

We have designed an application intended to support the strengthening of cognitive and emotional control skills in adults with ADHD. It was decided to implement the "Stop-technique" by intervening through an

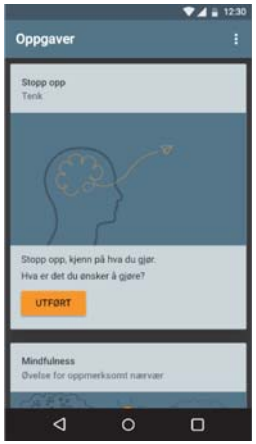

Figure 3: Tasks for "stopping" when the user accepts the intervention. These include mindfulness-based exercises.

INTROMAT research project
The work presented in this paper is part of a large research project funded by The Research Council of Norway - INTROMAT [7]. The multidisciplinary team comprises clinical psychologists/neuropsychologists, psychiatrists and HCI-researchers.

mHealth application. To initiate these interventions the Empatica E4 [5], a wristband device for monitoring EDA and other psychophysiological data, was chosen as a sensor for providing the system with tracking data.

Rather than treating the EDA-data as a veridical representation of an affective state, we have sought to support personal reflection through interventions that are triggered by the EDA-data. By asking the question "stop?" we seek to further support introspection (Figure 2). The user is free to either dismiss the intervention or proceed. The application is also customizable in that each user can choose their own word and imagery to cue the intervention.

For the actual intervention a basic model of "stop and reflect" was implemented. A guided breathing exercise is completed and followed by prompting the user to reflect on their current thoughts and behavior, and formulate what they want to achieve (Figure 3). Furthermore, the design is intended to support Ecological momentary assessment (EMA) [12]. The user may, at their discretion, annotate what happened prior to the intervention for later review.

Integrating PGD in Treatment Programs

Patient-generated data (PGD) has been defined as "health-related data created, recorded, or gathered by patients (or by family members or other caregivers) to help address their health concerns" [17]. In the case presented here focus is set on how we can integrate such data in clinical practice through the introduction of new technology in a training program for mental health care. The data generated can be classified as clinician-initiated tracking.

As our case deals with mental health treatments, PGD that can serve as an indicator of an emotional or cognitive state is essential in our design. It is pertinent to get data on emotional states through "pervasive affective sensing" [8]. This means that we seek to include both monitoring and analysis of affective interactions. Thus, PGD can also be understood according to the different interactional modes of pervasive affective sensing [6].

Since the use of PGD in this case is clinician-initiated, we have also considered whether it is necessary for the users to have access to the raw data (e.g. EDA-readings). As for now we have used an approach where we introduce an interpretive layer between the raw data and the information presented to the user. More concretely, information is presented to the user in the form of suggestive visual representations (Figure 1). This format is also used when the data trigger an actual intervention. This approach, however, might be contradictory to the idea that the patients should have ownership of their own data, and will be followed up in field trials.

In our case there are at least three potential uses of PGD: i) EMA/ ESM (experience sampling methods) - relevant for clinicians to review the impact of the training, as well as for patients as it may generate an improved basis for recognizing situations previously associated with a poor outcome; ii) Pervasive affective sensing (as in the case with Empatica E4) to provide a screening for intervention (relevant both for the patient and the clinician); iii) Learning analytics, where data from the app can serve as an indicator of whether the patient has followed the planned training [15].

Workshop participants:
Eivind Flobak is currently a graduate student in HCI. His research is focusing on the design of assistive technology for mental health care.

Frode Guribye is an associate professor at the University of Bergen (UoB). He is currently doing research on mobile interaction and affective interaction.

Daniel A. Jensen is a clinical psychologist at Betanien District Psychiatric Centre, and a Ph.D. candidate researching the use of non-pharmacological treatments for adults with ADHD. He is also a member of the K.G. Jebsen Centre for Research on Neuropsychiatric Disorders.

Astri J. Lundervold is a clinical neuropsychologist and a professor of neuropsychology at UoB. Lundervold is a partner at the K.G. Jebsen Centre for Research on Neuropsychiatric Disorders.

Future Work

We are currently in the process of evaluating the application by conducting a small-scale field trial, where six participants will use the app as a technology probe over a period of three days. Later, we will seek to test the assistive technology in a randomized clinical trial.

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