

MoodRadar-DAVID: Facilitating Insightful Care by Combining Caretaker Expertise and Real Time Insight in Electrodermal Fluctuations

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Introduction

Caretakers of people with severe mental handicaps report that the subjective interpretation of client behavior is difficult: Physical characteristics and behavioral signals are very heterogeneous. Identical client behavior is interpreted differently by different caretakers. Due to high workload (physically demanding chores for often more than one client at a time) the non-verbal signs of rising arousal levels are easy to overlook in real time situations. These behavioral signs are being labeled as important markers for the arousal build up leading up to outburst of challenging behaviors (e.g. aggressive acts) in retrospective video analysis.

Caretakers do indeed also explicitly report that they are often taken by surprise when a client shows challenging behavior. They express a need for additional tools to reliably and continuously track arousal states of their clients. Moreover, the clients who show unpredictable, challenging behavior often suffer dire consequences. For example, they get more medication, and they can be confronted with measures that constrain their freedom.

MoodRadar-DAVID

The MoodRadar-DAVID (MRD) project was set up to directly address the needs of the caretakers and increase well-being of clients. We aim to do this by creating a system that detects the continuous fluctuations of arousal by measuring electrodermal activity (EDA) of individual people with mental handicaps in their day-to-day life and that can alert caretakers when arousal is high (for that person). In addition, these physiological signals need to be aggregated and visualized in such a way that it provides the caretakers with relevant insight into the arousal state of their clients. Measures of EDA can be seen as a very pure measure of the activity of the sympathetic part of the autonomic nervous system, and as such can be taken as indicative of arousal levels of individuals [1]. In this project we focus on measuring skin conductance and extracting the most frequently reported parameters from this signal in ambulatory studies (such as the number of skin conductance responses per minute and the total amplitude of skin conductance response in a given minute)[1].

At this point it is important to note that the MRD project does not aim to use physiological signals to precisely classify complex emotional states or uniquely predict certain specific events in the future (such as an aggressive act). This would mimic mistakes made in other applied physiological domains such as some fields of lie detection (for a review see [2]). Here one could assume that, for example, a rise in skin conductance levels when answering a question indicates that someone is lying. This might very well be true, but the mistake is that this rise in skin conductance levels can also be expected when someone is afraid that their truthful answer might not be believed (for a review see [3]). Given our current scientific understanding of the interactions (or lack there-of) between human experience, observable behavior, cognitive functions, environmental conditions and (neuro)physiological states one cannot take fluctuations or regularities in (neuro)physiological signals and assume that they will correspond uniquely with specific behavior or emotional experiences (for a very clear and still relevant introduction in associated cognitivist and phenomenological traditions see [4]).

The strength of our approach is that we take a demanding, ambiguous vigilance task (i.e. monitoring the arousal states of other persons on the basis of non-verbal signs) and complement this with monitoring technology, which aims to do the same task on the basis of a different source (changes in skin conductivity). The basic assumption

here is that high arousal is one of the factors that is very often involved in the occurrence of and build-up towards challenging behavior. By providing caretakers with an accurate insight in the arousal of clients and by capturing their attention when arousal states move from low-medium to medium-high values (for an individual) MRD aims to alleviate some of the burden of caretakers. It does this by supporting them in their monitoring task and making sure their trained eye and caring expertise is, at minimum, focused on the client at relevant moments (i.e. when their clients' arousal is above average levels).

Implementation

From the start MRD was envisioned as a multi-stage design and research project where later stages were and are dependent on the success of earlier stages. Initially, we needed to establish whether an off-the-shelf ambulatory skin conductance sensor would suffice to measure skin conductance of the clients reliably during their normal lives, and whether relevant parameters (such as the rapid increases in the skin conductance levels denoted as skin conductance responses [1]) could be extracted from the measurements. In addition, we needed to find out whether the introduction of the wearable technology would not distress the clients even more, making the project immediately counter-productive relative to its aims. Previously we reported on the success of this first stage [5], and from there we started working on a suitable algorithm (programmed in Python) for aggregating and visualizing the skin conductance data (this will be reported elsewhere).

At this point we also started to focus on an initial prototype of the MRD system. For this we relied on practices from User-Centered Design involving important stakeholders to arrive at (a prioritization of) requirements for the system and a persona (a fictional description of characteristics and tasks of a relevant end user, which can be very helpful for software developers) [6]. The algorithm, requirements and the persona were taken as input for the construction of a MRD app through an agile development cycle (of approximately 12 weeks) lead by the company Move4Mobile (<http://www.move4mobile.com/nl/>).

Evaluation

At present a 3 month evaluation period is taking place of the MRD app (up to date information on the progress of the project will be provided at <http://buienradar.detwentsezorgcentra.nl>). Ethnographic methods and surveys will be used to assess the actual use, usability and user satisfaction with approximately 30 caretakers. In addition, three clients will participate in three separate single-case ABA research design [7] to establish whether an intervention with MRD has positive effects on their well-being. Firstly, announcing client arousal changes will hopefully allow a window of opportunity to arise to adjust caretaking attitude in order to prepare for, or to prevent challenging behavior from escalating, or occurring at all, through existing intervention techniques. Secondly, MRD aims to enhance the feelings of predictability in the caretaker in relation to the occurrence of challenging client behaviors and thereby diminish the feelings of caretaker stress and make negative, freedom constraining actions towards the client unnecessary.

Ethical Statement

This study was approved by the local Medical Ethical Committee, MST hospital, Enschede (METC no. P11-27 NL 37314.044.11, approved on 06-09-2011 & METC no. P13-32 NL 46166.044.13, approved on 18-02-2014). This study was also registered in the Netherlands Trial Register (Trial Code 3043).

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