Using Wearable Technology in the Treatment of OCD

- a feasibility study

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ABSTRACT

The potential of technology solutions to support both patients and therapists in the treatment of obsessive-compulsive disorder (OCD) has been to a limited extent explored with some encouraging results. However, the use of a wearable, ubiquitous and interaction frictionless, application has not yet been fully explored. This paper discusses the potential of using wearable technology in the exposure response-prevention (ERP) treatment of OCD. ERP treatment involves exercises where the patient is exposed to subjectively felt anxiety-causing situations, but without doing compulsive rituals that would normally follow. ERP exercises are both conducted in therapy sessions and given as homework. Here is where wearable technology can play a critical role, especially in the patient's every day life. Our approach has been to look into the objectives (literature) of current treatment, research in wearable technology, as well as conducting a semi-structured interview with an expert in field of treating OCD (pediatric: because of resource availability). Information extracted from the expert has been coded from the researcher. The results of our study summarize a list of benefits wearable technology presents in relation to the aforementioned disorder and gives solutions of how designers can take advantage of these benefits. As an illustrated example (a low fidelity prototype) we present a system with a wearable device (bracelet) that is to be used to log patient's exposure exercises and to encourage the patient.

KEYWORDS: product design, self-efficacy, ERP, bracelet, mobile application

1. INTRODUCTION

Mental health is one of the most pressing concerns for public healthcare systems worldwide. The potential of technology solutions to support both patients and therapists within mental health care has to an extent been explored [2][11]. In our study we look explicitly at the exposure and response prevention (ERP) treatment of obsessive-compulsive disorder (OCD). OCD is a psychiatric disorder affecting 2% to 3% of the world population. Patients having this disorder engage in repetitive and discomforting behaviors usually linked to controlling or cleaning. ERP has shown to be an efficient treatment for many patients suffering from OCD. To this end, in our study we look at the challenges related to the practical execution of the ERP treatment through the lens of wearable technology (WT). It is evident that most efforts to recover rest with the patient, and that the challenges to get in control of the disorder have to be faced on a daily basis, thus without the physical presence and support of a clinician. Here is where we see a potential for WT. As WT is to *"interweave technology into everyday life, being ubiquitous and interaction frictionless"* [19], applications for WT can provide extended support in between therapy consultations.

WT is related to both the field of ubiquitous computing and the history and development of wearable computers. Unlike wearable computers, which were initially mostly concentrated around full Personal Computer (PC) rigs [12], wearable electronics were

considered to be smaller devices, which could reach bigger and different target groups. Within healthcare, WT self-manifests its relevance because of its close relation to the body, and in which we have seen a potential in monitoring and supervision [2][3]. In our efforts to investigate how wearables can support ERP treatment, we have looked into the objectives (literature) of current ERP treatment method, the concept of WT, as well as conducted a semi-structured interview with an expert in the field of treating OCD (pediatric: because of resource availability). Information extracted from the expert was coded by the researcher and used as a basis for proposing a system with a wearable device (bracelet). The system is to be used to log patient's ERP exercises and to encourage the patient. The final results of our study summarize a list of benefits wearable technology presents in relation to the aforementioned disorder and gives solutions of how designers can take advantage of these benefits.

The paper is structured as follows: Section 2 presents an overview of relevant research in the areas of (1) ERP treatment and (2) WT. Section 3 describes our methodology, the involvement of the expert in the study, as well as the execution of the semi-structured interview. Section 4 presents the results as a) treatment considerations, b) transforming these treatment considerations into design considerations and c) a solution of how designers can take advantage of these benefits by an illustrative example: a low fidelity prototype of a wearable system. A discussion section is found in paragraph 5, and finally, limitations and directions for future research are given in the conclusion in section 6.

2. RELATED WORK

2.1 Exposure and response prevention (ERP)

ERP within cognitive-behavior therapy (CBT) has shown to be an efficient treatment for many patients suffering from OCD. For the purpose of our study we have focused on the practical execution of the ERP treatment. Realizations of requirements and challenges within this focus were formulated with complimentary information given by the Child and Adolescent Psychiatric Clinic (BUP Klinikken) at St. Olavs Hospital in Trondheim, Norway, here presented by an associate professor and psychology specialist in treatment development of OCD among children and adolescents. Although our expert works with children and adolescents, the tactics for ERP are more or less the same for adults [17].

Therapy Sessions In ERP

ERP is a part of the CBT of OCD. ERP involves in being exposed to situations the patient fears, but without doing the responsive act that would normally follow. "For example, an in vivo exposure for an OCD sufferer with contamination concerns might involve touching a doorknob perceived to be ''dirty'' (the distressing stimulus), without the compulsion of excessive hand washing" [7]. CBT for OCD has a relatively short duration; most often one will have 12 to 15 sessions over a period of 14-20 weeks, though more intensive treatment can also occur; with 4-5 sessions each week, plus homework exercises in both cases. An effective treatment includes: formulating specific exercises, encouraging the patient to perform the exercises despite high levels of anxiety and obsessions, and as a result: making the patient realize that felt anxiety will be reduced by time, without compulsive rituals. The goal for the treatment is not healing, as OCD is defined as a chronic disorder [6]. One would rather attempt to teach the patient how to control the compulsion and not vice versa, so that the compulsion do not influence the patient's daily life, development and opportunities [8]. The procedure in CBT for OCD is as follows; 1) psychoeducation, 2) mapping OCD symptoms, 3) exposure with response prevention exercises, both in the sessions and as homework and 4) measures to prevent recurrence.

An anxiety thermometer (figure 1) is used to map symptoms to better understand thoughts and beliefs in the patient and where to target exposure exercises; the training area (figure 2) [8]. The goal is to reach a state where the patient is able handle a scenario, which he or she initially considers to be a number 10 in the anxiety hierarchy. *"In order to be effective, ERP must fully address the avoidance and rituals that the patient falsely believes are preventing the feared outcomes from occurring"* [7]. It is the in vivo exercises that are the most powerful

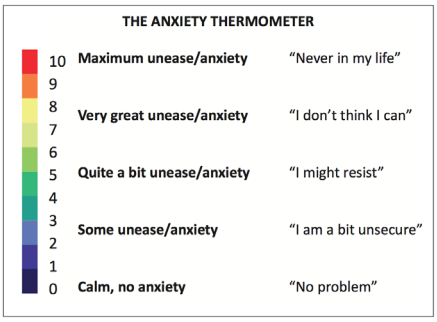

Figure 1: The number 0-10 describes the feelings to the selected scenario

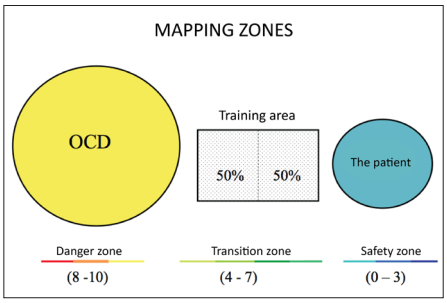

Figure 2: It is first when the training area is identified one would start with the ERP treatment.

tool in ERP, and an essential part of helping patients to go to the top of their hierarchy is to ensure that they complete the agreed upon exposures [7].

2.2 Wearable technology

Wearable technology, as with many other commercialized products, spawned from military research programs. *"Although military influence in wearable technology is undeniable, it was never even an important part in making wearables successful"* [12]. Because of the on-going miniaturization of electrical components, cheaper production methods and better wireless communication systems, we are today able to produce viable wearables for a broader audience. According to ABI Research (USA), the WT market will top 485 million units in annual shipments by 2018 [1]. Sports and fitness trackers, including multi-functional bracelets, account for 61% of the bulk of WTs that are available today. In our study we also explore the bracelet as a platform for supporting the treatment of OCD. As *"It is easily carried around and do not infringe on daily activities, it is the perfect platform to access technology"*[10].

3. METHODOLOGY

Figure 3 shows the approach that forms the basis of this paper. First, we had an initial research phase where we looked at literature and articles involving wearable technology and mental health, including e-mail correspondence with experts in psychology, which led to the focus of OCD. Subsequently, a semi-structured interview was conducted with a specialist in treatment development of OCD. Extracts from the interview were formulated into treatment considerations. Next, these formulations were transformed into design considerations for the application of wearables in ERP by the researcher. Finally, the researcher utilized the design considerations to prototype a draft of a wearable system.

3.1 Data Collection and analysis

During our initial research phase we made contact with psychology experts (e-mails), including a psychology specialist in treatment development of OCD at the Child and Adolescent Psychiatric Clinic (BUP Klinikken), at St. Olavs Hospital in Trondheim, Norway. E-mail correspondence with the specialist generated motivation for exploring the potential for

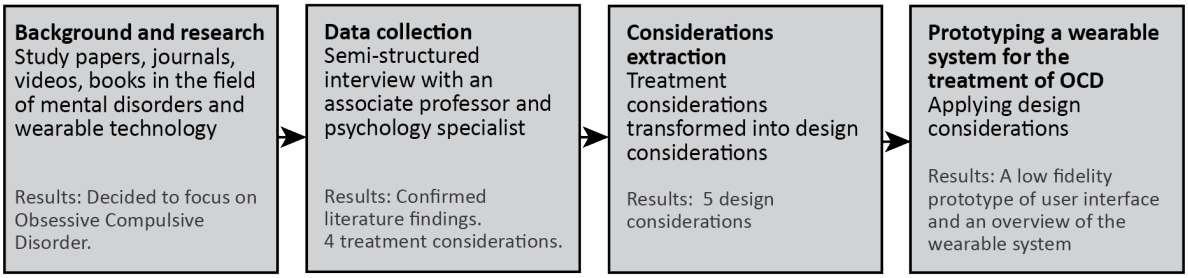

Figure 3: Overview of process

wearables explicitly for the ERP treatment of OCD, and he provided us with additional literature in the field [8].

The aim for the semi-structured interview was to gain insight in practical factors around the treatment of OCD that might not have been mentioned or overlooked in literature research. We started the interview by presenting a scenario of a typical therapy session to ensure that our understanding of a typical therapy session was correct. Other questions we could ask were: what is it with ERP treatment that works well? (what should we bring forward that already worked?) What do you think is the greatest challenge in the ERP treatment? Do the patients complete their agreed exposure-exercises (figure 4a)? Do you have any particular experiences from your own practice that you can refer to? Have you experienced a patient utilized other aids outside the regular consultations?

Furthermore, to generate a discussion around wearables, we showed him pictures of examples of wrist-worn devices (figure 4b) and gave clues about their benefits in terms of: imagine a bracelet that can keep track on where you are, that can show you what you want, remember what you want, tell you what you want and that can give you reminders. When talking about wearables we were conscious about the choice of not mentioning any specific technical terms such as GPS, Wi-Fi, etc. to rather focus on the useful functions these technologies could offer, hence this above wording. The interview lasted for one and a half hour. The researcher wrote down notes. After the semi-structured interview was conducted the researcher coded the answers and discussion reasoning from the expert into different categories of treatment aspects, and then she coded these considerations into design considerations.

4. RESULTS

The evaluation of the expert's answers led to the conclusion that there are aspects in the ERP treatment where wearables can be applied. Nonetheless, areas that were not fully covered to our desire, revealed the need for further investigation (see section 5: discussion).

4.1 Treatment considerations

The main focus under the interview came to be about the how the exercises were assessed. Here are extracts from the interview:

4.1.1 The importance of specifying exercises:
The exercises has to be accurately specified so that the clinician knows where the boundaries for the patient lies, and where one can set the right level of ERP exercises.

> –"We have to be very specific in what we agree to be the training exercise. For example, if the patient is to expose himself for a "dirty" public toilet the description has to be in terms of: Go into the restroom and stay at least 30 cm close to the toilet for 5 min. Or: Go into the public toilet and touch the sink with one finger and do not wash or brush you finger against your clothes or something similar".

4.1.2 The homework exercises:
The patient gets a sheet where he or she is to fill out how he or she feels in relation to the

Figure 4a: What happens in the time period between the weekly sessions?

Figure 4b: Examples of wearable bracelets (Source: Tokyo Flash LNK, Pebble and Jawbone Up)

anxiety thermometer before and after the exercise. Often the clinician's patients come back to a new session saying that they'd forgot to do the exercises or did not have the time. Our expert would get answers such as: -"My mom was supposed to remind me." -"I forgot the paper at home" or -"I didn't have the time". The expert emphasized that the treatment would not be effective if the patient did not involve in the exercises.

> -"They have to do the work, but I can be their coach."

4.1.3 Visualization of progress:
In order to motivate the patient in the treatment our expert said that he could show the patient his or her anxiety decline by sketching a chart (figure 5). He would take notes under an ERP session, before and after an exposure, asking the patient how he or she felt in relation to the anxiety-thermometer every now and then. He could then sketch up a chart, showing that often, patient's anxiety had gone down by time. Preferably, the logging of felt anxiety shall happen on set intervals so that one can see how the slope of felt anxiety declines steeper after several exposures.

> –"I do this so that the patient can see for himself that anxiety levels do go down by time. This is very effective, because it is written down and based on the patient himself, and not something that I am just saying. Often my patients are a bit surprised".

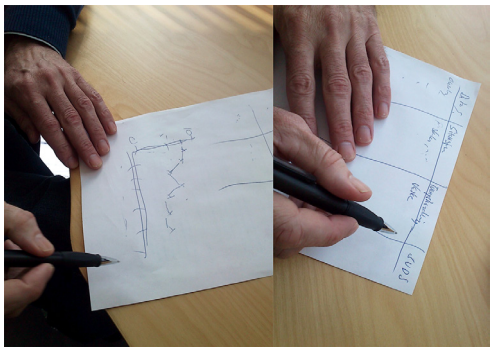

Figure 5: Sketching up anxiety-decline charts to show to the patient that his anxiety level decline by time.

4.1.4 Rewarding
We want to acknowledge patient's efforts and reward "won" exercises. It is also good to refer to success stories when a patient is in doubt of his own capability to proceeding an exposure-prevention exercise.

Other comments:
Regards to comments on applying wearables in the treatment, we can summarize the expert's feedback by saying that he was interested in the idea of implementing a wearable that could improve the challenges mentioned in the above section.

> -"I think is sound very interesting. My colleagues and I have also discussed the possibility in implementing something like a mobile application in the treatment".

4.2 Contribution of wearables:
Transforming treatment considerations into design considerations
The underlying reasons for patients not conducting their exposure-prevention exercises might be more of an intangible character than what we found under the interview: did not have the time, forgot the paper, forgot to do it. Factors like non-commitment to the methods used, high anxiety levels and strong obsessions might not be as easy to explain to the therapist. We can also envision that the practicality of bringing the evaluation sheet in for example a social setting might be inhibiting the patient to conduct an already anxious task. In this section we have therefore added factors such as: reduce social attention and increase user involvement in the formulation of the exercises.

Treatment considerations were coded by the researcher into design considerations: 1) making self-tracking practically easier, 2) present progress, 3) reduce social attention, 4) encourage and 5) invite the patient to participate in exercise formulation, hence increase patient involvement

4.3 Applying design considerations
A wearable device is limited by several factors, including memory and physical space. Naturally there need to follow a system. We present here a suggestion of a wearable system (figure 6).

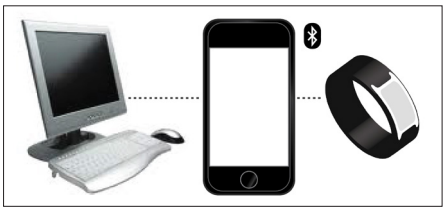

Figure 6: System overview

4.3.1 A concept of a wearable application for the execution of ERP exercises in the treatment of OCD:

1) Making self-tracking practically easier
A bracelet with a screen (see figure 6) is given to the patient to take home. It has a vibrator, which is used as a subtle notification (figure 7c) to remind the patient of 1) doing the exercises and 2) logging felt anxiety level after an exposure. This is simply done by registering a number between 0-10 in relation to felt anxiety (figure 7d). Consistent time intervals will give comparable data for following patient's progress. As the patient does not have to time these intervals him/herself, we hope that the activity of logging with the bracelet requires less effort from the patient than the scenario of taking the time "manually" and writing down felt anxiety levels on a piece of paper. Last, we hope that with this simple sequence of logging, the bracelet will enable the patient to fully focus on the exposure itself: The patient has *"to face the obsession-provoking stimuli head-on, without tricks or subtle forms of avoidance"* [7]. Now, the patient even has his hands free. It shall be mentioned that many factors plays a role for successful ERP treatment, involving the patient perception of what is "frictionless" interaction, so user-tests have to be conducted to validate the intended function of the system.

Furthermore, patient's logging from exposure activities, as well as a list of the patient's exercises are stored on a mobile application (app). The bracelet and the mobile communicate via Bluetooth (functioning the same way as with the product "Pebble" described in [15]). When the patient returns to his or her next therapy consultation, data can be transferred from the patient's mobile on to the therapist's computer (via bluetooth or wi-fi) for evaluation. Utilizing an electronic bracelet and a mobile phone will make paper and pen reluctant, as well as the bracelet will be accessible all the time, when worn.

2) Present progress
An effective and important factor for ERP treatment is to communicate to the patient that he or she has done progress [17]. Now, having sufficient, comparable data from the user, the patient can see for him or herself how he or she is doing by generated charts. Statistically, the patient will experience reduced distress. Seeing your self-improvement objectively on a screen is more tangible than "just something the therapist is saying". According to our expert, that is an effective tool. By this visualization of patient progress, we can also envision higher self-efficacy within the patient. By self-efficacy we mean the belief a person holds regarding his or her own ability to complete tasks and reach goals [14]. The data can as well provide guidelines for new measures in the treatment.

3) Reduce social attention
A shortcoming of mental health therapies is that they carry a social stigma in the society [18]. That is to say: unfavorable public opinions about mental illnesses. By utilizing a seemingly normal device such as a bracelet (or watch), one might reduce unwanted attention in a social setting, given that the interaction with the bracelet is subtle (contrary to writing with pen and paper). Furthermore, the bracelet can be "disguised" as a watch (figure 7a).

4) Encourage
Simple logging and confirmed progress can encourage in itself, but how can we encourage the patient in the moment of doing an ERP exercise? Research has found that even when patients are experiencing relatively high levels of anxiety and strong obsessions, they are able to push through with gentle and firm persistence on the part of the therapist *"It is crucial in these moments to encourage the patient to continue with the planned exposure"* [7]. How can we implement this aspect in the patient's everyday life? Our idea is to encourage the patient with motivational quotes sent from the therapist onto the screen of the bracelet when in the moment of conducting an ERP exercise. This is managed by the therapist pre-setting messages that are only sent when the patient has registered on the bracelet that he is about to conduct a new exercise. To have a significant impact, messages must engage emotionally [13], thus on a personal level. The messages

can for example refer to previous successes in the treatment (figure 7b). It can also be helpful to draw the patient's attention to his strengths: ''Remember how you confronted exposures lower on your hierarchy and it got better''; "You're strong enough to face your fears."

In addition we would like to add:
*5) Invite the patient to actively participate in exercise formulation, hence increase patient involvement (**this is for the mobile app in the system, and not the wearable itself*):
By implementing the exercise list onto the patients phone, the system requires that the patient writes down the agreed exercises him or herself. This procedure involves active participation. Only by the act of writing your own exercises, there implies a mutual agreement of what the patient is to do as homework. In the mobile app the patient can review exercise description and add comments.

5. DISCUSSION

In this section we discuss some relevant issues/ aspects of the presented system

5.1 Will the system generate an obsessive-compulsive behavior?

One question one shall ask is: will the system itself generate an obsessive-compulsive behavior? In an article regarding the use of mobile phones for adults with OCD the same question were asked to the patients and their answers were negative. *"Since patients viewed the application as something that was there to help them reduce and eventually stop repetitive behavior they avoided in engaging in repetitive behavior with the phone itself"* [11]. Because our system is different, one should test this hypothesis when having a working prototype ready. The design of the wearable, both functionally and aesthetically, plays a huge role. One does not wish to create a distraction that turns out to be just another ritual. We envision the sequence of the logging after the exercise especially needs to be studied for further development.

5.2 False logging

One issue that might arise is the patient's opportunity to fake the logging. Our expert, however, said that if the patient would come back showing unexpected results, he would request the patient demonstrate his or her progress. If the patient were to falsify his logging, the therapist will in either way get a confirmation/debunk that is what that has happened. It should be noted that the bracelet is meant to be a tool for the exercises and that the treatment as a whole should to be followed up by a professional clinician.

5.3 Why using a mobile app in addition to the bracelet?

The bracelet should not be uncomfortable, thus it should not be big or clumsy. Limited in size, data memory and power are also restricted. Utilizing a mobile app together with the bracelet allows more storage of data: the logging of the exercises. Moreover, a mobile app enables writing the content of the ERP exercises, and it also gives the patient the opportunity to write comments related to the exercises. Then why not only use a mobile application? The bracelets

a) "Disguised" as a normal watch *b) Message from the therapist* *c) Logging notification: Wearable vibrates* *d) The patient logs felt anxiety level*

Figure 7: Screenshots of wearable. (Product used: Pebble - E-Paper Watch for iPhone and Android)

advantage before the mobile is the subtle sequence of the logging. The bracelet does not contain many non-relevant distractions as on a mobile. And most importantly: notifications are less likely to be overlooked when placed on the patient's wrist.

5.4 Other factors for not tracking

We might have set the premises right to enable easy logging, but if there lies other reasons not mentioned in this paper for the patient not conducting the exercises, we will be in need of additional measures. However, the wearable system can diminish practical factors (and encourage the patient) and enable these other issues to be better identified.

5.5 Introducing technological solutions in a sensitive environment

For some patients, typically children and adolescents, therapy is something imposed upon them, and because of this they are often unwilling to accept it. In sensitive situations such as the treatment of OCD, it is important that the solutions presented to the patient are of high quality. If the technological intervention fails to perform as intended, the result may be detrimental for the therapy environment. Whether or not the proposed system will contribute to an effective treatment is left to be tested. However, studies regarding the use of a mobile application are having promising results, as mentioned in [11].

6. CONCLUSION

In this study we have focused on the importance of patients conducting their exposure-response-prevention exercises for a sucessful outcome of the treatment of compulsive obsessive disorder. Within this focus, and in the eyes of wearable technology, we have looked at the practical aspect of conducting ERP exercises. We have also included how to encourage the patient to perform ERP exercises. We collected information through literature, and we interviewed an expert in the field of pediatric OCD. Findings from the interview were coded into design considerations. Based on these findings, and literature research, we presented a wearable system. The system is to be used to log exposure exercises as we found that patients often return to therapy admitting that they have not followed up the agreed upon exercises.

This study was based on a qualitative method, which entails some disadvantages. For one, findings cannot be generalized to other disorders, as this study was conducted focusing in a particular context. Moreover, due to the nature of qualitative research (i.e., time consuming) we interviewed only one expert. Because we collected information from a clinician and not patients, it is a high chance that we have omitted some aspects regarding why patients do not log/follow up on their exercises. Despite these limitations, the findings generated valuable insights, which can be used in the design and development for future wearables in the treatment of OCD.

We acknowledge that to validate the presented system and to see if it has a significant effect, it has to be further developed, both functionally and aesthetically, and then tested on real users. One big pitfall for the system is the potential of generating compulsive obsessive behavior itself. However, the concept of utilizing a wearable for mental health purposes such as described in this paper is not new in the professional environment. During our initial research phase we had e-mail correspondence with all together 5 experts in the field of mental health, all showing interest in the approach of utilizing a wearable in the treatment.

We believe our contribution is the way we have approached the treatment: by an emotional (patient encouragement) and a practical point of view. We hope to stimuli motivation to consider challenges in mental health care from other perspectives. We have zoomed out of the therapist's office and looked at the challenges the patients face on an every day basis, which is the inevitable place where the patient should perform his best. The very essence of the exposure response prevention treatment is to make the patient realize that anxiety levels decline by time, without obsessive rituals - we have by this approach taken that intangible measure down to a tangible and visual wrist-worn platform.

We also want to emphasize that this initiative is at a preliminary stage; however, we believe that these results strongly indicate the emerging wave of the application wearable technology for healthcare purposes. In the next step of this ongoing study, we aim to improve and optimize the system and continue our research by conducting user studies with mixed methods (both qualitative and quantitative approach).

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