On the Use of Pervasive Computing to Support Patients with Obsessive Compulsive Disorder

Abstract
Obsessive-compulsive disorder (OCD) is a psychiatric disorder affecting 2% to 3% of world population. Patients having this disorder engage in repetitive and discomforting behaviors usually linked to controlling or cleaning. The potential of technical solutions trying to support both patients and therapists has been to a limited extent explored with some encouraging results. However, the use of a mobile phone application has not yet been explored. We present a study of a distributed application, partly running on mobile phone and partly on a website, with four patients suffering from OCD and their therapist. Our qualitative evaluation yields encouraging conclusions for practitioners and developers of such applications.

Keywords
Obsessive-compulsive disorder, pervasive health

ACM Classification Keywords
H5.1. Information interfaces and presentation (e.g., HCI):Multimedia Information Systems.

General Terms
Human Factors
Introduction
How many times have you had the sensation of having just left your house and not being quite sure if you have locked your door, or if you have put out the kitchen cooker, or whether you remembered to take your office keys; this feeling of uneasiness and the feeling of doubt; trying to retrace your actions in your mind, wondering whether you should go back and check. Most of us are having this experience once in a while. We are able to reassure ourselves by checking one time. However, approximately 2% of people are suffering from obsessive-compulsive disorder (OCD). They keep repeating the checking behavior, knowing it is unnecessary and often feeling ashamed and angry with themselves.

With OCD, people are engaged in repeating the same actions or thoughts over and over again. Most common are washing and checking behavior. This can be relatively innocent. For example, think of a person unable to stop checking the car lock and getting late for work every day. Nevertheless, it can also have dire consequences. For example, think of a parent unable to stop washing hands while an infant waits to be fed.

The disorder affects 2% to 3% of the world’s population [3]. The current treatment approach is Exposure and Response Prevention (ERP). With ERP, patients expose themselves daily to cues they avoid because those cues induce discomfort. Patients stay in contact with those cues till the discomfort and ritualizing subsides. Several studies show its effectiveness [5]. The effects of ERP last longer than those of medication. In a review of the last decade of behavior therapy research in OCD, it is concluded that ERP nowadays tends to be self-guided rather than therapist-guided, that the therapist’s role has become one of coach and that “computer aids to ERP instruction hold some promise” [5].

Leaving aside the current treatment approaches, there are several issues calling for technological solutions to support patients with OCD. First, in the context of our study we found that there are several patients in the Netherlands, in queue, waiting to receive ERP. Of those who have received treatment, there are patients who fall back and experience the same problems. When having completed ERP, the intensive exposure treatments are suddenly broken off with some limited contact with nurses. There is an expressed need for more contact between therapists and patients in the period where the exposure treatment is completed and patients are asked to return back to their homes. Moreover, there is an obvious need of reaching rural and remote communities, especially in countries with dispersed population such as Australia [8].

In conclusion, having remote solutions could certainly address most, if not all of the aforementioned problems, help patients and offer therapists tools to support their work. In the next section we present what has already been developed and reported on the topic of remotely supporting patients with OCD.

Use of technology to support mental health patients
Mobile applications to support patients with mental health problems have already been used. Doherty et al. [1] report on design and evaluation guidelines for mental health technologies. The authors present reflections of their experience with a mobile phone app for supporting adolescents in mental health care settings. A shortcoming of mental health therapies is
that they carry a stigma in the society for patients. Adolescents are even more sensitive of that shortcoming. Thus, privacy is an important user requirement. The mobile phone, being a personal device, affords for private use and thus a greater chance of actually being used for such patients.

Wootton and Titov [8] present a systematic literature review of articles reporting on the remote treatment of OCD. The authors identify three technologies that have been used: automated interactive voice response system, live therapist telephone treatments and videoconferencing. The automated interactive response system although having some benefits, resulted in a significant drop out rate so its applicability remains questionable. The two studies reporting on remote treatment by a live therapist were more promising. It was found that cognitive and behavioral therapy offered via the telephone was "as effective as that delivered face to face at both post treatment and at a 6-month follow up" [8]. Nevertheless, there is the obvious shortcoming of requiring therapists to be available for answering patients’ calls. Videoconferencing was also found to be effective and satisfactory for patients however it has the exact same shortcomings as live telephone treatment with the added requirement of both patients and therapists needing videoconferencing systems. They conclude that there is a need of extending current techniques, of exploring Internet based treatment and finally, of developing and evaluating self-guided help programs. It is noteworthy that each of the aforementioned three technologies would require the user to either be in complete privacy, or display their illness if they were to choose to use audio or video in public. The mobile phone again poses as a suitable medium for such applications.

**Figure 1.** Screenshot of website in which patients were asked to fill out the initial information. In this screenshot the initial page, that of inserting and updating the patient’s obsessive behaviors is seen.

**Figure 2.** Screenshot of the mobile application in which participants were asked to fill out daily a log whenever they were experiencing an obsessive behavior. The list seen on this figure was a mobile-friendly view of the data inserted at the website.

**A distributed application for asynchronous support and disorder logging of patients suffering from OCD**

Based on the identified problems, the fact that mobile phones are pervasive among mental health patient like the rest of the population and semi-structured interviews with the therapist we developed an application for patients to record the repetitive behaviors they experience during a typical day of theirs and the context under which those behaviors develop. This decision was taken for two reasons. First, it would serve as an input for the therapist to better understand the setting in which patients experience discomforting rituals. Second, it would serve as a log for patients to reflect upon.

The application was distributed, consisting of a website (Figure 1) and a mobile phone application (app) (Figure 2). Before handing a mobile device to patients, they were asked to visit the website. There, patients were asked to provide the following info: the obsessive behaviors that they experience during a typical day of theirs (Figure 1), the places in which each of the previous behaviors are being experienced, the activities for each place which was inserted and finally people who are usually around them.

The app serves as a daily data-capturing device for recording obsessive-compulsive behaviors that patients experience during a day of theirs and context information around those behaviors. To start reporting, participants would need to tap on the "START" button. To make the data capturing more efficient, patients would choose from drop-down menus the option to the questions: "which obsessive behavior (are you currently experiencing)?", "where are you?", "what are you
doing?”, “who is around?”. For all questions, patients had the option of choosing between existing answers, based on the initial insertion of the same questions which were posted on the website. Patients had also the option of answering: “Other”; i.e. “Other” (behavior), “Other” (place), etc. After answering these questions, participants would view a feedback message (Figure 3). This message, inserted by the therapist, was encouraging them to stop the repetitive behavior.

After answering the queries of the log constructed on the app, participants could view on the website the constructed log. While reviewing the log, patients could also further specify answers that were indicated as “Other”. The same principle of initial data insertion on a website and then relying on a shortlist of that data has been applied with success outside the therapy domain to facilitate experience sampling [4].

Along with the patients’ log, the therapist was able to choose, through the website, a specific patient, then a behavior that this patient has reported and then couple a feedback message with the purpose of helping the patient to stop the repetitive behavior. Initially, the app offered a single message, however soon it was expanded to coupling more than one message and later included the option of also adding an image. If a certain behavior was coupled to more than one message, a random message was chosen and displayed. Patients could also rate the feedback on its usefulness.

**Evaluation**

The usage of the distributed application was evaluated aiming to answer two research questions:

RQ1: Will patients with OCD experience obsessive-compulsive behavior with the mobile phone application itself? Especially if one takes into account that in most cases the discomforting behaviors have to do with checking and cleaning.

RQ2: If the answer to RQ1 is negative, what are the user requirements that would support patients to reduce or even stop the repetitive behavior? Moreover, what are the requirements from the therapist’s perspective?

**Method**

The methodology chosen was a non-controlled field trial, during which the experiences of the patients and the therapist were surveyed remotely and through three face-to-face interviews. As the objective of the study was to develop the application in iterations in order to better understand the user requirements and find out whether the application was actually the source of more obsessive behaviors, frequent informal interviews with all patients and the therapist were undertaken. In total three such meetings took place in a period of two months. Planned changes based on the interviews were crosschecked with the therapist before actually being developed.

**Participants**

Four patients (Table 1) and their therapist took part in the development and iterative evaluation of the prototype. All of them used the application for a period of two months. All patients were women, adults and have received treatment of at least seven months. They had a mobile phone and were using it; some regularly others infrequently. None of them had a touchscreen phone yet they were aware of the interaction style.

<table>
<thead>
<tr>
<th>Age</th>
<th>Occupation</th>
<th>Disorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>27</td>
<td>Nurse</td>
<td>Obsessive cleanliness</td>
</tr>
<tr>
<td>36</td>
<td>Housewife</td>
<td>Obsessive cleanliness</td>
</tr>
<tr>
<td>38</td>
<td>Accountant</td>
<td>Obsessive cleanliness</td>
</tr>
<tr>
<td>36</td>
<td>ICT assistant</td>
<td>Checking behavior</td>
</tr>
</tbody>
</table>

Figure 3. Screenshot of the therapist’s feedback message to a patient delivered on the mobile phone
Results
The results indicate for RQ1 the answer is negative. Participating patients did not report in engaging in repetitive behavior with the mobile phone, which was handed over to them neither with the app itself. Commenting on whether the phone was perceived as dirty, one patient said that the touchscreen with the absence of a keyboard was better in terms of perceived cleanliness since it was easier to wipe the screen and make it clean. Moreover, since patients viewed our app something that was there to help them reduce and eventually stop repetitive behavior they avoided in engaging in repetitive behavior with the phone itself.

In terms of user requirements, the feedback message, proved to be insufficient in the earlier version of the prototype. A single message was perceived as repetitive and not really adding value. Nevertheless, it was a source of inspiration. The therapist and one participant requested to have more than one message appear for a certain behavior and those messages to be evaluated by patients. In this way the therapist could have a more informed opinion of which message works better for a certain behavior. Another participant, requested instead of a text message to receive a photo. She thought of seeing a photo of her child, when engaging in a repetitive behavior and while filling out that behavior on the mobile phone. This photo, she mentioned, would serve as a stimuli for her to make her realize that this repetitive behavior has actually bad consequences for her child and family. In this way it would serve as a “wake up call” which would help her realize the effects of her action and stop repeating over and over again that action.

Another interesting requirement mentioned by one participant, was that of an alarm sound setting off when she would be in the middle of the repetitive action. This participant mentioned that she would more or less know when to expect a repetitive action would occur. She thought of our application having an alarm sound that could be set by her few minutes before the expected repetitive action would start. While being engaged in the repetitive action and while feeling helpless in stopping that, the alarm sound could serve as a something for her to draw her attention to and stop that disturbing action.

Furthermore, the patients also asked for the possibility to get some help messages before actually engaging in a repetitive behavior. If they know they have to perform a task with a high risk in leading to obsessive behavior they like to receive some advice beforehand. For example, in the case of a patient preparing to do the laundry, a message delivered through the app such as: “do the laundry in one step” would be helpful. They know, especially post-treatment, what they should do but when tired or excited they think they will find it helpful to get some advise from the mobile phone application.

Another unexpected observation was the change of behavior of one participant. One of the most difficult tasks for a patient was doing the laundry and that is why she was postponing that, until very late in the evening. The web log helped her realize the pattern of doing the laundry during the evening hours and she decided to change this into doing the laundry in the morning hours when she was relaxed. This change of time had a positive effect and she actually stopped engaging in the repetitive checking behavior. Thus, the
log served as a self-awareness tool and self-awareness helped changing a ritual that was probably the cause of obsessive behavior.

To sum up, the patients' feedback was enthusiastic. The reason for such a response was primarily their acute need of having something that would extend the existing support found in the clinic. A mobile phone application was perceived of even greater added value since it served as an extended hand of the therapist.

**Future work**
The participating psychologist had as an ultimate wish the device to be able to detect when patients would engage in repetitive behavior and appropriately assist them. Although being an obvious technical challenge, future developers of similar systems need to focus their efforts in integrating sensors, which would reliably detect repetitive behaviors. The task is difficult since repetitive behaviors are usually different for different patients. For example, for one patient it might be starting the washing machine whereas for another patient would be going in and out of a certain room to check whether the iron is still plugged, or whether the windows are still open.

For future work we would like to improve the prototype based on the user feedback we had and test more rigorously our tentative findings through data log analysis. We also want the log to be accessible through the mobile and make the feedback mechanism updatable by patients themselves. Although the application we tried out is far from perfect and in need of several extensions, the reported results show a clear trend that such application can be of tremendous value for both therapists and patients alike.

**References**


