

The 18th International Conference on Mobile Systems and Pervasive Computing (MobiSPC)  
August 9-12, 2021, Leuven, Belgium

# Literature-based requirements analysis review of persuasive systems design for mental health applications

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## Abstract

Mental health problems are becoming more common while access to treatment is often not available to everyone who needs help. Recent advances in information technology, the wide availability of the internet, the emergence of smartphones and their common usage worldwide raise hope for more treatment options for mental health disorders. Many mobile phone apps that claim to assist in treating a variety of mental health disorders are already available, and the number of such apps continues to increase. The availability of such apps raises many questions about their effectiveness, suitable treatment methods, possibilities for use alongside traditional treatment methods, possible risks and other uncertainties. Beside mobile apps, internet-based apps are also being introduced with similar sets of challenges and ambiguities. One area of research that is gaining a lot of attention recently is Persuasive System Design and Behavior Change. Persuasive System Design is considered one solution that has the potential to help solve the challenges of lack of user motivation and adherence when utilizing mental health applications. The goal of this paper is to perform a literature review, in order to determine the most essential requirements for a persuasively designed mental health application. As part of this process, the challenges and requests of the end-user will be taken into account in order to make recommendations for the future design of such applications.

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Peer-review under responsibility of the Conference Program Chairs.

*Keywords:* Persuasive Systems; Mental Health application; Web-based Interventions;

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## 1. Introduction

Recent advances in internet and mobile technologies have the potential to offer new opportunities in the way that we treat mental disorders [1]. The number of individuals using messaging apps in 2019 is understood to be around 2.18

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billion worldwide [2]. This indicates that the use of mobile phone apps is now widespread. Such numbers provide an opportunity for the use of internet and mobile technologies to deliver mental health support to individuals who require it. However, the use of internet technology and mobile apps comes with its own set of challenges. User adherence to a mental health app is one challenge when it is used as part of a treatment procedure. In a survey of mood app usage, it was found that the apps are used no longer than two weeks after download on average [3]. Similar results have been reported for anxiety, depression, or well-being apps [4]. There are other challenges facing both users and mental health professionals regarding the use of such apps, such as concerns regarding efficacy, ethical issues, users' discomfort, data safety and security concerns [5] [6], to name only a few. Moreover, several studies highlighted a missing link between user and expert ratings, with only modest average content quality of mental health apps as rated by domain experts [7] [8] [9]. To overcome users' lack of interest or decreased motivation after starting treatment, [10] and [11] suggest the use of persuasive technology to increase adherence. Persuasive design technologies have the potential to change or influence the behaviour of the user [12]. In the case of mental health apps, [13] states that persuasive design technologies can be used to alter the behaviour of the user in order to support them to keep using the app and achieve their goals. This paper provides a requirements analysis based on available literature for mental health applications that use Persuasive System Design (PSD). These requirements can be taken into consideration by anyone developing a mental health computer system, irrespective whether it is a web app, a mobile app, a desktop application or an internet intervention. Hence, this paper attempts to provide a contribution that can be used in practical settings in the development process of mental health persuasive applications. The remainder of the paper is organized as follows: Section 2 offers background information regarding mental health applications and Persuasive System Design, as well as describing the needs behind using Persuasive Design Technologies in mental health applications. The requirements discovery process is presented in Section 3. Furthermore, in Section 4, the identified requirements are discussed. Finally, Section 5 concludes the paper and suggests possible further areas of research.

## 2. Background and Motivation

The concept of Persuasive Design has already been put into practice through many notable research projects and in several different fields [14]. Persuasive technology as defined by Fogg in [15], is “the use of computer-mediated products in order to change people’s cognition and behaviors”. Furthermore, Fogg developed the widely-known Fogg Behavior Model (FBM) [16]. This model consists of three components: motivation, ability, and triggers [16]. According to the FBM, for people to reach their goals, all three components of the Behavior Model must be present. Aside from Fogg, other researchers have tried to put together definitions for persuasive systems. [12] states that persuasive systems are “computerized software or information systems designed to reinforce, change or shape attitudes or behaviors or both without using coercion or deception”. Using persuasive technologies is suggested by [10] to raise user’s adherence to mental health applications.

In terms of software engineering for behavior change and persuasive systems, [17] provides a discovery process for non-functional requirements. The discovery process contains three steps: 1) identifying unfulfilled user needs, 2) mapping to the PSD premises, and 3) categorizing user feedback to the PSD categories as described by [17]. Moreover, [17] explains that identifying the unfulfilled needs of users could be achieved by utilizing assessment questionnaires. Other studies have also investigated how gamification could be used to alter people’s behaviors. [18] provides a framework for software with gamification elements to influence the behavior of the user and make the software more engaging. Furthermore, [19] provides a software architecture design, which can support the development of behavior change support systems. It relies on understanding the user context, i.e., the differences amongst users and their individual cases. Additionally, it also relies on understanding the intent and the desired behavior change, and deciding on the technology stack and the implementation approach.

Based on our literature review, research into the area of software engineering and requirements analysis for Persuasive System Design is still growing. However, resources are more limited when it comes to software engineering for persuasive mental health applications. This work tries to provide recommended requirements that should exist in e-mental health applications. These requirements are elicited based on the experiences and feedback of the end-users of such applications.

### 3. Requirements Discovery

[20] provides a description for the requirements discovery process in general. It starts with the following: Identify customers and stakeholders, understand the customer's needs, define and state the problem and write system requirements as stated by [20]. The focus of this work will only be on two categories of stakeholders: users and service providers (clinicians, therapists, etc.). The first step deals with users' experiences, understanding user's needs, gathering information regarding what problems users faced when using mental health applications, what affected the usage of such applications negatively, and what suggestions users may have.

#### 3.1. Method

Several studies have already been carried out to investigate users' experiences with e-mental health apps and to try to identify the most common problems faced by the end-users. Using IEEE Xplore, the National Center for Biotechnology Information (NCBI), the databases of PubMed and Google Scholar, a literature review was performed to identify papers published in English from the year 2014 to the end of 2020. The papers describe the opinions and experiences of adult users in using internet and mobile technologies to access mental health. As mentioned in [20], understanding customers' needs is the second step in requirements analysis. In order to search for user feedback, the following terms are used: user's reviews, user's opinions, therapists' feedback, service providers, blended therapy combined with mental health apps, internet-based interventions and web-based mental health app. Since smartphones are now widely used [2], the search first focused on studies where users sought help using their mobile apps to access treatment courses or support materials. Further to this, the search looked for other types of technologies used to facilitate access for users to mental health support such as web-based apps, online forums, discussion groups, websites, and social media.

The next step was to identify studies that provided data on the opinions of clinical practitioners who provide mental health support. The search was divided into two parts; the first part sought to identify the opinions of therapists regarding therapy provided solely via internet and mobile technologies, and the second part sought to identify the opinions of therapists regarding the use of blended therapy, in which support is provided to patients using traditional therapy methods as well as using internet and mobile technologies. When similar results are identified in different papers, only one is included. The selected paper is the one that has the largest number of reviewed users. The previous workflow is presented in Fig. 1.

#### 3.2. Results

10 studies were identified, but two of them were excluded due to being outdated. One was rejected because it deals with adolescents' and not adults. Another was excluded because it only reviewed a small number of users' opinions. In total, six studies were shortlisted and the final list excluded one of these six studies for repeated outcomes and similarities to another study. Using machine learning and thematic analysis, [21] carried out a study to discover factors influencing effectiveness of mental health apps based on users' reviews. The total number of apps included in the study amounted to 105 apps and up to 88,125 reviews. The study discovered both negative and positive factors. Moreover, the study provides suggestions based on users' reviews. Results of the survey can be classified into liked features, suggestions, missing features and concerns. Among the features that users requested or found useful while using the apps were the following:

- Simplicity
- Personalized Content
- Logging
- Ease of Use
- Reminders
- Customizability
- Social Effect
- Analytics
- Enjoyability
- Virtual Reward

Regarding missing features and concerns, users reported the following:

- Lack of Customization

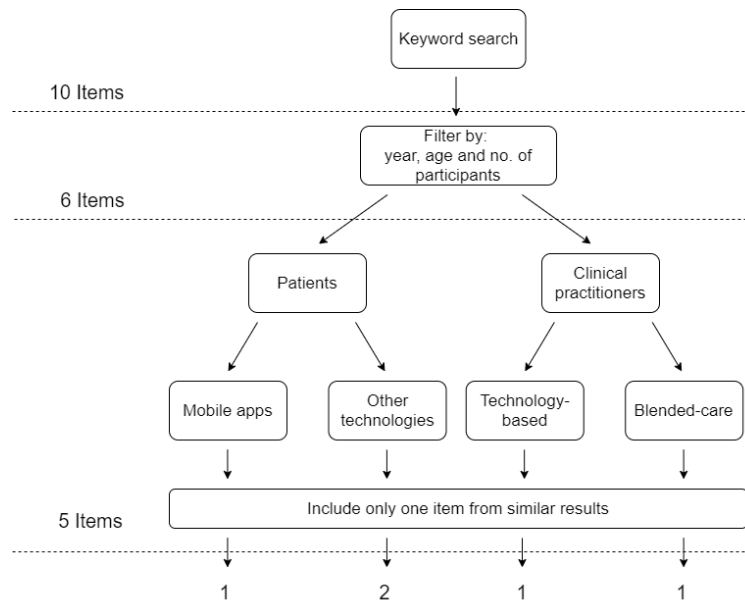


Fig. 1. Literature Review Workflow

- Navigation Issues
- Data privacy and Security
- Non-personalized Content

Since this paper does not focus on a specific platform, such as mobile or web, it is useful to look at findings from studies that focus on more varying technologies. [22] conducted an online survey to explore the use of technology to support individual's mental health. Unlike the previous studies, which focused on mobile apps, this study included a variety of technologies, such as mobile apps, web-based apps, online forums, discussion groups, websites, and social media. The study analyzed the responses of 81 participants to a survey consisting of 59 questions regarding their use of different types of technology to support their mental health. Among the features that users requested or found useful when using the apps were the following:

- Connecting with others
- Expert Interaction
- Tracking and Analyzing
- Recommendations based on Monitoring
- Personalization
- Customization
- Professional Input

While missing features and concerns were as follows:

- Trust (in the system, the content and the community)
- Fears of Overuse
- Non-personalized Content

Furthermore, [23] was conducted to understand the user's view on what impacted their interaction and its frequency with a web-based psychosis intervention application. 17 individuals (males and females) participated in the study with ages ranging from 18 to 65, with varying levels of education. Users reported the following positive influences:

- Incorporating it into the Daily Routine
- System-automated support Emails

- Connecting with Peers
- Flexibility of the Intervention (feeling in control)

While the negative influences were as follows:

- Outside Factors (levels of willingness, lack of time or space)
- Overwhelmed by Navigation
- Feeling the content is irrelevant
- Lack of connection with other users
- Content-related Factors (triggering contents)

Another important group of end-users are the therapists that use the platform to help their patients to overcome their mental health disorders. [24] conducted a study to explore the opinions and experiences of mental health providers on using web and mobile tools to help patients. A total of 15 participants were included in the interviews. Six questions were asked and articulated in a way that allowed room for discussion. The features requested by users were as follows:

- More support for complex presentations (more than one diagnosis and changing situation over the course of treatment)
- Remote Monitoring (behavior and symptoms)
- Colleague Interaction Tools (between providers)
- More support outside the office
- Supervision

While concerns and missing features were as follows:

- Confidentiality and security of patient data
- Security of Communications
- Ease of Use
- Low adherence to treatment activities

Another relevant study is [25], in which nine therapists were interviewed about blended care in clinical practice. The therapists identified several main areas that needed attention during the development of apps for clinical use: 1) The need to increase the ease of the patient's adherence to the program by providing information via different tools such as videos, animation, or expressive examples. They identified that this was preferred by patients over big blocks of texts. 2) The option for online feedback and reminders. 3) The integration of encouraging tools and features such as gamification. 4) The incorporation of a motivational aspect for the therapist within the app. 5) The inclusion of flexibility for the therapist, such that they can have a wide selection of tools to avail of, in order to tailor the app to the individual needs of each patient. Overall, therapists expressed an interest in motivating patients and encouraging them to finish their assignments [25].

Considering the studies previously discussed, closely related or similar requests can be grouped together, for example, enjoyability while using the application and virtual rewards can be grouped under gamification. Ease of use, simplicity, and navigation are grouped under usability. Furthermore, professional feedback, supervision and support outside the office is grouped under professional support. Data security related concerns were grouped under security category. Finally, monitoring user's situation, data logging, and analysis are grouped under monitoring and analyzing.

Table 1 shows how many times each category was mentioned over the five studies. From the table it can be seen that having highly customized apps was requested by both patients and therapists in all studies above. Tracking and analyzing user activity was mentioned by patients and therapists in three out of five studies. Supervision, expert feedback, data protection, and security concerns were also requested in three studies. Usability concerns, gamification, personalized content and recommendations, social interaction tools, and reminders were all mentioned in two out of five studies. Finally, a wide selection of media options, provider to provider interaction tools, and low adherence to treatment activities were mentioned in one of the five studies.

Table 1. Requested features occurrences over the five studies.

Request Category	Study 1	Study 2	Study 3	Study 4	Study 5	Total
Usability	1		1	1		3
Customization	1	1	1	1	1	5
Gamification	1				1	2
Personalization & Recommendation	1	1	1			3
Monitoring & Analyzing	1	1		1		3
Social Support	1	1	1			3
Professional Support		1		1	1	3
Reminders notifications	1		1		1	3
Security	1	1		1		3
Rich media choices					1	1
Colleagues interaction tools				1		1
Low adherence to treatment activities				1		1

### 3.3. Suggested Requirements

Based on the aforementioned literature analysis, the following requirements are suggested:

#### 1. Easy and intuitive user interfaces

Usability was mentioned at least three times in the studies above. Many of the users' reviewed in the studies above requested applications that were simple and easy to use. Some users even described their navigation experience through the web-app from study [23] as overwhelming.

#### 2. Customization

Customization is the feature mostly requested by users over the five analyzed studies. Therapists should be enabled to customize and adjust the content based on the specific needs of each patient. This could also counter the complaints from some users in study [23] that certain features felt irrelevant to their requirements.

#### 3. Protecting users' privacy

Privacy concerns were also mentioned by many users over at least 3 of the five studies. Either as lack of trust in the app, or as explicit privacy concerns as in [21]. Mental health applications should try to gain the trust of their users by being transparent about what data is being collected, i.e., the sharing data policy. Additionally, encryption is advised whenever possible to provide another layer of privacy and protection.

#### 4. Flexible notifications and reminders

Notifications and reminders are among the features most frequently requested by users. They can be helpful in reminding users of their tasks [26], but they should be used with care so that the user does not feel disturbed by their occurrence, as stated in [12], i.e., persuasive systems should not disturb their users. To avoid such a scenario, notifications and reminders should be personalized, based on the user's usage routines of the app [27], while providing users with the option to adjust reminders and notifications.

#### 5. Promoting users' autonomy

[28] suggests offering users more choice to set their own sub-goals and to work with the app according to their own pace. Additionally, [29] states that offering users more choices can be motivational. As people acquire skills at different speeds, it is important to have each user choose their own time frame to reach each small goal. This becomes more important when discussing ways to implement a reward and a gamification system, which is a feature often requested by the service providers. Forcing users to follow one pre-defined workplan could result in some users feeling "left behind" or unable to keep up with the speed suggested by the app.

#### 6. Track changes in users' status

As mentioned by the service providers in the studies above, users can sometimes have more than one diagnosis and their diagnosis can change over the course of time. The application should be able to adjust its activities and interventions accordingly. As mentioned in [29], tailoring should be dynamic and adapt to the changes of the user. This works hand in hand with other requirements.

#### 7. Users inter-communication tools

Some users in [22] and [23] expressed interest in being able to communicate with other users of the app in order to exchange experiences. As [23] states, some people registered on the website for the sole purpose of hearing what other people have experienced and sharing their own experiences as well. It also states that people's motivation dropped when they tried to get in touch with other users, but were not able to do so.

### 4. Discussion

The requirements suggested in the previous section can be helpful when trying to introduce persuasive design strategies into an e-mental health application. The requirements were discovered based on the suggestions of patients who use digital technologies and mental health applications to improve their mental health as well as service providers who assist patients during their treatment. The list of requirements is not final and can be adjusted according to each application-specific needs. There is always room for improvement based on the latest developments in the theory of persuasive design, technological advances and the varying needs of the users. This list offers a starting point and, to the best of our knowledge, it is the first list of its kind in the available literature. Furthermore, these requirements are aimed at e-mental health applications in general. While these recommendations can apply to many different software categories, it is not necessarily a definitive list of requirements for all e-mental health applications. For example, in some cases, mobile apps are developed to deal with one specific diagnosis, such as people being treated for post-traumatic stress disorder (PTSD) [8] or depression [7]. In this situation, the requirements recommended above can be a helpful starting point, but the app may have further requirements specific to helping users who are dealing with this disorder. Furthermore, as can be seen in the above requirements, collecting user data and behavior patterns is the cornerstone and the basis for many other requirements and functionalities of such applications. It is important to understand the legal requirements of such data collection based on the country of operation, as regulations can vary across countries.

### 5. Future Work & Conclusion

The requirements suggested above were based on utilizing persuasive design strategies to overcome challenges faced by patients and service providers. In some cases, the requirements of further stakeholders must also be taken into consideration (e.g., operating facilities, fundraisers, governments). These stakeholders can have their own set of requirements, challenges, and needs. This review focused on users who can directly affect the workflow of the treatment and are directly impacted by it. Furthermore, as suggested by [30], requirements should be further processed and reviewed in an iterative process in order to discover more requirements. This process will be discussed in more detail in future work. Another factor to consider constitutes the platform upon which the application is being developed on. This review did not put much emphasis on the application type. In a real-world scenario, the application can be designed to run on mobile devices, in a browser, in a smartphone, as a desktop application, or on a combination of more than one platform, such as a mobile application and a web app. Additionally, in the case of blended therapies, the application could have more than one part, for example, one app for the participants and one for the service provider. Such a scenario should be taken into account when designing an e-mental health application. Depending on the nature of the system being developed, all these requirements can be used together or individually. For example, when the application has a need for personalization, then the second, the fifth and the sixth requirements can be helpful. Another case is when user and service provider each use a different application with different needs. In this case, the requirements can be more specific for each application. Finally, more research could be done to validate the requirements and fine-tune them, by utilizing them in a persuasive mental health application to examine their effectiveness. This step is outside the scope of this work and will be addressed in future publications.

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