DEVELOPMENT OF A MOBILE APPLICATION FOR BORDERLINE PERSONALITY DISORDER TREATMENT: USABILITY, ACCESSIBILITY AND PLEASURE

Maryam Sharifineyestani

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DEVELOPMENT OF A MOBILE APPLICATION FOR
BORDERLINE PERSONALITY DISORDER TREATMENT:
USABILITY, ACCESSIBILITY AND PLEASURE

by

Maryam Sharifineyestani

A Thesis
Submitted in Partial Fulfillment of the
Requirements for the Degree of
Master of Fine Art

Graphic Design

The University of Memphis
May 2022
Dedication

This thesis is dedicated to my parents, husband, sister and my two brothers. Thank you for always supporting my goals and ambitions with your prayers, faith, love, and patience.
Acknowledgements

I would like to express my sincere gratitude to my advisor, Dr. Michael Schmidt for his unwavering support, insightful comments and suggestions, and belief in me. I would also like to offer my special thanks to my committee members, Prof. Gary Golightly and Prof. Lucas Charles, for their kind help and support.
Abstract

Digital technology especially mobile applications have improved health services significantly by making them more accessible and engaging. Nowadays, there are a lot of mobile applications that focus on mental health. Some of these applications are helpful in diagnosis, treatment, or support of patients with mental health problems such as borderline personality disorder (BPD). In this research, I investigate mobile applications that have been designed to help patients with borderline personality disorder (BPD), and I design and prototype a mobile application that addresses the weaknesses of previous solutions, particularly user experience (UX) and user interface (UI) design.
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Chapter 1: Introduction

Mental health is derived from our emotional, mental, and social health. It affects the way we think, behave, and act. It also helps us to manage our stress, communicate with others, and make the right choices in a timely manner (“MentalHealth.Gov” n.d.). However, some people have issues with their mental health and sometimes they suffer from serious personality disorders that impact their moods and thoughts and prevent them from doing their daily tasks such as studying or having a good relationship with others. One of the common personality disorders is borderline personality disorder (BPD). Patients with borderline personality disorder experience severe emotional changes, often see the world in black and white, and always seem to be going from one crisis to another (Trauma and Davison, 1999). Usually, only a few people may understand their reactions. Therefore, they do not have the support to cope with these sudden changes and intense attacks of emotions.

Dialectical Behavior Therapy (DBT) is a well-researched psychological treatment method that is very effective for treating BPD. There are four treatment modes in a standard out-patient DBT, including individual psychotherapy, skills training, psychotherapist consultation team, and phone consultation (Rizvi, Hughes, and Thomas, 2016). There are some helpful interventions besides DBT. Thanks to technological advances, mobile applications can be deployed as interventions in treating mental health issues (Alqahtani and Orji, 2020).

In this thesis, I investigate mobile applications that have been designed as an intervention in treating BPD, and I design and prototype a mobile application that addresses the weaknesses of previous solutions, particularly shortcomings in user experience (UX) and user interface (UI) design.
Chapter 2: Literature review

Digital health tools are helpful in improving health services by making them more accessible and more engaging (Alqahtani and Orji, 2020). Also, they often reduce the costs of the treatment process (Michaels et al., 2020). Among these tools, mobile applications play an invaluable role, as they are very effective interventions in the treatment of mental health problems (Alqahtani and Orji, 2020). Examples of applications that have been designed to support mental health diseases include apps that help to deal with anxiety. Most of these are games-based apps that are useful in self-monitoring for patients whose health issues are related to mood (Helweg-Joergensen et al., 2019). Different techniques have been used in theses apps including: “(1) tracking and monitoring to improve personal insight about causes and symptoms of mental illness, (2) providing techniques to mitigate and manage symptoms emerging as a result of a mental health issue such as breathing and meditation, and (3) providing a social community where users can ask and/or answer questions and find support” (Alqahtani and Orji, 2020, p. 3).

There are many applications designed to support borderline personality disorder (BPD) too. This chapter will provide reviews of some articles that talk about supporting the treatment of BPD with mobile applications.

An investigation of mobile applications that have been designed for borderline personality disorder (BPD)

In Using a Mobile Diary App in the Treatment of Borderline Personality Disorder (Helweg-Joergensen et al, 2019) the authors assess the feasibility of utilizing the mDiary app as a complement of dialectical behavior therapy (DBT) for the treatment of borderline personality disorder (BPD). Long-term monitoring of DBT courses using pencil and paper registration is
overwhelming and not practical. Accordingly, a mobile app has been designed to help monitor the progress of the patients (Helweg-Joergensen et al., 2019).

Nine focus groups were interviewed in a mixed-methods study, and a questionnaire assessed the perceived usability of the mobile app. Five focus groups were allotted to therapists only and four to patients. The platform of the app handles the data through either a mobile phone based app or a webpage to be filled out by patients on a mobile phone (Helweg-Joergensen et al., 2019).

In the mobile phone mode, registered data is retrieved, the data are visualized, and related educative material is delivered to the patient. The app supplants the DBT paper-based diary cards. The web-based sections designed for a tablet or a desktop and is mainly used in therapy sessions to monitor progress. The therapist and the patient can enter data together and the patient can evaluate the screen at home (Helweg-Joergensen et al., 2019).

The web-based interface includes a broader and more detailed present and long-term overview of the therapy progress. The phone-based submenus of the web-section consists of a time series format overview, a diary text overview and skills utilization overview (Helweg-Joergensen et al., 2019).

Generally speaking, the ratings derived from this study showed patients very highly pleased with this method. However, ratings from therapists were undoubtedly lower compared to those of patients, and older users rated the usability lower than the younger individuals. The mDiary app was rated an acceptable and relevant method of recording a DBT diary for patients' progress, although accepting new technological assistance in clinical work requires time for adaptation (Helweg-Joergensen et al., 2019).
In *The DBT Coach Mobile Application as an Adjunct to Treatment for Suicidal and Self-Injuring Individuals with Borderline Personality Disorder* (Rizvi, Hughes, and Thomas, 2016) the authors apply the dialectical behavior therapy (DBT) coach mobile application to the acquisition of behavioral skills for individuals with borderline personality disorder (BPD). The sample consists of 16 individuals diagnosed with BPD with a record of suicide and/or non-suicidal self-injury.

Based on dialectical behavior therapy, BPD patients suffer faulty interpersonal relations, emotion regulation and distress tolerance, and different factors can compromise their use of the limited skills they have. The foundation of using mobile application for treating mental disorders is that suicidal individuals require in-the-moment guidance to translate the skills worked on in therapy sessions into real situations, and the ubiquitous nature of smartphones provides the means to serve this purpose—especially during distressing periods (Rizvi, Hughes, and Thomas, 2016).

The DBT coach is a phone application installed on a mobile device as an adjunct to six months of standard DBT that provides interpersonal on-demand guidance in DBT skills in order to encourage and facilitate the use of DBT skills in individuals with BPD. The DBT coach application was used in this study. Participants claimed that the application was easy to comprehend and utilize. They found the app useful in self-harming cases and confirmed the app was helpful to some extent in their own treatment (Rizvi, Hughes, and Thomas, 2016).

At mid-treatment and post-treatment more than 90% of participants stated they would use the app if it were accessible outside of this study. Nonetheless, the app was rated poorly regarding how attractive and engaging it was. It was found that the DBT coach is effective for distress
control and impulses of self-harm in-the-moment. However, the frequency of using the app did not always correlate with the outcomes of treatment (Rizvi, Hughes, and Thomas, 2016).

*An Proposal to Support Wellbeing in People with Borderline Personality Disorder* (Good et al., 2013) aims to enhance the moods of not only people suffering from dementia and mood disorder but also different types of users. In this study the authors investigate the effects of an application that has been designed based on reminiscent theory to boost the mental health of all people, especially those with BPD. Seeking consultation from end users is advocated in this study (Good et al., 2013).

Considering the fact that BPD is rather widespread compared to other mental disorders, and that people with BPD are more likely to seek intervention, more attention and care is required here. Individuals with BPD require pervasive methods to be able to regulate their emotions. In developing this app, a user-centered design has been applied to adapt the features to the users (Good et al., 2013).

"My Favourite Things" (Good et al., 2013) is an application that draws upon Reminiscence Theory (RT)—originally developed for people with Alzheimer’s disease. Users upload photos, videos, recordings and notes and arrange them in different formats, e.g., a slideshow with music or a list of items to choose from. To conduct the research, a focus group of people with BPD assisted in the design and evaluation of the prototype mobile app (Good et al., 2013).

In *Insights from user reviews to Improve mental health apps* (Alqahtani and Orji, 2020) the authors conclude that using mobile apps has recently shown promise with individuals suffering mental issues. However, high rate of drop-outs is the main obstacle in the way of researchers trying to evaluate the effectiveness of the apps. This also causes mental health apps not to be implemented. People with mental health disorders require social support from family and friends
and around-the-clock assistants to regulate their moods (Dirkzwager AJE, et al., 2003). 

Therefore, due to the pervasive nature of mobile phone technology, over 10,000 mental health and fitness apps are designed and available to be downloaded for users (Torous J & Laura WR, 2017).

Firstly, unsatisfactory usability can be one of the causes of low adherence. Alqahtani and Orji (2019), using a thematic analysis, found usability issues in 106 mental health apps by the aid of 1,236 user reviews. They categorized usability problems as follows: bugs and undesirable design of UI, information loss, battery and memory problems, lack of clear instructions, internet problems, and lack of main features. Secondly, privacy issues is one of the plausible obstacles. Thirdly, another main issue with mental health apps is that they are not able to meet the needs of the users. And finally, distrust of the wellbeing apps hinders individuals form utilizing the apps. Only a few apps are based on scientific evidence, and some may even be detrimental (Alqahtani and Orji, 2020).

In Google Play and the App Store, user reviews and ratings are a source of user data based on their experience with apps and therefore can be drawn on for various studies on aspects of mobile apps. Mostly, users were satisfied with the apps. An important popular feature in the apps was the possibility of adapting the features and functionalities by users. They also preferred apps with ease of use and clear visualizations. Qualities that users preferred in the order of importance were usability, variety of options, personalization, affordability, being informative, credibility, social support, customer service, user control, security, regular updates, and emergency support. Qualities users requested were to a high degree similar to qualities popular among users. And finally, weaknesses of the apps, from the viewpoint of users, in the order of importance were
usability issues, lack of trust, unaffordability, lack of variety of options, poor customer service, lack of personalization, lack of security and lack of control (Alqahtani and Orji, 2020).

In Development of an Ambulatory Biofeedback App (Derks et al., 2019), the authors developed an ambulatory biofeedback app for mental health care. The app helped to recognize the personal emotional changes better and increase emotional awareness. They tested the app’s usability and user experience in a development process with different groups of patients, therapists, and UCD experts. In the first cycle of the prototyping process, most of the usability problems were identified. Therefore, the subsequent cycles were about applying new or developing existing functions. (Figure 1) shows the cycle process of usability testing.

Figure 1. Specification of the Method of Prototyping within the EMP-framework (Derks et al., 2019).
Some of the usability problems were related to navigation. For example, users could not find the option to go back to the previous screen easily. Also, users had difficulties with the location of the on/off button. It could be better if the on/off button was located on the upper right corner as it is common in most of the apps. In addition, there was another navigation problem in the visual layout of the homepage. For instance, when the user clicks one page, the other page is shown in light gray shading. The users may imagine that the function is not available. In contrast, the text coaching has a color like the active buttons. Furthermore, in textual layout the words for some windows and buttons were too professional and technical. Therefore, the users could not understand them. And finally, there were problems in visualization of measurement. To give an example, the overview of all measurements were justly textual and it caused difficulties for users to understand them (Derks et al., 2019).

In Smartphone Applications Targeting Borderline Personality Disorder (Ilagan et al., 2020), the authors evaluated the effectiveness of mobile applications designed as treatment interventions for adults with borderline personality disorder who had common symptoms in BPD, like anger, suicidality, or self-harm. The analysis did not show a significant difference in effects of conditions with and without of smartphone applications for BPD-related symptoms or general psychology. They concluded it is too early to recommend mobile applications as self-sufficient and even parallel treatments. However, they found helpful results in the observational studies with BeyondNow, RELAX, EMOTEO, and DBT Coach, noting some reductions in BPD-related symptoms. Llagan et al., had several suggestions from their study (Ilagan et al., 2020).

In Mobile App Integration into Dialectical Behavior Therapy (Austin et al., 2020), the authors studied the experiences of users who used a mobile application that was designed as an addiction treatment for DBT for borderline personality disorder (Figure 2). The app employed
many of DBT techniques. Indeed, the app was an alternative to the traditional paper therapy (Figure 3). The functions of the app were "psychoeducation, recording and monitoring of mood, descriptions and implementation guidelines for a range of cognitive behavioral strategies to deal with challenging situations, and memos where a person could note their experiences in situ" (Austin et al., 2020).

The participants could access the app functions when they needed them. Specifically, the self-assessment aspect of the app was very functional, as it provided participants to process information about their mood, behavior, sleep patterns, and other factors they desired to monitor. The participants could access to the app in all situations and use it as a support tool outside the therapy sessions. The information that was input by participations was summarized into graphs. These visual summaries provided an overview of symptoms and mood alterations over time. As the information could be accessed by both the person and therapist, the therapist could identify specific situations that were difficult to discuss in face-to-face appointments (Austin et al., 2020).

Figure 2. Self-assessment function menu of the mobile app (Austin et al., 2020)
Figure 3. Dialectical Behavior Therapy folder function with strategies (Austin et al., 2020).

In *Postsecondary Student Engagement with a Mental Health App* (Wong et al., 2021), the authors found that postsecondary students’ (ages 17-29) access to mental health support was of the utmost importance. Mobile app technology is a convenient and popular method among teenagers and the youth, and it is pertinent to be used as a mental health support aid (Wong et al., 2021).

Based on traditional computer science and research on human-computer interfaces, engagement is classified as being concentrated and interested when using the app. Sadly, though, insufficient engagement among this age group is prevalent (Wong et al., 2021). Wong et al. (2021) conducted a study with the purpose of evaluating user engagement of post-secondary students using Thought Spot, which is a mobile mental health app. Thought Spot was designed using methods of participatory design research and usability testing of college and university students. Based on the social cognitive theory and the theory of help-seeking, this app's purpose
is to provide students with mental health support and create the habit of seeking help (Wong et al., 2021).

This qualitative study also tried to determine factors that influence post-secondary students' viewpoints and behavior when working with the Thought Spot app. This paper is part of a larger study that contained a randomized controlled trial (RCT) to assess Thought Sport. Participants in the qualitative part of the study were the students who completed the Thought Spot RCT. Semi-structured interviews were conducted on the participants and the questions were concerned with the general information and features of Thought Spot, the help-seeking skills, the reasons and methods of using it, the advantages and disadvantages, the relation of this and other help-seeking experiences and opinions on how to enhance the app (Wong et al., 2021).

According to Wong et al (2021), users showed different degrees of satisfaction, and their engagement was affected by factors that can be grouped into five categories: (1) Students opted for detailed, inclusive and to-the-point content. (2) Technical problems influenced the general user experience. (3) Using the app to support friends and family increased app engagement. (4) Obtaining data from peers and mental health resources resulted in user engagement. (5) The app was commonly used as an emergency resource rather than a long-term mental health tracker (Wong et al., 2021).

The interview transcripts are drawn on to determine some of the edges and drawbacks of the app as well as suggestions to improve it. The edges included information about mental health services nearby, mental health information, the possibility to help others use mental health resources and services, and crowd-sourced information about mental health resources to increase user motivation to reach out for services (Wong et al., 2021).
The drawbacks were the lack of breadth and pertinent data, non-inclusive information about specific cases, lack of relevant information, technical glitches, incompetence in integrating with other apps and low engagement for some users to add information to the crowd-source.

There were also some suggestions, such as mentioning the kind of support brought in by mental health services, including the background of people providing the services, providing more tools, data and strategies to help users overcome their moods (Wong et al., 2021).

In *User experience (UX) in health education apps: Interaction testing with physicians in a Work Context in Brazil* (Junior, 2018), the author investigates UX of an app in Brazil. This paper evaluates an app through interaction testing with interviews and a follow-up questionnaire on user consent. Sixteen physicians participated in this research in a work environment (Junior, 2018).

In 1998, Donald Norman emphasized the importance of the quality of human-computer interaction (HCI) (Junior, 2018). User experience (UX) is about how satisfied and dissatisfied a user is with the visual and auditory experience while working with a device. The Theory of Situated Cognition (TSC) (Junior, 2018) is drawn upon in this study because of the potential for this theory contributing to the investigation of user interaction with digital technology. TSC is a cognitive theory based on an idea that cognition takes place in a social setting. This social aspect of TSC explains that user experience is not limited to physical stimuli received, but also includes the social context in which a new piece of technology is utilized (Junior, 2018).

Participants performed poorly in complicated tasks. They had difficulty understanding the graphic representations and their functions. Tasks requiring less actions (simple tasks) were more successfully accomplished, and clear graphic elements of the interface facilitated understanding. Tasks of accessing and closing the font size icon and enlarging the font were readily performed.
Only four out of 16 physicians needed help to perform these tasks. Three of these four participants had not installed an app on their devices. The participants' level of experience is a determining factor in the success of the UX (Junior, 2018).

There were tasks accomplished by the majority of participants, such as accessing a page using the hidden page menu (page navigation), pinpointing the clickable items and returning to a page; but tasks of advancing pages using the hidden page menu apparently demands more cognitive activity and therefore participants had difficulty conducting them. In areas such as accessing a page or recognizing icons on the page, the app interface design was not compatible with the principles of information design and a few participants faced problems performing these tasks (Junior, 2018).

The results showed that, overall, participants were able to perform the tasks. However, they had difficulty with navigation and grasping the elements of the graphic interface. All of it influenced UX and content learning. The results studied on the basis of information design and the Theory of Situated Cognition suggested some recommendations. While investigating UX, the users' profile, the device's features, and the circumstances are to be taken into consideration (Junior, 2018).

In *User perceptions of mobile digital apps for mental health: Acceptability and usability* the authors explored the conceptions of mobile mental health apps in order to pinpoint "the preferences and acceptability" (Chan and Honey, 2022, p. 1) of the end users. Four databases (CINAHL, EMBASE, Medline, PsycInfo) were used in this study. Whittemore and Knafl's (2005) integrative literature review procedure was followed.

The review revealed that apps are preferred to be considered as back-up choices to complement traditional mental health support. Participants opted for in-person mental health
treatment. What is obvious is that personalization of the app is of the utmost importance (Chan and Honey, 2022). Clarify that the thematic analysis of 17 studies uncovered six themes: “Helpfulness, Improvements/enhancements, Technical issues, Easy to use, Satisfaction with the app and Perceived issues.” (Chan and Honey, 2022, p. 4).

The theme "helpfulness" was revealed in participants' attitudes. It enhanced their treatment by managing their personal needs, being easy to understand and culturally appropriate, managing symptoms, facilitating better access to the clinical team, being helpful for learning new data and skills, giving confidence and control, providing the clinical team with more comprehensive data, being easily accessible and expressing their feelings. It also improved self-awareness and self-help. The recovery period helped the patient to accept the symptoms, gave motivation and a positive perspective. It also helped improve peer relationships. The negative points were singled out to be preoccupying the participants with negative feelings and reminding them of their previous acute symptoms (Chan and Honey, 2022).

"Improvements" revolve around suggestions by the participants on current mental health apps, such as adding reminders, adding social platforms to be connected with peers and tracking abilities. Participants also preferred to have more options to personalize the apps. They asked for more variation in order to reduce repetition. For the purpose of not being fatigued, participants asked for more in-depth content and a questionnaire. Technical issues included disconnecting, freezing the app, and draining the battery. A noticeable number of complaints regarding the mobile device included insufficient phone memory for new messages, issues with the touch screen, poor signal, and internet connectivity problems while downloading content. Most participants who dropped out of the study used Apple devices, unlike Android devices, but the author did not investigate the reasons. Ease of use of the app was mentioned in different studies.
by participants. Having experience with using mental health apps was an advantage in successfully using mental health apps. The neatness of the screen was also important. It was also mentioned that a mobile app brought a lot of convenience, though some participants expressed the intrusive quality of the app (Chan and Honey, 2022).

Regarding "satisfaction," there was an app reported to be "fun to use" since it resembled video games which introduced weekly challenges. Considering "perceived issues," concerns about privacy was very common. In some studies participant connected portability with a sense of security. In some studies participants were satisfied with the app, helping their medical team to identify their unique needs. The results showed the positive effect of mental health apps. However, participants mostly regarded the apps to be useful as a complement, not an alternative to in-person medical care and factors such as convenience in app usage; the quality of content and privacy where emphasized by the users (Chan and Honey, 2022).

In B·RIGHT: Usability and satisfaction with a mobile app for self-managing emotional crises in patients with borderline personality disorder, (Frias et al., 2021) investigated the B.RIGHT app, a psychotherapeutic app for emotion regulation of BPD patients to test its usability and satisfaction. The features of the B.RIGHT were based on psychotherapeutic artificial intelligence algorithms. The interface had the following parts: "need help," "my habits" and "my profile." The patients used the app for a month and took part in group sessions. Finally, they filled out several questionnaires (Frias et al., 2021).

Generally speaking, the usability scores were high and patients with BPD had a high level of satisfaction with the app, and the emotional experience was also positive. The usability score was negatively correlated to age and the level of depression of the individual and positively correlated to the educational level and emotional crisis after app testing. The app was rated as
user-friendly and satisfactory, and BPD patients had a positive experience with the app (Frias et al., 2021).

In *Variability in phase and amplitude of diurnal rhythms is related to variation of mood in bipolar and borderline personality disorder* (Carr et al., 2018), the authors explain instability in mood is a common issue in bipolar disorder (BD) and BPD, affecting 14% of the general population. Each mood may last for weeks to months. One determinant of mood stability relates to mechanisms that affect biological system including the circadian system and sleep-wake cycle (Carr et al., 2018).

The current study by (Carr et al., 2018) aims to "(a) develop a method of quantifying diurnal rhythm regularity, (b) explore how diurnal variability of activity, sleep, HR and variability in mood are altered in BD, BPD and HC (c) investigate the links between diurnal variability and mood variability in BD and BPD participants" (Carr et al., 2018, p. 2).

The information was gathered through Automated Monitoring of Symptom Severity (AMoSS) study at the University of Oxford. The AMoSS study gathered behavioral data all day. Data from participants and self-reported mood scores were gathered using a smartphone app and also a questionnaire including self-reported data. The data was gathered from 54 BD, 34 BPD and 53 HC (healthy control) participants. Participants experienced a high intensity monitoring period for one week, during which period the heart rate (HR) and acceleration in three directions at one sample per minute was recorded. MZ smartphone app collected mood data which asked participants to provide their mood 10 times a day (Carr et al., 2018).

On a smartphone app, participants rated each of the moods—anxious, elated, sad, angry, irritable and energetic—on a seven-point Likert scale from 0 to 6. Regarding the mood zoom variability, all measures of daily MZ variability in negative mood differed significantly from
BPD participants who had the most variable mood. Less variable than BPD participants were the BD group and the least variable were the HC participants. The only variable that was not statistically significant was the positive MZ variability between BD and HC groups (Carr et al., 2018).

The findings of diurnal variability—heart rate, activity and sleep—showed the following results: Activity measures showed an increase in the BPD participants, while BD and HC were similar. Regarding the phase and amplitude measures, sleep variability was greater in the BPD group. BD was variable as well (Carr et al., 2018).

In BPD and BD, mood was highly influenced by the phase and depth of sleep compared to the HC. In BPD as opposed to BD, irritability and mood variability were closely related to HR. Although both BD and BPD patients are affected by the diurnal cycle, BPD is the mental disorder which is closely related to the sleep-wake pattern. Overall, it was concluded that negative, positive and irritable moods rose higher in patient groups compared to the control group. The study suggests that BPD is related to the diurnal rhythm more than is presently believed to be and the variability of subjective mood in both BPD and BD can be reduced by controlling the sleep pattern (Carr et al., 2018).

In A Schema Therapy–Based eHealth Program for Patients with Borderline Personality Disorder (priovi) (Jacob et al., 2018), the authors investigated the effect of Priovi, an eHealth program based on the Schema Therapy (ST) approach, on 14 patients with BPD. This program was used as complementary to the main face-to-face ST program for 12 months to conclude whether it is feasible and acceptable to both patients and therapists. BPD symptoms were tracked using self-reports and qualitative interviews (Jacob et al., 2018).
Priovi is the first app based on the intervention of the web and ST, including a vast variety of psychoeducational content and various therapeutic exercises. It is a program based on written therapeutic dialogues. The content is tuned to the needs of each individual by developing the psycho-educational content based on the responses of the patients to the dialogue. In the dialogue, Priovi transfers psychoeducational materials, elaborates therapeutic techniques and tutors the individual by means of exercises. The sessions can be by paused and postponed at any time by the user. Besides the written text, Priovi provides audio guides as well as illustrations (Jacob et al., 2018).

As (Jacob et al., 2018) explain, "the first phase of the program covers psychoeducation on BPD symptoms, human needs, childhood abuse, and BPD-specific modes and emotions". The content is presented by means of games, comics, pictures, imagery, example exercises and texts. For example, comic strips are used to convey interpersonal disagreements. The user has to single out the mode upon which the main character acts (Jacob et al., 2018).

The second phase includes various exercises related to specific modes, which are adjusted to each individual. The instructions are set according to the ST instructions but can be ignored if the user is not ready to do them. Each mode includes multiple exercises, leveling up as the user progresses. Besides the features mentioned, Priovi provides the "mode toolbox," a "glossary," and BPD symptoms tracking tool, daily emails, and text messages. Provided that the users permit, therapists are allowed to screen their patients in the "cockpit," which is an interface for the therapist to overview the patient's Priovi activity. Therapists are asked to encourage the use of Priovi by the patients. This app can be installed on all screen devices on which the web is enabled. Patients are recommended to use the app twice a week, each time for half an hour. If the patients follow the suggestions, it takes six months to finish all the dialogues. The results show
that all changes were meaningful overtime but there was no correlation between the symptom changes and the time devoted on the app (Jacob et al., 2018).

The areas of technology included in the mental health discipline is comprised of (1) communication technology including eHealth, internet-based therapy, mHealth and telehealth (2) computing technology, (3) computational technology and (4) medical technology (Jacob et al., 2018). Technology can be used as an adjunct to the traditional face-to-face treatments in BPD patients. Technology-based psychological interventions can make the treatment process more feasible, economical, convenient, easily adjustable and comprehensive (Jacob et al., 2018).

In Technology-Based Psychosocial Interventions for People with Borderline Personality Disorder: A Scoping Review of the Literature (Frías et al., 2020), the authors conducted a scoping review of the previous studies that test mHealth technology on BPD patients. Fifteen studies were included in this paper, then scrutinized and summarized. Generally, about two-thirds used technology as adjunctive interventions to conventional treatment. Almost half of them followed dialectical behavior therapy and most of the studies tested the feasibility, acceptance and usability of the initial stages of clinical treatment and gained positive results. More than a third of the studies investigated the results of mobile apps. Frias et al. (2020) did not find any computational technology based clinical research or any kind of test for any software. Overall, the results proved that there are insufficient psychological interventions for BPD and the limited number of studies show little clinical evidence (Frías et al., 2020).

In DBT Self-Help Application for Mobile Devices (Washburn and Parrish, 2013), the authors test a smartphone app (DBT self-help) as an adjunctive tool to DBT. This app is accessible for both iOS and Android devices. This application teaches DBT skill, such as core mindfulness, distress tolerance, emotional regulation and interpersonal effectiveness. There are limitations
regarding the app. For instance, it's not easily navigated, especially by people unfamiliar with DBT skills development; for those familiar with the concept, the app can be helpful in mastering the DBT skills as an augmentation to conventional methods. It also may help users learn other mental health skills that require controlling maleficient thinking. For iOS devices the DBT Diary Card and Skills Coach App are more readily accessible and helpful applications (Washburn and Parrish, 2013).

The authors did not find any empirical study investigating the efficacy of the app in a clinical setting; therefore, this review is confined to the potential effects of the app. A few studies, however, have used the app in a limited scope to watch the effects. For example, over a two-week trial period, two patients used the app as an adjunct to face-to-face clinical treatment, and the study revealed the utility and user-friendliness of the app. The MSW students who had experience with DBT participated in a study to evaluate the app from a clinician's point of view. This study was performed on iOS and Android tablets. The app was quickly and easily installed on both devices. The app was installed in 30 seconds, providing the developer website and email before the installation in Android devices but after the installation process for iOS devices (Washburn and Parrish, 2013).

After launching the application, the user gains access to the "skills" tab which provides data on each of the skills modules—each of which has a premade and customizable list the clients can use to make notes on each page. This helps them keep track of what triggers their emotional states. These notes are easily accessible at a later time. There is another tab—“crisis”—that allows users to enter an emergency phone number that will be dialed on demand without exiting the app. This application includes sessions to practice each skill. The problem here is that the sessions are unstructured, i.e., the user must create a new session and enter the skill that he or she
worked on. After that, users must assess their skill practice on their own, which can be saved and accessed later. They can also email it to their therapist. Therefore, the sessions require more structure to be aligned with DBT training. The most problematic session was related to interpersonal relationships, which lacks interaction in order to be efficient. Sending email to the user's therapist, however, is useful for the next face-to-face session. Under the "list" tab, there are emotions of fear, shame, anger, and sadness which are the challenging emotions for individual who have problems regulating their emotions. Each list includes five to seven examples of managing these skills along with exercises that are associated with each emotion. In this app, the user is enabled to create a customizable list to address their emotions or problems that are not included in the premade list. This app lacks structure for the first-time users to go to the list tab to create their customized list, so they need outside tutoring in this regard (Washburn and Parrish, 2013).

Notes can be added to any page by the user and accessed from the "all notes" tab, which is linked to the original note. This way the user can add information that may help him or her control the next crisis. Unfortunately, though, the user cannot email them to the therapist (Washburn and Parrish, 2013).

An easily accessible feature is the "browsing history," which helps the user find where they left off the last time, and therefore it takes less time and effort to continue the session. The authors found that, generally, the application ran more smoothly on iOS devices than the Android ones. The main limitation was the device locking up if we tried to navigate between tabs and save information quickly. This may cause more anger and frustration for a patient experiencing emotional crisis. Users complained about this problem on Android devices frequently. In iPhone devices the locking up problem was more subtle. To summarize, the
limitations of the app are as follows: The app is not always smooth and sometimes confusing. If the appearance improves, it will be more engaging. For example, adding an illustration to the background may help calm the user who is dealing with an emotional crisis. Another problematic feature was that the app works less smoothly on devices that are not in a vertical position. It was not as cumbersome in iOS devices. This may be frustrating on Android tablets which are usually horizontally located. The issue exists in the full screen mode (Washburn and Parrish, 2013).

At present there is no access to music on this app without having to exit the app, which may hinder its performance. If stolen, the user's device lacks a passcode to the application to maintain its privacy and security. The thorniest problem with this app is that the user is not able to make diary cards with the option to email them to the therapist. Keeping diary cards is an important skill in DBT which helps regulate emotions and, through an email, the creators claimed that the reason was the limited screen space on mobile devices (Washburn and Parrish, 2013).

The DBT Self-help application has its strong points. For example, it is affordable and the information it presents is strong and thorough. Generally, this app is suitable for people who already have some experience with DBT-based treatment and those who need assistance in coping with difficult emotions, but it requires a more user-friendly outfit and an improvement in its navigation to enhance the performance (Washburn and Parrish, 2013).

EMOTEO is a smartphone application based on DBT to help borderline personality disorder (BPD) patients track their symptoms and regulate their emotional crises. In EMOTEO: A Smartphone Application for Monitoring and Reducing Aversive Tension in Borderline Personality Disorder Patients, a Pilot Study (Prada et al., 2017), EMOTEO was used to monitor and control the aversive tension in 16 BPD individuals over six months.
BPD patients are more likely to show self-harming behavior during the time that therapists are not available face-to-face, i.e., the office closing hours; so a mobile app is of great help here. To help BPD patients control their aversive tension, EMOTEO has an analogic visual scale ranging from 1 to 10 which evaluates the patients' tension, and BPD individuals are required to choose the level of tension they are experiencing. When the level is determined, EMOTEO randomly chooses an exercise, and the patient is required to complete the task. The exercises are audio and video files prepared by psychiatrists, nurses and psychologists. Different tension levels are related to different exercises adjusted to the need of the patient, for example tension levels between 7 and 10 initiate video and music that distract the patient from the thoughts that trigger dysfunctional behavior. Since the level above 7 are described as distress level by patients, the exercises mainly revolve around passive activities; for example, relaxation, listening to music or watching calming videos. Tension levels ranging from 1 to 6 trigger exercises requiring the patient to use traditional mindfulness exercises with the aim of controlling emotional distress. These mindfulness exercises include "observing, describing, acting with awareness and accepting without judgment" (Prada et al., 2017, p. 3). After the exercise, the app goes back to the tension assessment sale and requires the patient to evaluate his/her level of tension again; then the patient has the choice to do a different task or if he/she is able to handle the tension. This evaluation cycle of their tension continues until the patient exits the app. A graph is produced to track the progress of the tension levels of the patient during this event.

Patients answered questions like "Was the app a useful tool?" or "Did the app help me reduce self-damaging behavior?" or "Did I like the audio exercises?" Then they ranked them on a scale ranging from 1 to 5. The results displayed acceptance and interest on the part of the subjects. The
results proved to have gained satisfaction, acceptability and usability over the trial period (Prada et al., 2017).

EMOTEO was shown to be user-friendly, effective in calming aversive tension and easily accessible by individuals with BPD. Its usability, acceptability, and consent were high. The influence reported by patients on the prevention of self-harming behavior was also promising (Prada et al., 2017).
Chapter 3: Methods

One of the treatments for borderline personality disorder (BPD) is Dialectical Behavior Therapy (DBT). This evidence-based psychotherapy has been effective in treating mood disorders, suicidal ideation, and substance use that are the main features of BPD (Choi-Kain et al., 2017). This treatment method focuses on four main skills including, focusing attention, managing relationships, handling emotions, and relieving stress (Washburn and Parrish, 2013). For this treatment method, patients are required to record their moods daily and do some exercises that help them in treating BPD. In addition, they need to share their moods and exercise records with their therapists. Before the advancements of new technologies such as smartphones, patients recorded their daily moods in a notebook and talked about their notes with their therapists. However, the advancements of smartphones and mobile applications have simplified the process, and the mobile applications are an intervention in the treatment of these patients. As part of this study, the researcher evaluated different mobile applications designed to treat BPD. According to previous studies in this field, there are some issues related to user experience of these mobile applications listed below. For example, studies included the literature review (Washburn and Parrish, 2013; Junior, 2018; Alqahtani and Orji, 2020) have identified the following problems with current BPD mHealth tools:

- Poorly attractive and engaging (Rizvi, Hughes, and Thomas, 2016; Derks et al., 2019; Washburn and Parrish, 2013)
- Unsatisfactory usability, Lack of variety of options, Lack of personalization, Lack of security, Lack of control (Alqahtani and Orji, 2020)
- Difficulties identifying the clickable objects of the interface, and difficulties returning to the apps’ main screen (Junior, 2018)
- Problems in page navigation (Derks et al., 2019; Washburn and Parrish, 2013; Junior, 2018)
- Confusing, it was not easy to learn (Washburn and Parrish, 2013)
- Lack of an option to add note by patients, Lack of option to share note with therapist, Lack of option for diary cards to share them to the therapist (Washburn and Parrish, 2013)
- Lack of a feature for Browsing history of last user’s activities (Washburn and Parrish, 2013)

In this study, the researcher investigated these issues and developed a mobile application for DBT treatment that addresses these problems. In this section, further details will be provided about the structure and different pages of this mobile application. In developing the mobile application, five main pages were created: Home, Skills, Community, Exercises, and Profile.

![Home Screen Button Setting Notification]

![Navigation Bar]

Figure 4. Main five pages of mobile application
Users can access these main pages through a navigation bar located at the bottom of the screen. There is a setting button, located in the top right corner, on all five main pages. A notification button is provided in the top left corner of these pages for easier accessibility. In addition, there is a navigate button at the top and middle of these pages, which is linked to the home page or main screen. This button is the logo of the app (see Figure 4).

**Splash Screen or launch screen**

The logo of this mobile application in the Splash screen (Figure 5).

![Splash screen](image)

Figure 5. Splash screen

In creating the logo of this app, three symbols were used. First, a profile of a person, which represents the patient. Second, a settings button, positioned over the head, to represent cognitive regulation. Third, the researcher created a ray of light that comes from the mind to the face, which represents the knowledge this treatment will give the patient. Having a splash screen is
important in development of mobile application because it keeps users entertained while the app is loading (see Figure 5).

**Home Page**

On the home page, users can submit their moods daily.

![Home Screen Screenshot](image)

**Figure 6. Home**

The moods are categorized as follows: Great, Good, Okay, Bad, and Awful, and there is an option that helps users add a mood and emotions not included in the premade list. Moreover, users can submit their diary card check-in. These diary check-in cards help patients record which skills they used each day of the week. Additionally, users can log their sleep duration. Also, patients can access some other parts of the app through the home page, providing faster accessibility (see Figure 6).

**Skills Page**

On this page, users can work on the skills that need to be improved (see Figure 7).
Figure 7. Skills

These skills include focusing attention, managing relationships, handling emotions, and relieving stress (Washburn and Parrish, 2013). There is a settings icon, home icon, and notification icon at the top of this page, like the other main pages. Below these icons, there is an introduction. When the user clicks on this icon, he/she has access to an introduction about this page through both text and video. There are some instructional videos that help users engage in the learning process more efficiently. For more engagement, there is an audio icon at the top right side of the introduction page (speech voice reader), which can read the text for users aloud. There is another icon at the top for writing notes. Users also have an option to share their notes
with their therapist and in social media, as well. In the introduction, users can find out why learning skills is important for them in the treatment process. In addition, there is an option for users that enables them to add the skills in which they are more interested into their favorite skills list. Users can also use an alarm icon to schedule their practices to their convenience (see Figure 7).

**Community Page**

On this page, there are some channels for different skills through which clients can communicate with other people. In addition, users have an option to search the existing peer groups and add new groups that they need or are interested in (see Figure 8).

![Figure 8. Community](image)

**Exercises Page**

On this page, users can work on the skills that are needed to be strengthened to improve their BPD disorder. On top of that, there is an option for them to add exercises which are more interesting to them to their favorite’s exercises (see Figure 9).
Profile Page

This page includes five tools: timeline, favorites, profile setting, notes, and search history (see Figure 10).

In the timeline tool, users can see the skills, exercises, moods, dairy cards, and sleep duration that they have recorded at different dates and times. In the favorite’s tool, users can...
access their favorite skills, exercises, and everything that they have already added to their favorites (see Figure 11).

Figure 11. Profile, favorites

In the profile tool, users have an option to choose their favorite theme among different available themes (see Figure 12).

Figure 12. Profile, profile settings

They can also choose the dark mood option if they would like (see Figure 13).
In addition, they can submit their feedback about the mobile application for future improvement. In the notes tool, users can see the notes they have already written in the different parts of the app (see Figure 14).
The history feature helps users find the last activity that they did in the app. This feature helps users spend less time and effort continuing the session from where they left off (see Figure 15).

Figure 15. Profile, search history

The application development process involved researching applications, concepts, and designs. In the research phase, the author found gaps in previous applications and aimed to fill them in the present study. In the concept phase, ideas were generated based on the research findings; sketching was implemented during this phase. The researcher utilized a paper and pen to draw the sketch and, in some cases, wireframing was used. In the design phase, the researcher came up with ideas in order to obtain visual elements. Adobe illustrator, Adobe Photoshop and Adobe XD were utilized to prototype the application.
Chapter 4: Results

One of the problems in the previous mobile applications for DBT was that users have difficulty in navigating through the mobile application (Washburn and Parrish, 2013). In designing this mobile application, I tried to make the navigation easy to follow. For this purpose, I tried to design the navigation bar to resemble the navigation bars in common mobile applications. For example, in common mobile applications, the navigation bar is located at the top or bottom of the app to make it easier for users to find the subjects they are looking for. Therefore, in this application, I put the navigation bar at the bottom of the app to help users navigate more easily (see Figure 16).

Figure 16. Navigation bar

I placed links in the navigation bar to five major tools that are used in DBT apps, including home, skills, community, exercises, and profile settings pages to help users access these options easily. In addition to the icons for these tools, I provided the name of each tool below its corresponding icon to make it easier for users to distinguish them.
Returning to the app’s main screen was another observed problem in some of the previous applications for DBT (see, for example, Junior, 2018). For solving this issue, I put a navigation button at the top and middle of all the pages, which enables users to access the home page or main screen easily. This button is the logo of the app as well (see Figure 17).

![Figure 17. Main five pages, home screen button](image)

Users of prior apps had difficulty identifying the clickable objects of the interface (Junior, 2018). I addressed this problem by changing the colors of the button. For example, when a user pushes a button, its color will change. This responsiveness also engages users more.

One of the problems in the previous apps was that users did not have an option to add their notes and share them with their therapist (Washburn and Parrish, 2013; Wong et al., 2021). To address this issue, I added a tool that users can use to write their notes and share them directly with their therapist or on social media. Adding notes will help users control their next crisis (Washburn and Parrish, 2013) (see Figure 18).
One of the problems in most of the previous apps was that the apps were not attractive and engaging (Rizvi, Hughes, and Thomas, 2016). To solve this issue, I added a tool that lets users choose different designs for the background (see Figure 19).

Figure 18. Adding and sharing notes

Figure 19. Theme
Users can also change the mood of the app to a dark mood or a light mood (see Figure 20).

![Figure 20. Dark mood, light mood](image)

In addition, they can give feedback on the app. I also put the logo of this mobile application on the splash screen for the sake of engaging the users (see Figure 21).

![Figure 21. Splash screen](image)
Another problems that occurred in the previous apps was lack of personalization (Alqahtani and Orji, 2020; Chan and Honey, 2022). For the sake of solving this issue, users have some options in their profile to personalize the app. For instance, they can change the background of the app, choose a mood, add skills and exercisers to their favorites, and choose photos and a name for their profile.

Another problem was that users could not find the option to go back to the previous page (Derks et al., 2019). To address that, I put a back button where required. For example, I put a back button in every exercise, skill, and chat group as well as in timeline, favorites, profile settings, notes, and search history. To sum up, I put a back button on every page or part that users might click.

Some studies mention that creating a reminder or alarm button is necessary in the app, and it did not exist in the apps that they studied (Chan and Honey, 2022). To address this issue, I added a reminder button. Moreover, I added a notification button. Another problem was the lack of audio guides (Jacob et al., 2018). I addressed this issue by adding a text-to-speech reader icon, which can read the texts for users aloud (see Figure 22).

![Figure 22. Reminder, audio](image-url)
Some studies mention that in the mobile applications they studied, a “browsing history” feature, which helps users find where they left off is very helpful (Washburn and Parrish, 2013, p. 6). Therefore, I added this feature to help users search the history of their actions. This feature helps users spend less time and effort continuing the session (Figure 23).

![Figure 23, Search history](image)
Chapter 5: Discussion

In this study, I investigated some of the mobile applications that have been designed to help patients with borderline personality disorder (BPD). There are some UX design issues in these mobile apps found by previous studies that resulted in some difficulties for clients to use these applications. In this research, I have attempted to address the issues mentioned by previous studies. However, I was not able to test this mobile app with users and get feedback from them. For future studies, I am going to show this mobile app design to different experts in psychology and UI-UX to get feedback from them and try to improve the design based on their comments and suggestions.

In this research, I was interested in creating a real mobile app and testing my design with real patients. However, developing a human subject’s study protocol was beyond the scope of this thesis. Therefore, I decided to focus only on the design of the app based on the issues found in the previous mobile applications in BDP treatment and tried to prototype it based on the knowledge I gained through the literature review.

In this study I learned that in designing a mHealth tool, it is very important for app designers to gain knowledge about users’ needs. They need to know the problems that they are supposed to solve for them. Therefore, research could offer a great deal of insight. Research is very important for solving the users’ problems. Doing thorough research will help app designers understand who they are designing for, what the problems are and how they can solve the problems. In this study, I learned that most problems with the previous mobile applications were problems related to usability, accessibility, and pleasure. Therefore, I tried to solve these problems in the app that I designed.
References


