Managing Anxiety Through Mobile Application Training Suites

(Technical Paper)

The Ethics of Persuasion: Persuasive Technology and the Power Behind Design

(STS Paper)

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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According to the World Health Organization (WHO), mental health and behavioral disorders affect over 450 million people over the world. It is often overlooked due to more immediately life-threatening diseases, but individuals that suffer from psychological disorders are still at great risk ("Unite for Sight"). A majority of the individuals that deal with mental health issues fight an internal struggle, but the presence of mental illness can also impact families/caregivers and society. Individuals with psychological disorders are more susceptible to a decreased quality of life, lowered productivity and poverty, social problems, etc. The inhibiting abilities of mental illness cause education or being able to successfully pursue a career to be compromised. If an individual is already employed, then mental illness can cause lowered individual productivity, which also causes decreased employment. This outcome potentially puts mentally ill individuals at an increased risk of poverty ("Unite for Sight"). If left untreated, then all these developing factors of mental illness can have significant costs to society. In 2001, the World Health Organization estimated that mental health problems cost developed nations between three and four percent of their gross national product. When mental illness expenses and the seemingly low level of production are both taken into account, the World Health Organization estimated that mental disorders cost national economies several billion dollars annually. The negative effects of mental illness even extend to communities ("Unite for Sight"). Although the majority of individuals with mental illness do not exhibit dangerous behavior, there is evidence that there is a very high prevalence of mental health problems within the jail system. The World Health Organization recommends that nations should adopt a more comprehensive mental health program to reduce the damaging effects that experiencing mental illness can create for patients and their communities.

To better understand and help improve the destabilizing symptoms of mental illness on individuals and social systems, my capstone team will be designing and building a mobile application. The objective of the mobile application will be to assess the efficacy of online interventions, using Cognitive Bias Modification (CBM), a mHealth program to train healthier thinking styles. The data collected from participants using the application should inform the developers about the usefulness of the program and could reduce the negative effects inflicted on mental illness. Individually, for my STS topic, I will research how persuasive technology, which is broadly defined as technology that is designed to change attitudes or behaviors through persuasion affect mental health patients, as well as the most effective ways to implement these systems.

Technical Topic: Managing Mental Health Through a Health Sensitive Mobile Application

Mobile devices are gradually becoming the most indispensable computing device that a person owns. Mobile phones are currently as powerful as computers in terms of computing power and their ability to run a multitude of different applications (Wasserman, 2010). Since the opening of the first AppStore in 2008, there has been exponential growth in mobile application development. Mobile applications essentially have the same capabilities as web applications, but additional benefits to improve user experience can be exhibited in mobile form. While web applications have the ability to be mobile-friendly, an actual mobile application has the potential to target a different audience and provide a more immersive experience based on user content. According to Prentice (2014), mobile apps increase ease of access in a cost-effective, portable, and easy to use program that helps to alleviate time conflict or constraints. Apps are intrinsically interactive, which allows for increased user satisfaction and repeated use of the application. Although there are numerous benefits to the use of mobile applications, there are also several

potential risks when individuals use mobile apps. Smartphones are typically in the care of their owner, and many require an identification procedure to be turned on, but a user's privacy is still at risk. Confidentiality may be compromised if a mobile phone is stolen or misplaced; data stored in applications are also consistently vulnerable to digital theft (Prentice, 2014). Therefore, as mobile applications become more complex, it is important to apply software engineering processes to ensure the development of secure, high-quality mobile applications (especially for one containing sensitive information, such as mental health). Failure to adhere to these standards increases the vulnerability of the users and their information. In terms of implementation, there are numerous comprehensive programming environments available for major mobile platforms, such as iOS, Android, Windows, etc. These powerful development tools and frameworks greatly simplify the task of implementing a mobile application (Wasserman, 2010).

Fortunately, there is a significant amount of knowledge on mobile technology and the security risks that tend to accompany it. The largest and most complicated software systems have transitioned from a process-intensive approach to more agile techniques in their development (Alavandhar, 2017). Agile development (Fig. 1) uses an iterative and flexible approach to software development, which requires a sequence of short sprints to address a set of tasks in the backlog.

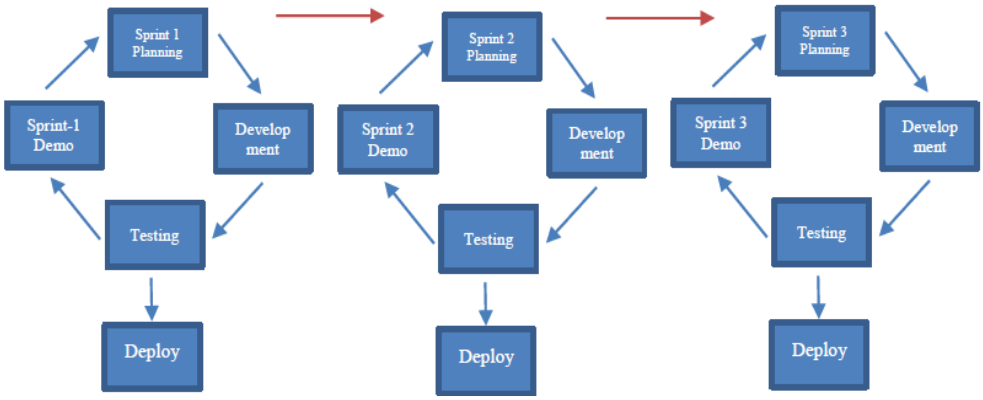

Fig. 1. Diagram of an Agile development process, showing the implementation of sprint planning and testing (Alavandhar, 2017, p. 3)

An agile process addresses the emergent nature of developing software, accounting for the fact that requirements tend to change during development. Mobile applications developed through the agile development process have three times the success rate than other established systems of development, such as waterfall. Being equipped with this information can help to facilitate the process and allow my capstone team to focus our energy on the importance of securing our design (Alavandhar, 2017).

Our capstone team will be working with MindTrails, a UVA research initiative, to create an application that can collect data from the user's phone through accelerometers, GPS, and heart rate sensors. This data will be used in addition to the existing data collected by MindTrails to create training that prepares the user to better handle their mental health illness. Currently, MindTrails offers its training session through a website platform. While the MindTrails team has had success with getting users to register for the study, they have face problems retaining users until the end of the study. In addition to the challenges with retention, MindTrails has faced issues with meeting users' needs during spikes in anxiety or stress. Due to the web application being web-enabled and requiring an Internet connection, the accessibility of the website is not always attainable. Therefore, if a user needs instant access or relief of symptoms and does not have Internet access, then they are unable to use the website.

In order to solve these problems, our capstone team has been tasked with creating a cross-platform mobile application for MindTrails. The retention rate can be improved through system notifications that remind the user of their available session. This would essentially replace and improve upon the current process that requires the user to check their email for a reminder or text

messages. The app will resolve accessibility problems by storing the user's current working sessions locally, allowing the users constant access to Mindtrails in the absence of an Internet connection.

STS Topic: How Behavior Change Support Systems and Cognitive Bias Modification Affect Mental Health Patients

New technology has opened up new opportunities to develop different kinds of information systems for influencing users. This has led to the development of Behavior Change Support Systems (BCSS) as a key construct for research in persuasive technology. As mentioned by Kulyk, BCSS is "a socio-technical information system with psychological and behavioral outcomes designed to form, alter or reinforce attitudes, and behaviors or an act of complying using coercion or deception" (p. 2). After defining the new technology and through experimentation of BCSS as a technique, five general design factors were formulated: anonymity, interactivity, portability, source, and comprehensibility (Kulyk). By implementing each of these factors into the system, online intervention usage is expected to have increased effectiveness. Anonymity was agreed to be a crucial factor for health support due to the stigma that is associated with seeking aid for mental health. The presence of interactivity and the level of interaction from participants is crucial in order to facilitate better engagement. Portability of the platform, such as having a mobile application, is preferred as it ensures privacy and effortless use from users. It was mentioned that the source of the information provided by the system is important in determining the level of trust that users will put into the application. By providing valid health information, the users are more willing to effectively participate in the intervention. Lastly, comprehensibility is important because users appreciate visually aided information, as it is enticing and makes participation in intervention more appealing.

Alternatively, another form of mental health intervention is Cognitive Bias Modification (CBM). CBM has been defined by Cristea (2015) as, “the direct manipulation of a target cognitive bias, by extended exposure to task contingencies that favor predetermined patterns of processing selectivity” (p. 1). In other words, CBM interventions are designed to directly modify attention and interpretation biases via repeated practice on cognitive tasks (Beard, 2011). CBM is mainly targeted to benefit cognitive biases, such as anxiety or depression. Anxiety disorders are the most common type of mental illness, with a recent estimate of approximately 30 percent of the US population predicted to suffer from an anxiety disorder in their lifetime. Individuals with anxiety disorder tend to selectively process threats within their environment. For example, if speaking with a group of people, an individual with anxiety might focus more on negative expressions rather than neutral or more positive facial expressions (Beard, 2011). This dysfunctional pattern of thinking contributes to the development of cognitive bias treatment. CBM interventions typically aim to provide patients with insight into the role of their thoughts and how these thoughts can drive their anxiety symptoms (Macleod, 2012). By an individual focusing attention on negative or threatening information, the amygdala, which is a nucleus found in the brain’s temporal lobe, instantly triggers the release of stress hormones. These stress chemicals can help to boost strength and speed, but it also has disrupting ability that hinders one’s ability to logically think or communicate. This is ultimately what causes feelings of anxiety and depression (Browning, 2010).

One method for testing these negative biases is known as the dot-probe task, which pairs negative stimuli with positive stimuli and then prompts the user to select the positive stimuli presented as quickly as possible. As shown below in Figure 2, the procedure consists of an initial fixation cross presented in the middle of the screen for 500ms. After that, an expressive face

(happy or sad) and a neutral face are presented simultaneously on either the left or right side of the central fixation point for a given duration of time. The presentation of the two faces is followed by a probe dot, immediately replacing the expressive or neutral face. Participants are then instructed to indicate the side in which the probe appeared using a keypress.

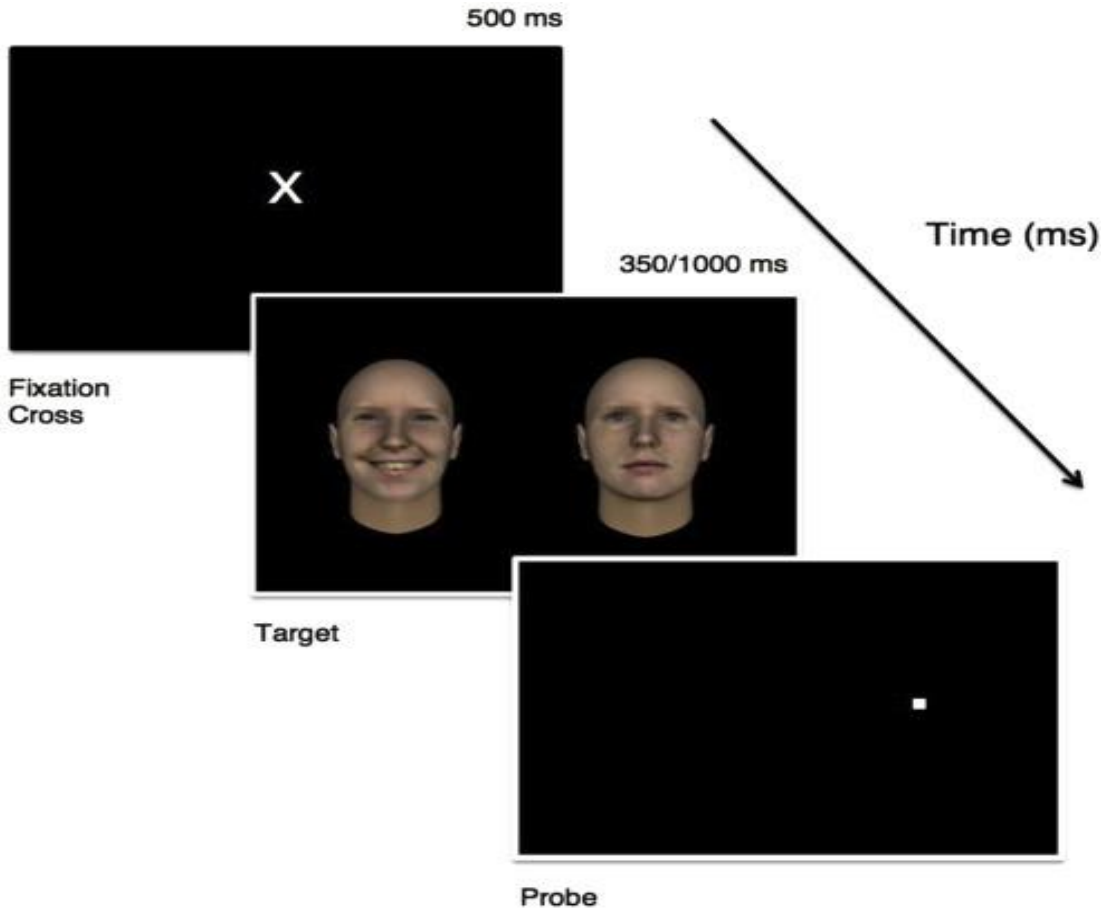

Fig. 2. Schematic representation of the dot-probe task, in descending order, with the fixation cross initiating the process

This forces the user to repeatedly select positive information over negative, which gradually helps them to develop a positive bias (Amir, 2009). The majority of studies on CBM have proven that its testing has been effective. For example, in 2009, the Journal of Abnormal Psychology

reported in a study that 72% of the volunteers were cured of their anxiety just after two hours of CBM therapy (Amir, 2009). With the application of this knowledge in my STS research paper, there will be a distinct identification of the system that would be most useful for mental health patients. Also, merging socio-technical experimentation with implementation should result in transparency and allow more insight into how behavioral systems can affect change.

Conclusion

By combining the knowledge of the persuasive technology behind Behavior Change Support Systems and Cognitive Bias Modification, there is potential for the development of a mental health intervention mobile application with high efficacy. The goal is for my capstone team to create this application and hopefully increase the number of mental health patients positively affected by it, while also raising awareness. It is important to create a mobile application that effectively utilizes user information to personalize realistic scenarios that encapsulate the user and promote positive thinking. In addition, the application should be able to maintain adequate security measures to ensure user privacy. In conjunction with this development, my STS research will contribute to an increased understanding of the numerous behavioral persuasion tactics and how these practices can be better implemented. If both of these tasks are completed successfully, then people suffering from mental illness have the ability to access a facilitated way to reduce their symptoms and live a healthier lifestyle.

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