Increasing Engagement in eHealth Interventions Using Personalization and Implementation Intentions

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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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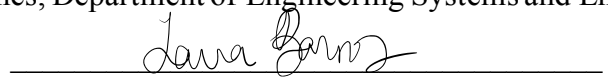

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***Abstract*—Approximately one in five adults in the United States have been diagnosed with some form of mental illness, but less than half received treatment in this past year [1]. An interdisciplinary team at the University of Virginia aims to reduce this gap in mental health coverage through its freely accessible online research platform, the MindTrails Project. The MindTrails Calm Thinking study evaluates cognitive bias modification for interpretation (CBM-I), an intervention that aims to reframe the thinking patterns of highly anxious individuals when they respond to ambiguous situations that they might interpret as stressful. MindTrails is experiencing a high attrition (dropout) rate, which is common to eHealth interventions. In response to this, our project utilized two novel approaches to online anxiety interventions to improve engagement and retention: (1) *personalization* of training content and (2) *implementation intentions and goal setting*. We designed a prototype for a new mobile interface that engages users with a journal to record implementation intentions and goals. Users also have the ability to choose the domain of anxiety (e.g., relationships, health) that they would like to work on. To further incorporate these psychological principles into the MindTrails program, suggestions for future work are also discussed. We hypothesize that, with its new user-centered mobile interface, the Calm Thinking mobile application will further connect users with an evidence-based mental health intervention and increase the efficacy of the program.**

Keywords—eHealth, anxiety

I. Introduction

Many adults in the United States do not receive mental health-related treatment due to barriers including lack of trained professionals, financial burden, and perceived stigma [2], [3]. Technology offers a way to overcome these obstacles to treatment through *eHealth* interventions, defined as "electronic communication to improve health and healthcare delivery" [4]. MindTrails is an existing eHealth intervention for anxiety created by an interdisciplinary research team at the University of Virginia. MindTrails uses cognitive bias modification for interpretation (CBM-I) to alter negative interpretations of everyday situations that might impact participants with anxiety [5]. The most recent iteration of the intervention, used in the Calm Thinking study, consists of five training sessions with a mandatory five-day break between each session. In each session, participants are asked to envision themselves in 30 to 40 emotionally ambiguous scenarios (e.g., meeting a friend for coffee). Then, individuals are required to resolve the ambiguity by filling in the missing letter of a word fragment at the end of the scenario. At the end of the session, participants think about their emotional experience and rate their anxiety. The repetition and interactive features within MindTrails are intended to help users think more flexibly in their daily lives [6].

Despite providing accessible treatment and building coping skills for participants, eHealth interventions like MindTrails experience high attrition (dropout) rates [7]. High attrition rates are often a result of users' lack of comfort with

or relatability to the characteristics of the intervention [8]. To address the attrition faced by MindTrails and other eHealth technologies, we have decided to focus on *personalizing* scenarios to users' demographic information and lifestyles and creating ways to set attainable goals through *implementation intentions*. These strategies are aimed at increasing user engagement and retention. Inspiration for incorporating personalized features came from video games, e-commerce, and other eHealth technologies. For example, avatars can make users feel that they are able to customize the interface, thus developing an emotional relationship with the technology [9]. The inclusion of implementation intentions in mental health interventions results in an increase in the number of participants acting on the goals they set for themselves [10].

II. Related Work

A. Personalization

The design of eHealth interventions can have a profound effect on the level of engagement users perceive as they use the interventions. An individual's approach and cognitive style have a significant effect on their information-seeking behavior and understanding [11]. Through altering the specific mechanisms and features of the designs to suit individual cognitive styles, personalization can optimize the design and increase engagement for specific users. User-centered design (i.e., incorporating prototype testing and direct user feedback) is essential when developing mobile applications, as it improves the app's usefulness and personalization for the target audience [12]. A web application for patients with cardiovascular disease (CVD) exemplifies the need to include users in the design process. Patients were presented with a personalized CVD risk score and charts to track their data over time [13]. The patients reported that they were motivated by the CVD risk score, but they wished it had changed based on their own data entry so that it would be more up to date. Thus, allowing users to contribute to the design process ensures that features are personalized in ways that users will find helpful and relevant.

Personalized eHealth interventions for anxiety are becoming increasingly common. The Challenger app is an example of a personalized mobile application that delivers treatment to individuals with social anxiety disorder [14]. Users select their own goals from a list of 27 options, ranging from social skills to physical activity. They can also suggest goals to the research team for future versions of the app. Individuals then rate their experience in the area of the goal, so that challenges of an appropriate level can be presented [14]. Users specify triggers for their anxiety, such as giving presentations at work or completing school assignments, and the app uses location tracking to provide timely challenges and psychoeducation when users enter a potentially triggering scenario (e.g., when they go to work). Users additionally input the names of and relationships to people close to them so that the app can incorporate these individuals into challenges, such as tasking a user to call a specific friend [14].

eHealth interventions need to be adapted to fit a specific target demographic, instead of generalized in an attempt to serve all patients [15]. Few eHealth interventions for mental health incorporate personalization according to demographic information. There are examples of personalized assessments, such as the InnoWell Platform [16]. There are also platforms that allow for analysis of patient data to assist medical professionals in making personalized decisions [17]. However, these do not personalize the content of the treatment. The Challenger app personalizes the content of its challenges by demographic information, such as employment status [14], and is the only readily available example that meets the established need of adapting eHealth interventions to a target population.

B. Implementation Intentions

Both goal setting and implementation intentions can be used to combat mental health issues [18]. Implementation intentions consist of if-then statements that facilitate goal setting by providing a potential scenario in the *if* part of the statement, preparing the person to be perceptually ready to encounter the situational cues and achieve the goal provided by the *then* part of the statement. With repeated use of implementation intentions, one can begin to act unconsciously during situations similar to the imagined scenarios. Goal setting is an essential component to implementation intentions, as the goal strength becomes vital in accomplishing the if-then statement [19]. Studies have investigated whether forming implementation intentions can help people with anxiety to complete relaxation exercises [20], people with social anxiety to control their attention [21], and people with mental health problems to attend psychotherapy appointments [22]. Already, the prospects look promising, with the effect of implementation intentions on goal attainment producing a noticeable change; "if-then planning can be an effective technique for promoting goal attainment among people with mental health problems, who are likely to experience particular difficulties striving for goals" [18].

In conjunction with goal setting, mood and thought trackers are effective elements to engage users [23]. A 2019 study analyzed user reviews and found that most appreciated having a space to keep track of their thoughts, customize, and work through their problems. Journal-like trackers allowed participants to identify gaps in their thinking and thought processes that were detrimental to their mood [23].

III. Methods and Design

Our goal was to design a prototype to increase user engagement and decrease attrition rates within the MindTrails program. After gaining an understanding of the current MindTrails program interface, we sought to implement new features that target user engagement strategies (personalization and implementation intentions). We implemented these new features by creating Figma prototypes of screens for a future mobile application. Finally, we conducted a pilot study involving user testing and interviews with MindTrails users to understand their opinions about the prototype.

A. Personalization

One way in which we incorporated personalization into the new mobile interface is by allowing users to select their domain of focus (e.g. relationships, resilience, etc) for the training session. In the left screen of Fig. 1, the user selects a domain in which they are interested or in which they hope to

improve their thinking. Once they have clicked a domain tile, the pop-up shown in the screen on the right of Fig. 1 appears, providing more information about the domain. The user can then select the module or choose a different domain. Once the domain has been selected, they will be presented with scenarios that relate to the chosen domain. For example, a person who is interested in working on their relationships with others would be presented scenarios about interactions with their professors, employers, and/or classmates. A person selecting the health domain may be presented scenarios about managing their anxiety about sensations in their body. If a user does not care for a particular topic, then he or she can click the "Surprise Me!" button which would present the user with a variety of scenarios. Additionally, if the user doesn't find an area that applies to them at the moment, they can send in their area that is of concern through the "Submit Ideas" tile. This provides feedback to the MindTrails research team for future scenario ideas not currently given or covered.

The team also implemented personalized training scenario content, based on the user's demographic information, in order to present scenarios that are more relevant to the individual. In Fig. 3, the scenario is presented to a user who is employed, and references their "job" and "boss." Fig 4. shows the version of the scenario that would be presented to a user who has indicated that they are a student; note that the scenario now references their "class" and "professor." Additional versions of the scenarios have been created for the case in which the person's employment status is unknown, typically referencing volunteer work. Similar personalization has been implemented for scenarios that reference the participant's relationship status (in a relationship vs. not or unknown). In addition to designing these screens, we found new images for the scenarios that would more generally fit all versions of the scenarios.

Fig. 1. Domain selection
Source: Icon adapted from [24]

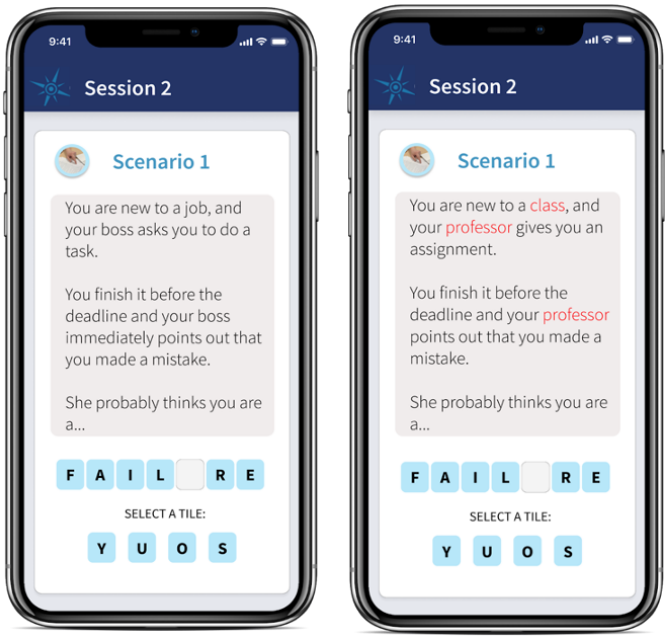

Fig. 2. Personalization of scenario content

B. *Implementation Intentions*

A team of doctoral candidates in psychology with knowledge of behavioral interventions developed the implementation intentions. We then developed a journaling feature to incorporate the implementation intentions into the interface and to ensure that users take steps toward completing their goals. The journal reinforces these statements by requiring the user to write them down themselves and provides an opportunity for the user to revisit the implementation intentions that they learned during the treatment session later. Not all scenarios have implementation intentions, but after those that do, the screen on the left of Fig. 3 will be displayed. There, the user is prompted to copy the relevant implementation intention onto the notecard. The screen on the right of Fig. 3 shows the user's view when the keyboard has been opened. Later, users will be able to return to the notecards and review them in their journal.

C. *User Testing*

We conducted a pilot study, which involved user testing of our prototype and follow-up interviews, with five former MindTrails participants. Overall, the users liked the app, averaging 4.6 on a 5-point Likert scale rating. They also felt engaged by the design, averaging 4.4 out of 5. The journaling component was a favorite addition for each of the users for varying reasons. One user liked the journaling feature because his therapist recommended a journal for managing his anxieties. Another user liked the feature because he felt that it reaffirmed the positive messages given during the scenarios. Being able to revisit the journal each time the app is opened was another reason a user liked the feature. Users also enjoyed the changes to the scenario content based on employment status. However, one user pointed out that including words like "boss" or "professor" could change the emotion of the situation for some people. One user also mentioned that he would most likely be bored by the end of the five-week

Fig. 3. Implementation intentions journal feature

training if the scenarios were not relevant or applicable. These are important considerations for future work.

Finally, users gave suggestions for making the mobile version even more engaging with increased customization and accessibility options. Changing the lighting of the app (e.g., offering a dark mode) or color scheme were examples of features that some users thought would help to meet users' needs and expectations. Accessibility options for users with color blindness or other physical ailments could provide a much more enjoyable experience. Generally, user suggestions centered around the ability to make their own choices and set their preferences for the design of the app and the content of the scenarios.

IV. Discussion

Our experience developing the mobile MindTrails prototype allows for modeling personalization of scenario content from other successful mediums, such as video games or other eHealth apps. Video games have similar goals as our project, namely providing individualized experiences and increasing the engagement of the user [25]. Video games sometimes use player modeling to present stories in a game that will be the most interesting for that specific player [26]. From indirect measurements, consisting of the actions taken by the player, and direct measurements, specified as an interestingness rating in this case, the model estimates the player's interest in the given story. An algorithm associates these measurements with the previous story elements and uses them to select story elements from a bank that are similar to the elements that the player enjoyed [26]. A similar algorithm for personalizing the MindTrails scenario content could be developed that takes as input how long the user spends on a given scenario (assuming greater time spent reflects greater engagement) and their ratings of scenarios to choose similar scenarios from a bank that will be relevant to reducing the user's specific anxieties.

The Challenger app [14] also provides examples of personalization that could be potentially beneficial for MindTrails. Future work could test making scenarios more specific by having users input the names of, relationships to, and level of comfort with individuals in their lives, such as friends and family members. For example, a scenario could then read, "You are co-hosting a dinner party with your friend *Angie*." Location tracking could be added to the mobile application so that scenarios can be presented when a user needs them. A scenario and associated implementation intention about giving a presentation at work could be presented when the location tracker notes that the user is in their office building, for example. One additional consideration would be to personalize push notifications from the mobile app so that users get individualized reminders to complete the intervention at times that are best for them. All of these personalization methods, though, come with an increased risk of privacy loss for users. Future work will also need to focus on the security of these personalization methods.

V. Conclusion and Future Work

We incorporated personalization and implementation intentions as psychological principles to increase user engagement and retention for the MindTrails program. The new mobile application seeks to offer a solution to the issue of attrition faced by MindTrails and other eHealth technologies. Personalizing scenario content by demographic information of the users is a novel approach to personalization in the eHealth space. While there is sufficient literature stressing a need for personalization in eHealth interventions, there is little literature regarding the personalizing of actual treatment content. The personalized scenarios and implementation intentions will both be tested in future iterations of the MindTrails Project to research their effectiveness as a treatment option and whether they increase engagement with the intervention, measured by a reduction in attrition.

Due to unforeseen circumstances as a result of the COVID-19 outbreak in the United States during the spring semester of this capstone project, we were unable to conduct as many user tests as we would have liked, and those we did conduct were done virtually rather than face-to-face interviews. These circumstances yielded a small sample size for the pilot test. In the future, additional user testing should be completed. Former MindTrails participants would be ideal subjects, as they are able to compare the current web version of the intervention and our new mobile design. They would also have familiarity with the intervention and would better understand which features are new and which are part of the original treatment program. The same list of questions produced for this session of user testing could be used for future testing.

Additional work could be completed to further incorporate the recommended elements of personalization given in this initial round of user testing. The use of implementation intentions could also be expanded in the web and mobile versions of the intervention as the journal seemed to be a popular feature in the mobile app. Users could start creating

their own implementation intentions in their journal after seeing many examples of them in the first few sessions. This would allow them to practice the skill of goal setting and also aid in personalization by allowing individuals to create a unique set of statements relevant to them.

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