Gamifying Mental Health Treatment: A Mobile Interface Design for PTSD Intervention

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Abstract

Post-traumatic Stress Disorder (PTSD) treatment faces significant accessibility challenges, with only 30-40% of diagnosed individuals receiving care. This work presents a PTSD intervention delivered through a mobile application designed based on evidence-based treatment principles, particularly cognitive restructuring. Rather than implementing traditional resource-intensive PTSD treatments, the app employs brief, daily, game-like interactions to train users to develop more adaptive perspectives of themselves, others, and the world. The app's text-based interactions incorporate three key mechanisms: directional swiping gestures for thought categorization, paired statement tasks with immediate animated feedback, and emoji-based labeling to reduce cognitive load during. These interaction patterns were designed to maintain therapeutic fidelity while leveraging familiar mobile interface conventions. Analysis of multiple assessments on the validated PCL-5 measure showed 28.1% achieved clinically reliable improvement (≥18 point reduction). These findings suggest that engagement with brief mobile interactions, designed based on evidence based techniques, may effectively reduce PTSD symptoms through digital platforms.

CCS Concepts

• **Human-centered computing** → Human computer interaction (HCI); • **Additional Keywords and Phrases: Mental health, PTSD, Mobile application design, Gamification, Digital therapeutics**;

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1 Introduction

The global impact of Post-traumatic Stress Disorder (PTSD) presents a significant challenge due to lack of access and affordability of professional clinical treatment [14]. Recent global estimates indicate that while PTSD affects 5-6% of the population worldwide [14], only 50% of those diagnosed receive any form of treatment, with rates dropping as low as 20% in low-income countries [14]. Although evidence-based therapies such as Cognitive Processing Therapy (CPT) demonstrate consistent efficacy in reframing unhelpful thought patterns that maintain PTSD [19, 23], the traditional format of therapist-patient conversation requires extensive training for therapists and multiple hour-long sessions for patients [11].

Specifically, CPT typically requires 12 weekly sessions of 60-90 minutes each, with recommended caseloads of 15-20 patients per therapist [11, 22]. Existing knowledge on the efficacy of the thought reframing technique [11, 23], coupled with the potential of digital platforms to provide mental health treatment in an affordable and accessible way [15], may assist and overcome some of the limitations of traditional therapy and present a promising opportunity for the HCI and interaction design communities.

Digital apps focused on mental health interventions can expand treatment access and effectiveness [15]. However, this full potential remains unrealized in PTSD treatment applications. Current digital interventions for PTSD primarily emphasize passive content consumption or symptom tracking, with only a limited number incorporating active therapeutic components such as thought reframing [27]. The limited implementation of evidence-based therapeutic techniques in digital formats represents a significant gap between the demonstrated effectiveness of traditional PTSD treatments and their digital adaptations [7].

In this study, we evaluated an app that adapted this evidence-based technique into structured digital interactions that enable users to systematically examine and reframe PTSD-related thoughts, following established principles of mobile interaction design [20, 29]. The intervention implements three interaction patterns: systematic thought categorization through directional swiping, guided selection tasks with immediate visual feedback, and pattern identification using emoji-based labeling. These interaction designs leverage familiar mobile interface conventions to facilitate therapeutic engagement [8].

1.1 RELATED WORK

Relevant previous work in digital PTSD interventions builds on three interconnected areas: traditional PTSD treatment efficacy, web-based therapeutic adaptations and mobile mental health applications.

1.2 Traditional PTSD Treatment

CPT treatment for PTSD represents an empirically validated approach through systematic reframing and modification of problematic thought patterns [21]. Research demonstrates that changes in

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these thought patterns mediate symptom improvement, particularly in areas such as self-blame and safety beliefs [18]. For example, studies of CPT show that reductions in trauma-related guilt cognitions predicted PTSD symptom improvement during intensive CPT treatment [18]. While this approach shows consistent efficacy [25], its implementation creates significant user experience challenges.

1.3 Digital Health Web-Based Adaptations

Initial digital health web-based platforms focused on systematically translating comprehensive therapeutic protocols to online formats, notably MoodGYM for depression and anxiety, PTSD Coach Online for trauma treatment, and Beating the Blues for cognitive behavioral therapy [7, 28, 31]. These online platforms maintained the structured therapeutic approach of traditional treatment while adapting content delivery for web interfaces. Studies demonstrate comparable efficacy to in-person treatment when incorporating professional support elements, such as weekly therapist check-ins via email or scheduled video calls [24]. However, the traditional multi-session format, while therapeutically sound, presents implementation challenges in digital contexts, with research indicating that therapeutic benefits correlate directly with completion of core therapeutic modules rather than mere platform access [10].

1.4 Mobile Mental Health Applications

Mobile apps enable novel adaptations of clinical intervention delivery through micro-interactions and real-time intervention capabilities [13]. Current PTSD apps employ distinct therapeutic mechanisms, ranging from symptom monitoring to interactive therapeutic tools, including guided exposure exercises, grounding techniques, and peer support networks [27]. The PTSD Coach app exemplifies the current state of mobile interventions. This app uses symptom tracking, relaxation exercises, and psychoeducation with findings supporting its feasibility and acceptability in trauma-exposed individuals. However, evidence on the effectiveness remains limited [7]. While these approaches demonstrate potential, their therapeutic impact remains below traditional treatment efficacy levels, potentially due to limited implementation of active therapeutic components such as cognitive restructuring exercises [13]. This gap between mobile capabilities and therapeutic implementation suggests opportunities for more sophisticated adaptation of evidence-based treatment components.

2 Design and Implementation

2.1 The Interactive Mobile App Exercises

The app evaluated for this study adapted traditional therapy techniques into interactive mobile app exercises. Building on established mobile interaction patterns such as swipe gestures, pull-to-refresh, tap-and-hold feedback, and animated transitions [8], and cognitive processing therapy principles [11, 21], the exercises target thought patterns across five domains that are central to PTSD treatment: safety, trust, power/control, esteem, and intimacy [21]. These domains represent the core areas where trauma disrupts adaptive thinking, and the interactive design of the app attempts to systematically address each domain through distinct mobile interactions that maintain therapeutic engagement while leveraging familiar interaction patterns.

Users engage with these exercises through three primary interaction mechanisms integrated into the mobile interface: directional sweeping, paired statements, and emoji-based thought tagging. Each mechanism is specifically designed to address key therapeutic components of traditional CPT while utilizing established mobile interactions.

The directional sweeping interface enables thought categorization through familiar touch gestures [8]. Embodied cognition theory suggests that cognitive processes are deeply rooted in the body's interactions with the world [26]. In traditional therapy, thought categorization is an abstract, purely mental process. However, research indicates that physical actions can enhance cognitive processing - for example, studies show that physical movements that align with cognitive tasks (like pushing away negative thoughts) strengthen the mental processes involved [26]. Building on this research, our interface couples the cognitive process of categorizing thoughts with corresponding physical swipe gestures - swiping down for adaptive thoughts (closer to oneself, adopting them) and up for maladaptive ones (off the screen, away from oneself) potentially increasing the accessibility of adaptive versus maladaptive cognitions.

In the paired statements interaction, users are presented with statements representing clinically-defined healthy versus maladaptive thoughts. When users select a statement, the interface provides differential feedback: healthy statements trigger an engaging animation effect, offering immediate positive visual reinforcement, while maladaptive statements receive no feedback. This selective reinforcement mechanism builds on operant conditioning principles [17], where positive reinforcement of adaptive responses increases their likelihood while the absence of reinforcement for maladaptive responses gradually reduces their occurrence.

The emoji-based thought tagging transforms traditional thought categorization, a cornerstone of cognitive therapy [3], into a visually intuitive process. While traditional therapy requires verbal labeling of thoughts as adaptive or maladaptive, which can be cognitively demanding, emoji-based tagging leverages the brain's capacity for rapid visual processing and categorical decision-making [30]. Users can quickly classify thoughts as adaptive (represented by a heart emoji) or maladaptive (represented by a garbage can emoji), reducing cognitive load while maintaining the therapeutic goal of thought discrimination. This binary visual classification system builds on research showing that simplified visual decision-making can enhance learning and retention of categorical distinctions [30].

2.2 Interaction Flow

The system implements a structured progression through interaction patterns. Users begin with an onboarding module explaining the relationship between thoughts and symptoms, a critical foundation as research shows that understanding the cognitive model increases treatment engagement and outcomes [12]. This psychoeducational component helps users recognize how thoughts influence emotions and behaviors, laying groundwork for the therapeutic exercises that follow.

Each subsequent day, the app introduces specific thought domains through brief educational content followed by interactive exercises. For example, when addressing trust-related patterns,

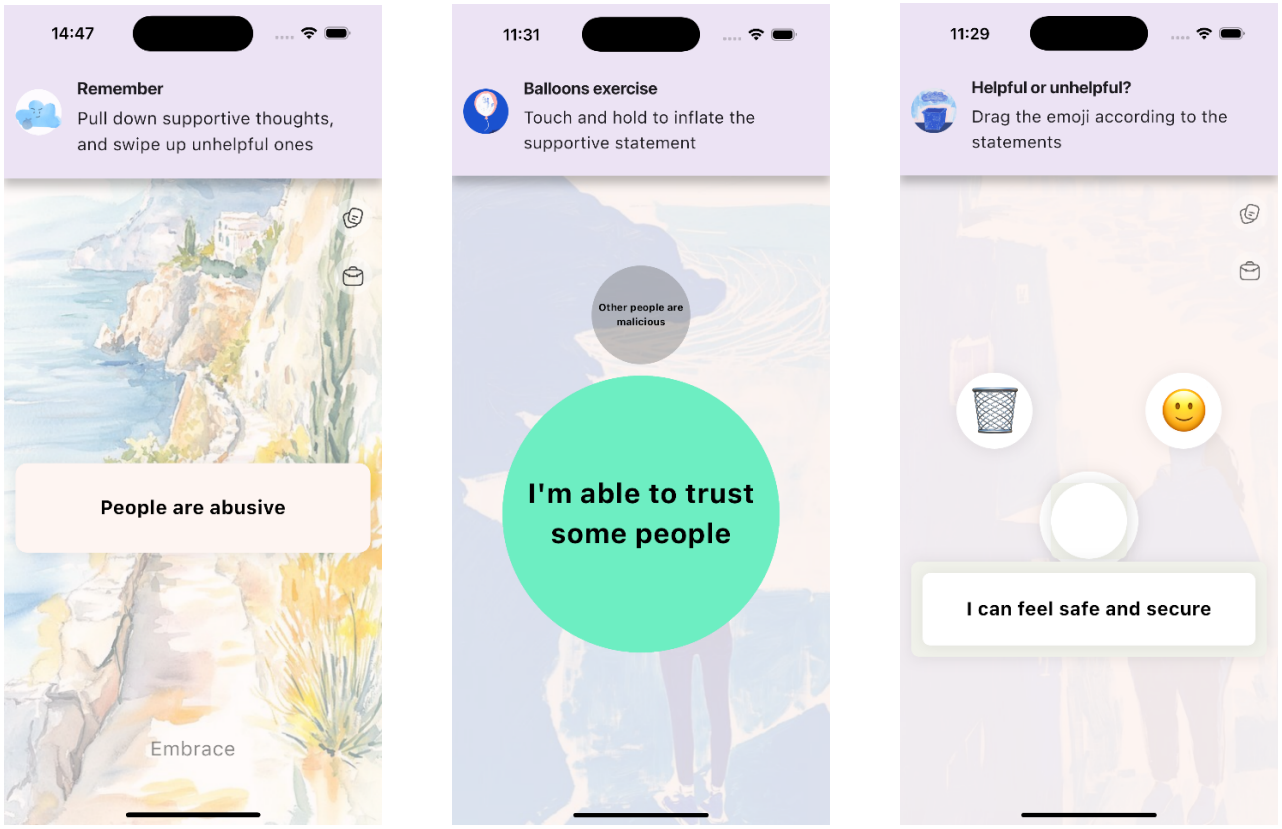

Figure 1: Screen shots of the three primary interaction mechanisms.

users receive contextual information such as "Trauma is often associated with self-doubts, particularly regarding the capacity to judge others. However, self-talk that undermines our ability to judge can severely limit our social functioning. Here, we learn to adopt a more balanced view of our interpersonal perceptions." Such educational primers activate relevant cognitive schemas [21], preparing users for the therapeutic work that follows.

Daily interactions follow a structured sequence focusing on the day's theme. These interactions are designed to build therapeutic skills progressively. Users' daily practice consists of all three types of interactions categorization through directional sweeping, paired statement exercises and classifying thoughts using emoji-based tagging. The number of exercises increases gradually over time. After every 5-7 days, a review level presents previously encountered thoughts in new combinations, reinforcing learning and helping users identify recurring patterns in their thinking.

2.3 Therapeutic Implementation Framework

The intervention implements evidence-based therapeutic components through three key mechanisms designed to maintain clinical effectiveness in a mobile format [21]. First, the system structures therapeutic exercises as focused micro-interventions that target specific cognitive patterns, allowing for precise implementation of cognitive restructuring techniques [4]. Second, the interface provides systematic feedback aligned with cognitive therapy principles of thought evaluation and reframing [3]. Third, the intervention maintains therapeutic fidelity through structured domain coverage across the five key areas affected by trauma (safety, trust, power/control, esteem, and intimacy), ensuring comprehensive treatment of PTSD-related cognitive patterns [21].

3 Methods

3.1 Participants and Procedure

The app comprises tracks for symptoms of various mental health issues (e.g., anxiety, depression, OCD and PTSD). An AI free text engine is, therefore, used to refer users to the relevant module. The study analyzed interaction data from 2,306 users (77.5% women) who downloaded the application through mobile platforms, were referred to the PTSD track and gave consent that their data will be analyzed for aggregated research analyses. The mean age was 29.4 years (SD = 11.56; range 13-80). Data collection was anonymous and approved by The University Ethics Committee. As a part of the user journey users completed assessments at three timepoints: baseline (T0), post-initial usage (T1), and post-payment barrier (T-Final).

3.2 Measures

We used a mixed-methods approach combining interaction metrics with clinical outcomes. The primary outcome measure was the PCL-5 (PTSD Checklist for DSM-5), a 20-item self-report measure that assesses the severity of PTSD symptoms [5]. Each item corresponds to DSM-5 criteria and asks participants to rate how much they were bothered by specific symptoms in the past month on a 5-point Likert scale (0 = "Not at all" to 4 = "Extremely"). Example items include "Repeated, disturbing, and unwanted memories of the stressful experience?" and "Avoiding memories, thoughts, or feelings related to the stressful experience?" Total scores range from 0 to 80, with higher scores indicating greater symptom severity. A cutoff score of 31-33 is typically used to indicate probable PTSD diagnosis [5].

4 Results

4.1 User Engagement

From the initial 2,306 participants that completed the initial PCL-5 assessment, 370 users (16.0%) completed the second PCL-5 assessment, with 189 (51.1%) completing the final assessment. Of the initial pool of participants that completed the first PCL-5 assessment, 698 (30.3%) did not complete a second PCL-5 assessment, but did go on to complete one of the other tracks (e.g., anxiety, mood, sleep). Mean usage duration between initial and second PCL-5 assessments was 31.99 days (SD=62.9), extending to 51.3 days (SD=59.2) between second and final assessments.

4.2 Sample Characteristics and Attrition

Significant age differences emerged between timepoints, with participants at T0 being younger (M=27.96, SD=11.01) than those at T1 (M=34.87, SD=10.98; t(2028)=-5.947, p<.001) and T-Final (M=38.35, SD=11.78; t(2123)=-12.307, p<.001). Gender distribution remained stable between T0 and T1 (79.5% and 75.5% women respectively; $\chi^2(1)=0.654$, p=.419) but showed significant changes at T-Final (60.8% women; $\chi^2(1)=5.376$, p=.02). Initial PCL scores were comparable between T0 (M=49.79, SD=17.12) and T1 completers (M=46.7, SD=15.61; t(2028)=1.713, p=.087). However, T-Final completers showed significantly lower baseline scores (M=41.8, SD=17.94) compared to T1 participants (t(281)=2.255, p=.025).

4.3 Clinical Outcomes

Paired t-test analyses revealed significant symptom reduction from baseline (M=43.45, SD=17.2) to T1 (M=35.54, SD=17.95; d=0.594, 95% CI [0.483, 0.705]) and T-Final (M=30.15, SD=19.6; d=0.789, 95% CI [0.624, 0.952]). The effect size d represents the standardized magnitude of symptom change, where values around 0.5 indicate medium effects and 0.8 large effects [9].

The PCL-5 measure defines reliable clinical change as a reduction of 15-18 points in symptom scores [16]. We measured such change among users completing at least two assessment points (N = 370). Of these, 104 users (28.1%) achieved reliable clinical change ($\geq$ 18 point reduction), indicating meaningful improvement beyond measurement error that likely reflects real-world benefits for patients. The average time to improvement was 33.88 days (SD = 54.68).

5 Discussion

This study demonstrates the potential of carefully designed mobile interactions for delivering PTSD interventions. The effect sizes and clinically reliable improvement in a meaningful proportion of users suggest that systematic adaptation of cognitive restructuring techniques into brief digital interactions can achieve meaningful therapeutic outcomes. These results are particularly noteworthy given that current digital PTSD interventions typically show more modest clinical improvements [27].

The findings advance our understanding of therapeutic interaction design in several key areas. For instance, the effectiveness of brief, structured cognitive exercises challenges assumptions about the necessary format of PTSD treatment delivery. Although traditional cognitive processing therapy requires 60-90 minute sessions [21], our results suggest that the core therapeutic mechanisms can be effectively delivered to some users through focused micro-interactions when systematically designed. Moreover, the 33.88 days average improvement time compares favorably to traditional CPT's 12-week timeline [21]. These findings have important implications for expanding access to evidence-based PTSD treatment, particularly for individuals unable to commit to traditional therapy formats.

The successful translation of cognitive restructuring techniques into mobile interaction patterns (paired statements, directional sweeping, and emoji-based tagging) also demonstrates how established therapeutic principles can be preserved while using familiar digital interactions. The clinical improvements suggest that, at least for some people, these interaction patterns effectively facilitated the core therapeutic process of identifying and modifying maladaptive thought patterns.

Although user retention patterns aligned with typical mobile health applications [6, 10], the clinical improvements among continuing users suggest that the interaction design successfully balanced therapeutic fidelity with user engagement. The average time to improvement (35.06 days for clinically reliable change) indicates that users who engaged with the cognitive restructuring exercises received sufficient therapeutic exposure to achieve meaningful symptom reduction.

The demographic patterns in attrition in this study may give insights about digital intervention accessibility. The significantly younger age at initial engagement (M=27.96) compared to completion (M=38.35) suggests that while younger users may be more likely to try digital PTSD interventions, older users show higher persistence. Similarly, the shift in gender distribution from 79.5% women at baseline to 60.8% at completion warrants further investigation into gender-specific engagement factors. The findings that more than 30% of users that completed only one PCL-5 assessment continued to complete a different track on the app suggest that a more refined mechanism of track allocation may be needed.

These results contribute to the growing literature on digital mental health interventions by demonstrating how evidence-based treatment components can be systematically adapted for mobile delivery and also maintain therapeutic effectiveness [27]. The achievement of clinically reliable improvement through brief, daily interactions suggest new possibilities for increasing the accessibility and scalability of PTSD treatment.

5.1 Limitations and Future Work

Several limitations warrant consideration. The self-selected user population and natural attrition in the real-world implementation limit generalizability of the findings [2]. Future research should examine outcomes across more diverse populations and investigate how different interaction patterns might support various therapeutic needs. Additionally, while the current study focused on short-term clinical outcomes, longitudinal research is needed to understand the durability of therapeutic gains achieved through mobile interventions [1]. Future work should also explore how these interaction patterns might be adapted for other evidence-based psychological treatments.

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