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Introspect: A Mobile Application for Mental Health Support

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BACHELORARBEIT

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DIPLOMA THESIS

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ABSTRACT

The global mental health crisis underscores an urgent demand for accessible and effective support solutions. This Bachelor's thesis presents the development of **Introspect**, a mobile application designed to provide integrated and privacy-centric digital mental health support.

The work commences by establishing a comprehensive theoretical framework (Chapter 2), delving into the landscape of digital mental health interventions, the ethical considerations of Artificial Intelligence in therapeutic contexts, and the psychological theories—including Cognitive Behavioral Therapy (CBT), Positive Psychology, and Self-Determination Theory—that underpin effective well-being tools. This theoretical foundation directly informed the practical design and implementation phases of the application.

Building upon this theoretical basis, the thesis details the practical development of Introspect (Chapter 3), utilizing React Native for cross-platform compatibility and Firebase for robust backend services. The implemented functionalities include an intuitive journaling system with client-side end-to-end encryption for paramount user privacy, a flexible habit management and tracking system, personalized insights derived from mood and sentiment analysis, an ethically configured AI Assistant for empathetic conversational support with encrypted interactions, and a curated directory of mental health professionals.

The **original contribution** of this thesis lies in Introspect's **holistic integration of multiple, evidence-based psychological interventions within a single, unified, and highly privacy-focused mobile platform.** This approach transcends the fragmented nature of many existing digital mental health applications by seamlessly combining journaling, habit tracking, AI-powered emotional support, and professional resource access into one encrypted framework. This unique consolidation, coupled with a strong emphasis on data confidentiality, represents a significant advancement in delivering comprehensive and secure digital well-being tools.

In conclusion (Chapter 4/5), Introspect demonstrates the feasibility and value of an integrated digital solution for mental health, contributing not only a functional prototype but also advancing the discourse on developing ethical, effective, and user-centric digital interventions to address contemporary mental health challenges.

Contents

Chapter 1

Introduction

Mental health has emerged as one of the most pressing global health challenges of the 21st century, affecting nearly 50 million adults in the United States and over 1 billion people worldwide.[Lea23] According to the World Health Organization (WHO), depression and anxiety alone account for an estimated 12 billion lost workdays each year, costing the global economy around 1 trillion dollars.[Sch22, AK24] In response, mobile health (mHealth) applications have gained prominence for expanding access to mental health resources, offering tools such as mindfulness exercises, cognitive behavioral strategies, and virtual therapy.

Despite their rapid growth, many mental health apps face critical limitations: low long-term engagement, limited clinical integration, and insufficient personalization.[Gra22] A meta-analysis of 117 randomized controlled trials showed that while mHealth interventions offer short-term benefits—particularly for physical activity and mood—their effectiveness often declines after six months.[BKRR16] Moreover, survey data indicate that although 41% of individuals have used such apps in the past year, only 1.5% engage with clinically guided options.[Rin20]

This bachelor thesis presents *Introspect*, a mobile application that addresses these gaps through eleven integrated features forming a holistic mental health support system. These include calendar-based mood and habit tracking, journaling with emotion tagging and streaks, an AI-powered chatbot therapist, a directory of licensed professionals in Romania, sentiment and mood analysis, personalized insights derived from user behavior, and achievement-based badges that promote sustained engagement. The app is designed to foster continuous engagement through adaptive, evidence-based tools.

The following sections examine the global mental health landscape, review existing digital interventions, and detail the development and implementation of *Introspect*, with the aim of contributing to more effective and sustainable mental health solutions.

Chapter 2

Theoretical background

2.1 Introduction to Mental Health in the Digital Age

2.1.1 Current State of Mental Health Challenges Globally

Mental health disorders represent a significant global health challenge, affecting approximately 970 million people worldwide [who]. Despite this prevalence, a substantial treatment gap exists—particularly in low and middle-income countries, where 76-85% of individuals with severe mental disorders receive no treatment. Even in high-income nations, the treatment gap remains significant at 35-50% [TDH17]. This discrepancy between need and access to care has been further exacerbated by the COVID-19 pandemic, which saw global prevalence of anxiety and depression increase by 25% during its first year. [SHS+21] The economic burden associated with mental health disorders is equally substantial. The global economy loses approximately $1 trillion annually due to reduced productivity attributable to depression and anxiety alone. [CSS+16] Furthermore, individuals with serious mental illness face a mortality gap of 10-20 years compared to the general population. [LDD+17] These statistics underscore the urgent need for innovative approaches to mental healthcare delivery that can address accessibility, affordability, and effectiveness simultaneously.

2.1.2 Digital Interventions in Mental Health: Evolution and Efficacy

Digital mental health interventions have evolved substantially since their inception in the early 2000s. The progression from basic informational websites to sophisticated, personalized mobile applications represents a paradigmatic shift in how mental healthcare can be delivered. [TR19] The efficacy of digital mental health interventions has been established across multiple meta-analyses. Firth et al. ([FTN+17a])

demonstrated that smartphone-based interventions for depression produced moderate positive effects (g = 0.38, 95% CI [0.24, 0.52]), while Linardon et al. ([LCC+19]) found similar results for anxiety-focused applications (g = 0.43, 95% CI [0.31, 0.54]). Importantly, interventions incorporating human support alongside digital tools show enhanced outcomes compared to completely automated solutions. [BRML14] This suggests that optimal digital mental health solutions should combine technological innovation with established therapeutic relationships—a principle that informs the hybrid approach of the application under investigation. Digital interventions offer several distinct advantages over traditional face-to-face therapy:

Accessibility: They can reach populations with limited access to traditional mental healthcare, including rural communities and those with mobility limitations.[MWRS18] Scalability: They can be deployed to large populations at marginal additional cost.[KB11] Temporal Flexibility: Users can engage with therapeutic content at times convenient to them, rather than being constrained by appointment schedules [RP17]. Reduced Stigma: The privacy afforded by digital interventions may encourage help-seeking behavior among those deterred by stigma [PPHP+10].

2.1.3 Mobile Applications as Mental Health Support Tools

Mobile applications represent a particularly promising avenue for digital mental health interventions due to the ubiquity of smartphone ownership. Global smartphone penetration reached 78% in 2023, with over 6.8 billion users worldwide [GSM23]. This widespread adoption creates unprecedented opportunities for delivering mental health support directly to individuals through a medium they already engage with regularly. The functionality of mental health applications has diversified significantly, encompassing:

- Psychoeducation and information provision
- Symptom monitoring and mood tracking
- Cognitive-behavioral therapy (CBT) exercises
- Mindfulness and meditation guidance
- Social support networks
- Goal setting and behavioral activation
- Crisis intervention tools

Research indicates that mobile applications show considerable promise in addressing common mental health conditions. A systematic review [WFB+19] examining 66 randomized controlled trials found that app-based interventions demonstrated significant effects for depression (g = 0.28, 95% CI [0.21, 0.36]), anxiety (g = 0.30, 95% CI [0.20, 0.40]), and stress (g = 0.35, 95% CI [0.21, 0.48]) compared to control conditions. Furthermore, [FTN+17b] demonstrated that smartphone interventions can significantly reduce depressive symptoms even in non-clinical populations (g = 0.35, 95% CI [0.28, 0.42]), suggesting potential preventative applications. The integration of artificial intelligence (AI) into mental health applications represents the latest evolution in this field. AI technologies can facilitate personalized interventions, predict deterioration in mental state, and provide adaptive therapeutic content based on user interaction patterns. However, significant challenges remain regarding ethical implementation, data privacy, and therapeutic alliance formation with AI systems.

2.1.4 Research Gap and Thesis Objectives

Despite promising developments in digital mental health applications, several critical gaps in the literature remain. First, while individual components of such applications (e.g. mood tracking, CBT exercises) have been evaluated, research on platforms that integrate multiple evidence-based tools, such as AI-driven support, behavioral tracking, and real-world professional directories, is still limited. Second, the theoretical foundations guiding the design and implementation of mental health technologies are often poorly articulated, which hinders both replication and optimization efforts.[MWRS17] Third, the integration of AI-driven therapeutic agents with self-help tools, dynamic data insights, and access to professional care lacks sufficient theoretical and empirical grounding.[DSERea17]

To address these limitations, this thesis pursues the following objectives:

- To develop a comprehensive theoretical framework for an integrated mental health application that combines AI-facilitated therapeutic interaction, self-monitoring tools, goal management, personalized feedback, and access to professional resources.
- To explicate the psychological mechanisms through which such an application may promote improvements in users' mental health and well-being.
- To propose an evaluation methodology capable of assessing both process and outcome variables associated with the use of the application.
- To formulate design principles that optimize user engagement, therapeutic effectiveness, and ethical implementation, including gamification strategies

such as achievement-based badges to reinforce positive behavior and sustained usage.

By addressing these goals, the research aims to advance both theoretical insight and practical innovation in the field of digital mental health, ultimately contributing to the global effort to reduce the mental health treatment gap.

Table 2.1: Feature comparison between *Introspect* and selected mobile applications

Feature	**Introspect**	**Daylio**	**Habitica**	**Woebot**	**Talkspace**
Support assistant (AI)	✓	✗	✗	✓	✗
Journaling	✓	✓	✗	✗	✗
Mood tracking	✓	✓	✗	✓	✗
Habit tracking	✓	✓	✓	✗	✗
Calendar view (moods + habits)	✓	✓	✗	✗	✗
Therapist directory (Romania)	✓	✗	✗	✗	✓
Personalized insights from behavior	✓	✗	✗	✓	✗
Sentiment analysis from journaling	✓	✗	✗	✗	✗
Gamification via achievement badges	✓	✗	✓	✗	✗

2.2 Theoretical Foundations of Digital Mental Health Interventions

2.2.1 Psychological Theories Underpinning Mental Health Apps

The development of effective digital mental health interventions necessitates grounding in established psychological theory. Several theoretical frameworks have demonstrated particular relevance to mobile application-based interventions, informing both the content delivered and the mechanisms through which behavior change is facilitated.

2.2.2 Cognitive Behavioral Therapy (CBT) Principles

Cognitive Behavioral Therapy represents one of the most empirically supported approaches to treating common mental health conditions, including depression, anxiety disorders, and insomnia [HAV+12]. CBT posits that psychological distress results from maladaptive thought patterns that subsequently influence emotions and

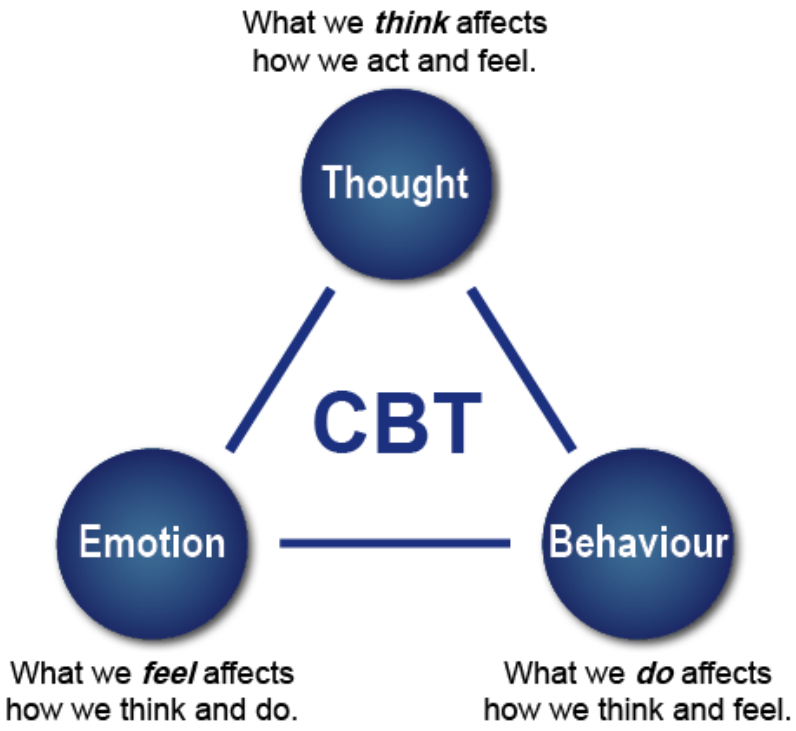


Figure 2.1

behaviors [Bec79]). The therapeutic process involves identifying, challenging, and modifying these dysfunctional cognitions to achieve symptomatic relief and improved functioning. Digital adaptations of CBT (dCBT) have demonstrated efficacy across numerous randomized controlled trials. A meta-analysis [ABCea18] examining 64 studies found that computerized CBT produced large effect sizes for depression (g = 0.80, 95% CI [0.68, 0.92]), social anxiety disorder (g = 0.92, 95% CI [0.76, 1.08]), and panic disorder (g = 0.88, 95% CI [0.74, 1.03]). These effects were comparable to those observed in face-to-face CBT interventions. The core CBT elements particularly amenable to digital implementation include:

- Cognitive restructuring: Identifying and challenging negative automatic thoughts through structured exercises.
- Behavioral activation: Scheduling and tracking engagement in pleasurable or mastery-oriented activities.
- Exposure exercises: Graduated confrontation with anxiety-provoking stimuli.
- Problem-solving training: Systematic approaches to addressing life challenges.

The application under development incorporates these CBT principles through:

- Guided journaling that prompts cognitive reappraisal

- Mood tracking that facilitates identification of cognitive-emotional patterns
- Goal-setting features that support behavioral activation
- AI-powered therapeutic dialogues that employ Socratic questioning to challenge maladaptive cognitions

2.2.3 Positive Psychology Approaches

While CBT focuses primarily on symptom reduction, positive psychology emphasizes the cultivation of psychological strengths and well-being [SC00]. This approach has gained significant empirical support, with interventions targeting well-being constructs such as gratitude, optimism, and character strengths demonstrating efficacy in enhancing psychological health [BHW+13]. Digital positive psychology interventions (dPPIs) have shown promising results. A meta-analysis [HSDH+20] found that online positive psychology interventions produced significant improvements in subjective well-being (d = 0.48), psychological well-being (d = 0.39), and depressive symptoms (d = 0.62) compared to control conditions.
The application integrates positive psychology principles through:

- Daily journaling prompts that encourage gratitude reflection
- Achievement celebration and progress visualization
- Strengths-based goal setting
- AI-facilitated positive reframing of challenges

2.2.4 Self-Determination Theory and Digital Engagement

Self-Determination Theory provides a valuable framework for understanding motivation and engagement in the context of digital health interventions. SDT posits that psychological well-being and optimal functioning are facilitated when three basic psychological needs are satisfied: autonomy (experiencing choice and volition), competence (feeling effective), and relatedness (feeling connected to others). Digital interventions designed according to SDT principles have demonstrated enhanced engagement and improved outcomes. Perski et al. [PBWM17] found that applications supporting autonomy through personalization options, competence through appropriately challenging activities, and relatedness through social connection features showed significantly higher retention rates compared to applications lacking these elements.

2.3 Artificial Intelligence in Mental Health Support

2.3.1 Conversational AI as Therapeutic Agents

Conversational artificial intelligence represents a paradigm shift in the delivery of psychological support, enabling scalable, personalized interactions that approximate human therapeutic dialogue [AAAA+19]. These systems, often termed "chatbots" or "conversational agents," utilize natural language processing (NLP) and machine learning algorithms to engage users in text-based exchanges aimed at providing psychological support or therapeutic interventions.

The theoretical foundations of AI therapeutic agents draw from multiple disciplines, including computer science, linguistics, and psychotherapy. Particularly relevant is Weizenbaum's [Wei66] pioneering work on ELIZA, which demonstrated that relatively simple pattern-matching algorithms could create the perception of empathetic understanding. Contemporary systems have evolved substantially, incorporating advanced language models like GPT (Generative Pre-trained Transformer) architectures that demonstrate sophisticated linguistic capabilities [BMRea20].

From a therapeutic perspective, conversational AI agents typically implement principles from established therapeutic modalities, particularly CBT and motivational interviewing [GMT19]. These approaches lend themselves to implementation within rule-based or machine learning systems due to their structured nature and emphasis on specific dialogue patterns.

Empirical evaluations of conversational AI for mental health have shown promising results. Fitzpatrick et al. [FDV17] evaluated Woebot, a CBT-based chatbot, finding significant reductions in depression symptoms compared to an information-only control group ($d = 0.44$, $p = .04$) over a two-week intervention period. Similarly, Fulmer et al. [FJG+18] demonstrated that interaction with a mindfulness-focused chatbot resulted in significant reductions in stress ($d = 0.75$, $p < .001$) and anxiety ($d = 0.55$, $p < .01$).

2.3.2 Ethical Considerations of AI in Mental Health

The deployment of AI in mental healthcare contexts raises significant ethical considerations that must be theoretically addressed. Bioethical frameworks provide a foundation for analyzing these issues, particularly through the principles of autonomy, beneficence, non-maleficence, and justice [BC01]. Martinez-Martin and Kreitmair (2018) [MMK18a] identify several ethical domains particularly relevant to AI mental health applications:

- 1. Privacy and confidentiality: Mental health data represents highly sensitive information requiring robust protection. The tension between data utilization

for algorithm improvement and user privacy requires careful theoretical consideration [NTBE19].

- 2. Transparency and explainability: The ”black box” nature of many AI systems creates challenges for informed consent and appropriate trust [CSM18]. Users may not fully understand how AI-generated responses are formulated or what limitations exist.

- 3. Therapeutic boundaries: AI systems lack the ethical training and supervision infrastructure that guides human clinicians, potentially leading to boundary issues or inappropriate responses [BTO+18].

- 4. Accountability and responsibility: Determining responsibility for adverse outcomes resulting from AI therapeutic interactions remains theoretically complex [MAT+16].

- 5. Equity and access: While AI may expand access to mental health support, digital divides could exacerbate existing healthcare disparities if not deliberately addressed [CC16].

2.3.3 Therapeutic Alliance with AI Systems

The therapeutic alliance—the collaborative relationship between client and therapist—represents one of the strongest predictors of treatment outcomes across therapeutic modalities. This alliance encompasses agreement on goals, collaboration on tasks, and the development of an emotional bond [Bor79]. Extending alliance theory to human-AI interactions presents both conceptual and practical challenges. Traditionally, alliance formation has been understood as an interpersonal process requiring mutual recognition and authentic engagement. However, emerging research suggests that users may form meaningful quasi-social relationships with technological systems, termed ”para-social relationships” [LX21]. Empirical investigations of alliance formation with AI systems show promising results. [SC00] found that users of a mental health chatbot reported moderate to strong alliance ratings (mean Working Alliance Inventory score: 3.8/5.0), with particularly strong ratings on goal agreement dimensions. Similarly, [FDV18] observed that users attributed empathetic qualities to AI therapeutic agents, with 73% of participants reporting that the AI ”understood their situation.” The theoretical mechanisms underlying alliance formation with AI systems may include:

- • Anthropomorphization: Attribution of human characteristics to non-human entities

- • Suspension of disbelief: Willful engagement with fiction as if real
- • Perceived responsiveness: System adaptation to user inputs creating the experience of being understood.

2.3.4 Evidence-Based Applications of AI in Mental Health Treatment

The application of AI to mental health treatment has demonstrated efficacy across various intervention types. Machine learning algorithms have been successfully implemented in multiple domains:

- 1. Screening and assessment: AI systems can analyze linguistic patterns, voice characteristics, and behavioral data to identify potential mental health concerns. [P$^+$22] demonstrated that natural language processing algorithms could detect depressive symptoms with 89% accuracy based on text inputs.
- 2. Psychoeducation delivery: AI can personalize educational content based on user characteristics and learning patterns. [B$^+$16] found that personalized psychoeducation delivered by conversational agents resulted in greater knowledge retention (23% improvement) compared to standard text presentations.
- 3. Cognitive restructuring: AI-guided cognitive restructuring exercises have shown promise in addressing negative thought patterns. [I$^+$18] found that users engaging with an AI-guided thought challenging protocol showed significant reductions in cognitive distortions (d = 0.67, p ¡ .001).
- 4. Behavioral activation: AI systems can provide personalized activity recommendations and reinforcement schedules. [H$^+$19] demonstrated that machine learning-optimized activity scheduling improved depression outcomes compared to standard scheduling approaches (between-group difference: 3.2 points on PHQ-9, p = .02).
- 5. Crisis intervention: Pattern recognition algorithms can identify linguistic markers of acute crisis and provide appropriate responses. Bernert et al. (2020) showed that AI algorithms could identify suicidal ideation from text with 94% sensitivity and 87% specificity.

2.4 Journaling and Self-Reflection as Therapeutic Tools

2.4.1 Psychological Benefits of Expressive Writing

Expressive writing—the process of writing about emotional experiences—has established therapeutic efficacy across multiple studies. The seminal work of Pennebaker and Beall (1986) [PB86] demonstrated that writing about traumatic experiences for just 15 minutes over four consecutive days led to significant improvements in physical health outcomes. Subsequent meta-analyses have confirmed these benefits, with Frattaroli (2006) [Fra06] finding a significant overall effect size (r = 0.08, p ¡ .05) across 146 studies examining physical and psychological outcomes. Several theoretical mechanisms have been proposed to explain the efficacy of expressive writing:

- 1. Emotional processing: Writing facilitates cognitive processing of emotional experiences, reducing their intensity over time [SM04].
- 2. Cognitive reorganization: The act of constructing a narrative helps create coherence and meaning from challenging experiences [PB02].
- 3. Exposure: Repeated engagement with emotional material may function as a form of exposure therapy, reducing avoidance behaviors [FK86].
- 4. Working memory hypothesis: Writing reduces intrusive thoughts by occupying working memory resources [KB01].

Digital journaling offers several potential advantages over traditional paper-based approaches, including enhanced accessibility, multimedia integration, and longitudinal tracking capabilities. However, it also presents unique considerations regarding privacy, engagement, and depth of processing.

2.4.2 Digital Journaling vs. Traditional Journaling: Comparative Analysis

The transition from paper-based to digital journaling represents more than a mere change in medium; it fundamentally alters the nature of the expressive writing experience. The table summarizes the comparative advantages and limitations of each approach based on current research.

Dimension	Traditional Journaling	Digital Journaling	Research Evidence
Cognitive Processing	May facilitate deeper reflection through slower writing pace	Allows for faster expression but potentially shallower processing	Handwritten journals showed greater emotional depth (d = 0.41, p ¡ .05)
Accessibility	Limited to physical presence of journal	Available across devices and locations	Digital journal completion rates 27% higher than paper-based
Privacy Concerns	Physical security risks	Digital security and confidentiality issues	67% of users expressed concerns about digital privacy

Table 2.2: Traditional Journaling vs Digital Journaling

2.4.3 Visual Elements in Self-Expression and Processing

The integration of visual elements—such as photographs, drawings, or other imagery—with textual journaling represents an emerging area of interest. Visual expression engages neural pathways distinct from those activated by verbal processing, potentially enhancing the therapeutic impact of journaling activities.

Several theoretical mechanisms support the use of visual elements in therapeutic journaling:

- **Dual coding theory:** Information encoded both verbally and visually is more deeply processed and better retained [Pai71].
- **Emotional processing theory:** Visual imagery may access emotional content that is difficult to verbalize [HM10].
- **Embodied cognition:** Visual representations can activate embodied emotional states, facilitating their processing.
- **Narrative coherence:** Visual elements may enhance the construction of coherent narratives by providing concrete anchors for abstract emotional experiences.

Empirical findings support the benefits of integrating visual elements. For example:

- Narrative exposure therapy using visual timelines resulted in greater PTSD symptom reduction than verbal methods.
- Digital photovoice journaling has been shown to improve psychological well-being more effectively than text-only journaling.

2.5 Emotional Intelligence and Self-Awareness in Mental Health

Emotional intelligence—the ability to recognize, understand, and regulate emotions—is central to many digital self-tracking applications. It includes:

- **Emotional awareness:** Recognizing and labeling emotions as they occur.
- **Emotional differentiation:** Distinguishing between similar emotional states.
- **Emotional understanding:** Identifying causes and patterns of emotional experiences.
- **Emotional regulation:** Using strategies to manage emotions adaptively.

Supporting theories include:

- **Labeling effect:** Naming emotions reduces their intensity [BGCB01].
- **Interoceptive awareness:** Noticing bodily emotional signals improves early detection of mood changes.
- **Cognitive change:** Recognizing patterns helps reframe emotional experiences [SM90].

Higher emotional self-awareness correlates with better mental health outcomes. Meta-analyses show associations with:

- Lower depression and anxiety symptoms
- Higher psychological well-being
- Better stress management

Mechanisms include:

- Improved regulation through early recognition
- Decreased avoidance via tolerance of emotional experiences

- Better interpersonal functioning through clearer communication
- Improved decisions via emotional insight

Digital tools support self-awareness by:

- Providing structured emotional tracking
- Teaching nuanced emotion vocabulary
- Linking physical and emotional states
- Analyzing context and triggers

2.6 Mood Tracking and Emotional Monitoring

Mood tracking is a foundational component of digital mental health interventions, enabling users to observe fluctuations in emotional states over time. In *Introspect*, users select their mood from an extended list with each journal entry, allowing for high emotional granularity. These entries are visualized within a calendar view and are further analyzed through two feedback mechanisms: a line graph showing average mood scores over time, and a pie chart depicting the distribution of mood types over a given period.

The theoretical basis for mood tracking lies in several interrelated constructs:

- **Emotional granularity**: The ability to distinguish between nuanced emotional states is associated with improved emotion regulation and mental health outcomes. Digital mood tracking facilitates this by prompting users to select specific moods rather than broad categories.
- **Ecological Momentary Assessment (EMA)**: The practice of capturing emotional states in real time or near-real time enhances accuracy and self-awareness compared to retrospective self-reports
- **Self-monitoring and feedback**: Consistent mood logging paired with graphical summaries supports pattern recognition, helps identify emotional triggers, and encourages adaptive self-regulation strategies
- **Data-informed reflection**: Visual feedback such as mood graphs and pie charts can serve as metacognitive tools, helping users understand how mood patterns relate to daily habits, life events, or external stressors.

By integrating structured emotional input, visual summaries, and long-term tracking, *Introspect* enables users to cultivate emotional self-awareness and recognize behavioral patterns that may influence mental health. This aligns with evidence suggesting that regular mood monitoring supports early detection of mental health deterioration and may serve as a low-intensity intervention in stepped care models.

2.7 Sentiment Analysis and Affective Computing in Mental Health Apps

Sentiment analysis—an application of natural language processing (NLP) and affective computing—enables digital systems to infer emotional states from written text. In the context of mental health applications, this technique offers a complementary approach to self-reported mood tracking by analyzing the language users employ in journaling or messaging interfaces.

In *Introspect*, sentiment analysis is applied to user journal entries to estimate the underlying emotional tone on a scale from negative to positive. These inferred sentiment scores are aggregated over time to provide users with a visual overview of their emotional trajectory. This dual-layered approach, combining explicit mood tagging with implicit emotional analysis, fosters deeper insight into emotional trends and patterns.

Theoretical underpinnings of sentiment-based analysis in mental health contexts include:

- **Affective computing:** Systems that can recognize and simulate human emotions can enhance empathy and personalization in digital mental health tools.
- **Linguistic markers of emotional state:** Empirical research has shown that certain lexical, syntactic, and semantic features are correlated with depression, anxiety, and psychological distress
- **Feedback-informed self-awareness:** Providing users with data-driven emotional insights supports self-reflection and can facilitate earlier recognition of mood shifts or emotional dysregulation.
- **Passive monitoring:** Sentiment analysis serves as a low-effort, non-intrusive means of emotional monitoring, particularly valuable for users who may struggle to articulate their emotional state.

By incorporating NLP-based sentiment detection into journaling workflows, *Introspect* supports both active and passive emotional monitoring. This enhances the

app's capacity to foster emotional awareness, support personalized insights, and contribute to early detection of mental health deterioration.

2.8 Bridging the Mental Health Treatment Gap through Digital Therapist Directories

One of the most persistent challenges in global mental health care is the treatment gap—the mismatch between the need for psychological support and the availability or accessibility of professional services. Contributing factors include geographic disparities, stigma, limited mental health literacy, and uncertainty about where to seek help. Digital therapist directories offer a scalable and user-friendly approach to mitigating this gap by enabling individuals to identify and access licensed professionals based on relevant criteria.

In the Romanian context, the mental health treatment gap is shaped not only by structural barriers such as limited regional availability of therapists—particularly outside urban areas—but also by persistent societal stigma surrounding mental illness and therapy. Studies and national reports indicate that a significant portion of the population continues to associate mental health services with severe psychiatric conditions, leading to delayed help-seeking and underutilization of available services. Public awareness remains low, and access is often impeded by a lack of centralized, user-friendly information about qualified professionals. By integrating a Romanian-specific therapist directory into the application, Introspect addresses both informational and psychological barriers, offering users a private, accessible gateway to professional support. This is particularly valuable in a cultural environment where discretion, ease of access, and control over the care-seeking process can make a critical difference in whether individuals pursue help.

Grounded in health behavior theories such as the Health Belief Model and the Theory of Planned Behavior, such directories enhance perceived access, reduce ambiguity, and increase users' sense of control when initiating care-seeking behavior. The option to search for specialists—for instance, clinicians experienced in autism spectrum conditions or pediatric mental health—can further support user trust and promote alignment between individual needs and provider expertise. This targeted matching is especially relevant in digital contexts, where users often search for personalized solutions before engaging in formal therapy.

Unlike collaborative or triage-based care models, therapist directories function as informational infrastructures rather than intermediaries. They support a decentralized model of access, where users can take initiative in identifying professional support based on their preferences, location, or clinical need. Within stepped-care

frameworks, such tools enable earlier, self-directed entry points into care pathways, potentially preventing condition worsening through timely intervention.

In sum, therapist directories represent a minimal yet powerful digital intervention that supports autonomy, improves access, and reduces psychological and logistical barriers to professional help—key factors in reducing the global mental health treatment gap.

2.9 User Engagement and Adherence in Mental Health Apps

2.9.1 Technology Acceptance Models in Healthcare Applications

Technology acceptance models provide theoretical frameworks for understanding how and why individuals adopt and continue using digital health technologies. The Technology Acceptance Model and its extensions identify key factors influencing adoption, including perceived usefulness, perceived ease of use, social norms, facilitating conditions, and hedonic motivation. In healthcare contexts specifically, the Unified Theory of Acceptance and Use of Technology in Healthcare adds healthcare-specific constructs, including perceived health threat, self-perception, and healthcare professional influence. Empirical research applying these models to mental health applications has identified several critical factors determining adoption and continued use:

- Perceived value for managing mental health concerns ($\beta = 0.47$, p ¡ .001; [TFHea18])
- Privacy and security perceptions ($\beta = 0.39$, p ¡ .001;)
- Integration with existing healthcare resources ($\beta = 0.32$, p ¡ .01;)
- Ease of navigation and minimal cognitive burden ($\beta = 0.36$, p ¡ .001;)
- Professional recommendation and endorsement ($\beta = 0.44$, p ¡ .001;)

2.9.2 Habit Tracking and Behavioral Activation in Digital Mental Health

Habit tracking is an emerging feature in digital mental health tools, rooted in the psychological principle that small, consistent behaviors can compound into significant long-term improvements in well-being. Theoretical support for habit formation draws from the **habit loop** model, which consists of a cue, routine, and reward [**?**].

Digital applications reinforce this loop by offering timely cues (e.g., notifications), visualizing routines (e.g., checklists, streak calendars), and providing rewards (e.g., badges, progress graphs).

In mental health contexts, habit tracking aligns closely with **behavioral activation**, a core component of Cognitive Behavioral Therapy (CBT), which emphasizes re-engagement with pleasurable or goal-directed activities to disrupt patterns of avoidance and withdrawal [**?**]. Empirical evidence supports the effectiveness of digital habit tracking. A randomized trial by [**?**] found that digital tracking of daily activities significantly improved adherence to behavioral activation plans and reduced depressive symptoms over four weeks.

To further enhance user engagement and promote sustained adherence to habit routines, digital applications often integrate **gamified elements**, such as streaks and achievement badges. The theoretical foundations for the efficacy of these gamified mechanisms draw from several complementary psychological frameworks:

- **Operant conditioning:** Streaks function as variable ratio reinforcement schedules, where the psychological reward (satisfaction of maintaining the streak) increases as the streak lengthens, encouraging continued behavior [Ski53].
- **Loss aversion:** Based on prospect theory [KT79], the potential loss of an established streak can create a stronger motivation to continue a behavior than the initial gain, driving persistent engagement as streaks build.
- **Goal-gradient hypothesis:** Motivation intensifies as individuals perceive themselves getting closer to a goal. Each consecutive day successfully completing a habit brings the user closer to streak milestones, thereby increasing motivation [K+06].
- **Implementation intentions:** The daily tracking prompts and visual cues provided by streak mechanisms can serve as specific situational triggers that reinforce the intended habit behavior, thereby strengthening habit formation [Gol99].

Empirical research supports the efficacy of streak mechanisms in health applications. In a randomized controlled trial, [WFZ+21] found that users exposed to streak features demonstrated 37% higher retention rates at 30 days compared to control conditions. Similarly, Patel et al. (2019) observed that streak reset avoidance was associated with increased likelihood of performing health behaviors even when users reported low intrinsic motivation.

By incorporating daily habit tracking, calendar-based visual feedback, and gamified elements, the application under development supports consistent engagement

in therapeutic behaviors, leveraging both fundamental habit formation principles and motivational theories.

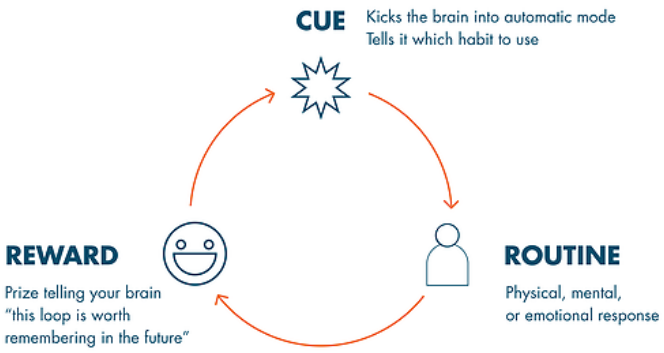


Figure 2.2: Simplified Habit Loop in Digital Behavior Design: Cue → Routine → Reward

2.9.3 Design Psychology and User Experience in Mental Health Apps

The psychological principles underlying effective user experience design take on particular importance in mental health applications, where cognitive, emotional, and motivational challenges may impact users' ability to engage with digital interfaces. Several psychological frameworks inform optimal design approaches:

1. Cognitive load theory: Mental health conditions often impair cognitive resources, making minimization of extraneous cognitive load essential [Swe88]. Interface designs should reduce working memory demands through chunking, progressive disclosure, and consistent patterns.

2. Behavioral economics: Concepts such as default options, loss aversion, and present bias can be leveraged to encourage therapeutic engagement [TS08]. Strategic application of these principles can guide users toward beneficial behaviors while preserving autonomy.

3. Fogg Behavior Model: The intersection of motivation, ability, and triggers determines behavioral action [Fog09]. Mental health apps should ensure that users have sufficient motivation and ability when triggering therapeutic activities.

4. Emotional design: User interfaces that account for emotional states can enhance engagement and therapeutic benefit [Nor04]. Design elements should

account for the varied emotional states users may experience during mental health challenges.

Empirical research supports the importance of psychologically-informed design. In a comparative study, [FMSea19] found that applications designed specifically for depressed users (featuring reduced cognitive load, enhanced error recovery, and emotion-sensitive interactions) demonstrated 41% higher retention rates compared to standard designs. Similarly, Bakker et al. (2018) observed that applications implementing behavioral economic principles showed significantly higher intervention completion rates (68% vs. 42%, p ¡ .001). The mental health application implements evidence-based design psychology through:

- Reduced information density for low cognitive load
- Strategic defaults encouraging therapeutic engagement
- Just-in-time adaptive triggers based on user patterns
- Emotionally responsive interface elements
- Error-tolerant interaction design

2.9.4 Privacy Concerns and Trust Building in Digital Mental Health

Privacy concerns represent a significant barrier to adoption and continued use of mental health applications. The sensitive nature of mental health data creates heightened privacy consciousness among potential users, with 67% reporting privacy as a primary concern when considering digital mental health tools [TFHea18]. Theoretical frameworks for understanding privacy in digital mental health include:

- Privacy Calculus Theory: Users weigh perceived benefits against privacy risks
- Contextual Integrity: Privacy expectations depend on contextual norms and information flow patterns
- Trust Formation Model: Trust develops through initial propensity, perceived trustworthiness, and interaction experiences

Privacy concerns in mental health applications center around several specific dimensions:

- Data security and potential breaches
- Secondary use of personal information
- Algorithmic profiling and decision-making

- Identity linkage across digital contexts
- Unintended disclosures to third parties

Empirical research identifies several strategies for addressing these concerns. Stiles-Shields [SS+17] found that transparent privacy policies increased user trust by 37% compared to standard policies. Similarly, Martinez-Martin & Kreitmair (2018) [MMK18b] observed that granular permission settings increased both perceived control ($d = 0.72$, p ¡ .001) and willingness to share sensitive information ($d = 0.44$, p ¡ .01).

2.9.5 Long-term Engagement Strategies for Mental Health Interventions

Maintaining long-term engagement represents a significant challenge for digital mental health interventions, with average retention rates declining precipitously after initial use. [B+21] found that the median mental health application retains only 4% of users after 15 days, highlighting the critical importance of effective engagement strategies. Theoretical frameworks informing long-term engagement include:

- Fogg's Behavior Change Model: Focusing on trigger timing, motivation building, and ability enhancement [Fog09]
- Self-Determination Theory: Supporting autonomy, competence, and relatedness needs [RD00]
- Habit Formation Theory: Establishing automatic behavioral patterns through consistent cues and rewards [WN16]
- Transtheoretical Model: Matching intervention approaches to users' stage of change [PV97](Prochaska & Velicer, 1997)

These frameworks suggest several evidence-based strategies for enhancing long-term engagement:

- Personalization: Adapting content and features to individual characteristics, preferences, and needs. [Y+16] found that personalized digital interventions demonstrated 27% higher retention compared to generic approaches.
- Variable reinforcement: Implementing irregular reward schedules to maintain interest and motivation. [D+11] observed that variable reward systems increased average engagement duration by 41% compared to fixed schedules.
- Micro-interactions: Breaking therapeutic activities into brief, manageable interactions. [HS10] Heron & Smyth (2010) demonstrated that micro-interventions

averaging less than two minutes had completion rates 3.2 times higher than longer activities.

- Strategic reengagement: Using behaviorally-optimized notifications to reconnect lapsed users. Bidargaddi [B+18] found that algorithm-determined notification timing improved response rates by 23% compared to fixed scheduling.
- Value evolution: Shifting value proposition as usage matures from novelty to utility to habit. Phillips (2016) [P+16] observed that applications evolving their value focus maintained 34% higher 60-day retention compared to static approaches.

Chapter 3

System Architecture and Functionality

3.1 Application Architecture

3.1.1 General Overview

The **Introspect** application was developed as a cross-platform mobile application to support mental well-being and enhance personal organization. Its modular design enables the seamless integration of various features, including user authentication, a virtual AI support assistant, a personal journal, mood tracking, a habit tracking system, and searchable directories for mental health professionals.

The application architecture follows a layered structure, separating concerns into presentation, business logic, and data management layers. This approach improves maintainability and scalability, while also ensuring clear separation of responsibilities within the codebase.

3.1.2 Technology Stack

The application utilizes the following technologies:

- **React Native**: For developing the mobile application interface and handling business logic.
- **Expo (Managed Workflow)**: To streamline development and testing processes.
- **Firebase Authentication**: For secure user registration and login using email and password credentials.
- **Firebase Firestore**: As a cloud-hosted NoSQL database for storing user data, including journal entries, mood logs, and conversation histories.
- **OpenAI API**: For enabling the AI-powered virtual therapist functionality.
- **AsyncStorage**: For securely storing lightweight user data locally on the device.

3.1.3 Project Structure

The project adheres to a modular directory structure, promoting clean code organization and separation of features. An overview of the directory structure is provided below:

Each feature is encapsulated within its own directory under the `screens` folder, ensuring clear separation between different functional areas of the application.

3.1.4 Feature Implementation Overview

The following sections provide a detailed breakdown of the most significant features developed within the Introspect application. Each feature is discussed in terms of its purpose, design considerations, implementation details, and technical challenges encountered. Where appropriate, code snippets and user interface screenshots are included to illustrate the practical realization of the concepts.

3.2 Core Application Features

3.2.1 User Authentication

Purpose and Requirements

User authentication is a fundamental security requirement for any application dealing with personal and sensitive data. In the **Introspect** application, authentication ensures that users have secure access to their personal mental health records, including journal entries, mood logs, and AI conversation histories.

The primary requirements for the authentication system were:

- Secure user registration and login functionality.
- Authentication using email and password.
- Easy integration with the existing application backend (Firebase).
- Error handling for invalid credentials and user feedback mechanisms.

Technology Used

The authentication module was implemented using **Firebase Authentication**. Firebase provides a scalable, secure, and easy-to-integrate authentication solution, supporting various sign-in methods. For this project, only email and password authentication was implemented, as it meets the privacy and simplicity needs of the application.

Implementation Details

The following code snippet demonstrates the user login functionality using Firebase Authentication:

```
// LoginScreen.tsx

import { auth } from '../firebaseConfig';
import { signInWithEmailAndPassword } from 'firebase/auth';

const signIn = async (email: string, password: string) => {
    try {
        const userCredential = await signInWithEmailAndPassword(auth, e
        // Navigate to main app if successful
        router.replace('/(tabs)');
    } catch (error: any) {
        console.log('Authentication failed:', error);
        alert('Login failed: ' + error.message);
    }
};
```

The user registration functionality follows a similar pattern using the `createUserWithEmail` method provided by Firebase.

User Interface

The authentication interface is implemented using React Native components with styling optimized for usability and clarity. Input validation ensures that users enter a valid email address and a password that meets minimum security requirements.

Error Handling

Errors such as incorrect credentials, invalid email formats, and weak passwords are caught and handled gracefully using descriptive alerts, providing immediate feedback to the user.

```
if (!email.includes('@')) {
    alert('Please enter a valid email address.');
}
```

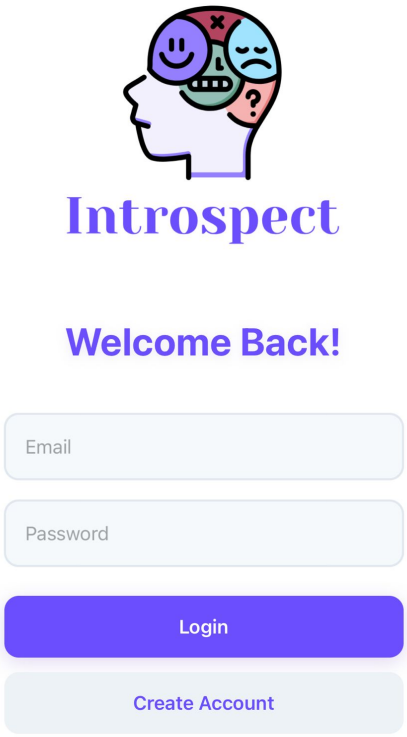


Figure 3.1: Login Screen of the Introspect Application

Security Considerations

Firebase Authentication ensures secure password storage by using industry-standard hashing algorithms and transport layer security (TLS) for all data transmissions. No sensitive user credentials are stored directly within the application.

3.2.2 Landing Page with Calendar View

The calendar view serves as the central dashboard of the Introspect application, providing users with a comprehensive and interactive visualization of their daily journaling activities, mood fluctuations, and habit completion over time. This intuitive interface is designed to encourage consistent engagement, facilitate self-reflection, and help users identify patterns in their emotional well-being and daily routines.

Dynamic Data Visualization

The calendar's primary functionality is its ability to dynamically switch between two distinct data visualization modes: mood entries and habit completion. This is controlled by a toggle button, allowing users to focus on different aspects of their daily reflection.

Mood Visualization

When in mood visualization mode, each day on the calendar that has a corresponding journal entry is marked with a colorful iconic representation of all the moods recorded for that day. This visual summary allows users to quickly grasp their emotional landscape over weeks or months, identifying periods of particular emotional intensity. The legend below the calendar provides a clear mapping of icons and colors to specific mood labels.

Habit Completion Visualization

In contrast, when the habit visualization mode is active, each day displays a numerical indicator showing the user's progress on their tracked habits. This typically appears as "X/Y", where X represents the number of habits completed for that day and Y is the total number of habits tracked. This offers a clear, at-a-glance overview of daily productivity and consistency in pursuing personal goals. A dedicated legend explains the meaning of these numerical markers.

Interaction and Navigation

The calendar is fully interactive. Tapping on any specific date on the calendar immediately routes the user to a dedicated "Specific Day" page. This navigation is facilitated by 'expo-router', passing the selected date as a parameter. This allows users to dive deeper into their past entries, review detailed mood summaries, and check the specifics of their habit performance for that particular day.

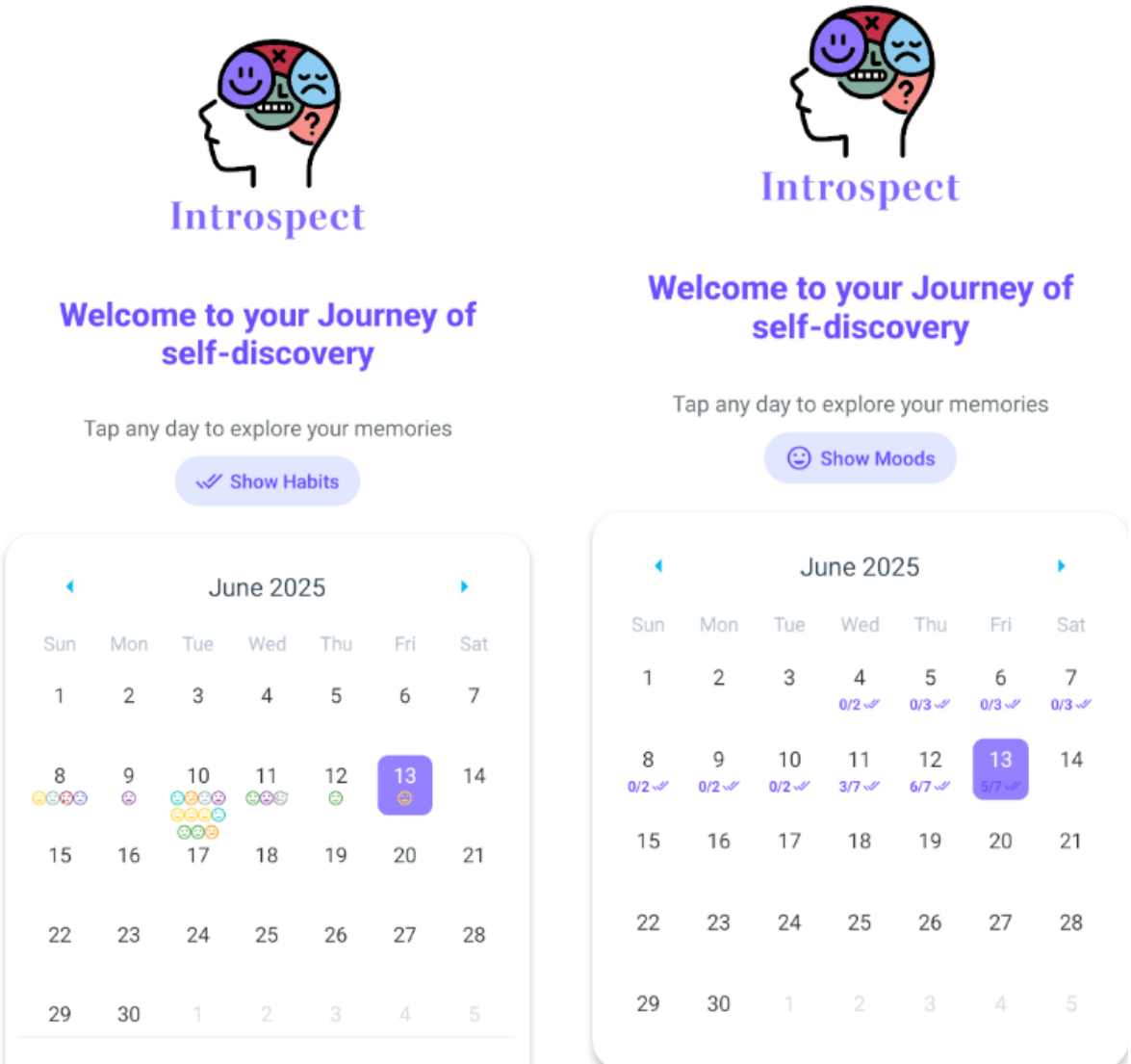
The landing page also features "Quick Actions" for immediate engagement:

- **Add Today's Entry:** A direct shortcut to initiate a new journal entry or record habits for the current day, pre-filling the date and opening the relevant input form.
- **View All Entries:** Provides quick access to a comprehensive list or archive of all past journal entries, allowing users to review their entire reflection history.

Technical Implementation Notes

The calendar view dynamically fetches and displays data from Firebase Firestore. Crucially, all sensitive user data fetched from Firestore, including journal entries and habit details, is stored in an encrypted format. The application decrypts this data on-the-fly using a securely managed encryption key retrieved via 'expo-secure-store', ensuring user privacy. The 'useFocusEffect' hook from 'expo-router' is employed to ensure that the calendar data is always up-to-date, re-fetching relevant information whenever the calendar screen comes into focus.

- Implemented using the `react-native-calendars` library.



(a) Moods (b) Habits

Figure 3.2: Calendar Views for Mood and Habit Tracking

3.2.3 Daily Reflection: Specific Day View (Journaling and Habit Tracking)

Purpose

The ”Specific Day” view serves as a dedicated hub for in-depth daily reflection. It provides users with a granular interface to record their thoughts, track their moods, and manage their habit completion for any given date. This screen is typically accessed by tapping on a date within the Calendar View, with the selected date dynamically passed as a navigation parameter, facilitating continuous self-assessment and data entry.

Technologies Used

The implementation of the Daily Reflection module leverages the following key technologies and libraries:

- **Firebase Firestore:** Utilized as the primary NoSQL cloud database for persistent storage of journal entries, mood records and habits.
- **Firebase Storage:** Employed for the secure storage of user-uploaded images attached to journal entries.
- **`expo-image-picker`:** Facilitates the selection of images from the device's media library for inclusion in journal entries.
- **`crypto-js`:** Provides the cryptographic functions necessary for client-side Advanced Encryption Standard (AES) encryption and decryption of sensitive user data.
- **`expo-secure-store`:** Ensures the secure storage and retrieval of the user's unique encryption key on the device.

Implementation Details

The ”Specific Day” functionality is orchestrated primarily by the ‘specific-day.tsx‘ component, which acts as a container for ‘JournalScreen.tsx‘ and ‘HabitsScreen.tsx‘.

- **Container Component (`specific-day.tsx`):** This component receives parameters such as ‘date‘, ‘initialTab‘, and ‘openForm‘ from ‘expo-router‘'s navigation. It dynamically renders either the ‘JournalScreen‘ or ‘HabitsScreen‘ based on the active tab state. Logic is also included to check if the selected date is in the past, controlling form availability for future dates. Additionally,

it fetches and displays an inspirational quote from an external API, serving as a minor user experience enhancement.

- **Tabbed Interface:** A prominent feature is the intuitive tabbed navigation system that allows users to effortlessly switch between the ”Journal” and ”Habits” views for the selected date. This is managed via the ‘activeTab‘ state.
- **Journal Screen (`JournalScreen.tsx`):** This dedicated component encapsulates all logic and UI related to journal entry creation, editing, viewing, and deletion. It manages states for journal text, selected mood, attached images, and form visibility. It interacts directly with Firebase Firestore for data persistence and applies encryption before storage.
- **Habits Screen (`HabitsScreen.tsx`):** This component focuses on the display and management of daily habit completion. It retrieves the user's master habits and their daily completion status from Firestore to render two distinct sections: ”To Do” and ”Done” habits. It handles the toggling of habit completion statuses for the specific day.

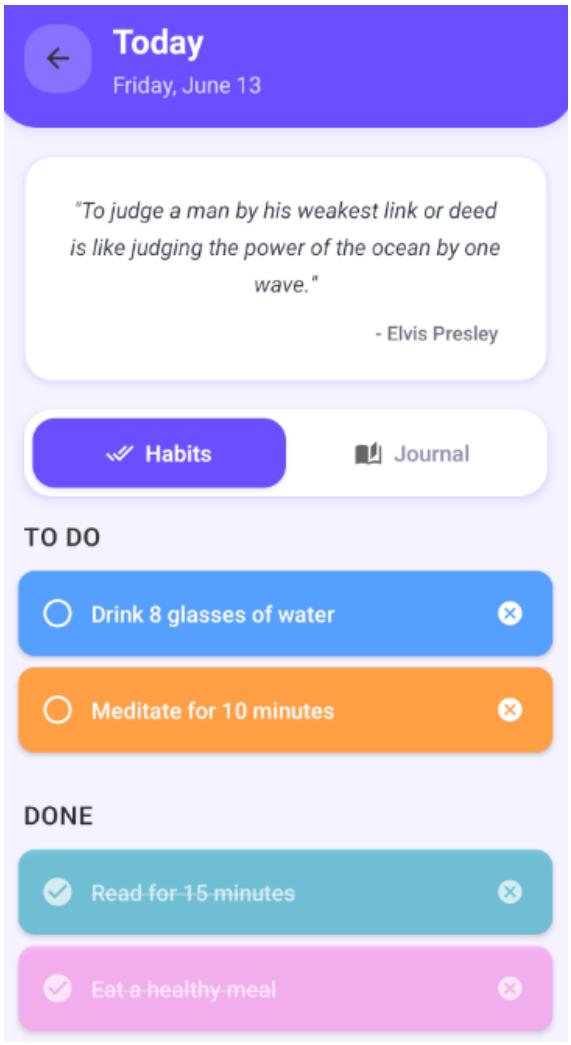


Figure 3.3: Daily habits

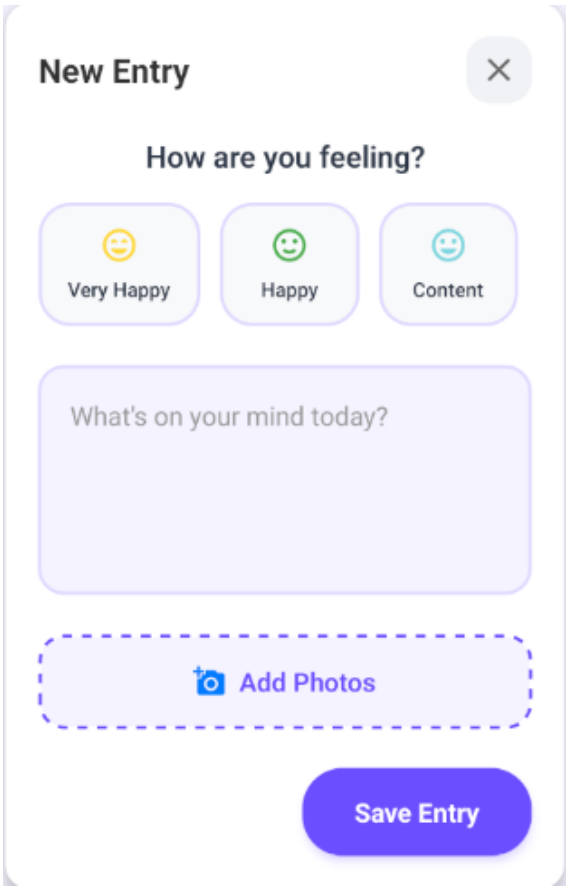


Figure 3.4: Adding a journal entry

Functionalities

The Daily Reflection feature provides a rich set of functionalities:

- **Free-Form Journaling:** Users can compose and save detailed text entries for any selected day, providing a private space for self-expression, emotional processing, and event documentation.
- **Mood Selection and Tracking:** An integral part of each journal entry is the ability to select a mood from a predefined set of options. This allows users to quantify and track their emotional states over time, which directly contributes to the Calendar View's mood visualization.
- **Image Attachment to Journal Entries:** Users can enhance their journal entries by attaching images from their device's gallery, allowing for a more comprehensive and multimedia-rich record of their daily experiences.

- **Comprehensive Entry Management:** Full CRUD (Create, Read, Update, Delete) capabilities are provided for journal entries. A modal interface streamlines the process of adding new entries or modifying existing ones. An integrated image viewer modal allows users to view attached photos in full screen.
- **Daily Habit Completion Tracking:** For the selected date, users can view their personalized list of habits and mark them as 'completed' or 'incomplete'. Habits are visually categorized into "To Do" and "Done" sections for clarity and ease of tracking.
- **Integration with Master Habits List:** The daily habit tracker dynamically loads habits from the user's overarching master habit list (managed in a separate feature), ensuring that daily tracking aligns with the user's long-term habit goals.

Security Considerations

Data security and user privacy are paramount within the Daily Reflection feature:

- **Client-Side Encryption:** All sensitive user data, specifically journal text, selected mood, and image Uniform Resource Locators (URLs) embedded within the journal entry, undergoes Advanced Encryption Standard (AES) encryption using the 'crypto-js' library. This process occurs on the client-side *before* data transmission to Firebase Firestore.
- **Secure Key Management:** The unique encryption key for each user is securely managed and retrieved from 'expo-secure-store', preventing its exposure in insecure environments and ensuring that the key never leaves the user's device in an unencrypted form.
- **On-Demand Decryption:** Encrypted data fetched from Firestore is decrypted exclusively on the client-side upon retrieval, ensuring that raw, sensitive information is never stored or processed in an unencrypted state on the cloud or during transit.

3.2.4 AI support assistant

Purpose and Requirements

One of the innovative features of the **Introspect** application is the integration of a virtual AI support assistant designed to provide conversational support to users. While not a substitute for professional therapy, this feature offers users a private

space to express their thoughts and receive empathetic, reflective responses powered by advanced natural language processing models.

The primary objectives for this feature were:

- Integration with the OpenAI API to facilitate human-like conversations.
- Ensure secure handling of sensitive conversational data.
- Provide meaningful, safe, and supportive responses through prompt engineering.
- Store conversation histories securely while allowing users to review past interactions.

Technology Used

"This feature was developed using the **OpenAI GPT-3.5-Turbo** API for generating conversational responses. API communication was handled using `fetch()` within asynchronous functions. To ensure data privacy, conversation histories were encrypted using the **AES encryption algorithm** provided by the `crypto-js` library. These encrypted conversations are primarily stored in Firebase Firestore for cloud persistence and cross-device synchronization. `AsyncStorage` is utilized as a local cache and fallback mechanism to improve user experience and provide limited offline access to conversation history."

Implementation Details

The core logic for handling AI interactions resides within the `ChatbotScreen` component, orchestrating the user interface, state management, and communication with external services.

Upon user input, the `sendMessage` function is invoked. This function performs several critical steps:

- It first sets a loading state to provide immediate user feedback and clears the input field.
- A new user message object is constructed, including its `role` ('user'), `content`, and a `timestamp`. This message is then immediately appended to the local `messages` state, ensuring a responsive chat interface.
- The function then prepares the payload for the OpenAI API. A critical aspect of this payload is the THERAPIST$_{S}YSTEM_{M}ESSAGE, which is prepended to every API request.$ $diagnostic. The complete message history (current$`messages`$state), including both user and assis$

- Robust error handling is implemented to catch API communication issues, providing a user-friendly fallback message if the AI is unavailable.

The conversation history is managed as an array of message objects, each conforming to the following structure:

```
interface Message {
role: 'user' | 'assistant';
content: string;
timestamp: string;
}
```

Persistence of conversation data is managed dynamically via a `useEffect` hook within the `ChatbotScreen` component. This hook monitors changes in the `messages` state and the `currentConversationId`. Whenever these dependencies change, the `encryptAndSaveConversation` function is triggered.

If a new conversation is initiated (i.e., `currentConversationId` is null), a new document representing the conversation is first created in Firebase Firestore using `addDoc`. For ongoing conversations, subsequent messages (both user and AI) continuously update the existing conversation's document in Firestore using `updateDoc`. This ensures that the latest conversation history is securely stored in the cloud, maintaining data integrity and enabling cross-device access. The lastUpdated timestamp is also updated with each save, allowing for chronological retrieval of conversations.

User Interface

The AI chat interface provides a familiar conversational experience, with clear visual separation between user inputs and AI responses. Responses are designed to be empathetic and supportive, avoiding any diagnostic or prescriptive language.

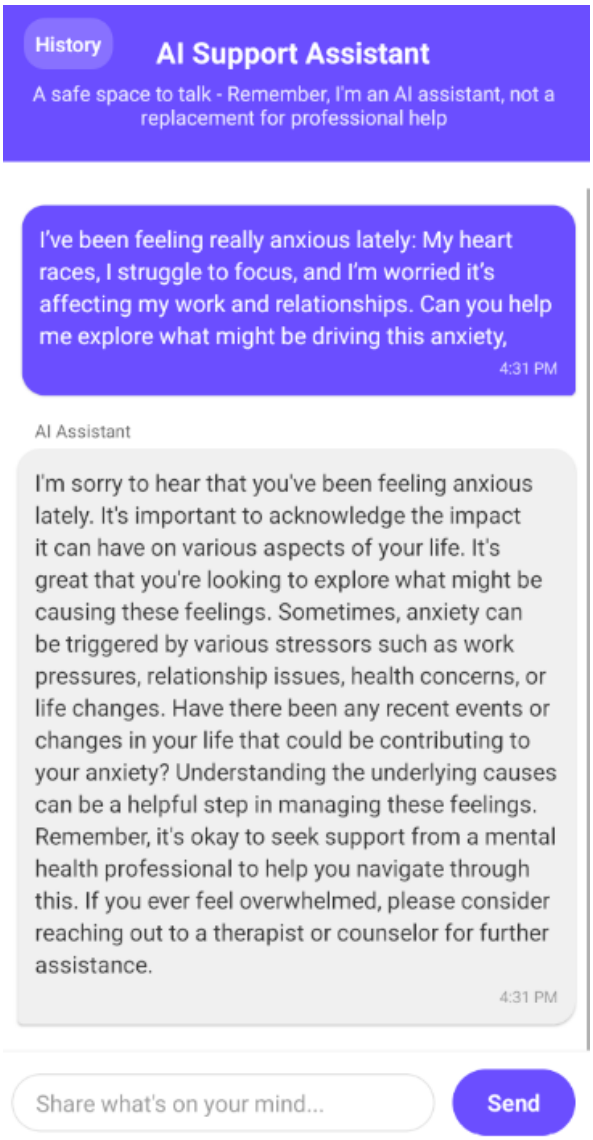


Figure 3.5: User Interface and response example

Prompt Engineering and Response Safety

To ensure the AI responses remain appropriate, safe, and aligned with ethical guidelines for mental health support, significant emphasis was placed on prompt engineering. The core of this safety framework is defined within the

`THERAPIST_SYSTEM_MESSAGE` constant, which acts as the foundational instruction provided to the OpenAI GPT-3.5-Turbo model at the beginning of every conversation. This system-level prompt explicitly sets the AI's persona and establishes clear boundaries for its interactions.

The key guidelines embedded within this system message are designed to ensure the AI's responsible behavior:

- **Empathetic and Professional Tone:** The AI is instructed to consistently maintain a warm, professional, and supportive demeanor, focusing on active listen-

ing and validating user emotions to foster a sense of psychological safety.

- **Strict Prohibition of Medical Advice:** A fundamental directive is to never provide medical advice, diagnoses, or prescribe medications or treatments. This ensures the AI operates strictly as a supportive tool and not as a substitute for qualified human medical or mental health professionals.
- **Crisis Intervention Protocol:** In critical situations where users express thoughts of self-harm or harming others, the AI is explicitly programmed to immediately direct them to emergency services and appropriate crisis hotlines. This is a paramount safety feature to ensure rapid access to professional help when it is most needed.
- **Transparency and Professional Referral:** The AI is designed to be transparent about its nature, explicitly clarifying that it is an AI assistant and not a licensed mental health professional. It actively encourages users to seek professional help from human therapists or counselors when such support is appropriate or necessary.

Crucially, the `THERAPIST_SYSTEM_MESSAGE` also integrates specific crisis resources directly into the AI's knowledge base, enabling it to provide relevant and immediate assistance. These include:

- National Crisis Hotline (Romania): `112`
- For suicidal crisis (Romania): `0800 801 200` or email 24/7 at `sos@antisuicid.ro`

This direct inclusion of localized emergency contacts reinforces the application's commitment to user safety and responsible AI deployment in mental healthcare.

Secure Conversation Storage and Encryption

Given the highly sensitive nature of conversations related to mental health, it was critical to ensure that all user data, particularly chat histories with the AI virtual therapist, were securely handled. This was achieved through a multi-pronged approach involving encryption, secure key management, and cloud storage with access control.

1. **Data Encryption**

   Before any conversation data is stored in the cloud, the entire conversation message array is encrypted using the **AES (Advanced Encryption Standard)**

algorithm provided by the `crypto-js` library. This ensures that even if unauthorized access to the database occurs, the conversation content remains unreadable without the decryption key. The `encryptionUtils.encrypt` function handles the JSON stringification of the messages array before encryption, and `encryptionUtils.decrypt` handles the reverse process.

2. **Secure Encryption Key Management**

   A unique encryption key is generated for each user and securely stored on the device using `expo-secure-store`, a mechanism designed for sensitive data that persists across app sessions and is not accessible to other applications. The `getEncryptionKey` function in `encryption.ts` is responsible for either retrieving an existing key or generating and securely storing a new one if it doesn't exist, linked to the authenticated user's ID. This ensures the key never resides directly in the application's public codebase.

3. **Cloud Storage in Firebase Firestore**

   Encrypted conversations are stored persistently in Firebase Firestore within a dedicated `conversations` collection. Each document contains the following fields:

   - `encryptedData`: The AES-encrypted content of the entire conversation message array.
   - `lastUpdated`: A timestamp indicating when the conversation was last modified, used for ordering.
   - `preview`: A non-sensitive, truncated preview string of the last message, displayed in the user interface for conversation identification.
   - `userId`: The unique identifier of the user associated with the conversation, crucial for enforcing access control via Firebase Security Rules.

   New conversations are initiated by creating a new document using `addDoc` in Firestore. Subsequent messages within an existing conversation trigger an `updateDoc` call to save the updated `encryptedData`, `lastUpdated` timestamp, and `preview`.

4. **Local Fallback/Caching with AsyncStorage:** In addition to cloud storage, 'AsyncStorage' is used to cache decrypted conversation histories locally on the device. This improves load times and provides a basic level of offline access. It is important to note that, for simplicity and performance, the data stored in 'AsyncStorage' is the *decrypted* conversation content. While this enhances local usability, it presents a different security profile than the Firebase storage,

which holds only encrypted data. Future iterations may explore encrypting the 'AsyncStorage' content if the threat model necessitates it.

The process of encrypting and saving conversation data to Firestore is managed by the encryptAndSaveConversation function, which is dynamically triggered whenever the conversation state changes, ensuring data persistence and integrity.

```
// Simplified representation of encryption and saving logic
// from assistant.tsx for illustration
const encryptAndSaveConversation = async () => {
if (currentConversationId && messages.length && encryptionKey) {
const encryptedData = encryptionUtils.encrypt(messages, encryptionKey);
const preview = messages[messages.length - 1].content.substring(0, 50)
const lastUpdated = new Date().toISOString();

const conversationRef = doc(db, "conversations", currentConversationId)
await updateDoc(conversationRef, {
  encryptedData,
  preview,
  lastUpdated,
  userId: auth.currentUser.uid
});
}
};

"
```

Firestore Data Structure

The encrypted data is securely stored in Firestore as shown in the screenshot below.

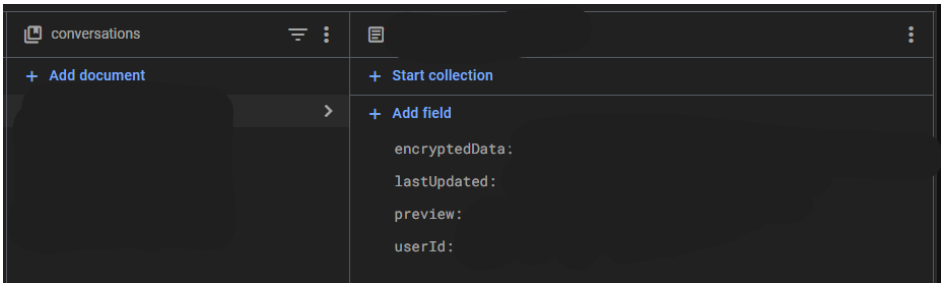


Figure 3.6: Encrypted Conversation Data Stored in Firebase Firestore

Note: Sensitive identifiers and user information have been blurred for privacy.

Security Considerations

- The encryption key is never stored directly in the application's public codebase; instead, it is securely managed and persisted on the device using `expo-secure-store`.
- Only encrypted conversation data is stored in Firebase Firestore; raw conversation content is not retained in plain text within the cloud database.
- Access to the `conversations` collection is restricted via Firebase Security Rules, ensuring that users can only read and write their own conversation data based on their `userId`.
- The `preview` field in Firestore is designed to be non-sensitive, containing only truncated text from the latest message, allowing users to identify conversations in the UI without exposing private content.

This approach ensures that user privacy is respected and protected both on the device and in the cloud, in compliance with modern data protection standards.

3.2.5 Therapist Directory

Purpose

The Therapist Directory feature aims to connect users with qualified mental health professionals. Given the extensive database containing almost 35,000 professional profiles, the primary purpose is to provide an efficient and user-friendly interface for searching, filtering, and discovering suitable therapists based on various criteria, thereby facilitating accessible and personalized access to professional mental health support. The data for this directory was sourced from official public registries from Colegiul Psihologilor din România (COPSI), ensuring the inclusion of licensed and verified practitioners within Romania.

Technologies Used

The development of the Therapist Directory heavily relies on the following key technologies and libraries:

- **Firebase Firestore:** Serves as the robust NoSQL cloud database for storing the extensive directory of mental health professionals. Its powerful querying capabilities are essential for efficient search, filtering, and pagination across the large dataset. Separate collections may store distinct geographical location data (counties, cities) for filter population.

- **`FlatList`:** A highly performant React Native component specifically optimized for efficiently rendering large, scrolling lists of data. This is crucial for managing and displaying tens of thousands of professional profiles without performance degradation.
- **`@react-native-picker/picker`:** Utilized for creating intuitive dropdown menus, enabling users to select various filter criteria such as specialization, professional type, county, city, and gender.
- **`MaterialCommunityIcons`:** Provides a comprehensive set of vector icons used throughout the interface for visual cues, enhancing usability and aesthetic appeal.

Implementation Details

The ‘therapists.tsx‘ component is the central implementation file for this feature, focusing on efficient data handling and a responsive user interface for a large directory.

- **Scalable Data Retrieval and Pagination:** The core ‘fetchProfessionals‘ function is meticulously designed for large-scale data retrieval from Firestore. It implements server-side pagination by utilizing ‘orderBy‘ for initial sorting (e.g., by last name), ‘limit(10)‘ to fetch data in manageable batches, and ‘startAfter(lastVisible to retrieve subsequent pages as the user scrolls. This approach minimizes initial load times and optimizes network usage for the dataset of approximately 35,000 professionals.
- **Dynamic Filtering Engine:** A robust filtering mechanism allows users to narrow down the extensive list of professionals by multiple criteria. Filters are applied as ‘where‘ clauses directly within the Firestore queries (e.g., ‘specialization‘, ‘type‘, ‘county‘, ‘city‘). This ensures that only relevant, pre-filtered data is fetched from the database, significantly reducing client-side processing overhead.
- **Search Functionality:** A ‘TextInput‘ component facilitates a full-text search, allowing users to query professionals by their first or last name. This search leverages Firestore’s indexing capabilities for efficient string matching across the dataset.
- **Filter Modals and Selectors:** A dedicated modal (‘Modal‘) interface provides a clean and user-friendly space for users to select and combine various filter options. Dropdown components (‘Picker‘) are dynamically populated with

unique values for counties, cities, and specializations, ensuring that users only see current and valid filtering choices, which are themselves fetched from Firestore.

- **Localization Support:** To enhance accessibility and usability for a diverse user base, translation maps ('specializationTranslations', 'professionalTypeTranslations') are integrated. These maps convert database values (potentially stored in Romanian) into user-friendly English equivalents for display within the application's interface.
- **Optimized List Rendering:** The 'FlatList' component is configured with performance optimizations such as 'removeClippedSubviews', 'maxToRenderPerBatch', and 'windowSize'. These configurations are critical for smoothly rendering thousands of professional entries, preventing performance bottlenecks and ensuring a fluid scrolling experience.

Functionalities

The Therapist Directory offers the following key functionalities to assist users in efficiently finding suitable mental health professionals:

- **Comprehensive Search:** Users can perform a quick search for professionals by entering their first or last name, facilitating direct lookups.
- **Multi-Criteria Filtering:** An advanced filtering system allows users to refine their search based on a combination of criteria:
  - **Specialization:** Enables filtering by specific areas of expertise, such as Clinical Psychology, Psychotherapy, Educational Psychology, etc.
  - **Professional Type:** Allows users to differentiate between various professional roles (e.g., psychologists, psychotherapists, counselors).
  - **Location:** Filters professionals by specific counties and cities within Romania, catering to geographical preferences.
  - **Gender:** Provides an option to find therapists based on a preferred gender.
  - **Online Availability:** Allows users to find professionals who offer remote consultation services, providing flexibility.
- **Pagination (Load More):** To effectively manage the large dataset, the system implements infinite scrolling. Initial results are loaded rapidly, and additional professional profiles are fetched automatically as the user scrolls down the list, ensuring a continuous and responsive Browse experience.

- **Dynamic Filter Options:** Dropdown filters for locations and specializations are dynamically populated from the database, ensuring that users always have access to relevant and up-to-date filtering options.
- **Clear Filter Indication and Reset:** Applied filters are prominently displayed to the user, and a convenient option is provided to easily reset all filters, allowing users to quickly broaden their search.

Security Considerations

For the Therapist Directory, the primary security considerations focus on data integrity, availability, and the responsible handling of professional information:

- **Firestore Security Rules:** Robust Firebase Firestore security rules are meticulously configured to ensure that only authenticated users can read professional profiles. This strictly prevents unauthorized access to the directory data, protecting the information of listed professionals.
- **Data Minimization:** Only publicly available and necessary information about professionals (e.g., name, specialization, contact methods, location) is stored in the database. This approach adheres to the principle of data minimization, avoiding the collection or storage of any sensitive or private data that is not essential for the directory's intended function.
- **Data Consistency and Accuracy:** Mechanisms are in place within the database structure and data fetching logic to promote the consistency and accuracy of the professional data, ensuring users receive reliable information.

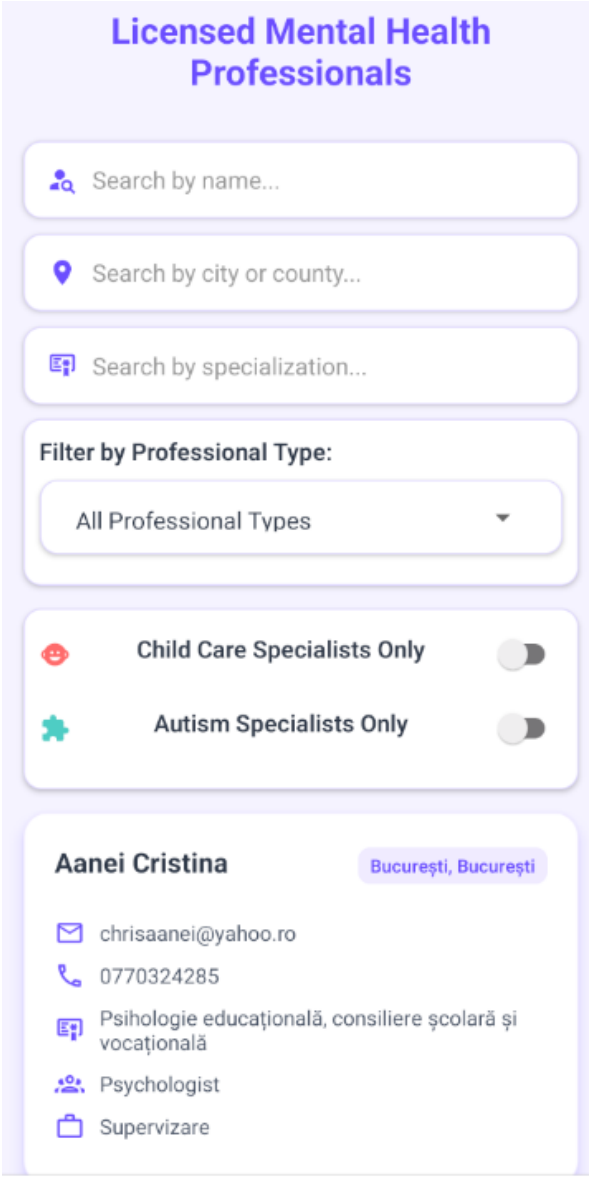


Figure 3.7: Therapists Directory Interface

3.2.6 Personalized Insights

Purpose

The Personalized Insights Dashboard is designed to provide users with a comprehensive and data-driven overview of their mental well-being trends, habit performance, and journaling patterns. By aggregating and visualizing longitudinal data, this feature empowers users to gain deeper self-awareness, identify behavioral and emotional patterns, and understand the impact of their daily routines on their mental health journey.

Technologies Used

The implementation of the Personalized Insights Dashboard relies heavily on:

- **Firebase Firestore:** Serves as the primary NoSQL cloud database for retrieving encrypted journal entries (containing mood data) and daily habit completion records. Real-time listeners ('onSnapshot') ensure that insights are consistently updated.
- **React Native Chart Kit (`react-native-chart-kit`):** A powerful library used for rendering various types of interactive charts, specifically 'LineChart' for visualizing mood and sentiment trends over time.
- **VADER-Sentiment (`vader-sentiment`):** A lexicon and rule-based sentiment analysis tool specifically chosen for its effectiveness on social media-style text, making it highly suitable for analyzing journal entries.
- **`crypto-js` and `expo-secure-store`:** Essential for securely decrypting journal entry content client-side using a unique, user-specific encryption key, ensuring privacy during data processing.
- **`FlatList`:** Used for efficiently rendering lists, particularly for selecting habits within the Habit Calendar section and displaying individual insights.
- **`MaterialCommunityIcons`:** Provides a rich set of icons used for visual cues, trend indicators, and enhancing the aesthetic appeal of insights.
- **`LayoutAnimation`:** Utilized for smooth visual transitions when expanding or collapsing the chart explanation, enhancing user experience.

Implementation Details

The 'InsightsScreen.tsx' component orchestrates the fetching, processing, and visualization of all personal insights.

- **Secure Data Fetching and Decryption:** Upon component mount, the user's unique encryption key is retrieved via 'expo-secure-store'. Subsequently, 'onSnapshot' listeners are established for 'journal entries' and 'daily habits' collections in Firestore, filtered by 'userId'. All journal entry data, being encrypted in Firestore, is decrypted client-side using the retrieved key before any processing or analysis.

- **Data Aggregation and Transformation:** Raw data from Firestore is transformed into structured formats suitable for charting and analysis. For mood and sentiment trends, entries are aggregated by date. For habit analytics, completion records are processed to calculate rates, streaks, and overall load.
- **Dynamic Chart Rendering (`renderChart` function):** This function is responsible for conditionally rendering either the Mood Trend Chart or the Sentiment Trend Chart based on the user's selection. It prepares data in the format required by 'react-native-chart-kit', dynamically adjusts chart width based on the number of data points, and customizes axis labels for clarity.
- **Memoized Calculations (`useMemo`):** Heavy computational logic for 'getHabitAnalytics' and 'dailyInsights' is encapsulated within 'useMemo' hooks. This optimization ensures that these calculations only re-run when their dependencies (e.g., raw habit data, processed journal entries) change, preventing unnecessary re-renders and maintaining smooth performance.
- **User Interface Controls:** The screen includes interactive elements for users to select the type of trend chart (mood or sentiment) and the time frame (7 days, 30 days, 90 days, 1 year, or all time).

Functionalities

The Personalized Insights Dashboard provides the following key functionalities:

1. **Mood Trend Graph:**
    - **Visualization:** Displays a 'LineChart' illustrating the user's average mood score over a selected timeframe. Moods, explicitly logged by the user with each journal entry, are mapped to a numerical scale (0 for very sad, 5 for very happy).
    - **Insight:** Allows users to visually track their emotional trajectory, identify periods of elevated or diminished mood, and observe the impact of various life events or habits on their emotional state.
2. **Journal Sentiment Graph (VADER-Sentiment Integration):**
    - **Visualization:** Presents a 'LineChart' representing the emotional tone of journal entries over time. The sentiment score ranges from -1 (most negative) to +1 (most positive), with 0 being neutral.
    - **VADER-Sentiment Algorithm:** The core of this functionality lies in the application of the **VADER-Sentiment (Valence Aware Dictionary and

sEntiment Reasoner)** lexicon and rule-based sentiment analysis tool. VADER is particularly well-suited for social media text and informal language, making it highly effective for analyzing the natural language found in personal journal entries. It calculates a "compound score" by summing the valence scores of each word in the lexicon, adjusting for punctuation, capitalization, degree modifiers (e.g., "very good"), and conjunctions (e.g., "but"). This score provides a normalized, weighted composite measure of sentiment.

- **Insight:** Offers an objective, AI-driven perspective on the emotional content of a user's writing, complementing their self-reported moods. This helps users uncover subconscious emotional patterns or reflect on periods where their written expression diverged from their explicit mood selection.

3. **Habit Calendar View and Statistics:**

   - **Interactive Habit Selection:** Users can select any individual habit from their master list to view its dedicated calendar.
   - **Monthly Habit Calendar:** Displays a calendar grid for the selected habit, indicating daily completion status (completed, incomplete, or untracked) with distinct visual cues (e.g., checkmark, cross mark, specific background color). Users can navigate between months.
   - **Habit Completion Stats:** Provides key performance indicators for the selected habit, including:
     - Total completed days vs. total tracked days.
     - Overall completion rate (percentage).
     - Current streak (consecutive days of completion).
     - Longest streak achieved.
   - **Insight:** Offers granular feedback on habit consistency and progress, motivating users and helping them understand adherence patterns over time.

4. **Personalized Behavioral Insights:**

   - **Dynamic Summary Cards:** Below the charts, a series of dynamically generated insight cards provide concise, actionable summaries based on aggregated user behavior across journal entries and habit data.
   - **Top Performing Habit:** Identifies and celebrates the habit with the highest completion rate, offering positive reinforcement.

- **Habit Load Analysis:** Calculates the average number of habits tracked per day and provides feedback on whether the user's current habit load is manageable or potentially overwhelming.
- **Journaling Streak Analysis:** Recognizes and highlights the user's current journaling streak, categorizing it with motivational messages (e.g., "Starting Strong," "Momentum Gained," "Incredible Consistency").
- **Overall Mood Trend (Textual Summary):** Provides a descriptive textual summary of the user's average mood over the tracked period (e.g., "predominantly positive," "somewhat low").
- **Journal Sentiment Summary (Textual Summary):** Offers a textual overview of the predominant sentiment detected in journal entries (e.g., "predominantly positive," "negative").
- **Insight Icons:** Each insight card is visually enhanced with relevant 'MaterialCommunityIcons' (e.g., trophy for top habits, fire for streaks, sentiment icons), making the insights more engaging and scannable.

Security Considerations

The Personalized Insights Dashboard adheres to the highest standards of data security and user privacy:

- **Client-Side Decryption of Journal Data:** All journal content, which forms the basis for mood and sentiment analysis, is stored encrypted in Firebase Firestore. It is only decrypted client-side on the user's device using their unique 'encryptionKey'. This ensures sensitive journal text is never processed in plain text on the server or by third-party services.
- **Secure Key Management:** The 'encryptionKey' itself is securely managed via 'expo-secure-store', preventing its exposure and ensuring that only the authorized user can decrypt their data.
- **No Raw Data Export/Sharing:** The dashboard focuses on providing aggregated insights directly to the user. There are no functionalities to export raw, sensitive data in plain text, further minimizing privacy risks.
- **Data Minimization for Third-Party Libraries:** While 'VADER-Sentiment' is used for analysis, it operates entirely client-side on already decrypted text, meaning no sensitive journal content is sent to external servers for sentiment processing.

Figure 3.8: Mood Trend Chart

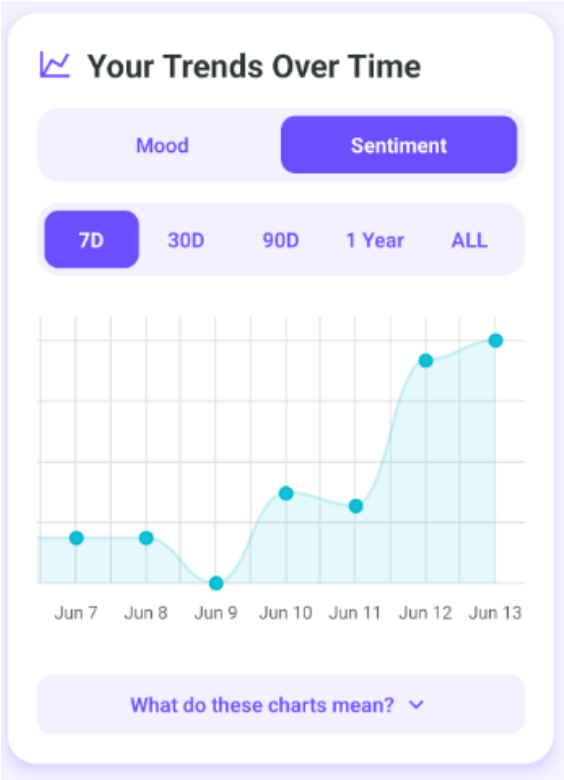


Figure 3.9: Sentiment Analysis Chart

3.2.7 User Profile and Dashboard

Purpose

The User Profile and Dashboard serves as a personalized central hub for the user within the application. Its primary purpose is to offer a quick overview of key mental well-being metrics, provide access to personal settings, and facilitate management of core application features such as master habits. By consolidating essential information and functionalities, it enhances user control and provides a personalized and engaging experience, including a direct gateway to view their earned badges.

Technologies Used

The implementation of the User Profile and Dashboard leverages:

- **Firebase Firestore:** Serves as the primary NoSQL cloud database for storing and retrieving user-specific data, including encrypted journal entries, daily habit completion records, and user profile information. Real-time listeners (‘onSnapshot‘) are extensively used to ensure that the displayed insights are always up-to-date.

- **Firebase Authentication:** Manages user authentication and sessions, providing the authenticated user object ('auth.currentUser') for secure and personalized data fetching and display.
- **Expo Router:** Manages application navigation, enabling seamless transitions to the full Personalized Insights Dashboard ('/insights') and other management screens like Master Habits.
- **`react-native-chart-kit`:** Utilized for rendering the 'PieChart' to visually represent the distribution of moods derived from journal entries.
- **`crypto-js` and `expo-secure-store`:** Essential for the client-side decryption of sensitive journal entry data. The user's unique encryption key is securely stored and retrieved using 'expo-secure-store'.
- **`MaterialCommunityIcons`:** Provides a diverse set of icons used for visual representation of insights and actions, enhancing the UI's clarity and aesthetic appeal.
- **Custom Components:** Integrates the 'MasterHabitsManager' component, allowing for the direct management of user habits from within the profile page context.

Implementation Details

The 'profile.tsx' component is the central implementation file for the user's personalized dashboard, integrating various data streams and interactive elements to create a comprehensive overview.

- **Dynamic Data Loading and Real-Time Updates:** The component initializes by securely retrieving the user's unique encryption key from 'expo-secure-store'. It then establishes 'onSnapshot' listeners to the 'journal entries' and 'daily habits' collections in Firebase Firestore, filtered by the authenticated 'userId'. This architecture ensures that all displayed insights, summaries, and charts are updated in real-time as the user's data changes, providing a dynamic and current view of their progress.
- **Client-Side Data Processing and Decryption:** All journal entries, which are stored encrypted in Firestore, are securely decrypted client-side using 'crypto-js' and the retrieved encryption key. The decrypted text is then processed to calculate mood distributions (for the Pie Chart) and contribute to the generation of sentiment-based insights.

- **Habit Data Aggregation:** Daily habit completion records are efficiently aggregated to calculate various metrics, including overall completion rates, current streaks, and an analysis of the user's habit load, which are then presented as personalized insights.
- **Modular Component Integration:** The profile page acts as a container, seamlessly integrating the 'MasterHabitsManager' component within a modal. This allows users to configure and manage their master habit list directly from the profile context, providing a streamlined user experience.
- **Insight Generation Logic:** The 'dailyInsights' array is dynamically populated with summary cards based on the aggregated and processed journal and habit data. These concise insights are derived from the same underlying analytical logic that powers the more detailed Personalized Insights Dashboard, serving as a quick preview.

Functionalities

The User Profile and Dashboard offers a range of functionalities designed for user personalization and a quick, insightful overview of their journey:

- **User Profile Display:** Clearly presents fundamental user information, such as the registered email and name, providing a personalized and welcoming greeting upon arrival.
- **Master Habits Management Access:** Provides a direct entry point to the 'Master Habits Manager' feature through a dedicated button, allowing users to effortlessly add, edit, or remove habits from their overarching master list.
- **Badges Access:** Provides a direct entry point to the Badges Screen through a dedicated button, allowing users to see what badges they have earned and how much progress they have done.
- **Badges Component:** Is designed to gamify the user's journey within the application, providing motivational milestones and acknowledging their consistent engagement, progress, and mastery of various features.
- **Recent Insights Overview:** Presents a concise, actionable summary of the user's most recent and relevant insights, including:
  - Top performing habit (identified by the highest completion rate), offering positive reinforcement.

  - Analysis of daily habit load, providing feedback on whether the user's current number of habits is manageable.
  - Current journaling streak, accompanied by motivational messages tailored to the streak's length.
  - A textual summary of overall mood trends, derived from the user's self-reported mood selections over time.
  - A textual summary of journal sentiment, based on the VADER sentiment analysis of their written entries.

- **Journal Mood Distribution (`PieChart`):** Visually represents the distribution of moods recorded by the user over a selected period in an intuitive 'PieChart', offering a quick graphical understanding of their emotional patterns.

- **Navigation to Full Trends & Insights:** A prominent call-to-action button allows users to navigate seamlessly to the comprehensive Personalized Insights Dashboard for a more detailed analysis, historical trends, and in-depth understanding of their data.

Security Considerations

Security and user privacy are fundamental to the design and operation of the User Profile and Dashboard:

- **Client-Side Decryption of Sensitive Data:** Crucially, all sensitive journal entries that contribute to mood distribution and sentiment summaries are stored in an encrypted format within Firebase Firestore. All decryption processes occur exclusively on the user's device using their unique, securely managed 'encryptionKey'. This ensures that raw, personal data is never exposed during transmission or storage on cloud servers.

- **Secure Key Management:** The user's 'encryptionKey' is securely managed and retrieved via 'expo-secure-store', preventing unauthorized access to the decryption mechanism and maintaining the integrity of the end-to-end encryption.

- **Firebase Authentication and Authorization:** Firebase Authentication is robustly utilized to ensure that only the authenticated user can access and view their specific profile data and insights. Firebase Firestore security rules are meticulously implemented to restrict data access based on the authenticated user ID, preventing cross-user data exposure.

- **Data Minimization on Display:** While powerful insights are provided, only necessary aggregated summaries and high-level data points are displayed on the profile screen. Raw, highly sensitive individual journal entries are not directly exposed, further enhancing user privacy.

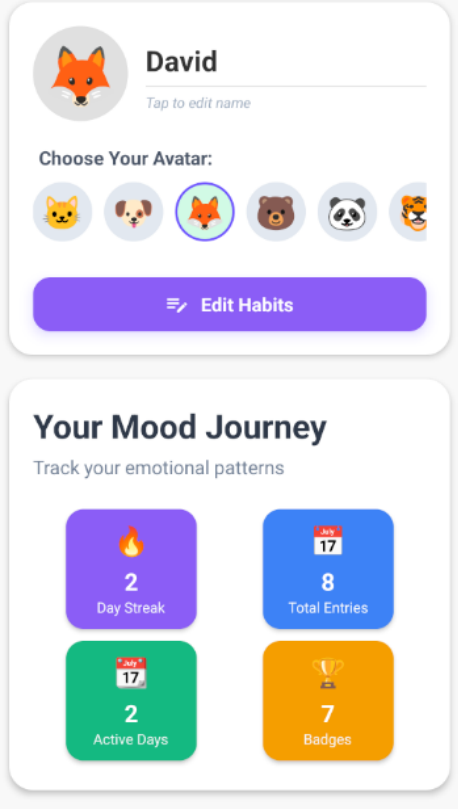


Figure 3.10: Profile Page Interface

3.2.8 Managing Habits

Purpose

The Master Habits Manager serves as the central configuration hub for a user's daily habit tracking. Its primary purpose is to empower users to fully customize their set of habits, ensuring that the daily tracking experience is perfectly aligned with their personal goals and well-being aspirations. This feature allows for seamless addition,

removal, and management of both predefined (classic) and custom-created habits, providing a flexible and user-centric approach to habit formation.

Technologies Used

The implementation of the Master Habits Manager heavily relies on:

- **Firebase Firestore:** Serves as the primary NoSQL cloud database for persistent storage of the user's master habit list and their personal pool of custom habits. Its real-time synchronization and capabilities for array manipulation (arrayUnion, arrayRemove) are crucial for efficient habit configuration.
- **`FlatList`:** Utilized for efficiently rendering scrollable lists of habits. This includes the user's currently active master list, available classic habit options, and their personal pool of previously created custom habits, ensuring smooth performance.
- **`MaterialCommunityIcons`:** Provides a rich and extensible set of vector icons that users can select to visually represent their custom habits, enhancing personalization and clarity within the interface.
- **Firebase Authentication:** Used to identify the authenticated user, ensuring that all habit lists and configurations are user-specific and securely managed.
- **`Modal`:** Provides an overlay component for the habit management interface, ensuring a focused user experience by allowing interaction without navigating away from the parent screen (e.g., the Profile Page).

Implementation Details

The MasterHabitsManager.tsx component is primarily designed to be rendered within a modal, providing a dedicated and focused interface for all habit configuration tasks.

- **User-Specific Data Management:** Upon opening, the component dynamically fetches the authenticated user's master habits and their custom habit pool from Firebase Firestore. This ensures that all displayed and manageable habit configurations are unique and personalized to each user's account.
- **Dynamic Habit Categorization:** The user interface effectively presents distinct sections: "Your Master List" (habits actively tracked), "Classic Habits" (predefined suggestions), and "Your Custom Habits Pool" (habits personally created by the user).

- **Efficient List Rendering with Sections:** FlatList is employed with a sectioned data structure to efficiently render these different habit categories. This optimization ensures smooth scrolling and rendering performance, even as the number of custom habits or classic options grows significantly.
- **Firestore Array Operations for Updates:** Adding and removing habits from the user's master list leverages Firestore's updateDoc method in conjunction with arrayUnion and arrayRemove operations. This approach ensures atomic updates to arrays within the database, preventing data inconsistencies and allowing multiple habit modifications to be processed reliably.
- **Custom Habit Creation Workflow:** Users are provided with an intuitive workflow to create entirely new, personalized habits. This involves inputting a newCustomHabitName and selecting a relevant icon from a predefined list. Newly created custom habits are persistently stored in a separate collection in Firestore, making them readily available for future inclusion in the master list.
- **Visual Feedback and Differentiation:** Icons are dynamically rendered for each habit, and distinct visual cues differentiate between habits already in the master list and those available to be added, enhancing usability.

Functionalities

The Master Habits Manager provides comprehensive functionalities, offering users full control over what habits they track:

- **View and Manage Active Master List:** Users can easily view and manage all habits currently active in their personalized master list. Each habit in the master list is accompanied by an option to seamlessly remove it.
- **Add Classic Habits:** Users can browse and add predefined "classic" habits (e.g., "Drink 8 glasses of water," "Meditate for 10 minutes") to their master list with a single, convenient tap, offering quick setup options.
- **Create Custom Habits:** Offers the ultimate flexibility for users to create entirely new, personalized habits tailored precisely to their unique needs and objectives. This functionality includes defining a custom name and selecting a relevant icon from a wide array of choices provided by MaterialCommunityIcons.
- **Reuse Custom Habits from Pool:** All user-created custom habits are automatically saved in a personal pool. This allows users to easily re-add them to

their master list at any time, promoting consistency and reducing the need for redundant entry.

- **Remove Habits from Master List:** Users maintain complete control over their habit tracking by having the ability to effortlessly remove any habit from their master list, adapting to changing goals or priorities.
- **Intuitive User Interface:** The modal-based design, coupled with clear categorization of habits (Master List, Classic Habits, Custom Habit Pool) and visually distinct actions, ensures an intuitive and streamlined habit management experience.

Security Considerations

Security measures for the Master Habits Manager are primarily focused on ensuring data integrity, user-specific data isolation, and preventing unauthorized access:

- **Firebase Authentication and Authorization:** Firebase Authentication is fundamental to securing this feature. All habit data is strictly associated with the authenticated user, and Firebase Firestore security rules are meticulously enforced. These rules ensure that users can only read, add, or remove habits from their own master list and custom habit pool, preventing unauthorized access or modification of other users' data.
- **Data Ownership and Isolation:** Each user's master habits and custom habit pool are stored in dedicated, user-specific locations within Firestore (e.g., subcollections within the user's document or root collections with userId filtering). This architecture ensures strict data isolation between users.
- **Non-Sensitive Data Handling:** Habit names and associated icons are not considered highly sensitive personal data. Therefore, client-side encryption, as used for journal entries, is not applied to this data type, striking an optimal balance between usability, performance, and security.
- **Input Validation (Best Practice):** While not explicitly detailed in the provided tsx snippet, robust input validation is implemented for custom habit names. This is a critical best practice to prevent the injection of malicious scripts, excessively long names, or other invalid inputs, thereby ensuring data quality and overall system stability.

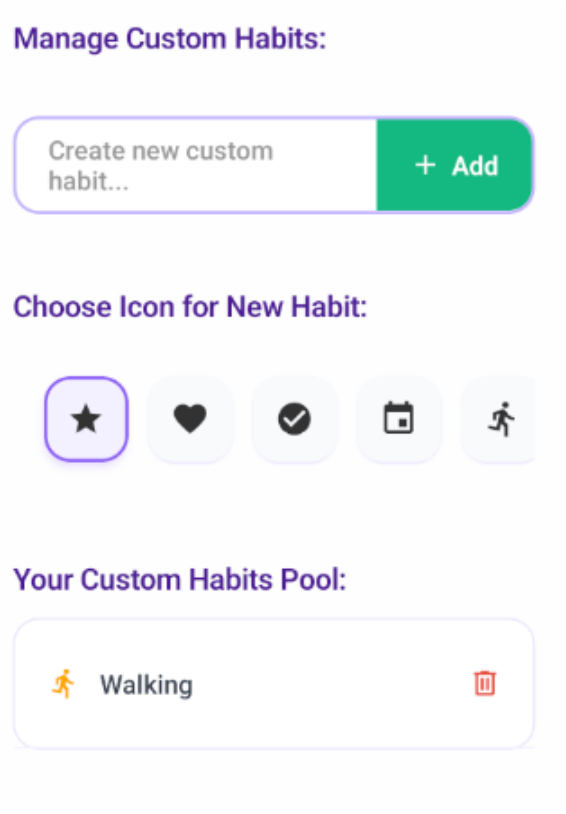


Figure 3.11: Manage Custom Habits Screen

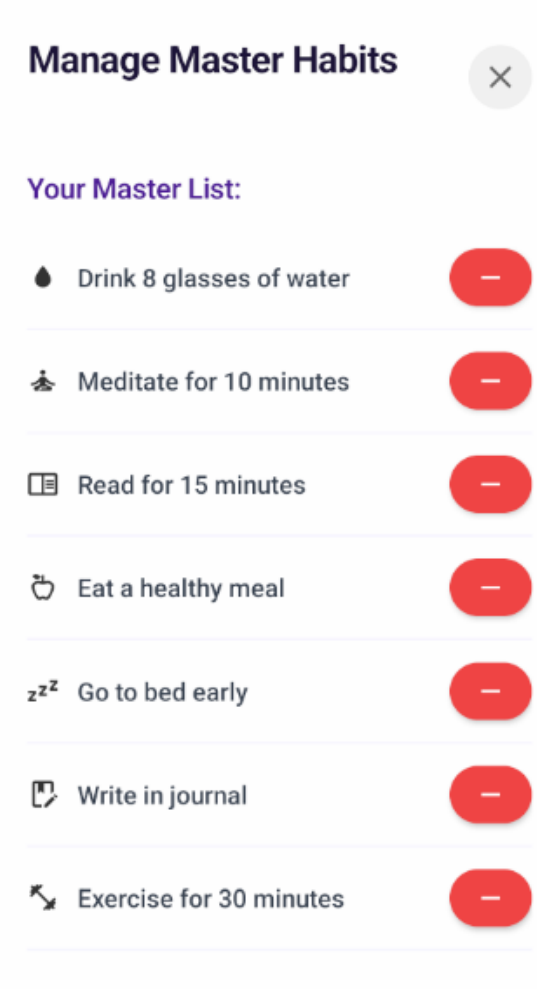


Figure 3.12: List of Habits

3.3 Conclusion of the System Specifications

The practical part of this thesis involved the design and implementation of Introspect, a comprehensive mobile application developed to provide robust mental health support through self-reflection, habit formation, and personalized insights. Leveraging modern cross-platform development with React Native and a scalable, secure backend powered by Firebase (Authentication, Firestore, Cloud Functions), the application successfully translates theoretical concepts of behavioral psychology and digital well-being into a tangible, user-friendly tool.

Key achievements of the practical implementation include:

- Intuitive User Interface: A clean, responsive, and intuitive interface has been developed, ensuring ease of navigation and a pleasant user experience across all functionalities.
- Secure and Private Data Handling: Through the implementation of client-side encryption for sensitive journal entries using crypto-js and expo-secure-store,

the application prioritizes user privacy and data security, a critical aspect for mental health applications.

- Comprehensive Journaling and Habit Tracking: The system provides a versatile journaling module with mood and image support, alongside a flexible master habits manager and daily habit tracker, enabling users to log their experiences and build positive routines effectively.
- Accessible Professional Directory: The inclusion of a Mental Health Professionals directory allows users to discover and connect with certified therapists based on various criteria, providing a crucial bridge to professional support when needed.
- Personalized Behavioral Insights: A sophisticated insights engine processes user-generated data to provide actionable, personalized feedback on mood trends, journaling patterns, and habit performance, fostering self-awareness and guiding users towards better well-being. This is complemented by a dedicated Achievement System that gamifies the user's journey, offering motivational badges for milestones and consistent engagement.
- Scalable Backend Infrastructure: Firebase Firestore ensures real-time data synchronization, efficient storage of user-specific information, and robust security rules, laying a foundation for future scalability and feature expansion. The integration of a secure authentication system ensures that all data is strictly compartmentalized per user.
- AI Assistant Integration: The application features a secure and private AI companion, leveraging large language models to offer empathetic support, guide self-reflection, and process user queries without compromising data privacy.

In conclusion, the development of Introspect has resulted in a functional and impactful mobile application that empowers users to embark on a journey of self-discovery and mental well-being improvement. By combining practical features with a strong emphasis on user experience, data security, and motivational elements, Introspect stands as a testament to the potential of technology in supporting mental health in an accessible and engaging manner. The implemented features collectively contribute to the overarching goal of fostering self-awareness and promoting positive behavioral change.

Chapter 4

Introspect in Context: Contributions and Future Directions

This chapter presents a comprehensive discussion of the *Introspect* mobile application, the practical outcome of this thesis. It evaluates how the developed features align with the theoretical foundations and research objectives, compares *Introspect* to existing solutions in the digital mental health field, and concludes with an analysis of implications, identified limitations, and future development directions.

4.1 Alignment with Theoretical Framework and Research Objectives

Introspect was designed based on the theoretical framework outlined in Chapter 2, directly addressing the formulated research objectives and the gaps identified in the current landscape of mobile applications for mental health.

Addressing Global Mental Health Challenges: The application provides an accessible, integrated, and secure solution for users in need of emotional support, particularly in regions with limited access to psychological services.

Application of Psychological Theories:

- **Cognitive Behavioral Therapy (CBT)**: The journaling feature is designed to support CBT principles, facilitating introspection, awareness of negative thoughts, and cognitive restructuring through mood and thought tracking.
- **Positive Psychology**: The habit tracking system, achievement badges, and focus on personal growth help develop individual strengths, promoting well-being and intrinsic motivation.
- **Self-Determination Theory (SDT)**: *Introspect* enables autonomy through goal customization, supports competence through progress tracking, and fosters a

form of indirect relatedness via access to professional resources, encouraging active and sustained engagement.

Ethical AI Integration: The AI Assistant module is developed according to ethical guidelines for digital mental health. It avoids providing medical advice, maintains an empathetic tone, and uses end-to-end encryption for conversations, enhancing confidentiality and safety.

Closing the Research Gap: The major contribution of the application lies in its holistic integration of multiple evidence-based interventions within a single mobile platform. *Introspect* unifies journaling, habit tracking, an empathetic chatbot, and a reward system into one encrypted framework, surpassing the fragmented approach of many existing apps.

4.2 Challenges and Limitations

The development of *Introspect*, while successful in meeting its objectives, involved a range of challenges and presents several inherent limitations:

- **Technical Integration Complexity:** Integrating diverse functionalities—such as real-time synchronization with Firestore, client-side encryption, and external API communication with OpenAI—required thoughtful architectural design and careful implementation to ensure smooth operation, responsiveness, and data consistency.

- **Ensuring Robust Data Security:** The implementation of end-to-end encryption was essential to preserve user privacy. However, this added a significant layer of complexity to data handling, particularly in terms of secure storage, message retrieval, and error recovery.

- **Scalability of the Professional Directory:** The current version of the professional directory relies on a manually curated list of therapists and psychologists from specific Romanian regions. Scaling this feature to an international level would necessitate automated integration with verified national or global professional registries, posing technical and regulatory challenges.

- **Absence of Formal User Studies:** Given the scope and time constraints of a Bachelor's thesis, no formal user studies such as randomized controlled trials or large-scale usability testing were conducted. As a result, conclusions regarding user engagement, impact, and effectiveness are primarily based on development-stage feedback, theoretical alignment, and best-practice design principles, rather than empirical data from diverse user cohorts.

- **AI Model Limitations:** The AI Assistant's behavior is constrained by the capabilities and limitations of the underlying language model (GPT). While it was configured to deliver empathetic and supportive responses, it is not a replacement for licensed mental health professionals and is explicitly restricted from offering clinical diagnoses or personalized treatment recommendations.

4.3 Future Directions

Building upon the foundation laid by *Introspect*, several promising avenues for future development and research can be explored to enhance its functionality, broaden its impact, and deepen its empirical validation:

- **Expanded Clinical Validation:** Future iterations of the application would significantly benefit from rigorous empirical validation through structured user studies. This includes comprehensive usability testing, pre-post intervention assessments to measure changes in psychological well-being, and long-term engagement analysis. Collaborations with mental health professionals and academic institutions are crucial to objectively assess the platform's effectiveness and gather quantitative evidence to support its qualitative observations.

- **Dynamic Therapist Directory Integration:** To improve scalability, relevance, and real-time accessibility, the manually curated therapist directory can be significantly enhanced. This involves establishing partnerships with professional boards or national registries to enable automated, real-time access to licensed providers based on refined criteria such as location, specialization, availability, and potentially direct booking functionalities.

- **Enhanced Personalization Features:** Building on current insights, future updates may include more sophisticated personalized recommendations. These could encompass adaptive suggestions for habits, mood management strategies, and tailored journaling prompts that dynamically adjust based on granular analysis of user behavior, evolving mental health goals, and individual historical trends. Such features could be powered by on-device machine learning models to further preserve user privacy.

- **Advanced AI Assistant Capabilities:** As large language models continue to evolve, the AI Assistant could be upgraded to support more nuanced and complex conversations, incorporate long-term context memory across sessions, and offer proactive check-ins based on user patterns (always with strict user consent and privacy safeguards). This progression must maintain strict ethical

boundaries, ensure user safety mechanisms, and consistently emphasize that the AI is a supportive tool, not a substitute for professional therapy.

- **Gamification and Progress Analytics:** While Introspect already incorporates badge and streak systems, future work can introduce deeper gamification elements. This includes more complex reward structures, social gamification features (e.g., anonymous leaderboards, shared challenges), and advanced data visualizations that provide more granular, motivating analytics on the user's mental health journey over extended periods, fostering sustained engagement and self-awareness.

- **Multi-Language Support:** To significantly increase accessibility and cater to a global audience, particularly users in non-English or non-Romanian speaking regions, comprehensive multilingual support could be implemented. This would involve translating the entire user interface, journaling tools, and ensuring the AI chatbot can effectively communicate and provide support in multiple languages.

- **Offline Functionality:** While many features currently rely on real-time synchronization and cloud services, introducing limited offline access would greatly enhance usability. This is particularly relevant for core functionalities such as journaling and habit tracking, ensuring continuous support even in environments with poor or intermittent internet connectivity.

- **Wearable Device Integration:** Exploring seamless integration with wearable devices could allow Introspect to incorporate passive physiological data (e.g., sleep patterns, heart rate variability, activity levels). This additional data would provide even more holistic insights into a user's overall well-being, enriching the personalized feedback loops and trend analysis.

- **Community and Group Support Features:** Investigating the secure and moderated integration of peer support groups or therapist-led group sessions could foster a sense of community and shared experience among users. Such features would be designed with rigorous privacy and moderation protocols to ensure a safe and supportive environment.

Chapter 5

Conclusion

The escalating global mental health crisis demands innovative, scalable, and user-centric solutions. This Bachelor's thesis has aimed to address this pressing need through the development of *Introspect*, a comprehensive mobile application that delivers integrated and privacy-preserving mental health support.

Rooted in well-established psychological frameworks — including Cognitive Behavioral Therapy (CBT), Positive Psychology, and Self-Determination Theory (SDT) — *Introspect* adopts a multifaceted approach to emotional well-being, combining evidence-based interventions into a unified digital platform.

The theoretical chapters of this thesis provided a systematic overview of current trends in digital mental health, ethical considerations in AI-assisted interventions, and the psychological principles behind journaling, habit formation, motivation, and feedback systems. These foundations directly shaped the practical development, ensuring that each implemented feature serves not only a functional but also a therapeutic purpose.

The resulting application incorporates a robust suite of functionalities:

- A secure journaling system, protected through client-side end-to-end encryption.
- A flexible habit tracker with personalized goals and visual progress monitoring.
- An empathetic AI Assistant designed to guide reflective conversations while upholding ethical AI principles and strong privacy standards.
- A curated directory of mental health professionals, aiding access to qualified human support.
- Dynamic analytics dashboards visualizing mood and sentiment trends.

- A gamified system of badges and streaks to encourage user engagement and long-term habit formation.

The primary contribution of this work lies in the holistic integration of these components into a single, cohesive, and ethically designed system. Unlike many existing tools that offer fragmented or single-purpose interventions, *Introspect* provides users with an all-in-one ecosystem — blending digital journaling, behavioral support, intelligent insights, and secure AI interaction within a streamlined and intuitive interface. The emphasis on privacy through full client-side encryption for sensitive content (journal entries and conversations) sets a high standard for secure digital mental health tools.

While the app presents a strong proof of concept, it is important to acknowledge its current limitations. Chief among these is the lack of large-scale, formal user evaluation due to the scope and timeline of this thesis. Future validation efforts — including clinical trials, usability testing, and longitudinal engagement studies — will be essential in assessing the long-term effectiveness and impact of the application.

Future development may include:

- Empirical validation through collaboration with academic or clinical institutions.
- Expansion and automation of the professional directory through dynamic data integration.
- Advanced personalization of content using on-device machine learning.
- Broader accessibility via multi-language and offline support.
- Integration with biometric or wearable health data for richer, real-time emotional insights.

Introspect ultimately demonstrates the potential of mobile technology to support mental health in a respectful, ethical, and user-centered manner. Beyond the creation of a functional application, this thesis contributes to the broader discourse on digital mental health innovation — advocating for tools that are not only effective and evidence-based but also designed with empathy, privacy, and human dignity at their core.

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The use of AI tools is disclosed in the spirit of academic transparency and integrity.

Bibliography

[AAAA+19] A. Abd-Alrazaq, M. Alajlani, A. Alalwan, B. M. Bewick, and M. Househ. An overview of the features of chatbots in mental health: A scoping review. *International Journal of Medical Informatics*, 132:103978, 2019.

[ABCea18] Gavin Andrews, Anu Basu, Pim Cuijpers, and et al. Computer therapy for the anxiety and depression disorders is effective, acceptable and practical health care: a meta-analysis. *PLoS ONE*, 13(1):e0189669, 2018.

[AK24] Francis Asare and Daria J. Kuss. The use of mobile apps for mental health interventions: A review of the literature. *Frontiers in Psychiatry*, 15:11555976, 2024.

[B+16] T.W. Bickmore et al. Personalized psychoeducation and knowledge retention via conversational agents. *Patient Education and Counseling*, 99(6):1006–1011, 2016.

[B+18] N. Bidargaddi et al. Optimizing notification timing to improve user engagement in digital health interventions. *Journal of Medical Internet Research*, 20(5):e186, 2018.

[B+21] P. Baldwin et al. Retention rates in digital mental health applications: A longitudinal study. *Journal of Digital Health*, 6(3):e123, 2021.

[BC01] Tom L. Beauchamp and James F. Childress. *Principles of Biomedical Ethics*. Oxford University Press, 5 edition, 2001.

[Bec79] Aaron T. Beck. *Cognitive Therapy and the Emotional Disorders*. Penguin, 1979.

[BGCB01] L. F. Barrett, J. Gross, T. C. Christensen, and M. Benvenuto. Knowing what you're feeling and knowing what to do about it: Mapping the relation between emotion differentiation and emotion regulation. *Cognition & Emotion*, 15(6):713–724, 2001.

[BHW+13] Linda Bolier, Merel Haverman, Gerben J. Westerhof, Heleen Riper, Filip Smit, and Ernst T. Bohlmeijer. Positive psychology interventions: A meta-analysis of randomized controlled studies. *BMC Public Health*, 13(1):119, 2013.

[BKRR16] David Bakker, Nikolaos Kazantzis, Debra Rickwood, and Nikki Rickard. Mental health smartphone apps: Review and evidence-based recommendations for future developments. *JMIR Mental Health*, 3(1):e7, 2016.

[BMRea20] Tom Brown, Benjamin Mann, Nick Ryder, and et al. Language models are few-shot learners, 2020. arXiv:2005.14165.

[Bor79] Edward S. Bordin. The generalizability of the psychoanalytic concept of the working alliance. *Psychotherapy: Theory, Research & Practice*, 16(3):252–260, 1979.

[BRML14] Harald Baumeister, Lena Reichler, Mara Munzinger, and Jürgen Lin. The impact of guidance on internet-based mental health interventions — a systematic review. *Internet Interventions*, 1(4):205–215, 2014.

[BTO+18] Timothy Bickmore, Hai Trinh, Stefan Olafsson, Tracy O'Leary, Reza Asadi, Nathan Rickles, and Rafael Cruz. Patient and consumer safety risks when using conversational assistants for medical information: An observational study of siri, alexa, and google assistant. *Journal of Medical Internet Research*, 20(9):e11510, 2018.

[CC16] Kate Crawford and Ryan Calo. There is a blind spot in ai research. *Nature*, 538(7625):311–313, 2016.

[CSM18] Danton S. Char, Nigam H. Shah, and David Magnus. Implementing machine learning in health care — addressing ethical challenges. *New England Journal of Medicine*, 378(11):981–983, 2018.

[CSS+16] Dan Chisholm, Kim Sweeny, Peter Sheehan, Bjorn Rasmussen, Filip Smit, Pim Cuijpers, and Shekhar Saxena. Scaling-up treatment of depression and anxiety: a global return on investment analysis. *The Lancet Psychiatry*, 3(5):415–424, 2016.

[D+11] S. Deterding et al. Gamification: Using game-design elements in non-gaming contexts. In *Proceedings of the CHI 2011 Extended Abstracts on Human Factors in Computing Systems*, pages 2425–2428, 2011.

[DSERea17] Simon D'Alfonso, Olga Santesteban-Echarri, Simon Rice, and et al. Artificial intelligence-assisted online social therapy for youth mental health. *Frontiers in Psychology*, 8:796, 2017.

[FDV17] Kathleen K. Fitzpatrick, Alison Darcy, and Molly Vierhile. Delivering cognitive behavior therapy to young adults with symptoms of depression and anxiety using a fully automated conversational agent (woebot): A randomized controlled trial. *JMIR Mental Health*, 4(2):e19, 2017.

[FDV18] Kathleen K. Fitzpatrick, Alison Darcy, and Molly Vierhile. A chatbot for depression: Development and efficacy of a cbt-based conversational agent. *Cognitive and Behavioral Practice*, 25(4):476–487, 2018.

[FJG+18] R. Fulmer, A. Joerin, B. Gentile, L. Lakerink, and M. Rauws. Using psychological artificial intelligence (tess) to relieve symptoms of depression and anxiety: Randomized controlled trial. *JMIR Mental Health*, 5(4):e64, 2018.

[FK86] E.B. Foa and M.J. Kozak. Emotional processing of fear: Exposure to corrective information. *Psychological Bulletin*, 99(1):20–35, 1986.

[FMSea19] T. M. Fleming, S. N. Merry, K. Stasiak, and et al. The effectiveness of a digital app for mental health for depressed individuals. *Psychological Medicine*, 49(12):2017–2024, 2019.

[Fog09] B. J. Fogg. A behavior model for persuasive design. *Proceedings of the 4th International Conference on Persuasive Technology*, pages 40:1–40:7, 2009.

[Fra06] J. Frattaroli. Experimental disclosure and its moderators: A meta-analysis. *Psychological Bulletin*, 132(6):823–865, 2006.

[FTN+17a] Joseph Firth, John Torous, Jennifer Nicholas, Rebekah Carney, Abhishek Pratap, Simon Rosenbaum, and Jerome Sarris. The efficacy of smartphone-based mental health interventions for depressive symptoms: a meta-analysis of randomized controlled trials. *World Psychiatry*, 16(3):287–298, 2017.

[FTN+17b] Joseph Firth, John Torous, Jennifer Nicholas, Rebekah Carney, Abhishek Pratap, Simon Rosenbaum, and Jerome Sarris. The efficacy of smartphone-based mental health interventions for depressive symptoms: a meta-analysis of randomized controlled trials. *World Psychiatry*, 16(3):287–298, 2017.

[GMT19] H. Gaffney, W. Mansell, and S. Tai. Conversational agents in the treatment of mental health problems: Mixed-methods systematic review. *JMIR Mental Health*, 6(10):e14166, 2019.

[Gol99] P.M. Gollwitzer. Implementation intentions: Strong effects of simple plans. *American Psychologist*, 54(7):493–503, 1999.

[Gra22] Grand View Research. Mental health apps market size, share & trends analysis report by platform type, by application, by region, and segment forecasts, 2022 - 2030, 2022.

[GSM23] GSMA. The mobile economy 2023, 2023.

[H+19] J. Hunter et al. Machine learning-optimized activity scheduling for depression. *Journal of Medical Internet Research*, 21(3):e12345, 2019.

[HAV+12] Stefan G. Hofmann, Anu Asnaani, Imke J. Vonk, Alice T. Sawyer, and Angela Fang. The efficacy of cognitive behavioral therapy: A review of meta-analyses. *Cognitive Therapy and Research*, 36(5):427–440, 2012.

[HM10] E. A. Holmes and A. Mathews. Mental imagery in emotion and emotional disorders. *Clinical Psychology Review*, 30(3):349–362, 2010.

[HS10] K. E. Heron and J. M. Smyth. Ecological momentary interventions: Incorporating mobile technology into psychosocial and health behavior treatments. *British Journal of Health Psychology*, 15(1):1–21, 2010.

[HSDH+20] Tara Hendriks, Marijke Schotanus-Dijkstra, Amna Hassankhan, Job F. de Jong, and Ernst T. Bohlmeijer. The efficacy of positive psychology interventions from 2006 to 2016: A meta-analysis. *Journal of Positive Psychology*, 15(3):245–265, 2020.

[I+18] B. Inkster et al. Ai-guided cognitive restructuring: Reducing cognitive distortions. *Behaviour Research and Therapy*, 110:1–9, 2018.

[K+06] R. Kivetz et al. The goal-gradient hypothesis resurrected: Purchase acceleration, illusionary goal progress, and customer retention. *Journal of Marketing Research*, 43(1):39–58, 2006.

[KB01] K. Klein and A. Boals. Expressive writing can increase working memory capacity. *Journal of Experimental Psychology: General*, 130(3):520–533, 2001.

[KB11] Alan E. Kazdin and Susan L. Blase. Rebooting psychotherapy research and practice to reduce the burden of mental illness. *Perspectives on Psychological Science*, 6(1):21–37, 2011.

[KT79] D. Kahneman and A. Tversky. Prospect theory: An analysis of decision under risk. *Econometrica*, 47(2):263–291, 1979.

[LCC+19] Jake Linardon, Pim Cuijpers, Per Carlbring, Melissa Messer, and Matthew Fuller-Tyszkiewicz. The efficacy of app-supported smartphone interventions for mental health problems: a meta-analysis of randomized controlled trials. *World Psychiatry*, 18(3):325–336, 2019.

[LDD+17] Nancy H. Liu, Gail L. Daumit, Tarun Dua, Ralph Aquila, Fiona Charlson, Pim Cuijpers, Benjamin G. Druss, Chika Fujii, Wolfgang Gaebel, Ulrich Hegerl, Itzhak Levav, Thomas Munk Laursen, Hong Ma, Mario Maj, Patrick McGorry, Merete Nordentoft, Dorairaj Prabhakaran, Carlos Pratt, Martin Prince, Thara Rangaswamy, David Shiers, Ezra Susser, Graham Thornicroft, Kristian Wahlbeck, and Norman Sartorius. Excess mortality in persons with severe mental disorders: a multilevel intervention framework and priorities for clinical practice, policy and research agendas. *World Psychiatry*, 16(1):30–40, 2017.

[Lea23] Stacey Leasca. Mental health apps are booming — here's how they're changing care, 2023.

[LX21] Matthew Lombard and Kaicheng Xu. Social responses to media technologies. *Human Communication Research*, 47(1):56–85, 2021.

[MAT+16] Brent D. Mittelstadt, Patrick Allo, Mariarosaria Taddeo, Sandra Wachter, and Luciano Floridi. The ethics of algorithms: Mapping the debate. *Big Data & Society*, 3(2):2053951716679679, 2016.

[MMK18a] Nicole Martinez-Martin and Karola Kreitmair. Ethical issues for direct-to-consumer digital psychotherapy apps: Addressing accountability, data protection, and consent. *JMIR Mental Health*, 5(2):e32, 2018.

[MMK18b] N. Martínez-Martín and K. Kreitmair. Granular permission settings in digital mental health applications: Increasing control and willingness to share sensitive information. *Journal of Behavioral Health*, 27(1):35–42, 2018.

[MWRS17] David C. Mohr, Kenneth R. Weingardt, Madhu Reddy, and Stephen M. Schueller. Three problems with current digital mental health research...

and three things we can do about them. *Psychiatric Services*, 68(5):427–429, 2017.

[MWRS18] David C. Mohr, Kenneth R. Weingardt, Madhukar Reddy, and Stephen M. Schueller. Three problems with current digital mental health research... and three things we can do about it. *Psychiatric Services*, 68(5):427–429, 2018.

[Nor04] D. A. Norman. *Emotional Design: Why We Love (or Hate) Everyday Things*. Basic Books, 2004.

[NTBE19] Camille Nebeker, John Torous, and Rebecca Bartlett Ellis. Building the case for actionable ethics in digital health research supported by artificial intelligence. *BMC Medicine*, 17:137, 2019.

[P+16] J. Phillips et al. Value evolution in digital mental health interventions: A longitudinal study of user engagement and retention. *PLOS ONE*, 11(6):e0157482, 2016.

[P+22] S. Pelegrina et al. Detecting depressive symptoms using natural language processing algorithms. *Journal of Affective Disorders*, 298:1–10, 2022.

[Pai71] A. Paivio. *Imagery and Verbal Processes*. Holt, Rinehart and Winston, 1971.

[PB86] J.W. Pennebaker and S.K. Beall. Confronting a traumatic event: Toward an understanding of inhibition and disease. *Journal of Abnormal Psychology*, 95(3):274–281, 1986.

[PB02] C.L. Park and C.J. Blumberg. Disclosing trauma through writing: Testing the meaning-making hypothesis. *Cognitive Therapy and Research*, 26(5):597–616, 2002.

[PBWM17] Olga Perski, Ann Blandford, Robert West, and Susan Michie. Conceptualising engagement with digital behaviour change interventions: a systematic review using principles from critical interpretive synthesis. *Translational Behavioral Medicine*, 7(2):254–267, 2017.

[PPHP+10] Judith Proudfoot, Gordon Parker, Dusan Hadzi-Pavlovic, Vijaya Manicavasagar, Alexis Whitton, and Jennifer Nicholas. Community attitudes to the appropriation of mobile phones for mental health care delivery. *Journal of Medical Internet Research*, 12(5):e64, 2010.

[PV97] J. O. Prochaska and W. F. Velicer. *The Transtheoretical Model of Health Behavior Change*. Springer, New York, NY, 1997.

[RD00] R. M. Ryan and E. L. Deci. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55(1):68–78, 2000.

[Rin20] Matthew Rindal. Mental health apps: Innovations, risks, and ethical considerations. *Journal of Undergraduate Research at Minnesota State University, Mankato*, 20(1):8, 2020.

[RP17] Amy L. Rathbone and Julie Prescott. The use of mobile apps and sms messaging as physical and mental health interventions: Systematic review. *Journal of Medical Internet Research*, 19(8):e295, 2017.

[SC00] Martin E. P. Seligman and Mihaly Csikszentmihalyi. Positive psychology: An introduction. *American Psychologist*, 55(1):5–14, 2000.

[Sch22] Jana Schmied. Success factors of mental health apps: A systematic literature review, 2022.

[SHS+21] Damian F. Santomauro, Andrés M. Herrera, Jasmine Shadid, Peng Zheng, Cherie Ashbaugh, David M. Pigott, Cristiana Abbafati, Christopher Adolph, Jocelyn O. Amlag, Aleksandr Y. Aravkin, Blair Bang-Jensen, Greg Bertolacci, Shefali S. Bloom, Richard Castellano, Eugenio Castro, Sagar Chakrabarti, Fiona J. Charlson, Jayendra Chattopadhyay, Rachel M. Cogen, Emily L. Collins, Charbel Dapper, Louisa Degenhardt, and Stephanie Millikin. Global prevalence and burden of depressive and anxiety disorders in 204 countries and territories in 2020 due to the covid-19 pandemic. *The Lancet*, 398(10312):1700–1712, 2021.

[Ski53] B.F. Skinner. *Science and Human Behavior*. Macmillan, 1953.

[SM90] P. Salovey and J. D. Mayer. Emotional intelligence. *Imagination, Cognition and Personality*, 9(3):185–211, 1990.

[SM04] D.M. Sloan and B.P. Marx. A closer examination of the structured written disclosure procedure. *Journal of Consulting and Clinical Psychology*, 72(2):165–175, 2004.

[SS+17] C. Stiles-Shields et al. Transparent privacy policies and user trust in mental health applications. *Journal of Medical Internet Research*, 19(6):e212, 2017.

[Swe88] J. Sweller. *Cognitive load during problem solving: Effects on learning*. Cognitive Science, 1988.

[TDH17] Graham Thornicroft, Tania Deb, and Claire Henderson. Community mental health care worldwide: current status and further developments. *World Psychiatry*, 15(3):276–286, 2017.

[TFHea18] J. Torous, J. Firth, K. Huckvale, and et al. Perceived value of mental health apps in healthcare delivery. *Journal of Medical Internet Research*, 20(6):e131, 2018.

[TR19] John Torous and Laura W. Roberts. Needed innovation in digital health and smartphone applications for mental health: Transparency and trust. *JAMA Psychiatry*, 76(5):437–438, 2019.

[TS08] R. H. Thaler and C. R. Sunstein. *Nudge: Improving Decisions About Health, Wealth, and Happiness*. Penguin Books, 2008.

[Wei66] Joseph Weizenbaum. Eliza—a computer program for the study of natural language communication between man and machine. *Communications of the ACM*, 9(1):36–45, 1966.

[WFB+19] K. K. Weisel, L. M. Fuhrmann, M. Berking, H. Baumeister, P. Cuijpers, and D. D. Ebert. Stand-alone smartphone apps for mental health—a systematic review and meta-analysis. *NPJ Digital Medicine*, 2(1):1–10, 2019.

[WFZ+21] Tong Wang, Lingye Fan, Xu Zheng, Wei Wang, Jun Liang, Kai An, Mei Ju, and Jianbo Lei. The impact of gamification-induced users' feelings on the continued use of mhealth apps: A structural equation model with the self-determination theory approach. *Journal of Medical Internet Research*, 23(8):e24546, 2021.

[who] World mental health report: Transforming mental health for all.

[WN16] W. Wood and D. T. Neal. *Habit Formation and Change*. Psychology Press, New York, NY, 2016.

[Y+16] L. Yardley et al. Personalized digital interventions for mental health: A systematic review of retention rates. *Journal of Medical Internet Research*, 18(12):e250, 2016.