SponsorLens: Designing a Human-Centered Computational System to Support Peer Mentorship in Substance Use Disorder Recovery.

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Zachary Lloyd Schmitt

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Dedication

To those who held me up over the years, especially my wife Nicole.

Abstract

Substance use disorders (SUDs), such as alcohol and drug abuse, are widespread and hazardous to public health. Over the last two decades, nearly one million Americans have died from a drug overdose. In 2020 alone, over ninety thousand died from a drug overdose in the United States. This marks a 31% increase in overdose deaths from 2019 to 2020 [1]. Due to this dramatic increase in overdose deaths, the need for effective treatment is great. However, SUDs have been historically difficult to treat, given their chronic cycles of treatment and relapse. To improve treatment outcomes, new and supplemental approaches are needed. This dissertation aims to position participants as co-designers and subject matter experts in designing technologies that complement, rather than disrupt, the current values, practices, and challenges of individuals in recovery from SUDs.

To contribute a rich qualitative understanding of the values, practices, and challenges of individuals in recovery from SUDs, I conducted a series of participatory design workshops with sixteen women living in a sober living environment. While several challenges and practices were highlighted in these workshops, participants independently and unanimously chose to focus their designs on technology to support their relationship with their peer mentor (*i.e.,* sponsor). I then expanded this study to investigate how social computing may support or hinder dyadic mentorship within SUD recovery. I conducted twenty-seven semi-structured interviews with fifteen mentors (*i.e.,* sponsors) and twelve mentees (*i.e.,* sponsees). This study informed the creation of specific design implications to increase mentor (*i.e.,* sponsor) capacity, facilitate mentorship (*i.e.,* sponsorship) initiation, and grow a broader support community for mentees (*i.e.,* sponsees).

Finally, to contribute a deeper empirical understanding of social computing interventions for peer mentorship in SUD recovery, I designed and developed a high-fidelity prototype called SponsorLens. SponsorLens functioned as a synchronous communication and scheduling system to increase mentor (*i.e.,* sponsor) capacity and the frequency of contact between mentors (*i.e.,* sponsors) and mentees (*i.e.,* sponsees). To investigate the feasibility of SponsorLens, I conducted a four-week field deployment study with four dyadic mentorship pairs in recovery from SUDs.

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Chapter 1

Introduction

Substance use disorders (SUDs), such as alcohol and drug abuse, represent one of society's most widespread and hazardous public health issues. Each year, SUDs cost the US economy a combined 442 billion dollars in expenses related to health care, crime, and lost productivity [2]. For the individual, SUDs can contribute to social, familial, and financial difficulties, health complications, and death. Due in part to a dramatic rise in opioid abuse, overdose deaths resulting from SUDs have nearly tripled over the last 20 years [3].

Given the sudden rise in overdose deaths, the need for effective SUD treatment is great. However, SUDs have been historically difficult to treat given their chronic nature consisting of multiple cycles of treatment, abstinence, and relapse [4]. Previous studies indicate that up to seventy-five percent of individuals relapse within one year following acute SUD treatment (e.g., detoxification and rehabilitation) [5, 6, 7, 8]. Consequently, after acute treatment ends, healthcare providers typically recommend a long-term continuing care program, such as a twelve-step group, cognitive behavioral therapy (CBT), or motivation enhancement therapy (MET) to reduce the ongoing risk of relapse [9]. Prior studies indicate that long-term continuing care positively impacts SUD outcomes when paired with acute treatment [10] and is considered an essential component of a robust recovery [4].

However, despite the extensive benefits of long-term continuing care in treating SUDs, many individuals struggle to successfully transition from acute in-patient treatment to long-term and self-driven care. Many encounter barriers that prevent engagement with traditional continuing care programs, such as a lack of knowledge about SUD care options,

insurance barriers, low expectations of program efficacy, concerns about stigma, and a lack of available and flexible care options [7, 11, 12]. Additionally, those who engage in long-term continuing care programs often drop out before the recommended duration [6, 13]. Further, the possibility of relapse remains high even among those who adhere to a long-term continuing care program. Kleber et al. [9] posit that social influences (e.g., substance-using family or friends), economic influences (e.g., unemployment), medical conditions (e.g., chronic pain, fatigue), and psychological influences (e.g., hopelessness, despair) increase vulnerability to relapse, even amongst individuals adhering to a continuing care program. Thus, due to the struggles related to traditional forms of long-term continuing care, new and supplemental approaches are needed to extend the impact and accessibility of these potentially lifesaving forms of ongoing support.

Technology may be a promising source of additional support for individuals attempting to make the difficult transition from acute treatment to long-term recovery due to the high penetration of specific technologies (e.g., in 2018, 77 percent of Americans owned smartphones [14]), the relatively low cost of scaling (compared to formal treatment interventions), and the potential for customization and personalization. Prior research indicates that the design of such technologies must consider how these systems can complement, rather than replace or contradict, the practices, values, and traditions of existing approaches to recovery [15]. This value-sensitive design is best conducted in close collaboration with relevant participants [16].

1.1 Research Questions

While many supportive technologies for SUD recovery exist in today's marketplace, few, if any, have been developed in close collaboration with individuals in recovery from SUDs. This proposal aims to position participants as co-designers and subject matter experts in designing technologies that complement, rather than disrupt, the current practices, values, and priorities of individuals in recovery from SUDs. In service of this goal, this dissertation addresses three overarching research questions.

> **RQ1: What are the challenges and practices of individuals in SUD recovery that provide the best opportunities for computational SUD support?**

RQ1 was rigorously investigated through a series of participatory design workshops detailed in chapter four. While several challenges and practices were highlighted, participants independently and unanimously chose to focus their designs on technology to support their relationship with their dyadic mentor (*i.e.,* sponsor). This focus demonstrated the belief that technology designed to support mentorship is compelling and valuable to individuals in recovery. This participant focus was prioritized in RQ2 of this proposal.

RQ2: What challenges, practices, needs, and motivations must be considered in designing technologies to support dyadic mentorship in SUD recovery?

Chapter five details a rigorous investigation of RQ2. Twenty-seven semi-structured interviews with mentors (*i.e.,* sponsors) and mentees (*i.e.,* sponsees) informed the creation of specific design implications to increase sponsor capacity, facilitate sponsorship initiation, and grow a broader support community for sponsees. These design implications prioritized RQ3.

RQ3: How do peer dyadic mentorship pairs in SUD recovery perceive and utilize a computational system (*i.e.,* SponsorLens) that aims to support daily mentor logistics and promote frequent and consistent communication between mentor and mentee through behavioral nudging?

In chapter six, I conduct a formative evaluation of RQ3 by developing and testing a low-fidelity prototype based on participant design requirements. In chapter seven, I utilize findings from chapter six to design and develop a high-fidelity prototype called SponsorLens, a synchronous communication and scheduling system to increase sponsor capacity and the frequency of in-person contact between mentors (i.e., sponsors) and mentees (i.e., sponsors). Finally, in chapter eight, I conduct a field deployment study to investigate the overall feasibility SponsorLens as a source of additional support for individuals in recovery from SUDs.

1.2   Contributions

In this section, I summarize contributions of this dissertation (see Figure 1.1). To address RQ1, I conducted six participatory design workshops with individuals in early recovery from SUDs. This research contributed to a broad empirical understanding of the challenges, practices, values, and traditions of individuals in recovery from SUDs. Additionally, this study led to the discovery of several implications for the design of computational support for SUD recovery.

During the aforementioned participatory design workshops, participants independently and unanimously chose to design technology to support their relationship with their mentor (*i.e.,* sponsor). The unanimous belief in the value of dyadic mentorship among participants led me to investigate how social computing may support this critical aspect of recovery support (*i.e.,* RQ2). To investigate how social computing may support or hinder dyadic mentorship, I conducted twenty-seven semi-structured interviews with fifteen mentors (i.e., sponsors) and twelve mentees (i.e., sponsees). This work contributed to a robust empirical understanding of dyadic mentorship pairs' challenges, practices, needs, and motivations in SUD recovery. Additionally, this work resulted in several implications for the design of social computing technologies to support dyadic mentorship in SUD recovery. These design implications inspired RQ3.

To address RQ3, I conducted a four-week field deployment study to evaluate a high-fidelity prototype called SponsorLens. I developed SponsorLens using a set of developer tools and extensions provided by the Slack [17] and Cronofy [18] suite of technologies. Developing a prototype atop currently available enterprise systems is called "piggyback prototyping" and has precedence in HCI research [19]. Piggyback prototyping (*i.e.,* using Slack and Cronofy developer tools to build SponsorLens) provided SponsorLens the robustness necessary to function efficiently during a 4-week field trial.

This work resulted in two contributions to SUD recovery and social computing. First, I developed open-source tools and extensions to the Slack suite of technologies to support dyadic mentorship. All code has been published to a publicly available GitHub [20] repository to enable its reuse in future research. Second, this research contributed to a rich empirical understanding of the overall feasibility of social computing interventions for

dyadic mentorship in SUD recovery.
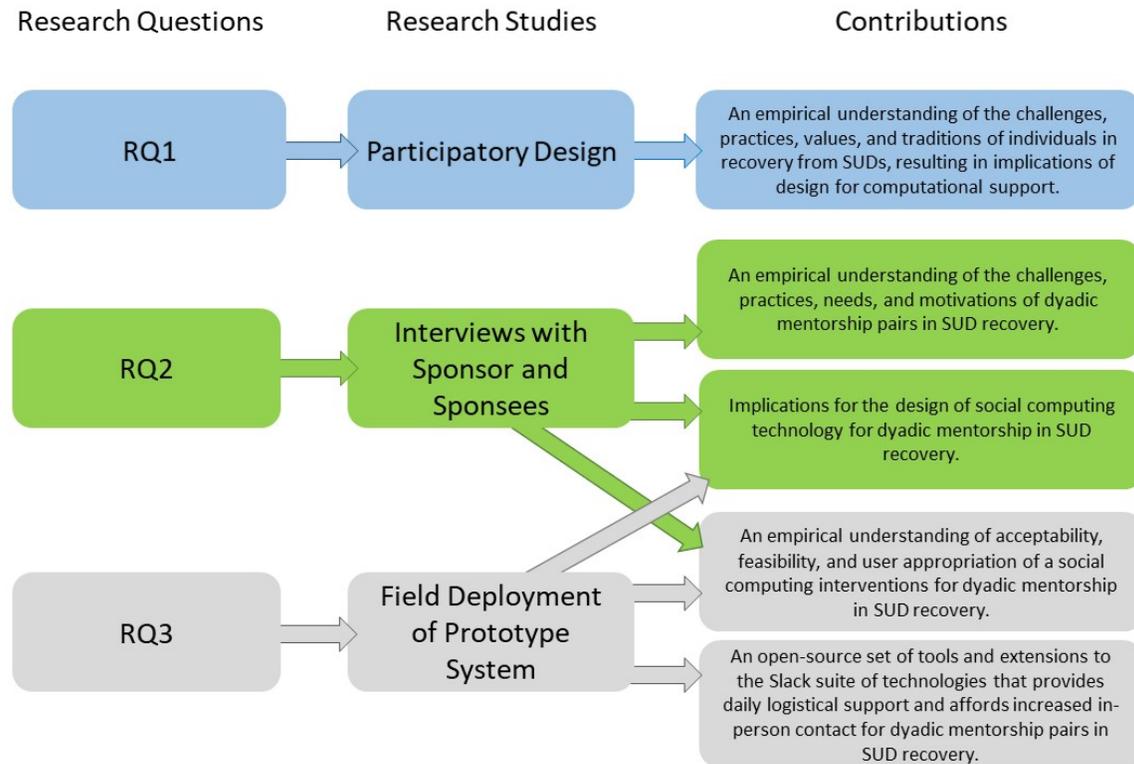
Figure 1.1: Conceptual map of the relationship between the proposed research questions, the proposed research activities, and the expected contributions.

1.3 Overview of Dissertation

I begin this dissertation by discussing the background and motivation for this proposal. I then discuss the relevant related work concerning computational support systems for SUD recovery and how this proposal will fill gaps within that work. I then introduce and discuss three completed research studies to investigate RQ1, RQ2, and RQ3. Finally, I discuss the overarching contributions of this dissertation and outline future research opportunities and challenges in this domain.

Chapter 2

Background and Motivation

In this section, I provide a critical context for this dissertation by exploring individuals' lived experiences in SUD recovery by examining traditional clinical treatment options. I begin by providing definitions for SUDs and SUD recovery, terms which I will refer to throughout this dissertation. Second, I give a summary of SUD treatment within traditional clinical settings. I then provide an in-depth overview of long-term continuing care options for SUD recovery (*e.g.,* 12-step groups, cognitive behavioral therapy) and explore barriers that prevent individuals from engaging in these potentially life-saving forms of ongoing support. Finally, I argue that technology designed in close collaboration with individuals in recovery may help break down those barriers and expand access to traditional forms of long-term continuing care.

2.1 Substance Use Disorders (SUDs)

In the context of SUDs, a "substance" is defined as any psychoactive compound with the potential to cause health and social problems [21]. Substances may be legal (*e.g.*, alcohol), illegal (*e.g.*, heroin), or controlled for medical purposes (*e.g.*, Fentanyl) [22]. A SUD is classified as prolonged and repeated use of any of these substances at high doses and high frequencies (quantity and frequency thresholds vary by substance) that significantly impairs health and function and may require specialized treatment [21]. Disorders can range from mild and temporary to severe and chronic [9]. Severe and chronic cases of

SUDs are colloquially referred to as "addiction" [22].

2.2   SUD Recovery

SUD recovery goals include the achievement of abstinence or reduction in the use and effects of substances, reduction in the frequency and severity of relapse to substance use, and improvement in psychological and social functioning [9]. Due to the chronic nature of SUDs, an individual is never "cured"; instead, they continue to maintain recovery throughout their lifetime. Two differing theoretical approaches, harm reduction and abstinence-only, exist in the context of SUD recovery.

Harm reduction practitioners seek to develop interventions that reduce drug-related harm without necessarily promoting abstinence as the only solution [23]. Methadone treatments and safe injection sites (SIS) are two prominent examples of harm reduction. The core strategy of Methodone treatments is to substitute a safer, controlled, and long-acting drug (i.e., Methodone) for the more risky, short-acting drug (e.g., heroin) [24]. SIS, another example of a harm reduction strategy, aims to reduce overdose deaths and improve public health. SIS provides people who use drugs (PWUD) with a sterile and medically monitored environment to inject or ingest drugs (legal and illegal drugs) [25]. SIS employees provide medical care to PWUD during an overdose event, thus lowering the probability of death [25]. Additionally, SIS staff provide sterile needles, referrals to recovery programs, and generalized medical care and education [26].

While harm reduction approaches are becoming more common, most treatment programs advocate participants to strive towards complete abstinence from all recreational drugs and alcohol [23]. Individuals in recovery typically track their continuous abstinence as "sober" or "clean" time, and returning to substance use is considered a relapse that resets this clock. Most patients treated for SUDs have at least one relapse during the first year following treatment [9].

2.3   SUD Treatment

This section provides an overview of traditional and formal clinical settings for SUD treatment. Analogous to treatment models for other chronic conditions, the standard treatment

for individuals with SUDs typically occurs in temporal phases, including initial assessment, acute stabilization, and long-term continuing care [9]. However, it is important to recognize that many individuals (approximately 46%) resolve a substance use problem without engaging in formal SUD treatment or skipping one or more of the traditional treatment steps outlined below [27].
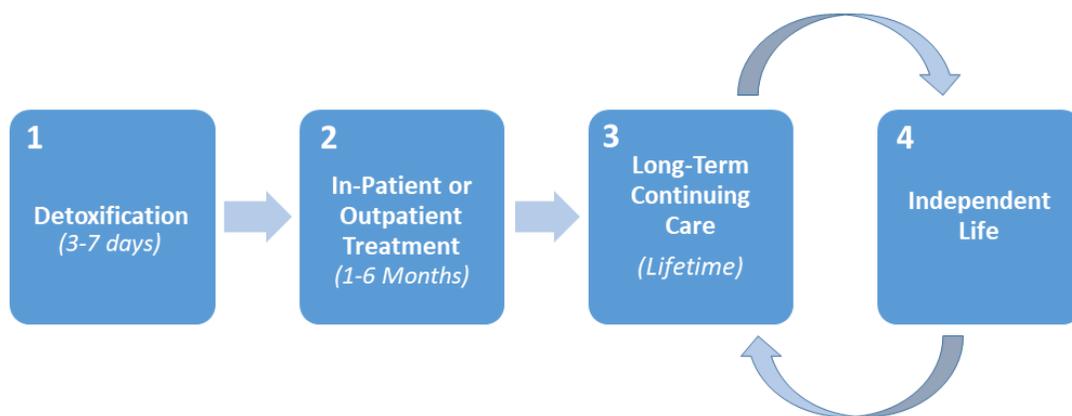
Figure 2.1: The traditional treatment process includes three temporal phases, detoxification, in-patient or outpatient treatment, and long-term continuing care [9].

Individuals seeking formal clinical SUD treatment typically require an individualized medical assessment at the onset of treatment to determine immediate physical and psychological risks and develop an overall treatment plan [9]. Following assessment, individuals undergo detoxification. For cases with a high risk of medically complicated withdrawal symptoms, detoxification often occurs in an in-patient facility under the supervision of a medical professional [9]. Detoxification is the medical management of substance withdrawal to prevent complications, such as seizures or delirium tremens, which may be fatal [28]. For withdrawal from alcohol use disorders (AUD), clinicians strive to reduce central nervous system irritability and restore physiological homeostasis [9]. This treatment generally requires the use of thiamines, benzodiazepines, and anticonvulsants [9]. Severe opioid intoxication often requires hospitalization as an overdose can cause fatal respiratory depression [9]. Withdrawal from prolonged opioid use is typically treated with slow tapering of methadone treatments [9]. It is important to note that detoxification does not and should not serve as standalone care for substance dependence. Instead, detoxification

should function only as an entry point to treatment [28].

Following detoxification, physicians often refer individuals to an in-patient or outpatient treatment setting for several months. I will refer to this period as **acute treatment** throughout this dissertation. In acute treatment, the American Psychological Association (APA) recommends that individuals receive treatment in the least restrictive setting that is likely to be safe and effective [9]. Common treatment settings include hospitals, residential treatment facilities, partial hospitalization, and outpatient programs [9]. Hospitalization is recommended for individuals who have a documented history of not benefiting or engaging in less intensive treatment or are a danger to themselves or others [9]. Residential facilities are prescribed for individuals who do not meet the clinical criteria for hospitalization but whose lives and social interactions have come to focus predominantly on substance use [9]. For example, physicians often prescribe residential facilities for individuals who lack sufficient social and vocational skills and a substance-free social support system [9]. Partial hospitalization is recommended for individuals who require intensive care but have a reasonable probability of refraining from the illicit use of substances outside a restricted setting [9]. Finally, outpatient treatment is appropriate for individuals whose clinical condition or environmental circumstances do not require intensive care [9]. Most individuals remain within one or more of the aforementioned treatment settings for approximately three to six months before returning to an independent life.

Transitioning from acute treatment (*i.e.*, in-patient or residential treatment setting) to an independent life is difficult and dangerous for many individuals in recovery. At this point, individuals lose the support and structure provided by the treatment facility and return to their pre-treatment environment. In returning to their pre-treatment environment, individuals confront dangerous stressors such as social connections not supportive of abstinence, work stress, familial stress, medical conditions (*e.g.*, chronic pain), and psychological distress (*e.g.*, hopelessness, anxiety) [9]. Confronting these stressors without adequate support can and often does lead to relapse. To ease the transition from acute treatment to an independent life and help prevent relapse, clinicians almost always recommend that individuals in recovery engage in a long-term continuing care program that provides continuous support and recovery maintenance.

These programs typically fall into one of three categories, Mutual support groups *e.g.,*

AA, NA, SMART Recovery), clinical therapy interventions (*e.g.,* cognitive behavioral therapy [CBT]) and pharmacological treatment (*e.g.,* Methadone, Naltrexone). While prior studies suggest that long-term continuing care is considered an essential component of a robust recovery [4], individuals encounter significant obstacles that prevent them from engaging in these potentially life-saving forms of support. These barriers represent a glaring vulnerability within traditional treatment models for SUDs. I delve into this period of recovery in the next section.

2.4 Long-term Continuing Care for SUDs

This section outlines three commonly prescribed forms of long-term continuing care: mutual help groups, clinical therapy, and pharmacological treatment. I then explore barriers that prevent individuals from accessing these vital forms of ongoing care.

2.4.1 Mutual Support Groups

Mutual support groups, or self-help groups, are groups of two or more people who share an experience or problem and come together to provide problem-specific help and support to one another [29]. Individuals in recovery run these groups themselves in local venues, without professional involvement, free of charge [30]. Below I cover two types of mutual support groups relevant to this dissertation, 12-step groups and Self-Management and Recovery Training (SMART).

The 12-Step Approach

Twelve-step groups such as Alcoholics Anonymous (AA) and Narcotics Anonymous (NA) are the most commonly used form of long-term continuing care among individuals with SUDs in the United States [31, 32, 33]. Twelve-step groups are also widely attended internationally, with several million members from over 180 countries [29]. The prevalence of the 12-step approach in SUD continuing care is due in part to its wide-reaching availability [9], free cost of membership, and the high rate of referrals from professional treatment centers [34]. Prior research indicates that up to 80 percent of treatment centers in the United States refer patients to 12-step groups following acute treatment [35, 36, 37].

12-step groups operate through peer-led, nonprofessional meetings in local community accommodations such as churches, hospitals, community centers, and colleges [29]. Meetings typically last sixty to ninety minutes. During these meetings, members share personal experiences of their substance use and recovery, offer encouragement and understanding, and help each other practice the principles and traditions of 12-step programs intended to increase or enhance psychological well-being, interpersonal skills, coping skills [38, 37]. Members attend meetings on a self-determined schedule, which, if necessary, can be every day [9].

The 12 steps, for which the group was named, focus first on surrender and acceptance of one's disease, second on a personal inventory, third on making amends and personal change, and finally on bringing the message to others [9]. However, at their core, 12-step groups provide care for individuals recovering from SUDs through social support mechanisms. 12-step groups help members with relapse prevention by providing role models, social support, social strategies for maintaining a sober lifestyle, and opportunities for structured and unstructured substance-free social events and interactions [9]. Further, members are also encouraged to obtain a "sponsor," a peer mentor who provides guidance, daily support, and accountability [38].

The robust social support enacted through 12-step groups has been found to provide a sense of belonging and universality that can diminish negative affect and shame [39], reduce or buffer the adverse psychological impacts of exposure to stressful life events and ongoing life strains [40], facilitate social network change from a high percentage of peers who support substance use to a high percentage of peers who support abstinence [41], and provide a sense of hope through seeing others succeed in recovery [38].

Previous studies have demonstrated that 12-step groups are more effective or equally effective compared to clinical interventions such as CBT and MET. In a recent meta-analysis, Kelly et al., [38] demonstrated that engagement in 12-step groups and 12-step facilitation significantly improved the rate of continuous abstinence at 12, 24, and 36-month follow-ups compared to clinical interventions. Additionally, 12-step groups and 12-step facilitation performed similarly to clinical interventions regarding the number of drinks consumed per day and the percentage of heavy drinking days at a 12-month follow-up [38]. Finally, 12-step groups and 12-step facilitation led to more significant individual

health cost savings than outpatient programs, CBT, and no-treatment groups [38].

Despite their popularity, the 12-step approach is not without controversy. The spiritual foundation of traditional 12-step programs can deter participation for individuals who do not embrace these ideals [9]. Although not widely available, alternative self-help groups such as Women for Sobriety [42], Secular Organizations for Sobriety [43], and SMART [44] have been developed to address this problem and provide an alternative option for individuals not comfortable with the spiritual perspective of traditional 12-step programs [9].

Self-Management and Recovery Training (SMART)

The aforementioned SMART [45] is an evidence-based mutual support group developed as an alternative to 12-step groups. Unlike most traditional 12-step groups, SMART eschews spirituality and works to instill an internal locus of control through self-empowerment [45]. Further, SMART does not endorse sponsorship, a key tenant of 12-step groups, but recommends professional therapy for individuals needing one-on-one support.

Similar to 12-step groups, SMART revolves around weekly ninety-minute meetings [46]. The basic format includes check-in, group discussion, request for donations, and group review. Group discussion is the longest part of the meeting. Group discussion may focus on one or more members' concerns or a theme or reading chosen for further discussion [46].

While SMART meetings are growing in popularity, they represent only a small fraction of worldwide mutual support meetings for recovery. For instance, in 2019, SMART recovery hosted 3,000 weekly meetings worldwide [47]. During the same period, AA, a 12-step group for individuals in recovery from AUDs, hosted 110,000 meetings with over 2 million members worldwide in 2019 [48].

2.4.2   Clinical Therapy Treatment

Similar to mutual support groups, clinical therapy is an oft-used option for long-term-continuing care [49]. Unlike mutual support groups, clinical therapy requires a licensed professional and can be expensive (typically $100-$200/hr). Below, I cover two types of clinical therapy relevant to SUD recovery, Cognitive Behavioral Therapy (CBT) and Motivation Enhancement Therapy (MET).

Cognitive Behavioral Therapy (CBT)

CBT is a short-term, focused approach that usually occurs in outpatient settings to help individuals recognize situations in which they are most likely to use substances, avoid these situations when appropriate, and cope more effectively with a range of problems and problem behaviors associated with drug abuse [50]. Individuals engaging in CBT work with a licensed professional to (1) identify intrapersonal and interpersonal triggers for relapse, (2) develop coping skills and drug-refusal skills, and (4) increase sober activity frequency [51]. Overall, CBT is effective in treating substance use disorders [51], especially in individuals with co-morbid diagnoses of depression and anxiety [9].

Motivation Enhancement Therapy (MET)

Similar to CBT, MET is a one-on-one therapy session conducted by a licensed professional. MET is based on motivational psychology principles and is designed to produce rapid internally motivated change [52]. MET does not guide and train the client, step by step, through recovery; instead, it employs motivational strategies to empower the client's motivational resources [52]. MET is characterized by an empathetic approach in which the therapist helps to motivate the patient by asking about the pros and cons of specific behaviors, exploring the patient's goals, and listening to the patient's responses [9]. MET is effective even for patients who are not highly motivated to change, which gives it a practical advantage over other therapies for SUDs in many settings [9].

2.4.3 Pharmacological Treatment

Pharmacological therapies are effective adjuncts to behavioral therapies and mutual self-help groups and exist in two forms: agonist therapies and antagonist therapies [9].

Agonist therapies act on the same types of neurotransmitter receptors as those stimulated by substance use [9]. The core strategy of agonist treatments is to substitute a safer, controlled, and long-acting drug for the more risky, short-acting one [24]. Classic examples of agonist treatments for opioid use disorders include Methadone, and Buprenorphine [9]. Both stimulate the μ opiate receptor sites and prevent withdrawal symptoms [9].

Conversely, antagonist therapies block μ opiate receptor sites in the brain from being

stimulated by opiates [24]. This treatment counteracts the physiological and subjective reinforcing effects of substance use [24], thereby discouraging opioid use and diminishing conditioned craving [9]. For example, Naltrexone, a narcotic antagonist, blocks the subjective and physiological effects of subsequently administered opioid drugs such as heroin.

2.4.4 Barriers to Long-Term Continuing Care

As discussed above, long-term continuing care (*e.g.,* mutual support groups, clinical therapy, and pharmacological treatment) is an essential component of SUD recovery [9]. For instance, Walker *et al.,* [53] found that participation in long-term continuing care was a stronger predictor of positive drinking outcomes than the length of hospitalization, neuropsychological functioning, pre-treatment drinking, and social stability. Additionally, in their study, Gilbert *et al.,* [54] randomly assigned participants to one of three conditions that varied the therapists' effort to keep participants in long-term continuing care treatment for AUD. Participants in the maximum effort group were most likely to participate in long-term continuing care. Those participating in long-term continuing care had significantly better outcomes than those not. These findings strongly suggest that long-term continuing care provides critical ongoing support and maintenance for individuals in recovery.

However, despite the efficacy of long-term continuing care options, individuals in recovery from SUD encounter significant barriers that prevent them from engaging in these potentially life-saving forms of ongoing care. First, traditional treatment is commonly delivered in a manner that is more appropriate for acute care disorders (*e.g.,* influenza, allergic reaction), rather than chronic lifelong conditions (*e.g.,* SUDs, Diabetes) [7, 55]. For instance, many individuals with a SUD receive detoxification treatment only [56] and do not follow up with specialized acute treatment or long-term care. Second, due to insurance restrictions, many individuals do not have access to long-term continuing care resources such as pharmacological treatment and clinical therapy [7]. Third, in addition to the high cost, clinical treatments are time-consuming for the clinician and patient and do not scale to large groups of people. For instance, CBT typically involves between 5 and 20 sessions [57] delivered by a therapist with a doctorate or master's degree in mental health, medicine, or a related field. This substantially narrows access and availability of care. Fourth, barriers also exist that prevent individuals from engaging in free long-term continuing care

resources (*e.g.,* 12-step groups, SMART), such as lack of knowledge about options, low expectations of treatment efficacy, concerns about stigma, and a lack of available and flexible treatment options [11, 12]. These persistent barriers contribute to high relapse rates amongst individuals in recovery from substance use (see figure 2.2) and ultimately to the rising rates of overdose deaths.
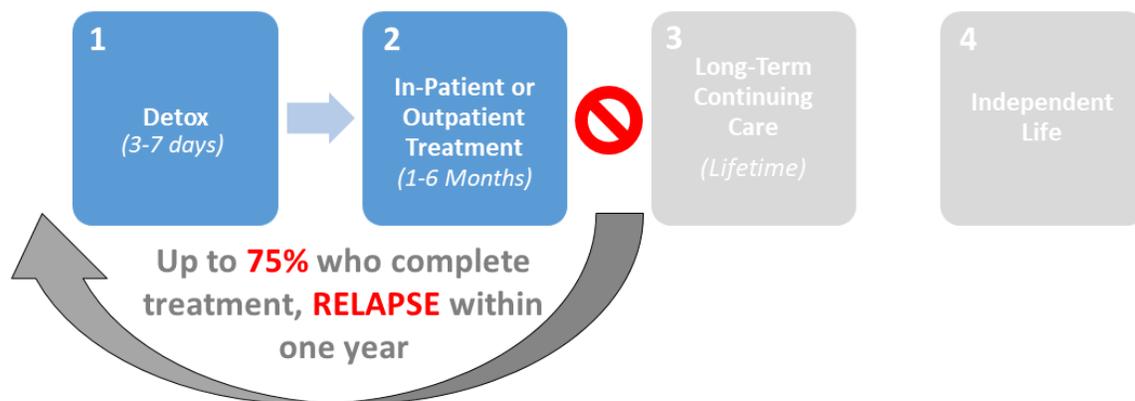
Figure 2.2: Seventy-five percent of individuals relapse (i.e., begin using drugs again) within one year of completing a formal treatment plan [5, 6, 7, 8].

2.4.5   Opportunities for Technology to Support Long-Term Care

Thus, new and supplemental approaches are needed to improve SUD treatment outcomes and break down these trenchant and life-threatening barriers to long-term care. Technology may be a promising source of additional support for individuals attempting to make the difficult transition from acute treatment to long-term recovery due to the high penetration of specific technologies (e.g., in 2018, 77 percent of Americans owned smartphones [14]), the relatively low cost of scaling (compared to formal treatment interventions), and the potential for customization and personalization. Prior research indicates that the design of such technologies must consider how these systems can complement, rather than replace or contradict, the practices, values, and traditions of existing approaches to recovery [15]. This value-sensitive design is best conducted in close collaboration with relevant participants [16]. Therefore, in this dissertation, I work with individuals in recovery from SUDs to design technological solutions to help individuals overcome barriers to long-term care and

expand the accessibility and efficacy of traditional treatment options.

Chapter 3

Related Work

In this section, I discuss relevant related work concerning computational support systems for SUD recovery. The majority of this work originates from four broad research domains: 1) human-computer interaction (HCI), 2) medical and clinical domains, 3) ubiquitous computing (UbiComp), and 4) health informatics. I provide a brief overview of each research domain to highlight how this dissertation builds upon these previous investigations. Additionally, I highlight three opportunities that exist for computational support for SUD recovery:

1. Represent patient values and priorities in the design process.
2. Design technology to support the transition to and maintenance of self-managed long-term SUD recovery
3. Design technology to support and enhance social support mechanisms in SUD recovery.

3.1   HCI Design Research

HCI is an interdisciplinary field devoted to facilitating user interactions with computerized systems [58]. HCI research focuses on designing and developing new interactive systems (i.e., smartphone apps to support mental health), empirically investigating existing systems, augmenting community and peer support online, and pioneering new methods of

managing information [22]. HCI practitioners design, implement, and evaluate interactive technologies to ensure the user experience is effective, efficient, and satisfying for the user [59]. As noncompliance is a perennial problem in SUD treatment [9], HCI's focus on positive user experiences may directly benefit SUD recovery by increasing treatment compliance.

I begin reviewing relevant related work by exploring HCI design research concerning mental health disorders. Given that SUDs are one example of a mental health disorder (as designated by the DSM-5 [60]), this dissertation can be informed by technology design for mental health. HCI design research for mental health has a long tradition of forming an equal partnership with individuals with mental health disorders to co-design technology to support ongoing care. A clear theme within this research is the empowerment of marginalized communities (*i.e.,* individuals diagnosed with mental health disorders) by providing them a voice in the design of technology that will benefit them most. Another theme in this work is the numerous benefits of merging technologist and user expertise to create novel insights and technologies. Conversely, while HCI research for mental health disorders has consistently sought to represent patient values and priorities in the design process, HCI design research focusing on SUDs has yet to implement a similar user-centered design focus. Below, I contrast the HCI approach to mental health with the HCI approach to SUDs and discuss gaps within these previous investigations.

3.1.1   HCI Design to Support Mental Health

Prior work in the design of technology for mental health has focused on supporting individuals' ability to self-monitor and take an active role in the long-term management and treatment of chronic mental health conditions such as depression [61, 62], stress [63, 64, 65, 66], general anxiety [67], bipolar disorder [68, 69, 70], mental illness [71], and ADHD [72].

In addition to developing technology on behalf of individuals, HCI design research has a long tradition of working with individuals with mental health disorders to co-design user-centered technology to support ongoing care. For instance, O'Leary *et al.* [71] conducted a participatory design study with participants with mental health disorders to make mental health support technologies accessible, safe, and empowering. Additionally, Matthews *et al.* [70] conducted a participatory design study with nine individuals diagnosed with bipolar

disorder to co-design MoodRythm. This mobile app helps users set and track their daily routines. Using a similar approach, Simm *et al.* [73] co-developed wearable technology with individuals diagnosed with autism to assist in anxiety self-management.

This research methodology, in which technology is designed in close collaboration with individuals with mental health disorders, is termed participatory design (PD). PD is a widely used approach within the HCI community that positions the end-user as a full participant in the design process [74]. This method is particularly salient when the goal is to empower traditionally marginalized or overlooked user groups by providing them a voice in the design process [74]. In addition to the work mentioned above with individuals with mental health disorders, PD has also been utilized to develop technologies with individuals belonging to traditionally marginalized user groups. For example, PD research has been conducted with individuals with special needs [75], elderly adults [76, 77, 78], blind individuals [79], and individuals in recovery from stroke [80].

PD is also helpful in merging the areas of expertise of both designers and users [81]. The knowledge gap between the expert domains of the designer and user is a fertile environment in which participants can combine their diverse knowledge bases to challenge assumptions and develop novel insights [82]. The advantage gained from working in close collaboration with core users is evident within Lindsay *et al.' s* [83] participatory design study conducted with individuals with dementia. In their study, the authors stated that their research approach (*i.e.,* PD) "highlighted areas where designers and participants held radically different views [83]." In creating an empathetic working relationship, designers and participants merged their perspectives to create a digital aid to facilitate "safe walking" for individuals with dementia (*i.e.,* walking outdoors unaccompanied by a caregiver with minimal risk of becoming lost or experiencing anxiety).

Design research to support individuals with mental health disorders and other chronic conditions has been dramatically enhanced through user-centered participatory design. These research studies were conducted "with" people experiencing real problems in their everyday lives, not "for," "about," or "focused on" them. This methodology has enabled prior research in mental health to ground the creation of novel technologies in participants' lived experiences, concerns, and priorities. Additionally, treatment compliance concerning mental health disorders is a perennial problem [9], particularly in SUD recovery. Thus,

participatory design may be a promising design approach to address non-compliance issues.

3.1.2 HCI Design Research to Support SUD Recovery

Despite the benefits of PD, the vast majority of HCI design research regarding SUDs has been qualitatively different from the user-centered approach adopted for other mental health disorders. SUD recovery has instead focused on computational methods to detect and predict substance use behavior (note: UbiComp and health informatics will be covered later in this chapter), eschewing the participatory design of digital tools to support self-management of the emotional, physical, and environmental factors critical to long-term recovery.

A small minority of HCI design studies have attempted to understand how technology can be integrated into established recovery traditions and practices. For instance, Yarosh [15] conducted in-depth interviews with AA and NA members concerning the use of technology in traditional 12-step recovery programs. Yarosh identified several tensions in how technology is perceived and adopted, including anonymity, identity, consensus, access, unity, autonomy, and physical presence when utilizing technology for recovery purposes. Similarly, Rubya and Yarosh conducted further design studies on how individuals engaged in traditional 12-step programs defined anonymity in online support groups [84] and navigated video-mediated peer support in online meetings [85]. Findings from these studies strongly suggest that the design of such technologies must consider how these systems can complement, rather than replace or contradict, the practices, values, and traditions of existing approaches to recovery (*e.g.,* 12-step programs). This value-sensitive design is best conducted in close collaboration with relevant participants [16].

HCI design research has also focused upon the development of specific technologies to support family communication in SUD recovery [86], communicate with a recovery coach [87], suggest relapse prevention skills [88], and explore the efficacy of virtual counseling agents [89]. However, dissimilar from HCI design research for other mental health disorders, only Patar et. al's [87] work was developed through formative research or close collaboration with individuals in recovery from SUDs (Patar et. al's research [87] was published after my research outlined in chapters four and five and cites both studies). Thus, an

explicit limitation of previous SUD research within HCI is a lack of design work **with** people in recovery. This research is needed to align with individuals' specific priorities, values, and challenges as they transition from acute in-patient treatment to long-term independent recovery.

3.2   Medical and Clinical Technology

Whereas HCI design research focuses on user experience, clinical practitioners focus on the effectiveness of novel treatment interventions. Specifically, clinical practitioners empirically investigate the health outcomes of novel treatment interventions through clinical research trials, including randomized controlled trials, case-controlled field evaluations, and time series evaluations. These interventions, or their implementation process, include numerous examples of computational support in the form of digital artifacts and information management approaches for SUD recovery [22]. The development of clinical technology interventions for SUDs has increased rapidly over the past two decades [90] as a means of reducing the cost of and extending access to resource-intensive in-person treatments.

The majority of medical and clinical SUD intervention technologies are designed as digital extensions or replacements of traditional in-person clinical treatments such as CBT [91, 92, 93, 94, 95, 96, 97, 98], motivational interviewing [99, 100], brief interventions [101, 102, 103, 104], relapse prevention therapy [105, 106], community reinforcement therapy [107], cue exposure therapy [108], and contingency management [109].

For instance, Carroll *et al.* [91] deployed a "computerized" version of CBT therapy called CBT4CBT to participants seeking treatment for SUDs at an outpatient substance use treatment facility. CBT4CBT consisted of six computer-delivered lessons based upon the CBT manual published by the National Institute on Drug Abuse [110], including 1) understanding and changing patterns of substance use, 2) coping with craving, 3) refusing offers of drugs and alcohol, 4) problem-solving skills, 5) identifying and changing thoughts about drugs and alcohol, and 6) improving decision-making skills. Participants that completed computer-delivered CBT4CBT modules had comparable outcomes to participants receiving in-person CBT therapy. Additionally, CBT4CBT is an effective adjunct to traditional addiction treatment even in historically challenging treatment scenarios such as cocaine-dependent individuals enrolled in methadone maintenance programs [111, 112].

Further, Mason *et al.* [99] translated traditional motivational interviewing (MI) techniques into an interactive text message system to support problem drinking. Traditional MI is an in-person counseling style that explores and resolves ambivalence about changing personal behaviors [113]. It emphasizes exploring and reinforcing intrinsic motivation toward healthy behaviors while supporting their autonomy [113]. Mason *et al.* sent participants interactive MI-based text message sequences over four days in their study. Despite a small sample size, participants in the intervention group self-reported significantly higher "readiness to change" than the control group.

Finally, technology has also been utilized to detect substance use to enforce contingency management (CM) strategies. CM is a highly efficacious adjunct to traditional therapy that provides financial incentives to individuals to achieve targeted behaviors such as treatment adherence, and the moderation or elimination of substance use [109, 114]. Until recently, CM research was limited due to the feasibility of monitoring substance use remotely and continuously outside of in-patient treatment centers. Many studies have examined how technology can continuously and remotely monitor substance use to enforce CM incentives. For instance, Dougherty *et al.*, [115] utilized transdermal alcohol monitoring, which detected alcohol excreted through the skin and provided a continuous measure of transdermal alcohol concentration (TAC) over time. Researchers found that participants in both CM conditions (i.e., $25 and $50) had fewer drinking episodes and reduced frequencies of heavy drinking compared to the $0 condition (i.e., control group).

In summary, novel medical and clinical technology interventions for SUDs have greatly expanded access to proven therapies beyond the bounds of in-person appointments within brick-and-mortar locations. Additionally, the empirical focus of clinical and medical research has strongly suggested that digital interventions can be an effective adjunct to in-person interventions for individuals in recovery. However, despite these advantages, many limitations exist within this research domain. Namely, most medical and clinical technology for SUDs focuses solely on the initial acute treatment phase, ignoring the long-term continuing care phase. Furthermore, research within this domain fails to address or utilize social support mechanisms, which have shown to be highly effective in caring for SUDs [116]. Finally, similar to limitations in HCI design research for SUD recovery, medical and clinical technologies have not been developed in close collaboration with individuals

in recovery from SUDs.

3.3   Ubiquitous Computing

Ubiquitous computing (UbiComp) is an interdisciplinary field of research and development that utilizes and integrates pervasive, wireless, embedded, wearable, and mobile technologies to bridge the gaps between the digital and physical worlds [117]. UbiComp researchers innovate novel sensors and mobile computing analysis techniques to support gathering information about human activity in the world [22]. Concerning SUDs, sensors and computational analysis are used to detect individuals' risky behavior in recovery and act upon that information by intervening before a potential relapse may occur. I cover two examples of UbiComp research in this section: 1) Ecological Momentary Assessments/Interventions (EMA/EMI) and 2) mobile phone-based sensors used to detect substance use.

EMAs are designed to collect real-time data concerning individuals' behavior, thoughts, and feelings in their day-to-day lives to understand the factors that lead to relapse [118]. Ecological Momentary Interventions (EMI) then use that real-time information to intervene at the right moment to prevent relapse.

For instance, Marhe *et al.* used EMA to track cravings and attitudes of sixty-eight individuals with heroin use disorders (HUD) during in-patient detoxification at an addiction treatment center [119]. Participants carried around a personal digital assistant for one week and completed four random assessments of mood and craving per day. They also completed an assessment when they experienced a temptation to use drugs [119]. Compared to non-relapsers, relapsers reported higher craving levels and more positive explicit attitudes to drugs [119].

Ingersol *et al.,* [120] and Gustafson *et al.*, [106] took EMA one step further and used it to send customized interventions to individuals in recovery when individuals crossed a preset relapse risk threshold. For example, Ingersol *et al.*, [120] sent four text message queries per day to individuals at a non-urban HIV clinic with a history of substance use regarding mood, adherence to treatment, and attitude toward substance use. Their text message system sent customized intervention messages to individuals whose EMA data reports indicated the individual was in danger of relapse or substance use. Moreover, Gustafson *et al.' s* smartphone app ACHESS [106] tracked risky items related to alcohol

use, such as lifestyle balance, quality of sleep, negative affect, and recent substance use. If a participant's score exceeded a preset risk threshold, the app sent a message to the participant's counselor or therapist.

EMA/EMI technology has also focused on tracking and intervening based on external experiences such as geographic location. Dulin *et al.,* [121, 96] developed the smartphone app called LBMI-A, which identifies and alerts the user if they entered a geographical area in which they frequently have drunk alcohol in the past. The app alerts the user that they are entering a high-risk zone and provides numerous strategies for managing the situation, including; leaving the area, calling a supportive person, viewing reminder photos, and viewing reasons for change.

In addition to EMA/EMI, UbiComp research has developed numerous smartphone-based sensors to detect individual substance use in the physical world. For example, You *et al.* developed a smartphone-based sensor to detect substance use utilizing breath [122] and saliva [123]. Kao *et al.,* [124] developed a computational system to detect substance use using walking gait patterns. Furthermore, Bae *et al.,* [125] used standard built-in smartphone sensors to monitor behavioral patterns associated with the initiation of drinking occasions. Researchers then developed a machine learning-based model that was 96.6% accurate at identifying participants' non-drinking, drinking, and heavy drinking episodes.

In summary, UbiComp research has enabled greater fidelity in the continuous assessment of individuals' internal affect and external behavior in recovery. The just-in-time intervention capability of EMA/EMI has great potential to prevent relapse outside of traditionally monitored environments such as in-patient treatment facilities. Additionally, smartphone-based sensors allow for the continuous detection of substance use. However, in a similar fashion to clinical technology interventions, UbiComp has eschewed social support mechanisms and has not yet designed technology in close collaboration with individuals in recovery. Thus, additional opportunities exist for UbiComp methodologies to positively impact individuals in recovery from SUDs.

3.4 Health Informatics

Health informatics researchers apply statistics and computational analysis (*e.g.,* machine learning) to large data sets such as electronic health records and social media traces to

improve healthcare-related behaviors, and outcomes [22]. Health informatics and data science research have analyzed the language used in social media sites to categorize and predict relapse, better understand factors that lead to a successful SUD recovery, and track SUD treatment outcomes. [22].

For example, Chancellor *et al.,* [126] used machine learning to investigate individual use of clinically unverified alternative treatments to combat opioid use disorder (OUD), such as untested and unregulated drugs. Researchers identified and analyzed 93,000 posts concerning OUD on the social media site Reddit to determine which alternative treatments people use, whether they are effective for recovery, or if they cause harmful side effects. These findings may benefit clinicians in soliciting more accurate patient histories and managing better dosing protocols.

Additionally, health informatics and data science researchers have used computational methods to demonstrate how linguistic cues on Reddit can indicate a user's cessation of alcohol and tobacco use and their risk for relapse [127]. Further, Kornfield *et al.,* [128] investigated specific language in online forums that is predictive of relapse amongst individuals with AUD. Finally, MacLean *et al.,* [129] investigated SUD recovery trajectories and timelines within the online community Forum77 and demonstrated a significant positive correlation between online forum use and recovery.

In summary, health informatics research has the unique ability to analyze large datasets to increase our understanding of the behavior and recovery outcomes of individuals battling SUDs. Additionally, health informatics has increased our understanding of social relationships and social support in social media and peer support forums. However, designing technology to leverage those social support mechanisms or support an individual's transition from acute treatment to long-term continuing care is outside this research domain's scope.

3.5   Opportunities for Technology Design

In my review of relevant related work in HCI design, clinical and medical technology, UbiComp, and health informatics, I discovered three overarching opportunities for computational systems supportive of SUD recovery, including 1) represent patient values and

priorities in the design process, 2) design technology to support the transition to and maintenance of self-managed long-term SUD recovery and 3) design technology to support and enhance social support mechanisms in SUD recovery. I discuss each opportunity below.

3.5.1   Represent patient values and priorities in the design process

An explicit limitation of previous SUD research is a lack of design work **with** people in recovery to seek alignment with the specific priorities, values, and challenges individuals face as they transition from acute in-patient treatment to long-term independent recovery. HCI design research for mental health disorders has a long history of successfully utilizing participatory design to empower traditionally marginalized communities and merge designer and user expertise domains. However, similar research has not been conducted with individuals in recovery from SUDs with the same frequency. In chapter four (*i.e.,* study 1), I address this gap by conducting six PD workshops with thirteen women who have recently finished acute treatment and have transitioned to long-term continuing care. This study positions participants as co-designers and subject matter experts in the design of supportive technology to support SUD recovery. During the PD workshops, participants discussed how and why they currently use technology to support their recovery, interacted with currently available technology designed for SUD recovery, identified prominent problems related to their recovery, brainstormed technical solutions to these problems, and finally, sketched the most promising solutions.

3.5.2   Design technology to support the transition to and maintenance of self-managed long-term SUD recovery

In chapter two, I examined traditional clinical treatment options for SUDs. In that examination, I discussed the difficulty experienced by individuals in SUD recovery as they attempt to transition from acute treatment to long-term continuing care. Many individuals encounter significant barriers preventing them from engaging in long-term care. These barriers contribute to high relapse rates and ultimately precipitate substance overdose, which can be fatal. New and supplemental treatment options are needed to aid individuals in making this difficult transition.

However, despite this need, few computational systems have focused on supporting

long-term continuing care. Instead, most computational systems focus on recovery's detox-ification and acute treatment phases. This dissertation aims to fill this gap by working with participants to design support for transitioning to and maintaining long-term continuing care. In chapter four, I conduct a participatory design study with participants who have recently completed acute treatment and are transitioning to long-term care. In chapters five, six, and eight, I work with individuals with a wide range of experience in recovery (i.e., from 8 months to 23 years) to design technology to increase the quantity and quality of social support for individuals in the long-term continuing care phase of their SUD recovery.

3.5.3 Design technology to support and enhance social support mechanisms in SUD recovery

Social connection and social support are critical to long-term recovery from SUDs. Dr. Marvin Seppala, chief medical officer at the Hazelden Betty Ford Foundation, refers to "addiction" as a "disease of isolation" [130]. Ghose *et al.,* [131] posits that the rapid increase in overdose deaths during the COVID-19 epidemic was in part due to higher levels of isolation associated with epidemic. Prior research has demonstrated that social support acts as a buffer to life stress and mitigates the negative impact of said life stress upon mental health and substance use [40]. Previous research has also suggested that high levels of social support are predictive of abstinence, treatment retention [116] and positive treatment outcomes [132, 133]. Additionally, in a randomized controlled trial, Tracey *et al.,* [134] demonstrated that peer mentorship was predictive of significantly higher adherence rates to post-discharge substance abuse, medical, and mental health outpatient appointments.

However, despite these well-documented benefits, few computational systems have attempted to leverage social support mechanisms to support SUD recovery. This dissertation fills this gap through three independent but connected research studies. Primarily, in chapter four of this proposal, participants in participatory design workshops independently and unanimously chose to focus their technology designs on supporting their relationship with their dyadic mentor (*i.e.,* sponsor). This finding demonstrated the belief that technology designed to leverage social support mechanisms is compelling and valuable to individuals in recovery. This focus on social support was prioritized in chapter five (*i.e.,* study 2) of

this proposal. In chapter five, I conduct semi-structured interviews with fifteen peer mentors (*i.e.,* sponsors) and 12 peer mentees (*i.e.,* sponsees) to inform the creation of specific design implications to support the sponsorship relationship. Finally, in chapter eight, I conduct a field deployment research study to investigate the feasibility of a synchronous communication and scheduling system to increase sponsor capacity and the frequency of social support and contact between mentors (i.e., sponsors) and mentees (i.e., sponsees).

Chapter 4

Participatory design of technologies to support recovery from substance use disorders

4.1 Introduction

In this study, I explore how computational systems and novel technologies may enhance existing SUD treatment and provide additional support to individuals in recovery from SUDs. Specifically, I rigorously investigate **research question #1 (RQ1)** (*i.e.,* What are the challenges and practices of individuals in SUD recovery that provide the best opportunities for computational SUD support?) through a series of participatory design workshops designed to identify the prominent challenges of SUD recovery, brainstormed technical solutions to these challenges, and finally sketch the most promising solutions.

In addition to investigating RQ1, this study addresses acute limitations within related research regarding the development of computational systems for SUD recovery. Specifically, while many supportive technologies for SUD recovery exist in today's marketplace, few, if any, have sought to represent patient values and priorities in the design process (see chapter 3). This study addresses this limitation by positioning participants as co-designers and subject matter experts in the design of supportive technology to support SUD recovery. Furthermore, few computational systems have been designed to support the transition to

and maintenance of self-managed long-term SUD recovery (see Chapter 3). This study addresses this limitation by conducting participatory design workshops with individuals who have recently completed acute SUD treatment and are transitioning to long-term care.

I begin by defining terms essential to SUD recovery. I then discuss core themes resulting from the workshops. Finally, I connect the themes to larger implications for design.

4.2 Background: Important Concepts related to SUD Recovery

The following terms and concepts are important for understanding the experience of people in early recovery from SUDs:

- **Role of the 12-step Approach in Long-Term Continuing Care:** Despite the recent increased focus on formal evidence-based care (*e.g.,* CBT), 12-step groups such as Alcoholics Anonymous (AA) and Narcotics Anonymous (NA) are the most commonly used form of long-term continuing care program among individuals with SUDs in the United States [31, 32]. The prevalence of the 12-step approach in SUD continuing care is due in part to its wide reaching availability [9], free cost of membership, and the high rate of referrals from professional treatment centers [34]. Prior research indicates that up to 80% of treatment centers refer patients to 12-step groups following acute treatment [135, 37].

- **Sponsorship, Stepwork, Meetings, and Service:** four specific activities espoused by 12- step groups as components of a strong recovery program. Sponsorship involves working with a member of the program who has more experience in recovery. The nature of this relationship focuses on the sponsor guiding their sponsee through the 12-steps. Such stepwork usually consists of sharing written journal entries on topics such as admitting the problem, understanding one's maladaptive behaviors or responses, making amends to others, and establishing spiritual maintenance practices. Both 12-step groups and alternative programs (*e.g.,*, SMART recovery [45]), emphasize the importance of regular in-person attendance and sharing at social support meetings. Early in recovery, daily meeting attendance is encouraged. Finally,

12-step groups also encourage involvement in service activities such as participating in outreach meetings at hospitals and institutions, helping with the logistics of running a meeting, and participating at the regional and national levels of a 12-step group.

- **Sober Living Environment (SLE):** is intended to serve as a transitional residence for individuals no longer enrolled in acute treatment who are unable to manage independently without significant risk of relapse [9]. SLEs are alcohol and drug-free living atmospheres that typically require residents to comply with house rules such as maintaining abstinence, paying rent and other fees, participating in house chores, and attending house meetings [136]. Furthermore, SLEs typically mandate or encourage residents to participate in 12-step groups [136]. Even among SLEs that do not mandate 12- step participation, residents are likely to participate in 12-step activities due to social norms and the availability of these programs (*e.g.,*, [136, 137]). In this study, I worked with an SLE that is part of the Minnesota Association of Sober Homes (MASH). All 150 sober homes associated with MASH require residents to meet with a 12-step sponsor and attend three 12-step meetings per week. While this requirement is common nationwide, I discuss this particular perspective throughout this paper.

Finally, in this chapter, I do not seek to advocate for a specific treatment approach or maintenance program, rather I seek to connect with and design towards the lived experience, priorities, and values of people in early recovery from SUDs with the goal of amplifying their voices in the design process.

4.3   Methods

In order to align the design of supportive technology with the experience, values, and priorities of the recovery community, I conducted six participatory design workshops with women in early recovery from SUDs. During these workshops, participants discussed how and why they currently use technology to support their recovery, interacted with currently available technology designed for SUD recovery, identified prominent problems related to

their recovery, brainstormed technical solutions to these problems, and finally sketched the most promising solutions.

4.3.1 Ethical Considerations

Recovery from substance use is a demanding and private endeavor, requiring additional consideration of participant protections. I took several steps to safeguard participant anonymity and well-being during the study. I wanted to ensure that the identity of each participant remained anonymous even if one of them chose to disclose their own participation to others outside of this study (this action would reveal our partner SLE and could therefore allow others to identify other participants based on demographic data). To do so, I chose not to collect participant demographic data (*e.g.,* age, length of sobriety, substance use history) that could point to a participant's identity. Furthermore, I sought and received permission from the IRB to waive the documentation of consent. I handled compensation for participation in each workshop through anonymous gift cards handed out at the end of each workshop, thus precluding the need for participants to contact us to receive pro-rated compensation if they could not participate in future workshops. Additionally, through a special dispensation from our department, I did not collect names or signatures to confirm compensation. By removing the requirements for documenting consent and compensation, I circumvented the need for participants to provide their name at any point in the process.

In addition to safeguarding participant confidentiality, I took steps to ensure that research workshops did not interfere with activities beneficial to participant recovery. I worked with SLE managers and residents to schedule the participatory design workshops around events related to participant recovery including AA or NA meetings, meeting with sponsors, job duties, and service commitments. Individuals could self-select to participate (or not participate) in the workshops that fit in their schedule on a case-by-case basis.

4.3.2 Research Site and Participants

I worked with residents of a women's SLE. The SLE provides a safe and drug-free residence where women lend support to each other as they begin the long-term process of SUD recovery. Generally, residents are in early recovery (*e.g.,* < 1 year clean/sober) as SLE residency serves as a stepping-stone to independent living.

As part of their decision to live in the SLE, residents agreed to a number of house rules intended to provide structure and support to their recovery. Primarily, residents were required to attend three 12-step group meetings per week, meet with a sponsor, and engage in service work (the majority of SLE's nationwide either require or strongly encourage 12-step participation [138]). Additionally, residents were required to spend a minimum of 25 hours per week working, attending school, or attending recovery related activities. Residents were free to choose the specific type of 12-step program in which they were to participate. For example, the SLE manager informed us that some residents attended 12-step groups that emphasized mindfulness meditation and others participated in 12-step groups for non-believers (i.e atheist 12-steps). Furthermore, residents could supplement their participation in 12-step groups with other forms of treatment such as CBT, SMART recovery, etc. At the time of the study, sixteen women resided in the SLE and each of them took part in at least one participatory design workshop (of which there were six). Most residents attended multiple workshops and some participated in all workshops (see Table 1 for workshop attendance). As previously stated, to protect the anonymity of the participants, I did not collect individualized demographic data. However, the SLE manager provided aggregate information such as the average age of residents (29.5 years old), the average length of stay (10 months), and the specific substances used by residents which included alcohol, heroin and other opioids, methamphetamine, ketamine, cocaine, MDMA (commonly known as ecstasy), and benzodiazepine. Some participants were in recovery from the use of multiple substances. Each participatory design workshop took place in the living room of the SLE.

4.3.3 Procedure

As not to interfere with the participants' recovery related activities, the SLE manager recommended that the duration of our interactions with them be restricted to a maximum of ninety minutes per session. Therefore, rather than conducting a single participatory design workshop that would have engaged participants for many hours, I conducted six separate ninety-minute workshops that took place over the course of six weeks (see Table 4.1 for more information). Each workshop was separated by an interval of five to ten days. The divided structure was also beneficial to us as researchers. I used the data collected in

each workshop to prepare for and adjust the content of subsequent workshops to create a more engaging and productive experience for participants. For example, after the initial brainstorming and idea selection workshop, the researchers tallied votes to present only the most promising ideas to the group for the following session.

In the first participatory design workshop, participants discussed their experience using technology to support their recovery. Participants formed groups of three to discuss and record (on poster paper) the names of the technologies they used to support their recovery, how it supported their recovery, as well as the device they used to access said technology. Following small group discussion, each group presented their poster.

In the second workshop, participants interacted with commercially made smartphone applications designed specifically to support SUD recovery (see Table 4.1). I selected popular applications, many of which were not currently used by participants, to expose them to the breadth of supportive technologies currently available. Participants spent 15-20 minutes exploring each app and then recorded what they liked and disliked about each app. Participants followed the same protocol in workshop 3, but interacted with smartphone applications designed for the promotion of emotional and physical health (*e.g.,* Fitbit, Koko, Pacifica), rather than apps designed specifically for SUD recovery.

I designed the first three workshops to accomplish three core objectives towards familiarizing participants with supportive technology for recovery including: 1) expose participants to supportive technology that may aid them in their personal SUD recovery process, 2) demonstrate technical possibilities of supportive technology to better prepare participants to brainstorm and design their own solutions in upcoming workshops, and 3) identify gaps in the current landscape of supportive technology for SUD recovery. During the subsequent and final three workshops, I utilized the technological foundation I built with participants over the first three workshops to identify prominent recovery challenges and to brainstorm and design technological solutions to these challenges.

During the fourth workshop, participants identified the most prominent and difficult problems they face in their day-to-day recovery. I asked participants to give specific attention to the problems that currently do not have an effective technological solution or technological support system. Framing the workshop in this manner allowed us to challenge participants to focus on aspects of their recovery not supported by the current landscape

of supportive SUD technologies. Additionally, the results from this workshop allowed us to shape the agenda of the upcoming brainstorming workshop to focus on problems that were personally relevant to the participants. Thus, in the fifth workshop (*i.e.,* brainstorming workshop), I revisited the problems that participants deemed most personally relevant and worked with them to brainstorm technological solutions to these problems (see Table 4.1 for more detail).

In the sixth and final workshop, participants worked in groups of two or three to sketch designs for supportive technologies inspired by the technological solutions they developed in the preceding workshop. To attenuate the impact of the relatively low attendance of the second the third workshops (see Table 4.1), I ensured that a participant that attended either the second or the third workshop was present in each sketch group. Additionally, I reviewed the main findings of previous workshops at the start of each subsequent workshop to contextualize the activity for participants.

Table 4.1: Participants, activities, and goals for each PD workshop.

Workshop	N	Participant Activities	Engagement & Research Goals
1. Currently Used Tech	10	Listed and discussed the technology they use to support their recovery.	• Gather in-depth accounts of how and why participants currently use technology for recovery. • Determine participant familiarity with technology to inform upcoming workshops.

Table 4.1 – Continued from previous page

Workshop	N	Participant Activities	Engagement & Research Goals
2. Recovery Apps	5	Interacted with and reflected on four apps designed to support recovery: WeConnect[1], Addicaid[2], InTheRooms[3], and NoMo[4].	• Prepare participants for upcoming design workshops by demonstrating existing SUD recovery apps. • Gather participant impressions of each app.
3. Health Promotion Apps	3	Interacted with three health apps not specifically designed for SUD recovery (KoKo[5], Pacifica[6], and Fitbit[7] and reflected on the applicability to recovery.	• Prepare participants for upcoming design workshops by demonstrating existing health promotion apps. • Gather participant impressions of each app.
4. Problem Identification	9	Identified 25 problems related to their SUD recovery and voted for the problems they found most personally relevant.	• Identify core themes in the most prominent problems participants face in day-to-day recovery. • Provide focus and context for the upcoming ideation and sketching workshops.

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[1] https://www.weconnectrecovery.com/
[2] https://addicaid.com/
[3] https://www.intherooms.com/
[4] http://meetnomo.com/
[5] https://itskoko.com/
[6] http://www.thinkpacifica.com/
[7] https://www.fitbit.com

Table 4.1 – Continued from previous page

Workshop	N	Participant Activities	Engagement & Research Goals
5. Ideation	7	Brainstormed 54 potential technical solutions to problems identified in the problem identification workshop, and voted for the most promising solutions.	• Brainstorm potential technological solutions to the problems outlined in previous workshop. • Identify core themes in participant ideation.
6. Sketch	8	Worked in groups to sketch their favorite ideas from the ideation workshop.	• Provide participants with agency in designing technology that will benefit them most. • Identify core themes in participant designs.

4.3.4 Analysis

During the participatory design workshops, I collected qualitative data including researcher field notes (as a team of researchers carried out the work, one member could lead the workshops while the other took detailed notes), participant discussions, lists of problems related to recovery, participant writing, brainstormed ideas, and participant design artifacts (*e.g.,* sketches). To protect participant anonymity, I did not use audio or video recording. I converted non-textual data (*e.g.,* reflections on field notes, descriptions of participant design artifacts) to text through the generation of memos when appropriate. I analyzed this textual dataset using data-driven inductive thematic analysis characterized by the generation and constant comparison of open codes in order to reveal underlying themes (*e.g.,* [139]). I began the analysis by performing line-by-line open coding on the qualitative data collected from each workshop, identifying short, individual units of meaning within the textual data. I used the process of affinity diagramming to spatially cluster open codes together based on similar meaning. I discussed and iteratively refined these clusters

to identify core themes in the data. In this paper, I report emerging themes that are relevant to opportunities, challenges, and considerations for the design of SUD recovery technologies.

4.3.5 Study Limitations

While the participatory design method allowed us to incorporate the experience, values, and priorities of individuals in recovery from SUDs into the design of supportive technology, the methodology contains inherent limitations. Primarily, participatory design is a subjective process and carries with it the individual perspectives of both participants and researchers. A different group of participants or researchers may have come to different conclusions, focused on different obstacles related to recovery, and may have emphasized different design solutions. These limitations are true of all qualitative work and future studies should triangulate with work that utilize other methods.

Furthermore, the small size and homogeneity of our participant group limits the external validity of our findings. Participants in our study were exclusively women residents of an SLE, the majority of which were young (mean age of 29.5). Previous research on gender differences in SUDs suggests that men and women differ in the onset of substance use, social stigmas resulting from substance use, and barriers to treatment [140]. Furthermore, young individuals who voluntarily enter an SLE may have different needs and priorities compared to older individuals, those who are no longer living in an SLE, or those who have never lived in an SLE. Additionally, participants were required to participate in 12-step groups as part of their living agreement with their SLE. While this mandate is very common among SLE's nationwide, and 12-step groups are the most common help setting for adults with SUDs, the requirement limits the generalizability of our results. Future research should seek to extend our findings by engaging in co-design activities with a more diverse or a complementary set of participants.

Despite these limitations, this work provides valuable insight into the design of supportive technology for SUD recovery by establishing alignment with the values, traditions, and priorities of the recovery community. Furthermore, while the homogeneity of our participant group limits generalizability, it is also a strength of this paper. This specific context and setting enabled focused this research on the unique experience and needs of women in

recovery – an often overlooked population within SUD research [141].

4.4   Results

Through our analysis, I identified 5 major design themes for supportive technologies for individuals in recovery from SUDs: 1) supporting twelve-step traditions and practices, 2) management of restlessness and moments of crisis, 3) agency and control over privacy and personal safety, 4) tracking progress and maintaining motivation in recovery, and 5) constructing a new normal. Below, I discuss each theme and provide examples of participant discussion and design artifacts.

4.4.1   Supporting Twelve-Step Traditions and Practices

Throughout the workshops, participants consistently sought ways to leverage technology to support and extend their participation in 12-step practices to support their recovery. Specifically, participants focused their designs on solving problematic logistical issues surrounding their engagement with 12-steps practices such as finding a sponsor and securing safe and affordable transportation to 12-step meetings. This focus on extending and streamlining engagement in 12-step recovery was present in every workshop, but was especially prominent in the problem identification, ideation, and sketching workshops (*i.e.,* workshops 4, 5, and 6).

During the problem identification workshop, participants identified twenty-five prominent problems related to their day-to-day recovery, and then individually voted for the problems they found most personally relevant. Participants most often voted for problems related to traditional 12-step practices such as *"Finding service opportunities," "Sponsor communication,"* and *"Transportation to AA meetings"* (Figure 4.1). In describing the challenge of finding local "same-day" service opportunities, a participant stated, *"It's very difficult to find a unified list of service opportunities in the area. A list that is updated and could be filterable would be a godsend."*

Participants also focused on leveraging technology to support 12-step practices and traditions during the ideation workshop. Participants brainstormed fifty-four solutions to their most salient problems related to recovery and then individually voted for the

most promising ideas (Figure 4.2). Among the thirty ideas that received the most votes, sixteen focused on providing support for 12-step practices and traditions such as *"Rideshare service for AA meetings"* and *"Searchable service work listings."* Additionally, the idea that received the most participant votes was a smartphone application that would assist the user in searching for and communicating with a sponsor (Figure 4.2) — a core element of 12-step fellowships.

In the final workshop (*i.e.* sketching workshop), participants worked in groups of two and three to design and sketch technology to support their recovery. Each group was allowed to choose any idea developed in the previous workshop (*i.e.* ideation workshop), but independently, each group decided to focus on the same idea – the *"Sponsor finder app."* While this core app functionality was included in each team's app sketch, there was some diversity in terms of additional functionalities, features, and approaches. Participant sketches were comprised of four core themes focused on providing support for engagement with 12-step practices. First, participant sketches featured the ability to search for a potential sponsor based on individual characteristics (Figure 4.3a). These characteristics were diverse and specific to the individual. For instance, participants stated they wanted the ability to search for sponsors based on *"experience," "length of sobriety," "spirituality," "personality," "hobbies," "location," "expectations for sponsees,"* and *"the way they work the 12-steps."* Second, participants designed multiple ways for the user to schedule meetings and communicate with a potential or existing sponsor via text or voice communication (Figures 4.3b and 4.3c). Third, participants designed a *"family tree"* interface that would allow the sponsee to gain access and form connections with their sponsor's peer support network (Figure 4.3d). Finally, participant designs emphasized the importance of service work featuring functionalities to find local service work (Figures 4.4a and 4.4b) and view completed service work (Figure 4.4c).

4.4.2 Management of Restlessness and Moments of Crisis

In addition to supporting the traditions and practices of 12-step fellowships, participants frequently focused on the dangers of restlessness and boredom in early recovery. During the first workshop, participants focused their discussion on several technologies that help them cope with these emotions. For instance, a participant stated she uses a low-tech

Theme	# of Problems	Total # of Votes		Example Problems from Data
Supporting Twelve-Step Traditions and Practices	6	████████████	13	*"Service opportunities you can do that day"* *"Transportation to AA meetings"*
Logistics of Self-Care	9	███████	8	*"Forming healthy sleeping habits"* *"Self-esteem issues"*
New People, Places, and Things	5	█████	6	*"Meeting new people"* *"Figuring out the bus system"*
Management of Restlessness and Moments of Crisis	2	████	5	*"Boredom/Restlessness"* *"Distraction from cravings"*
Self-Tracking	3		0	*"Tracking relapse triggers"* *"Tracking sleep patterns"*

Figure 4.1: Prevalence (*i.e.,* number of problems) and personal relevance (*i.e.,* total votes) of participant recovery related problems organized by design theme. Data were collected from the problem identification workshop in which participants identified twenty-five prominent problems related to their day-to-day recovery and voted for the four problems they found most personally relevant.

strategy to mitigate restlessness.

> *"A simple strategy for me is coloring. I think it's good, it calms me down and makes me forget. If I'm thinking way too much about things that are going on in my life and getting close to wanting to drink, then I just color and that makes me focus on that instead of everything else."*

Another participant reported using Headspace, a mindfulness meditation app, to find focus during periods of restlessness: *"The headspace app helps me meditate every day at the same time and makes it a habit... it helps with coaching me through the meditation and leaves little room for my mind to wander."*

Restlessness is particularly dangerous for individuals in early recovery as it can precipitate emotional crises such as panic attacks and strong cravings — emotional states associated with relapse. Due to their unpredictable nature, several participants discussed the need for technology that would allow them to self-manage these crises — regardless of the time of day or situation in which they occur. This is especially vital since peer support,

Theme	Support Functionality	# of Ideations	Total # of Votes	Example Ideations from Data
Supporting Twelve-Step Traditions and Practices	Service Work	16	27	*"Searchable service work listings"*
	Sponsorship	5	23	*"Sponsor finder app"*
	Transportation to Meetings	4	3	*"Rideshare service for AA meetings'*
	Sober Events	1	1	*"Searchable sober event listings"*
Tracking Progress and Maintaining Motivation	Gamification	14	21	*"Points/rewards for completing service"*
	Self-Tracking	4	4	*"Personal location tracking for increased accountability"*
New People, Places, and Things	Social Support Network	6	15	*"Tag along with me"* invite button
Agency and Control over Anonymity and Personal Safety	Safety	3	8	*"An external password distributed at meetings to gain access to app"*
Management of Restlessness and Moment of Crisis	Moment of Crisis	1	4	*"I'm struggling"* reach out to others for help button

Figure 4.2: Prevalence (*i.e.,* number of ideations) and popularity (*i.e.,* total votes) of participant ideations organized by design theme and support functionality. Data were collected during the ideation workshop in which participants brainstormed solutions to their most salient problems, then voted for the ideas showing the most promise.
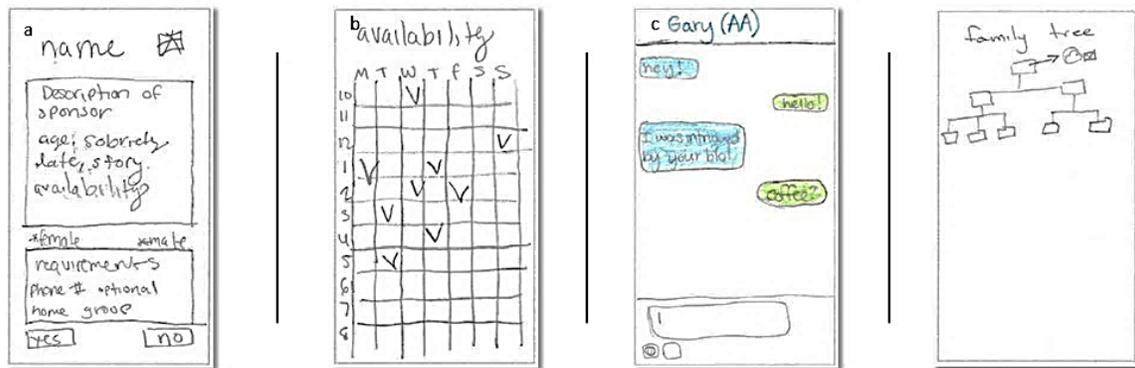
Figure 4.3: Participant designs concerning a) finding a sponsor, b) scheduling meetings with a sponsor, c) communicating with a sponsor, and d) connection to a sponsor's support network.
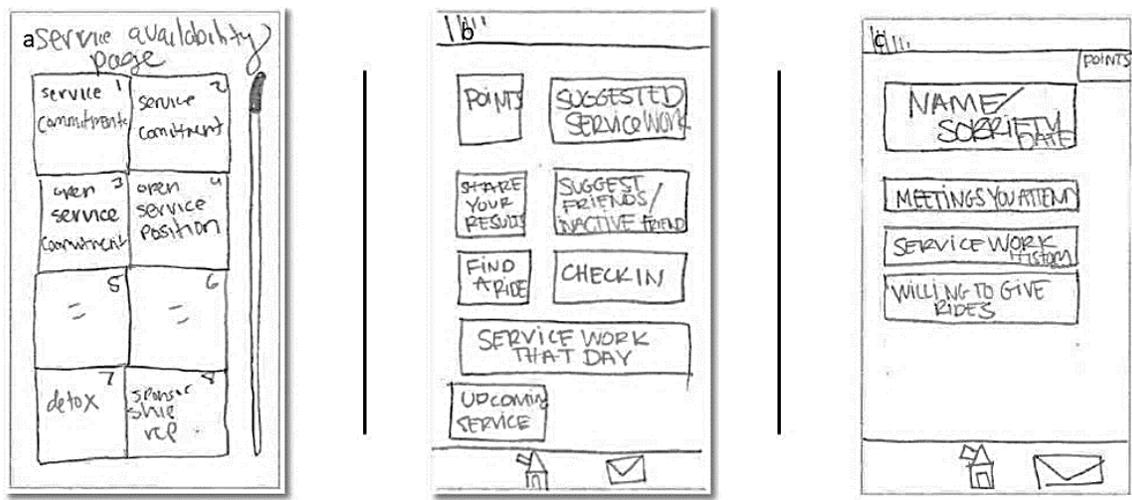
Figure 4.4: Participant designs concerning a) finding service work, b) same-day service opportunities, and c) tracking service history.
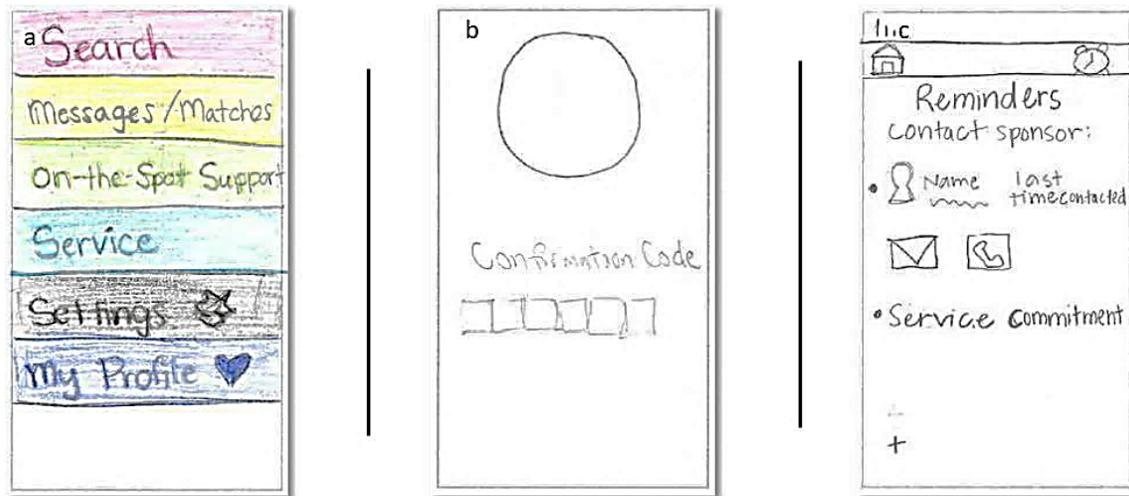
Figure 4.5: Participant designs emphasizing need for a) on-the-spot support, b) user safety via password protected app access, and c) customized daily reminders

such as calling a sponsor or attending an AA meeting, may not always be readily available. Thus, it is important that individuals possess a consistently accessible self-management tool. For example, while exploring NoMo, a smartphone application designed for recovery, a participant said that she would use the *"Guided breathing feature for panic attacks before they become unmanageable"* or *"if I felt an episode come on and I was say on the bus or something."* However, participants also stated the simplicity of this feature might become dull or monotonous over prolonged use—thus limiting its effectiveness. In an attempt to create a more dynamic solution, a participant suggested the following feature.

> *"A thirty-minute timer activated when you have a craving. While the countdown is happening, it could give you things you can do like a coloring activity, games that are mindless and entertaining, or different options like a walk".*

In addition to technology that would allow participants to self-manage crises, participants also brainstormed solutions that would instantly connect the user to their peer support network. For example, a participant suggested that supportive technology include an *"I'm struggling button"* that would instantaneously contact the user's support network – an idea that was well supported by other participants (Figure 4.2). A participant's

sketch further developed this idea by implementing an *"On-the-Spot Support"* button that would immediately contact the user's sponsor and other pre-selected members of the user's support network via text message (Figure 4.5a).

In summary, participants highlighted the need for technology to get access to in-the-moment support either through self-management or through social support during dangerous periods of restlessness, panic attacks, and intense cravings.

4.4.3 Agency and Control over Anonymity and Personal Safety

Early recovery can be a particularly vulnerable stage in a person's life. Considerations for managing stigma, privacy, personal and group anonymity, trust, and personal safety were all recurrent themes for participants in our design workshops.

While interacting with currently available supportive technology designed for recovery, participants expressed concern and caution when confronted with the ability to share personal recovery details with unknown individuals in an online mutual support environment. For instance, a participant stated, *"I don't like that there are random people viewing my comments and sober time. I don't like receiving messages from random people."* She went on to say that she wanted *"privacy to be the default setting,"* and that she would like the option of changing the privacy setting when she felt *"ready"* to share.

Other participants saw the potential benefits of an open online community, but only if properly aligned with 12-step traditions regarding anonymity. For instance, participants liked the open community structure found in KoKo, a social media platform that allows the user to anonymously help and receive help from users concerning issues related to stress, bullying, dating, etc. *"If you use an algorithm to restrict the use of specific places (e.g., meeting groups) or names, it may work well for recovery. The fact that it is anonymous is cool."*

In addition to concerns for personal anonymity, participants also mentioned the need to protect the anonymity and sanctity of local 12-step meetings. For example, a participant disliked the user-generated reviews of local AA and NA meetings she saw on Addicaid, a smartphone app designed for recovery.

> *"A comment might steer me from meetings I really like. A meeting is not like a restaurant on Yelp. They should not be judged in that way. Each time a*

> *meeting is different. You should give it multiple tries."*

Protecting personal safety while using technology for recovery was also of primary importance to participants. For example, while sketching her design of the *"Sponsor Finder"* smartphone application, a participant suggested the app include a mechanism to report *"Creepy"* behavior in order to remove *"13th steppers"*—individuals trying to initiate a sexual relationship with somebody new to recovery (which is viewed as a predatory practice in the community). Furthermore, many participants featured password protection in their sketches (Figure 4.5b). Participants suggested that app passwords be distributed during in-person AA meetings to help prevent individuals outside of recovery from using the app in a predatory manner. Physical attendance at a meeting was reported as a reasonable means for vetting online attendees as that real-world action allowed the development of trust and a mutual agreement of respecting others' anonymity and the group's primary purpose.

Participants were wary of using technology for recovery if it did not provide means for establishing trust or mutually agreed upon practices around personal anonymity, personal safety, group anonymity, and the primary purpose of a recovery venue. Thus, to gain the trust of the recovery community, technology must consider ways in which anonymity and safety practices could be established and continually reinforced through socio-technical means.

4.4.4 Tracking Progress and Maintaining Motivation in Recovery

Participant discussions and designs frequently focused on self-tracking and gamification functionalities to track progress and maintain motivation in recovery. Participants adopted opposing views regarding the appropriateness of these functionalities for the purposes of recovery. Some participants stated that self-tracking and gamification could assist individuals in staying accountable to their recovery goals. However, others expressed trepidation, stating that these functionalities trivialize the recovery process and undermine intrinsic motivation. Below, I review participant discussion and design artifacts regarding self-tracking and gamification technology for recovery.

Self-Tracking Recovery

Participants reacted positively to self-tracking functionalities while interacting with currently available technologies designed to support recovery (*i.e.,* workshop 2). For example, while interacting with WeConnect, a smartphone application designed for recovery, a participant stated, *"I like the fact that it's a daily planner and you can track meetings, locations, daily chart of meetings so I can keep track of my 90 in 90* [ninety meetings in ninety days]." Another participant saw self-tracking as potentially helpful in coping with cross-addictions, *"tracking your fill-in vices like drinking soda or smoking cigarettes....track how often you log on to your phone to procrastinate when you have a lot of things to do."* Furthermore, participants stated that self-tracking provides a tangible recognition of their progress and accomplishments - a rare opportunity in recovery. For instance, a participant stated she uses journals to *"track how I have changed over time."* Another participant stated she uses daily checklist on her smartphone to *"help me feel like I accomplished something today. That's important for when I get down on myself."*

However, despite positive reactions to the self-tracking features they experienced in currently available technology, participants did not focus on self-tracking when asked to brainstorm solutions or sketch designs for their versions of supportive technology. For instance, participants generated four ideas that featured self-tracking; however, these ideas received a relatively low number of votes compared to other support functionalities (Figure 4.2). Participant sketches followed a similar pattern.

Finally, while some participants reacted positively to self-tracking, others felt self-tracking might exacerbate feelings of guilt and inadequacy during the recovery process. A participant stated that the money saving calculator featured in the NoMo app induced feelings of guilt regarding her past spending behavior. Participants also stated that self-tracking has the potential to exacerbate existing problems related to low self-esteem and perfectionism — two salient problems raised by participants during the problem identification workshop (Figure 4.1).

Gamification in Recovery

Analogous to how participants viewed the role of self-tracking in recovery, opinions regarding extrinsic motivational tools (*e.g.,* gamification) were discordant. Some participants

stated that gamification has great potential value for recovery, while others feared it would negatively influence their recovery. However, unlike self-tracking, participants featured gamification prominently in their brainstormed solutions (Figure 4.2) and design sketches. For example, participants suggested receiving points, trophies, or medals for engaging in service to the community, and featured said functionality prominently in their sketches (Figures 4.4b and 4.4c). Furthermore, a participant suggested that gamification could help individuals in recovery stay accountable. She stated that a potential user of the technology would *"lose points if you say you were going somewhere but then don't show up without 24-hour notice or find a substitute."*

Participants eschewed the idea of individual leaderboards, as they would break with the 12-step tradition stating that all members are equal. Rather, participants suggested creating community leaderboards and sober house community competitions. Participants were also careful to ensure that gamification not be used to *"shame people for relapsing."* Therefore, rather than losing points for relapsing, participants suggested providing *"amplified points for coming back"* following relapse. When asked how points should be used, a participant suggested that users redeem points for prizes such as *"luxuries we don't usually buy like nail polish, spa treatment, getting nails done."*

Other participants raised concerns regarding the appropriateness of gamification for recovery. A participant stated that receiving points for recovery related activities *"trivializes recovery."* In addition to undermining intrinsic motivation, participants stated that gamification is "too similar to gambling" and may exacerbate underlying problems.

The potential roles of self-tracking and gamification in SUD recovery are both promising and risky. Given the split opinion of participants, supporting technologies should at the very least include an opportunity to opt out of these functionalities.

4.4.5 Constructing a New Normal

Participants, most of whom were new to recovery, described the inherent difficulties associated with navigating a novel substance-free lifestyle and fostering new relationships supportive of their sobriety.

Logistics of Self-Care

In beginning a new life in recovery, participants often spoke of their struggle towards incorporating a renewed focus on physical and mental health. Participants frequently spoke of their day-to-day difficulties in forming new healthy habits including personal hygiene, cleaning their living space, and eating healthy. For those unfamiliar with recovery, it may be challenging to view these activities as new or difficult. However, during the months or years of substance use, these beneficial daily routines often take a backseat, making it difficult to develop and sustain new healthy habits. For instance, a participant discussed the difficulties she has with self-care and suggested the following solution, *"Having a checklist of things you need to do to care for yourself, like showering and grooming."* Her design featured a daily reminder page that would allow the user to create custom alert prompts (Figure 4.5c). Additionally, participants also described problems they have with healthy eating and co-morbid eating disorders (Figure 4.1) and expressed a desire for technology to provide support toward consuming a sufficient amount of protein, avoiding purging after meals, and maintaining a healthy weight.

In addition to physical self-care, participants identified multiple problems related to reshaping their sense of self and confronting deleterious emotions and mental states that precipitated and sustained their substance use in the past. For example, during the fourth workshop, participants identified problems such as *"perfectionism," "self-esteem issues," "co-dependency,"* and *"anxiety"* as being inextricably linked to their substance use (Figure 4.1). Participants stated that these harmful emotional states were key contributors to the onset of their substance abuse. Additionally, participants stated that they used substances to mask and cope with these emotions in the past and believe, if not properly confronted, will lead them to relapse in the future. To this point, a participant stated that she believes the key to her long-term recovery is to *"learn more about myself and finding those triggers and just finding more about why I do the things that I do."*

New People, Places, and Things

In addition to focusing on physical and mental health, participants spoke of difficulties in forming new *"sober"* relationships, finding reliable transportation, and securing employment supportive of their recovery. Participants highlighted the challenge and importance of

forging supportive and nurturing relationships and identified *"meeting new people," "relationship issues,"* and *"sober dating"* as prominent recovery challenges (Figure 4.1). During the ideation workshop, one of the most popular ideas was a smartphone application feature that would allow users to invite others in recovery to service events and sober activities they will be attending. Participants referred to this feature as a *"Tag along with me"* button (Figure 4.2). In addition to forming a social support network, participants focused on finding accessible and reliable transportation and securing employment. For example, a participant stated, *"I am afraid of bus system and I don't have enough money for Uber. I would love to get a ride from other people in recovery going to the same meeting or running errands."* Another participant detailed her struggle finding a job that *"does not serve liquor and is a positive work environment for my recovery."*

Participants expressed the importance and difficulty of navigating the major life changes associated with beginning the recovery process such as focusing on physical and mental health, finding transportation and employment, and developing and maintaining a social support network. Supportive technology that guides individuals through these difficult transitions could greatly assist the recovery process.

4.5 Discussion

In this section, I use terminology outlined in Sas et al. [142] to present implications for the design of supportive technology for individuals in recovery from SUDs. In their research, Sas et al. [142] present a taxonomy to describe and categorize design implications within HCI including sensitizing concepts, abstractions, meta-abstractions, instantiations, and prescriptions. Below, I use this terminology to frame our design implications. Specifically, I present design implications in the form of one abstract functionality, and one instantiation. Finally, I discuss the limitations of this study.

4.5.1 Abstract Functionality: Leveraging Existing Recovery Support Networks

Throughout the participatory design workshops, participants focused on developing supportive technologies that would leverage 12-step traditions and practices to form additional

socio-technical pathways toward peer support, mentorship, and assistance in times of need. As shown in the Supporting Twelve-Step Traditions and Practices section of our results, participants focused on developing technology to support their search for a 12-step sponsor to meet their individualized need for mentorship in recovery. Furthermore, as shown in the New People, Places and Things section of our results, participants described their need for a supportive peer network and suggested technologies for inviting others to AA meetings and service work opportunities. Finally, as outlined in the Management of Restlessness and Moments of Crisis section of our results, participants sketched an "On-the-Spot Support" feature that would immediately connect them to their 12-step sponsor and peer support network in times of need. In each of these examples, participants focused on developing tools that would empower them to leverage the robust peer support network made available through their engagement in 12-step fellowships.

The design emphasis on 12-step fellowships as a means to facilitate peer support was a participant-driven focus. Without participant input, I may have overlooked this viewpoint due to the sphere of controversy surrounding 12-step fellowships within scientific literature. For instance, many detractors of 12-step fellowships cite the core religious elements of the program—likening their practices to that of a cult rather than a treatment program [143]. Furthermore, concerning the contexts in which 12-step practices are effective in treating SUDs, the underlying causal mechanisms contributing to their efficacy remain unclear and understudied. Thus, without sufficiently understanding the mechanisms of 12-step fellowships that contribute to their efficacy, there is no credible way to improve the treatment they offer—calling into question whether additional time and money should be invested into technologically extending them as a treatment.

In contrast to the controversy around 12-steps as a treatment, there is a considerably more favorable view of 12-steps as a source of social support. Our results indicate that 12-step fellowships were extremely important to participants in providing a robust and readily available social support network. Future design in this context should refrain from dismissing the impactful role of 12-step programs. Prior research indicates that peer support has been shown to be effective in facilitating SUD recovery, reducing relapse rates, and increasing retention in treatment programs [144, 145]. Furthermore, Allen et al. [146] suggest that 12-step fellowships may leverage peer support more effectively than other

psychosocial treatments, especially among individuals who lack a strong social support network. Thus, future design of technologies for SUD recovery should leverage the robust and readily available support network available through 12-step fellowships as a means of creating additional pathways for users to connect with peer support, mentorship, and assistance in times of need. This design recommendation represents a contrast to previous work in HCI regarding SUD recovery, where most technical solutions have focused on detecting and tracking substance use, [147, 88, 148] and has not connected with 12-step programs and approaches.

While participants in this study focused on leveraging the social support aspects of 12-step fellowships, this study serves as a template for future work investigating how technology can enhance and compliment other forms of long-term continuing care. 12-step fellowships are the most commonly used help setting in today's recovery landscape, however, that may change over time. Future work should continue to strive towards integrating technology as a complimentary source of support in commonly used long-term

4.5.2   Instantiation: Sponsor App

The "Sponsor Finder" app, developed by participants during the sketching workshop, is a concrete instantiation addressing the abstract functionality presented above (*i.e.,* leveraging existing recovery support networks). I focused upon this specific instantiation due to its universally acknowledged potential among our participants and due to the participants' shared commitment toward its design. Particularly, among their fifty-four brainstormed ideas, participants recognized the "Sponsor Finder" app as the single most promising solution towards supporting their recovery. Additionally, when instructed to select a single ideation to sketch during the sixth workshop, each design team independently decided to work on the "Sponsor Finder" app.

Participant sketches of the "Sponsor Finder" app identify three explicit functionalities of this instantiation: 1) finding a sponsor, 2) supporting the logistics of working with a sponsor, and 3) leveraging a sponsor's contacts and support networks. Primarily, participants designed a customizable search functionality that enables an individual to find a sponsor to fit their personalized recovery needs (Figure 4.3a). Previous investigations into the benefits of sponsorship support this functionality. For instance, Bond et al. [149] found

that having a sponsor was significantly and positively correlated with abstinence at one and three year follow-ups. In addition, having a sponsor predicted an increase in perceived personal and social support during recovery [150]. Furthermore, Tonigan et al. [151] suggested that acquiring a sponsor early in recovery (*i.e.,* within first three months) leads to a higher probability of abstinence compared to acquiring a sponsor later in recovery (*i.e.,* after 7 months into recovery). This finding indicates a potential time-sensitive relationship between sponsorship and abstinence from alcohol. The "Sponsor Finder" app may expedite the search for a sponsor and allow users to acquire a sponsor earlier in their recovery, resulting in a relationship that is potentially more beneficial. Moreover, prior research indicates that sponsorship is also beneficial for the sponsor. Pagano et al. [152] found that individuals with an AUD who helped other individuals with an AUD were better able to maintain long-term sobriety.

In addition to the sponsor search functionality, participant sketches of the "Sponsor Finder" app focused on supporting the logistics of working with a sponsor. Participants designed technical features to schedule meetings, share recovery "homework" assignments, and communicate with their sponsor via text message. Improving the logistics of working with a sponsor may allow for more consistent sponsor/sponsee meetings. In support of this functionality, prior research indicates that increased contact with a sponsor is negatively associated with relapse [153].

Finally, participants designed a "family tree" interface that would allow the sponsee to gain access and form connections with their sponsor's peer support network (Figure 4.3d). This feature provides sponsees with a bridge to a robust peer support network available through their sponsor's existing recovery contacts. Sheeran [153] suggests that the most significant factor in successful recovery is the ability and willingness to "reach out to others for help." A larger peer support network may enable the sponsee to connect with a more diverse set of perspectives and experiences in recovery. Specifically, peers in recovery may share specific relevant experiences that their immediate sponsor may not, such as dealing with a divorce, issues related to childcare, or finding local sober-appropriate employment. Finally, a large peer network is more robust to changes in sponsorship that may result from a sponsor moving to a new area or relapsing (a relapse means that they are no longer eligible to sponsor). When a change occurs, a larger support network will provide the

sponsee with additional peer support resources to close the gap in mentorship.

The "Sponsor Finder" app instantiation leverages existing recovery support networks to expedite and customize the search for mentorship, to enable consistent face-to-face meetings with a sponsor, and to connect with a robust support network via a sponsor's existing recovery contacts.

4.6   Conclusion

SUDs are an increasingly widespread and dangerous public health issue facing our society. Technology designed for the needs and values of people in recovery may be able to supplement traditional treatment options, enhance long-term abstinence maintenance, and create new opportunities for social support. In this study, I conducted six participatory design workshops with women living in a sober living home to address **RQ1** as well as acute limitations present in related work.

In **RQ1**, I asked, "What are the challenges and practices of individuals in SUD recovery that provide the best opportunities for computational SUD support?" To answer this question, I worked with participants to identify their most prominent day-to-day challenges in recovery. Regarding recovery challenges, participants indicated the most significant obstacles included problematic logistics surrounding 12-step participation, forming new "sober" relationships, managing maladaptive emotional states (*e.g.,* restlessness, low self-esteem, and anxiety), physical self-care, and maintaining anonymity while using supportive technology. Regarding recovery practices, I co-designed potential supportive technologies with participants. Their designs focus on tools that would empower them to leverage the robust peer support network, peer sponsorship, made available through their engagement in 12-step fellowships, revealing the possible benefits that technologies may provide to 12-step practices.

This study also addressed acute limitations within relevant related work. Specifically, while many supportive technologies for SUD recovery exist in today's marketplace, few, if any, have sought to represent patient values and priorities in the design process (see chapter 3). Through their ideations, sketches, and discussion, participants highlighted the importance of anonymity and safety in recovery. Additionally, participants focused on enhancing their intrinsic motivation and eschewed external sources of motivation that trivialized the

recovery process, shamed relapse, or tracked metrics misaligned with recovery priorities.

Finally, few, if any, computational systems have been designed to support the transition to and maintenance of self-managed long-term SUD recovery (see Chapter 3). This study addresses this limitation by conducting participatory design workshops with individuals who have recently completed acute SUD treatment and are in the process of transitioning to long-term care. Throughout the participatory design workshops, participants focused on developing supportive technologies that would leverage 12-step traditions and practices to form additional socio-technical pathways toward peer support, mentorship, and assistance in times of need.

Chapter 5

Opportunities for Enhancing Access and Efficacy of Peer Sponsorship in Substance Use Disorder Recovery

5.1 Introduction

In the previous chapter, I investigated **RQ1** through a series of participatory design workshops. While several challenges and practices were highlighted, participants independently and unanimously chose to focus their designs on technology to support their relationship with their dyadic mentor (*i.e.,* sponsor). This finding demonstrated the belief that technology designed to support mentorship is compelling and valuable to individuals in recovery. This participant focus prompted **RQ2**, *"What challenges, practices, needs, and motivations must be considered in designing technologies to support dyadic mentorship in SUD recovery?"*

In this chapter, I rigorously investigate **RQ2** by conducting semi-structured interviews with 12 sponsees and 15 sponsors regarding their experiences with providing or receiving sponsorship. Common topics across our interviews included experiences initiating the sponsorship relationship, challenges faced and strategies used in maintaining a healthy

relationship, and perceived priorities and concerns in the potential use of technology to augment current sponsorship practices.

In addition to investigating **RQ2** in this chapter, I continue to address acute limitations within related research regarding the development of computational systems for SUD recovery. Specifically, few, if any, computational systems have been designed to support and enhance social support mechanisms in SUD recovery. This study addresses this limitation by conducting interviews with 12 sponsees and 15 sponsors to inform design recommendations to support these critical peer relationships.

I begin with an abbreviated review of relevant related work regarding technology designed for dyadic mentorship and peer support. I discuss the semi-structured interview methodology used in this study. I then present core themes resulting from the interviews. Finally, I connect the themes to broader implications for design.

5.2 Related Work

In this section, I provide an abbreviated review of related work in dyadic mentorship and peer support to contextualize my findings.

5.2.1 Social Computing for Dyadic Mentorship

Recovery sponsorship is a form of dyadic mentorship—a concept investigated in HCI and other scholarship traditions. Traditionally, dyadic mentorship is defined as an intentional nurturing process by which the more experienced individual (*i.e.,* the mentor) fosters growth and development in a less experienced *protégé* [154, 155]. Prior work shows that dyadic mentorship positively impacts *protégés*, including youth development in foster care [156], facilitation of career advancement [155], and the reduction of substance use in SUD recovery (*i.e.,* sponsorship) [157]. Dyadic mentoring also benefits the mentor by contributing to a sense of fulfillment and self-efficacy [158].

Beyond face-to-face mentorship, prior research demonstrates the efficacy and challenges of e-mentoring (use of social computing technologies, such as video-conference, email, online networking sites) as the primary connection between a mentor and *protégé* in a dyadic

mentorship relationship [159]. E-mentoring sidesteps many of the barriers seen in traditional face-to-face mentorship models that may prevent a potential *protégé* from obtaining and benefiting from a mentor [160, 161]. Such barriers include a lack of available mentors in an industry, profession, or support community, a lack of time and availability of would be mentors, and unmanageable geographic distance between a would be mentor and *protégé*.

While e-mentoring sidesteps traditional barriers inherent in face-to-face mentorship, research shows relationship quality may suffer. For instance, Cotton and Adya [162] demonstrate that as dyadic mentoring relationships become more virtual, relationship satisfaction decreases. Similarly, Stone and Lazereski [163] suggest *protégés* may misunderstand information, have fewer opportunities to clarify advice, and be less receptive to information and advice that mentors provide through electronic media compared to face-to-face communication. Blended online approaches have been suggested to circumvent some challenges associated with face-to-face mentorship while still retaining in-person benefits [164, 165].

Prior work in HCI explored the blended mentorship model. For example, Yuan and Yarosh [166] explored design opportunities for technology to support and expand intergenerational dyadic mentorship in schools. However, prior research has not investigated how technology might support and expand access to face-to-face mentorship (*i.e.*, sponsorship) in SUD recovery. Further, prior work demonstrates a strong need for understanding privacy, safety, and other social concerns for blended mentorship [159]. I address these challenges by identifying socio-technical opportunities and risks of blended mentorship for SUD recovery.

5.2.2 Social Computing for Peer Support in Mental Health

Given that SUDs are frequently categorized as a mental health disorder [60], I examined social computing scholarship concerning peer support for mental health to inform this study.

In-person peer support groups are a common and effective support mechanisms for individuals with mental health disorders because they provide an opportunity to share personal experiences, feelings, coping strategies, and firsthand information about treatment. Participation in in-person peer support groups often reduces re-hospitalization rates,

increases engagement in outpatient services, and increases quality of life outcomes (*e.g.,* increased employment rates and reduced depressive symptoms) [167]. Unlike the traditional mentor-*protégé* dyad, peer relationships involve multiple individuals of similar status and experience level and offer a higher degree of mutual assistance, where both individuals give and receive support [155]. Peer relationships have the potential to serve some of the same functions as mentorship, but are often more accessible and available [155].

Online peer support has grown in popularity due to ease of access, flexible participation, and the ability to maintain a degree of privacy [168, 169]. However, health researchers found that unmoderated online support may have mixed results for people with mental health disorders [170, 171]. HCI research has also sought to characterize these effects by analyzing activity in online communities. For example, De Choudhury and De [172] investigated the language attributes and content that characterize self-disclosure as well as the factors that drive social support in mental health related posts on reddit. Pater *et al.* [173] analyzed user-generated content regarding eating disorders across several popular social media platforms. Broadly, online support groups or social media use for mental health may need to be used in particular ways to be beneficial, with some evidence that unmoderated online engagement may worsen symptoms [174] and lead to negative experiences such as exposure to misinformation [175].

Recent HCI research sought to mitigate these negative experiences in online peer support by integrating evidence-based strategies. For instance, O'Leary *et al.* [71] conducted a participatory design study with participants with mental health disorders in order to make mental health support tools accessible, safe, and empowering. Further research by O'Leary attempted to mitigate the negative effects of online peer support by deploying peer support training in the form of a guided chat tool that empowers peers to utilize evidence-based talk therapy strategies [176]. In another example, Morris *et al.,* created Panoply [177], an application to treat depression symptoms by combining evidence-based therapy techniques with peer-to-peer interactions and support.

I build upon this body of work, but rather than focusing on exclusively online peer support, I explore how technology can leverage existing face-to-face peer support networks and social structures of 12-step fellowships.

In this paper, I explicitly investigate opportunities for technology-mediated sponsorship.

Research detailed in Chapter 4 has identified sponsorship as a potentially fruitful area for socio-technical intervention [178]. However, this prior work did not specifically explore which aspects of such interventions would be acceptable to the recovery community and did not include perspectives of potential sponsors. This chapter contributes to these ongoing discussions by identifying sponsors and sponsees's specific recovery needs, priorities, and strategies, and by identifying opportunities and risks for socio-technical interventions in this context.

5.3 Methods

I used in-depth interviews to characterize opportunities and risks for socio-technical support for sponsorship.

5.3.1 Participants

I interviewed 12 sponsees (see Table 5.1) and 15 sponsors (see Table 5.2) who identified as members of one or more 12-step fellowships regarding their experiences with providing or receiving sponsorship. All sponsee participants were in an active relationship with a sponsor. Sponsor participants were either in an active relationship with one or more sponsees or had prior experience providing sponsorship. Participant sponsees and sponsors were not affiliated with each other (*i.e.,* I interviewed individuals, not dyadic pairs).

I began by recruiting seven sponsee participants through their affiliation with an all-female recovery home in [location redacted] with which I had an existing research partnership. I then continued "abductive sampling" [139] to include experiences and perspectives which may not have been represented in this original set. As the recovery home mostly included people who were receiving rather than providing sponsorship, our first abductive sampling priority was including the perspective of sponsors. I recruited 15 sponsor participants through word of mouth and through a local recovery certification agency in [location redacted]. Next, I sought to diversify the gender balance of our sponsee sample by recruiting three male participants affiliated with an all-male recovery home in [location redacted]. Finally, I sought to recruit participants with more long-term experience being

P#	Gender	Recovery Time	Time w/ Sponsor	Fellowship
P1	F	5 months	AA	
P2	F	8 months	AA, NA	
P3	F	7 months	AA	
P4	F	9 years	AA	
P5	F	13 months	AA, NA	
P6	F	8 months	AA	
P7	F	12 months	NA	
P8	M	7 months	AA, NA, HA	
P9	M	2 years	NA	
P10	M	1 months	AA	
P11	F	19 years	AA	
P12	M	15 years	AA, NA	

Table 5.1: Sponsee demographics and fellowships. Fellowships included: AA, NA, HA (Heroin Anon.).

a sponsee, as most of our initial participants were relatively new to recovery. Thus, I recruited two participants with more than a decade of experience being a sponsee through their affiliation with an addiction intervention center in [location redacted].

5.3.2 Ethical Consideration for Anonymity

I took several steps to safeguard participant anonymity during the study. Since many of the participants recruited were affiliated with the same institution (*e.g.,* a specific recovery facility, sober home, meeting), I wanted to ensure that participants could remain anonymous even if a specific participant from an institution disclosed their own study participation. To do so, I chose not to collect or report participant demographic data (*e.g.,* age, drug of choice), which may otherwise allow identifying a specific individual within an institution. To respect 12-step fellowships' tradition of anonymity, I received permission from the IRB to waive documentation of consent and permission from our departments waive collecting signatures confirming compensation. By removing the requirements for documenting consent and compensation, I circumvented the need for participants to provide their name at any point in the process.

P#	Gender	Time as Sponsor	Fellowship
P13	M	6.5 years	AA
P14	F	6 years	AA, NA
P15	F	5 years	AA, CA
P16	F	10 years	NA
P17	F	20 years	AA
P18	F	16 years	NA
P19	M	3 years	AA, NA
P20	M	6 months	NA
P21	F	4 years	AA
P22	M	5 years	NA
P23	F	23 years	AA
P24	F	10 years	AA
P25	F	4 years	AA
P26	F	22 years	AA
P27	F	10 years	AA

Table 5.2: Sponsor demographics and fellowships. Fellowships included: AA, NA, CA (Cocaine Anon.).

5.3.3 Procedure

I used email or phone to set up a time and place for the interviews. Fourteen interviews were conducted in-person (seven sponsors and seven sponsees) at a location of the participant's choosing, such as a coffee shop or their home. The remaining thirteen interviews were conducted over the phone, with consent information forms emailed to the participants prior to the call.

After verbally confirming informed consent, each interview lasted between 45 and 90 minutes. Interviews were semi-structured, allowing participants to drive the conversation. I began by discussing the participant's background, history in recovery, and relevant experiences either receiving (for sponsees) or providing (for sponsors) sponsorship. Common topics across interviews including experiences initiating and maintaining a sponsorship relationship, challenges faced and strategies used (including current technology use), and perceived priorities and concerns in the potential use of technology to augment current sponsorship practices. After completing the interview, participants were compensated with a fifteen-dollar gift card.

5.3.4 Analysis

Each interview was audio recorded, transcribed, and analyzed by the interview leads from each site. I used inductive thematic analysis characterized by the generation and constant comparison of open codes in order to reveal underlying themes (*e.g.,*[179, 180]). I began analysis by performing line-by-line open coding and memoing on the qualitative data collected from each interview, identifying short, individual units of meaning within the textual data [179]. I used the process of affinity diagramming to spatially cluster open codes based on similar meaning [180]. Following this initial analysis, the research team came together to discuss the preliminary findings and thematic code clusters from the sponsor and sponsee data sets. I then iteratively refined and combined these clusters to identify five recurring and consistent themes across the sponsor and sponsee participants.

5.4 Results

Through thematic analysis of sponsor and sponsee interviews, I identified five sponsorship practices that characterized the relationship between sponsors and sponsees. 1) *assessing dyadic compatibility*, 2) *managing sponsorship with or without technology*, 3) *establishing boundaries*, 4) *building peer support networks*, and 5) *managing anonymity*.

5.4.1 Assessing Dyadic Compatibility

For sponsees and sponsors, dyadic compatibility served as a foundational building block of sponsorship. Dyadic compatibility is the shared understanding that the mentoring relationship is likely to be successful, effective, and viable based on mutual assessment of "fit." However, sponsors and sponsees valued different aspects of the relationship when assessing dyadic compatibility. Sponsees assessed their sponsors to understand if they had similar or complementing personality traits and recovery experiences. Whereas sponsors assessed dyadic compatibility in terms of common expectations and goals for the relationship.

Sponsees Value Compatible Personality and Experience

Sponsees are responsible for identifying and initiating contact with a potential sponsor, so sponsees were able to articulate a number of issues they considered in deciding whom to

ask. Sponsees stated that an ideal sponsor is a person with whom they can be *"completely vulnerable, and honest"* (P2) and *"if you do fall down and relapse, they are gonna be there to pick you up and not judge"* (P4). Sponsee P6 stated that finding a sponsor with whom she felt comfortable with was essential for open communication. *"You need that comfort level with your sponsor so you feel like you can open up to them about things. Because if you're afraid to talk to them about what is really going on, then you are not benefiting from it."*

Sponsees often used the in-person 12-step fellowship meetings to connect with and assess a potential sponsor's personality, recovery background, and interaction style. For instance, sponsee P4 stated that she *"listens to others at meetings and I look for somebody that either says something that was important to me or they seem to have qualities that I would like to have"* when searching for a sponsor. This method provides her with a *"gut feeling"* regarding which individual present at the 12-step fellowship meeting might be a compatible sponsor.

For sponsee P1, a 12-step fellowship meeting provided an opportunity to identify a sponsor with whom she established a successful sponsorship relationship. *"I just liked her personality. She was really charismatic and artistic and after spending time with her and seeing how she interacts with people, that was just how I wanted to interact with people."* In this case, a brief introduction at a 12-step fellowship meeting was sufficient to assess compatibility with a potential sponsor.

However, while some sponsees were able to get a *"gut feeling"* (P4) regarding a potential sponsor, the 12-step fellowship meeting format may not provide sufficient information to gauge sponsor fit. For instance, sponsee P6 stated that political ideology, a topic rarely discussed at 12-step fellowship meetings, is vital to compatibility. *"I don't want to work with the right wing conservative, like that is just not something I would be comfortable with. That is just important to me."* Differences in political ideology led to the end of the sponsorship relationship, forcing sponsee P6 to restart her search for a sponsor. Similarly, sponsee P12 stated that he struggled working with a sponsor whose experiences were too different from his own. *"We just didn't click completely. I did a lot drugs, but he only drank, I spent time in prison, he didn't. Our viewpoints were different. I couldn't connect and wasn't completely honest with him."* In this case, the lack of shared experience led to

an incompatible match and an unwillingness for sponsee P12 to be open and honest with his sponsor.

Throughout our interviews, sponsees were able to articulate the type of relationship they wanted with their ideal sponsor, but discussed many difficulties and false starts in their attempts to find and initiate that ideal relationship. Sponsees are faced with reaching out to potential sponsors which can be a daunting task for somebody who is new to a 12-step fellowship. For instance, sponsee P5 stated, *"I think I had a lot of fears in finding a sponsor. Like what if I don't pick the right one? What if I let this person down? I think it was hard for me to pick somebody."* From the perspective of the sponsee, choosing the right sponsor will have a large impact on their recovery. In an attempt to choose the right sponsor to support their recovery, they assess the compatibility of a sponsor based upon personality, life experience, and recovery experience.

Sponsors Value Compatible Relationship Expectations

A person who is asked to become a sponsor may agree or reject the offer either immediately or after a trial period of evaluating the sponsorship relationship. While a small number of sponsors agreed that similar personality and life experiences were valuable components of a successful relationship, the majority of sponsors focused more heavily on the value of compatible expectations. All 15 sponsor participants emphasized that their primary expectation was that a sponsee display a consistent *"willingness"* to commit to the recovery program and be open to the sponsors' suggestions. Only by meeting this expectation of willingness, were sponsors prepared to fully devote their time and energy to help a sponsee. *"Willingness requires that a sponsee be willing to work their recovery. I'm not going to carry somebody through recovery...but if they are willing and they want to get sober, then by all means I'd love to help them do that"* (P20). Sponsors focused on setting up clear relationship expectations and roles to foster a successful sponsorship experience. Sponsors often established expectations early in the relationship through in-person meetings that take place prior to starting other activities together.

5.4.2 Managing Sponsorship with and without Technology

Throughout the interviews, sponsors and sponsees consistently and unanimously stated that frequent in-person, face-to-face meetings are essential to a successful relationship. While technology such as texting, video chat, and phone calls are more convenient and less time consuming than face-to-face communication, participants stated that in-person sponsorship is irreplaceable. When asked about using technologically mediated communication exclusively in their relationship, the vast majority of participants worried about losing the deep and meaningful bonds that promote closeness, confidentiality, and familiarity developed during in-person meetings.

For instance, sponsors indicated that face-to-face contact is essential for building trust and forming open and honest communication patterns. Sponsor p26 stated that she prefers to be in the same room with her sponsee to be receptive and open to her sponsee's emotions. *"I can look at [my sponsee] when I talk to her and I can tell if she is exaggerated or they're lying or they're withholding. You can kind of tell that with body language and sometimes you can hear it in people's voices when they are more upset about something. I can't see that in a text."* Further, sponsor p21 stated that face-to-face communication affords physical presence and comfort, two crucial aspects for individuals new to recovery. *"Just being physically present, giving them a hug can...that can affect a new sponsee in a way that just cannot happen over the phone."* In both cases, sponsors indicated that in-person, face-to-face contact is critical to their ability to mentor and provide support.

Sponsees also stated that consistent face-to-face contact is essential to their relationship with their sponsor. Sponsee p5 indicated that she is more comfortable revealing intimate details during in-person meetings with their sponsor than over the phone. *"It is just easier for me to talk to her one on one, face-to-face rather than on the phone. It is just hard for me sometimes... I don't know. I have bad phone anxiety. It is just hard for me to like pick up the phone and talk. It is easier for when I'm just there with her...in the same room and can hold her hand if I need to."* Sponsee p6 shared a similar sentiment. Face-to-face communication allows her to be more open with her sponsor and feel less alone (compared to text messaging). *"We text a little bit but I lay it out heavy when we meet [in-person]. I am able to open to her when we are in the same room...it makes me feel less alone (p6)."* Sponsees consistently highlighted the importance of in-person contact with their sponsee

as it promotes honest and open communication.

However, despite the drawbacks of mediated communication, sponsors and sponsees admitted to opportunistically using technology to supplement in-person meetings. For instance, sponsors used text messaging to perform daily check-ins with sponsees (P14), Doodle poll to schedule a future meeting time with their sponsee (P13), Snapchat to share recovery literature (P16), and a smartphone to share PDFs of step work assignments (P24).

Moreover, sponsors and sponsees agreed that video chat could be useful when one or more members of the relationship are traveling. For instance, sponsor P26 stated, *"My sponsee is on spring break right now. We used FaceTime and just talked through things while I'm cooking dinner, making a meal (p26)."* Similarly, Sponsor P27 used her smartphone to send and receive assignments while her sponsee was traveling. *"I got a sponsee right now that is out of town and she texts me pictures of her worksheets and ... we've been reading over the phone together"* While consistent in-person meetings are vital to the sponsorship relationship, they can be supplemented with communication technology.

In summary, sponsors and sponsees independently and unanimously agreed that consistent in-person meetings are vital to the relationship's health. Face-to-face communication engenders meaningful bonds that promote closeness, confidentiality, and familiarity. Further, while computer-mediated communication does provide opportunities to expand access to one's sponsor when temporarily geographically separated, such technologies should be used sparingly in the sponsorship context. However, this does not mean that technology cannot be used opportunistically to augment the relationship. Technology could play a key role in supporting daily sponsorship logistics, such as scheduling one-on-one meetings, receiving step work assignments, and following up with sponsees.

5.4.3 Establishing Boundaries

For sponsor participants, constructing and enforcing relationship boundaries with their sponsee is a vital component of a successful sponsorship relationship. For example, sponsors erected boundaries concerning the type of support they offer their sponsees (*e.g.,* legal and medical support are considered outside the scope of a sponsor's responsibilities) and created boundaries concerning the amount of time they give their sponsee on a daily basis. Throughout the interviews, sponsors stated that they utilize relationship boundaries with

their sponsees to accomplish two vital goals in the relationship. First, sponsors establish boundaries concerning the amount of time they give their sponsee daily and control the extent to which they are available and contactable. This boundary allows sponsors to carve out social and emotional time away from their relationship with their sponsee to focus upon their own recovery, well-being, and work-life balance (*e.g.,* attending recovery meetings, focusing on their career, and dedicating time to their family and friends). Second, sponsors encourage their sponsee to seek support from peers and often refuse to be their sole source of recovery support. This boundary is meant to model healthy relationships to their sponsees and, thus, prevent sponsees from becoming psychologically and emotionally dependent on a single person (*i.e.,* their sponsor).

The responsibilities of a sponsor can be daunting when combined with recovery, career, and family responsibilities. Regarding the toll sponsoring can take upon one's well-being, Sponsor P20 stated, *"A lot of sponsors can get burnt out, a lot of sponsors can relapse if they don't take care of themselves before they take care of others. If they are a bucket with holes in it and ya know what I mean. . . you gotta patch those holes. (p20)"* Similarly, Sponsor p24 stated, *"I took a break last year [from sponsoring] because of overwhelming work responsibilities, home responsibilities, buying a new house, I got four teenagers at home. I'm trying to keep all the balls in the air and I needed to take care of me (p24)."*

To avoid burnout, sponsors often create and affirm boundaries with their sponsee to carve out social and emotional time away from the relationship to focus upon their own well-being and recovery. Sponsor p20 states that she informs her sponsees that she will not be available 24/7. *"I let them know they can contact me anytime, but I also let them know that if I'm at work or with family I will not answer right away, but I will text them when I can (p20)."* Similarly, p16 creates a boundary with all her sponsees saying that she *"needs to have my own personal time and space, so I will not always answer every call (p16)."* Sponsor p17 dealt with burnout in the past and now limits the number of sponsees she can have at one time. *"I burnt out because I had too many at the time. Now, I will not sponsor more than two newcomers at a time. That's it. Its not fair to them and its not fair to me (p17)."* Finally, sponsor p20 distances herself from a sponsee if their behavior begins to affect her recovery negatively. *"if a sponsee calls me and says I just used, I wouldn't necessarily not be their sponsor any more but if it kept occurring and kept*

occurring then I'd tell them you know we can maybe pick this back up when your willing again but your just... your just full blown using and that's gonna affect me. Ya know I can't be around that stuff. (p20)" These boundaries allow sponsors to focus on their own recovery and well-being. If sponsors do not prioritize well-being, it could trigger relapse amongst sponsors.

Furthermore, sponsors also erect boundaries around the type of support they provide their sponsees. For example, sponsors are careful not to allow their sponsees to become wholly dependent upon them. *"You have to set [boundaries] to make sure [sponsees] do not become dependent on you...because if they do and a [sponsor] leaves or dies then guess what? [The sponsees] are gonna go drink or [do] drug[s]. (p17)"* Further, sponsor p19 is careful to refer her sponsees to others if they need advice outside the scope of the sponsorship relationship. *"If they need advice on mental health or legal issues, I have to stop them and tell them to call their doctor, counselor or lawyer. I don't have a degree - I don't have that background."*

While recognizing the importance of consistent boundaries, most sponsors acknowledged that their boundaries varied depending on the sponsee's needs and experience in recovery. For instance, sponsor P13 stated they do not erect boundaries around communication and contact for sponsees that are new to recovery. *"Very early on we [sponsors] try to be as available as we can. So you try to answer as much as you can in the beginning...because when you've got five days clean an emergency can be a lot different than when you got two or three years clean and what constitutes an emergency (p13)."* For many of the sponsors, their established boundaries or rules became more flexible during moments of crisis, such as a relapse or a deterioration after improvement, due to the severe emotional, mental, and physical strain that often accompanies the first few weeks of recovery after a relapse.

Sponsors use boundaries to provide sponsees with healthy models of relationships, decrease co-dependence, and to carve out time to focus on their own recovery and well-being. However, boundaries need to be versatile to the sponsee's individual needs while still prioritizing the sponsor's own recovery.

5.4.4 Building Peer Support Networks

Individuals in recovery often have unpredictable and complicated needs that cannot be fully addressed by just their sponsor. For that reason, sponsors encourage sponsees to form a robust and trusted peer support network to supplement sponsorship. In this section, we explore how peer support occurs and how sponsors and sponsees build these potentially lifesaving peer support networks. We also discuss how sponsees and sponsors develop peer support networks to help during crisis moments and to find support beyond individual sponsor's expertise.

Building Peer Support Networks Via Sponsorship Family

The sponsor often helps the sponsee build a peer support network for their recovery. A sponsor often connects sponsees to their larger *"sponsorship family"* (*i.e.* their sponsor's sponsor and their other sponsees), which adds trusted individuals to the sponsee's social support network. As sponsee P5 describes: *"One thing I really like about my sponsor is that we kind of have a few women to lean on that are also in the sponsorship family, I have my sponsee sisters, so you know if I can't get an answer from [my sponsor], I can also go to my sponsee sisters."* The sponsorship family provided sponsees with a vetted peer group that was close in geographic proximity, and attended many of the same 12-step fellowship meetings — which provides additional opportunities to strengthen bonds.

Urgent, Time-sensitive Support

Sponsees discussed how stress, restlessness, and other relapse triggers come about suddenly and unpredictably, especially in early recovery. Timely trusted social support helps manage these situations and avoid relapse. Given that a single sponsor cannot provide social support 24 hours a day, sponsees often relied on their peer networks to provide them with support when their sponsor was unavailable. For instance, sponsee P2 discussed how she reaches out for support in times of need. *"I would try and call my sponsor first, but she has a life too, I'm not expecting her to answer right away, I have a lot of other people I can call, which is awesome."* Sponsors encourage sponsees to have multiple people to rely on in an emergency situation, as sponsor P14 describes: *"I encourage people [to connect*

with others when she is unavailable]. My phones off when I go to bed ... if you call the first person and they do not pick up, keep calling other people. Somebody will pick up." For sponsees, a peer support network helps overcome periods of distress or cravings, especially when a sponsor is unavailable.

Support Needed Beyond the Sponsor's Experience

Beyond the urgent and time-sensitive support, peer support helps fill-in gaps in the sponsor's experience when sponsees need specific guidance. As sponsors are tasked with sharing only about their own "experience, strength, and hope," [1] there may be times when they need to refer the sponsee to others in their network for specific guidance. For example, when asked for childcare guidance, sponsor P14 shared their approach: *"if you need single mom help, let's go find you some single moms to talk to."* Similarly, sponsor P17 discussed a hypothetical situation regarding how to support a sponsee that is grieving a family death: *"We just call somebody that has experience, strength, and hope in what you're going through....ya know [redacted name] lost her mom two years ago, honey you may want to call her."* A diverse peer support network with a wide spectrum of life experiences is a vital resource for sponsors to connect their sponsees with necessary support—especially when sponsors themselves does not have experience with a particular topic.

5.4.5 Managing Anonymity

"Anonymity is the spiritual foundation" of all 12-step fellowship traditions [181]. Prior work examines how 12-step communities strive to preserve anonymity with digital technologies [182, 183] and found three critical ways the group strives to protect anonymity. First, these groups protect people's privacy by having strict rules regarding disclosures of private information, including not revealing who is in recovery nor what is said in meetings [182]. Second, anonymity means that people do not publicly identify as members of a particular 12-step fellowship, which helps protect the program's reputation from any individual's misconduct [182]. Third, anonymity is interpreted as a quality of "namelessness" which is used to emphasize that all members are equal—this definition diverges from the conventional definition of "anonymity" but is critical in the context of 12-step fellowships

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[1] na.org/admin/include/spaw2/uploads.pdf

[182]. Prior work examining digital technologies in this context suggest that individuals in recovery are reticent to use technology that implements a persistent digital identity as it may conflict with this desire for equality through "namelessness" [183]. We examine our participant's anonymity preferences and the tensions that result when anonymity needs directly conflict with sponsorship's social priorities.

Anonymity and Managing Stigma

Stigma associated with SUDs has the potential to severely and negatively impact employment, social relationships, and even custody of children. As sponsor P23 shared about her early experiences: *"I was absolutely mortified when I first got sober. Somebody was gonna find out I was in AA and then how would they look at me professionally."* Anonymity helps participants and others manage social stigma by keeping their recovery status private outside of 12-step contexts. Helping protect others' anonymity is considered an important priority: *"I am big on everyone else having their anonymity, so I don't want to break someone else's anonymity"* (P19). In alignment with prior work in the 12-step context [182], participants emphasized the importance of being able to control when and how they break their anonymity.

However, our interviews revealed that one element of managing stigma was unique to the sponsorship context, in that concerns about stigma applied not just in relating to the outside world, but also in protecting individuals from stigma *within* the program. As part of working the steps, sponsees disclose information to their sponsor that they may not share with others, including close ties or others in recovery. Sponsee P7 maintains that *"[a sponsor must be] someone I can trust not to divulge shit that I have done, like whatever indiscretions, secrets, crimes, and dark thoughts to other people."* Sponsee P6 also emphasized the importance of *"protecting anonymity and the privacy of the conversations that you have with a sponsor, so not everybody in the whole program will have access to that."* For a sponsor, this may mean treading carefully when seeking additional support for their sponsees, since some experiences may be revealed in confidence.

Identity Disclosures are Necessary

While sponsors emphasized protecting others' anonymity, many of them described being willing to disclose their own recovery status to help others. For instance, sponsor P17 recounted an experience where she revealed she was in recovery to someone struggling with substance use: *"I revealed who I was because I knew she had a problem. I introduced her to the program and started taking her to meetings..."* Self-disclosure of one's own recovery status is necessary in order to make oneself available as a sponsor or as a sponsee. In conventional 12-step arrangements, this need to maintain anonymity outside of the program while making yourself available to give and receive support within is managed through the social contract of 12-step meeting attendance—meetings can be seen as safe spaces to disclose recovery status. Sponsor P22 discussed the importance of similar "addicts-only" spaces online: *"Yeah, addicts only ... until we prove you are, you can't get on the page."* Sponsees were also enthusiastic about some kind of access control: *"make sure that it's not just like Joe-Schmoe joining. [Otherwise it's] like Tinder ... you don't want your face to be like, boom"* (P7). Future technologies will have to identify strategies to enable disclosing recovery status while protecting anonymity.

Anonymity Conflicts with Individual Safety

Prior work argues for ephemeral identities in online recovery spaces to support the qualities of "namelessness" and equality as interpretations of anonymity in 12-step fellowships [183]. However, our interviews revealed a divergent set of priorities introduced by the specifics of the sponsorship context. Unlike general recovery activities, which happen in public spaces with multiple participants, sponsorship inherently requires one-on-one work with some degree of privacy. This increases the potential risks to an individual's safety, so many participants described a need for persistent, verifiable identities to protect members from predatory behavior. Unlike other 12-step contexts, where the dominant message to disruptive members is to "keep coming back," in the context of sponsorship participants wanted to, *"be able to report harassment ... if someone gets reported several times, they get kicked out... and can't join again"* (P2) and were willing to have *"the system [moderators] handle ... the guidelines and boundaries ... to show that we are safe using this app."* Participants also wanted another layer of safety by only gradually revealing information

that could affect personal safety (*e.g.,* phone, address, photo). For example, one sponsee liked how in-app messaging could remove the need to share a phone number: *"...that way they don't have my phone number ... and from there, I can decide if I want to give them my phone number or not"* (P5). Another sponsee mentioned waiting until *"after you make that first initial contact ... to exchange photos"* (P7). Each of these ideas point to the importance of a persistent online identity in tools that attempt to support sponsorship—a perspective that may be at odds with other areas of recovery.

5.5 Discussion: Implications for Design

Based on our interview findings, I identify two critical opportunities for socio-technical interventions to support sponsorship in recovery communities: (1) develop sponsors' capacity and (2) grow the support community for sponsees. I expand on each of these opportunities based on our findings. Finally, I discuss limitations and future work related to this study.

5.5.1 Develop a Sponsor's Capacity

Developing Sponsors' Capacity Prior investigations by Witbrodt et al.,[67] and Tonigan [62] found that the earlier a sponsee finds a sponsor the more likely they are to maintain continued abstinence. In 12-step fellowships, sponsorship is critical to recovery programs. In "Assessing Dyadic Compatibility," sponsees discussed the difficulties of finding compatible sponsors or staying with less effective sponsors due to the lack of available sponsors. In "Establishing Boundaries," sponsors shared being overwhelmed with responsibilities of helping sponsees while also managing their own recovery. Therefore, a key opportunity for technology is to develop sponsors' capacity to meaningfully support multiple sponsees.

In-person sponsorship is irreplaceable in recovery and should only be supplemented with mediated communication. In "Managing Sponsorship," participants worried about losing the deep and meaningful bonds that promote closeness, confidentiality, and familiarity developed during in-person meetings and would not be open to mediating such recovery aspects. While computer-mediated communication does provide opportunities to expand access to one's sponsor when temporarily geographically-separated, such technologies should be used sparingly in the sponsorship context.

However, this does not mean that technology cannot develop sponsors' capacity. Technology could play a key role in **supporting daily sponsorship logistics, such as scheduling one-on-one meetings, receiving step work assignments, and following up with sponsees.** In "Managing Sponsorship," some sponsors and sponsees shared the complex ecology of tools that they employed to support their practices—step work assignments were shared using photo-sharing apps, check-ins handled via text, meetings scheduled using calendar applications. In "Establishing Boundaries," sponsees shared the need for more regular follow-ups to hold them accountable for their recovery. Facilitating these routine recovery activities is a clear opportunity for mobile applications or virtual assistants.

In "Establishing Boundaries" and "Building Peer Support Networks," our findings highlight the challenges sponsors face. Sponsees may want more support than sponsors can reasonably offer. Sponsees may experience crises that sponsors may not have the experience, time, or capacity to handle. Sponsees often need to connect with people who have relevant experiences beyond their sponsor. This points to an opportunity to **create spaces for sponsors to exchange support and sponsorship strategies to grow their capacity** to meet these challenging needs. Health informatics research focuses on supporting caregivers [11, 26] and adapting similar strategies to "help the helpers" may help sponsors be more effective both in their own recovery and as sponsee support. Solutions may range from social (e.g., providing sponsors with guidance on how to seek advice without breaking sponsee anonymity) to technical (e.g., soliciting sponsees to assent before posting any specific message that pertains to them)."

One challenge for technology designers will be providing such a support space while respecting the need for absolute confidentiality in the sponsorship relationship revealed in "Managing Anonymity". Another challenge will be thoughtfully interpreting these findings when considering design interventions. Designers must be wary not to design technological interventions that might seem applicable yet are inappropriate [9], as may be the case with current low-tech or in-person communication practices that are currently used to exchange support and sponsorship strategies.

5.5.2 Growing Sponsees' Support Community

In "Establishing Boundaries" and "Building Peer Support Networks," my findings reveal that sponsors and sponsees rely on peer support networks to provide complementary support to the sponsorship relationship. Sponsors encourage sponsees to develop robust peer support to foster independence and multiple avenues to get help. Dependence on a sole sponsor is unhealthy, stressful, time-consuming, and ultimately unsustainable for sponsors and could leave a sponsee without adequate support if a sponsor was unavailable or were to move, pass away, or relapse. Peer networks provide support during crisis moments (when a sponsor was unavailable) and help diversify their support base beyond their individuals sponsor's expertise. Thus, we recommend that technology design assist individuals in recovery by building vetted diverse peer support networks to complement sponsorship support.

One opportunity in this design space is informed by prior work: **identifying nearby non-substance-users to help sponsees grow their recovery network by making new clean/sober friends.** Zywiak et. al., [74] found that peer support is only beneficial to SUD recovery if a peer network has a higher proportion of individuals who do not use substances compared to individuals who use substances. Peer networks with more substance users than non-substance users are not beneficial, and can negatively influence treatment outcomes [36]. Furthermore, the size of the daily peer support network (i.e., the number of people that an individual in recovery interacts with on a daily basis) is negatively correlated with relapse rates [74]. In other words, a large peer network is more beneficial than a small peer network, but only if frequent interaction occurs. Thus, we propose that future technology design assist individuals in recovery in finding and forming bonds with non-substance-users who live in close geographic proximity and help identify opportunities for in-person interaction.

Another clear opportunity in this space is **connecting sponsees with their broader sponsorship family so they have more places to seek support.** Participants in this study often cited their "sponsorship family" (i.e., their sponsor's sponsor and other sponsees) as a reliable and meaningful source for peer support relationships. Future design may focus on providing individuals with additional opportunities to meet and interact with members of their "sponsorship family" as it consists of individuals who meet the

criteria of a beneficial peer support network (i.e., non-substance users who generally live in close physical proximity). For example, technology that alerts or encourages individuals to attend an event, recovery meeting, or casual meet-up that is being attended by members of their extended sponsorship family may provide additional opportunities to connect with this valuable peer group. However, based on our findings in "Managing Anonymity" it is critical that such a system be designed to allow members of the "sponsorship family" to control their level of engagement. For example, designing an "opt-in" functionality would allow each person to set degrees of separation and involvement ensuring that "sponsorship families" are not inundated with new uncommitted members or bombarded with unrelated requests.

5.6   Limitations and Future Work

While in-depth interviews enabled me to investigate sponsors' and sponsees' experiences, values, and priorities, this methods supports transferability but not generalization. My findings will need to be corroborate using quantitative methods.

Second, 19 of our 27 participants were women, presenting a gender imbalance. This is not atypical, as women are more likely to volunteer for research studies [184, 185]. While this imbalance allowed me to focus more on the needs and priorities of women in recovery (an often-overlooked population in SUD research [141]), future work should investigate the perspectives of men and non-binary people in recovery.

Third, this study focused on peer mentorship in 12-step recovery. While this approach is considered controversial as a "treatment", 12-step approaches are currently considered best medical practice for long-term maintenance programs [186] and thus should be investigated and supported. Detractors cite the core religious elements of the program [143] as an argument for alternative evidence-based approaches (*e.g.,* SMART Recovery [187], Cognitive Behavioral Therapy (CBT) [188]). However, I found it valuable to focus on 12-step recovery, as this approach is the most widely used form of long-term maintenance and social support for individuals with SUDs [189, 190], it contributes to positive recovery outcomes [35], and it is recommended as a best practice by the NIH [191]. Due to my focus on 12-step recovery, some of our findings may be specific to the practices in these programs (*e.g.,* "managing anonymity"), while others (*e.g.,* establishing boundaries, building peer

support networks) may apply to peer support more broadly. Investigations with other forms of peer support may help articulate the generalizability of these findings. Additionally, while AA and NA are international organizations active in 180 nations [48], there are geographic differences in how AA and NA practices are enacted that may diverge from our Midwestern U.S. sample. Despite these limitations, I believe this work provides valuable insight on how design may support access to peer mentorship in SUD recovery.

5.7 Conclusion

In **RQ2**, I asked, "What challenges, practices, needs, and motivations must be considered in designing technologies to support dyadic mentorship in SUD recovery?" To answer this question, I conducted twenty-seven interviews with sponsors and sponsees in active recovery from substance use disorders. Sponsors and sponsees had divergent priorities when assessing compatibility and setting boundaries. While sponsors established boundaries to protect their recovery and discourage co-dependence, sponsees wanted and sought additional peer support through their broader recovery community. Second, we found that participants engaged in frequent in-person meetings with their sponsor or sponsee and were wary of replacing that physical connection with mediated communication. Finally, participants were vigilant in protecting others' anonymity to mitigate SUD stigma but could choose to break their anonymity to make themselves available to help others.

This study also addressed acute limitations within relevant related work. Specifically, while many supportive technologies for SUD recovery exist in today's marketplace, few, if any, have sought to design technology to support and enhance social support mechanisms in SUD recovery (see chapter 3). Through interviews with sponsors and sponsees, I outlined the following design opportunities to enhance social support in long-term recovery from SUDs. First, utilize technology to expand the sponsees' pool of potential sponsors and reduce false starts by identifying compatible nearby sponsors. Second, utilize technology to increase in-person contact between the sponsor and the sponsee. Third, support daily sponsorship logistics, such as scheduling one-on-one meetings, receiving step work assignments, following up with sponsees, and creating spaces for sponsors to exchange support and sponsorship strategies to grow their capacity. Fourth, identifying nearby non-substance users to help sponsees grow their recovery network by making new clean/sober

friends. Finally, connect sponsees with their broader sponsorship family to increase social support opportunities.

Chapter 6

Low-Fidelity Prototype

6.1 Introduction

In the previous chapter, I detailed the thorough investigation of **RQ2**. In that investigation, I conducted twenty-seven semi-structured interviews with sponsors and sponsees to inform the creation of specific design implications to increase sponsor capacity, facilitate sponsorship initiation, and grow a broader support community for sponsees.

In this chapter, I discuss the development of a low-fidelity prototype that operationalizes three specific design implications discovered in chapter five. The three design implications include the following:

1. Expand the sponsees' pool of potential sponsors and reduce false starts by identifying compatible nearby sponsors.

2. Support frequent in-person, physical meetings between sponsor and sponsee.

3. Ease the burden of daily sponsorship logistics, such as scheduling one-on-one meetings, receiving step work assignments, and following up with sponsees.

I also discuss the process of working with participants in active recovery from SUDs to evaluate and provide feedback regarding the design concepts presented in the low-fidelity prototype. The design of a low-fidelity prototype, along with participant feedback, serves as a formative investigation of **RQ3** which asks, "How do peer dyadic mentorship pairs in

SUD recovery perceive and utilize a computational system (*i.e.,* SponsorLens) that aims to support daily mentor logistics and promote frequent and consistent communication between mentor and mentee through behavioral nudging?" I will utilize the results of this formative evaluation to improve and streamline the final design of *Sponsorlens*, the computational system detailed in chapter seven of this proposal.

Historically, A low-fidelity prototype is an expedient and low-cost method utilized in HCI and Human Factors research to communicate initial design ideas, gather feedback regarding the feasibility and acceptance of those initial design ideas, and generate additional design ideas with participants [192, 193]. I begin this chapter by discussing the design of the low-fidelity prototype. I then discuss the methodology used in evaluating the low-fidelity prototype, and finally, I discuss the evaluation results.

6.2 Methods

In this section, I discuss the design process of the low-fidelity prototype. Specifically, I focus on how I operationalized design requirements discovered in chapters 4 and 5. Second, outline the research study in which I tested the usability and acceptability of the low-fidelity prototype with participants in active recovery from SUDs. Finally, I discuss the results of the research study and use those results to develop six participant design requirements for the high-fidelity prototype I develop in chapter 7.

6.2.1   Design of Low-Fidelity Prototype

In this section, I discuss the design of the low-fidelity prototype. I developed the prototype using Balsamiq [194] software. Balsamiq is a rapid wireframing software that enables designers to communicate initial design ideas to key stakeholders, in this case, participants. In each subsection below, I detail how the three design requirements were visualized and operationalized within the low-fidelity prototype.

Design Requirement #1: Expand the sponsees' pool of potential sponsors and reduce false starts by identifying compatible nearby sponsors

In chapter five, sponsee participants expressed significant anxiety about finding the right sponsor to aid their recovery, while sponsor participants expressed frustrations with divergent expectations in the sponsorship relationship. Furthermore, findings from chapter five suggested that a lack of fit between a sponsor and a sponsee can lead to an ineffective sponsorship experience or the dissolution of that relationship. These "false starts" are costly to the recovery community regarding reduced sponsor capacity (i.e., a sponsor in an incompatible relationship is not available to take on a more compatible sponsee) and the increased relapse risk. Thus, the low-fidelity prototype design facilitates the sponsorship initiation process by expanding the pool of sponsors and ensuring a compatible fit between the sponsor and sponsee.

For sponsees, the low-fidelity prototype features several ways to search for a compatible sponsor, including a sponsor's age group, gender, experience level (*i.e.,* years of experience) fellowships the sponsor attends, geographic location (*i.e.,* and zip code) (see figure 6.1). Each of these filters was directly informed by sponsee and sponsor participants during study 1 (*i.e.,* chapter 4) and study 2 (*i.e.,* chapter 5) to increase the likelihood of a compatible match. After the sponsee uses the filters in the low-fidelity prototype, a list of sponsors that match the search criteria appear in the list. Each sponsor in the list is shown alongside their "about me" text section. Upon clicking on a sponsor, their full profile is displayed. The full profile includes an "about me" text section, years of experience, the number of current sponsees, a "my expectations for my sponsees" text section, a "meetings I regularly attend" text section, a "my current service work" text section, and a "how I like to work the 12 steps" text section. If the sponsee sees a suitable match, the sponsee can send a text message to the selected sponsor.

The low-fidelity prototype also enables a potential sponsor to fill out their sponsor profile to make themselves available for potential sponsees to find them via the search functionality (see figure 6.2). The design of the "create a sponsor profile" section of the prototype focuses heavily upon anonymity and privacy - a consistent finding within studies 1 and 2 (*i.e.,* chapters four and five). For example, in figure 6.2C, the prototype allows the potential sponsor to determine if potential sponsees can find their profile. Selecting

"No" will hide their profile from everyone on the app. Additionally, while the prototype collects the potential sponsor's phone number, it will never be disseminated (see figure 6.2B). Finally, only sponsees can contact sponsors via the app prototype. A sponsor cannot search for sponsees. This direction of initiation mirrors the direction of the sponsor/sponsee relationship initiation within the real world.

Design Requirement #2: Support frequent in-person, physical meetings between sponsor and sponsee

In chapter five, participants consistently discussed that in-person sponsorship is irreplaceable in recovery and should only be supplemented, not replaced, with mediated communication. Sponsor and sponsee participants worried about losing the deep and meaningful bonds that promote closeness, confidentiality, and familiarity developed during in-person meetings and would not mediate such recovery aspects with technology. While computer-mediated communication does provide opportunities to expand access to one's sponsor when temporarily geographically separated, such technologies should be used sparingly in the sponsorship context. Thus, this section details how I designed the prototype to encourage frequent in-person meetings between the sponsor and the sponsee.

The design of the low-fidelity prototype encourages frequent in-person meetings in three ways. First, the prototype sends an alert to the sponsor and sponsee if they have not met in person in a preset number of days. A reminder is also sent to the sponsor and sponsee if they do not have a future meeting scheduled. For example, Figure 6.3A and B shows an alert that a meeting is not currently scheduled with Katniss (*i.e.*, the sponsee) and that the sponsor has not met with Katniss in ten days. These alerts are meant to nudge the sponsor and sponsees to schedule meetings earlier rather than later.

Second, the prototype encourages frequent in-person meetings through its meeting scheduling interface. The interface allows the user to propose multiple meeting dates and times (see figure 6.3C and D), instead of just a single meeting date and time. This scheduling interface is meant to cut down on failed attempts to find a time that works for both parties. These failed attempts can delay an in-person meeting by several days until a successful meeting date is scheduled. By proposing multiple dates and times, the odds of success are increased, and the time elapsed between meetings will be reduced.
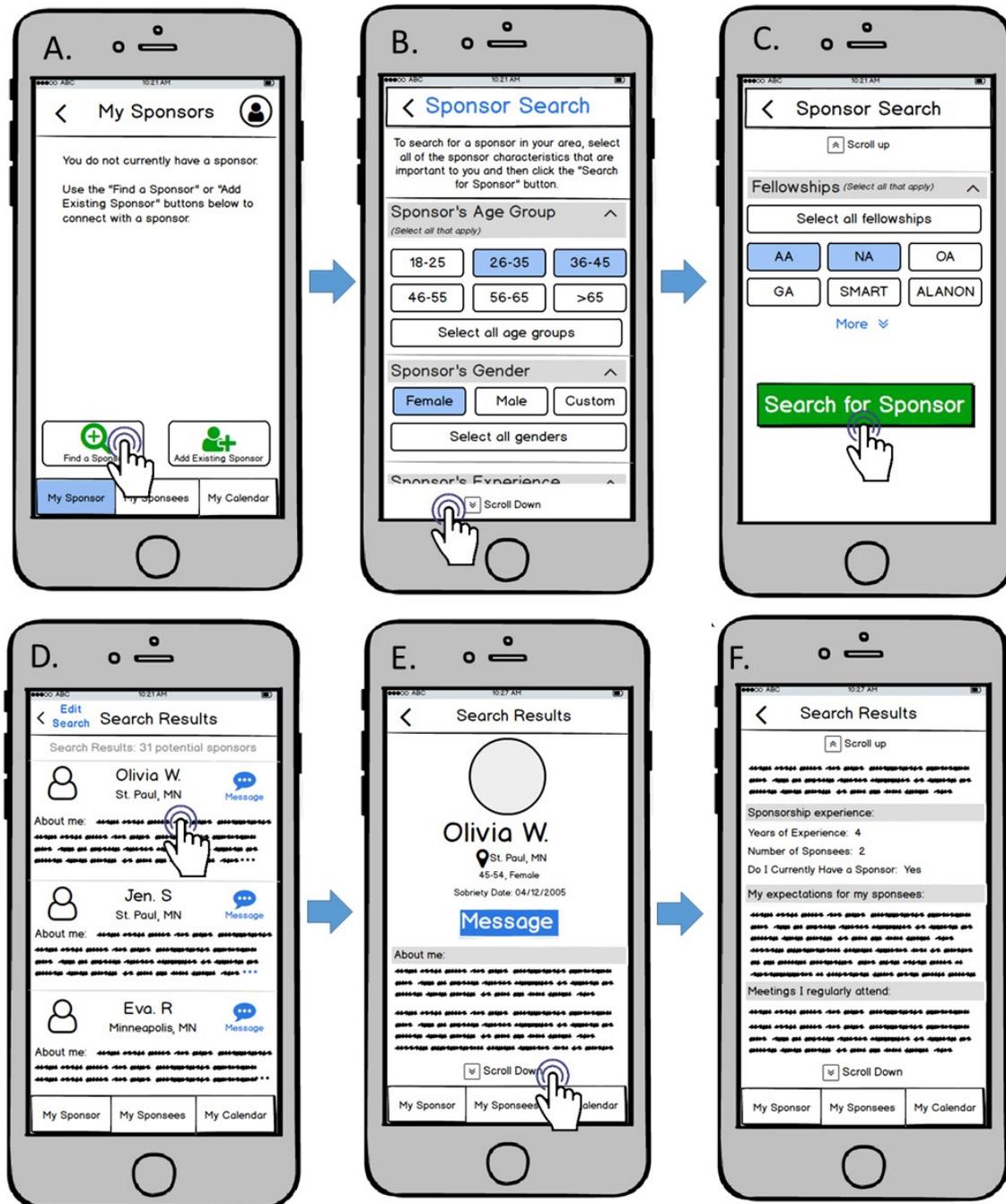
Figure 6.1: Images of the low-fidelity prototype. Images A, B, and C show the "search for a sponsor" interface with filtering capability. Images E, F, and G show the list of sponsors resulting from the search and the ability to learn more about a specific sponsor (*i.e.,* Olivia W.)
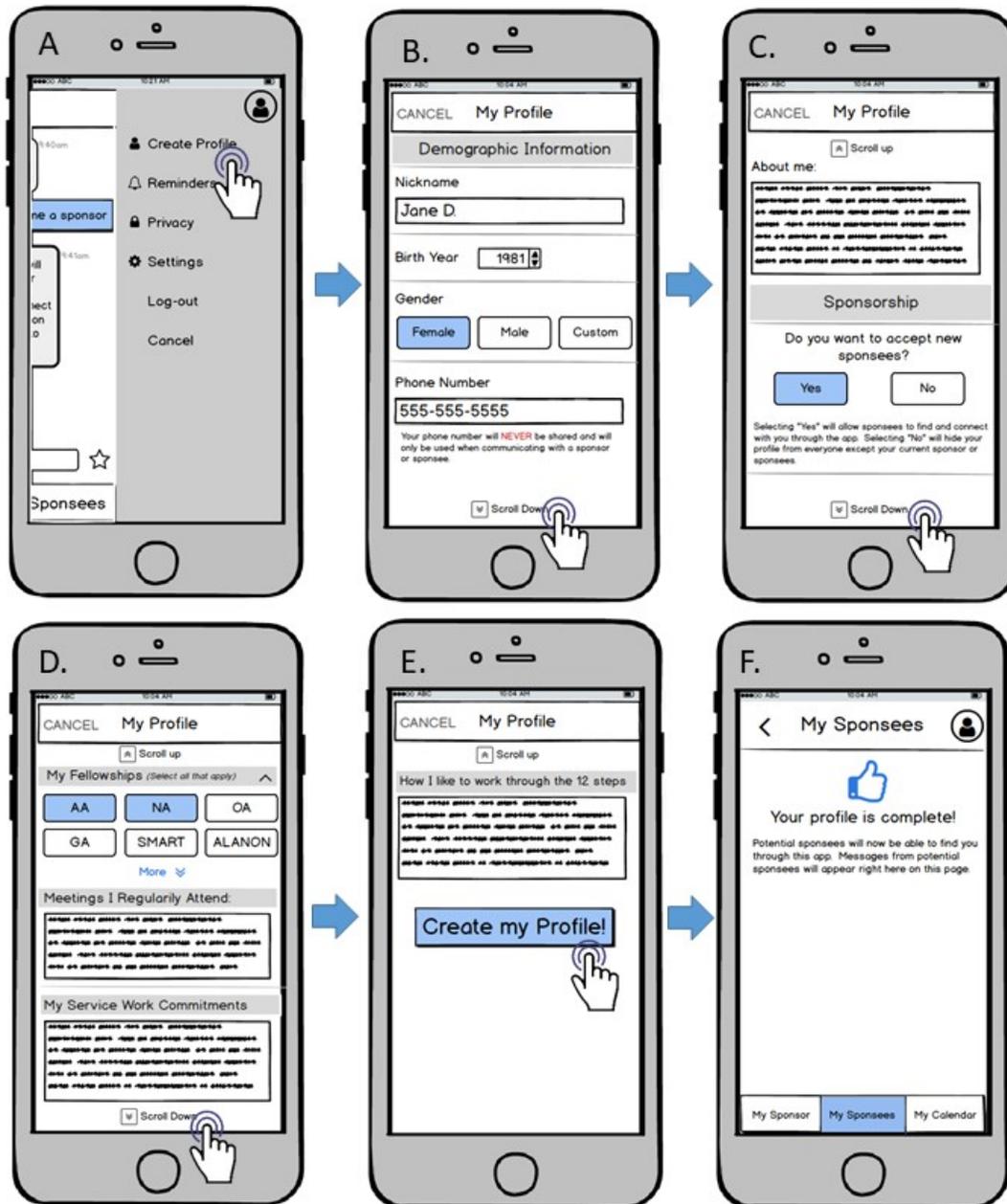
Figure 6.2: Images of the low-fidelity prototype. These Images show the progression of creating a sponsor profile. This progression allows sponsees to find the sponsor via the application.

Finally, the low-fidelity prototype encourages frequent in-person meetings through its meeting calendar interface. The calendar features all meetings with sponsors and sponsees scheduled through the app in two views - a list view and a monthly calendar view (see figure 6.4). Additionally, the calendar is one of three home buttons on the prototype that can be accessed from any screen. This feature places upcoming meetings at the top of the mind, lowering the probability of missing a future meeting.

Design Requirement #3: Ease the burden of daily sponsorship logistics, such as scheduling one-on-one meetings, receiving step work assignments, and following up with sponsees

In the previous section, I discussed the design focus toward supporting frequent in-person meetings and eschewing computer-mediated communication between sponsor and sponsee. However, this does not mean technology cannot develop sponsors' capacity. Technology could play a key role in supporting daily sponsorship logistics, such as receiving step work assignments and following up with sponsees after in-person meetings. In chapter five, sponsors and sponsees shared the complex ecology of tools they employed to support their practices—step work assignments were shared using photo-sharing apps, check-ins were handled via text, and meetings were scheduled using calendar applications. Sponsees also shared the need for regular follow-ups to hold them accountable for their recovery. Facilitating these routine recovery activities was a primary design focus of the low-fidelity prototype.

To support these daily logistics, I designed a method to share and save homework assignments, photos and other documents within the text message thread shared by sponsors and sponsees (see figure 6.5B). Additionally, the prototype allows the user to "Star" (*i.e.* mark as important) any individual text message (see figure 6.5C), giving users easy access to vital previously sent messages, such as a homework assignment.

Additionally, the prototype encourages the sponsee to write a post-meeting summary immediately after an in-person meeting with a sponsor (see figure 6.6B and C). Writing this meeting summary encourages the sponsee to think about what occurred in the meeting and organize their to-dos for the following meeting. This design is meant to take post-meeting follow-up responsibility off the sponsor's shoulders and place that expectation on
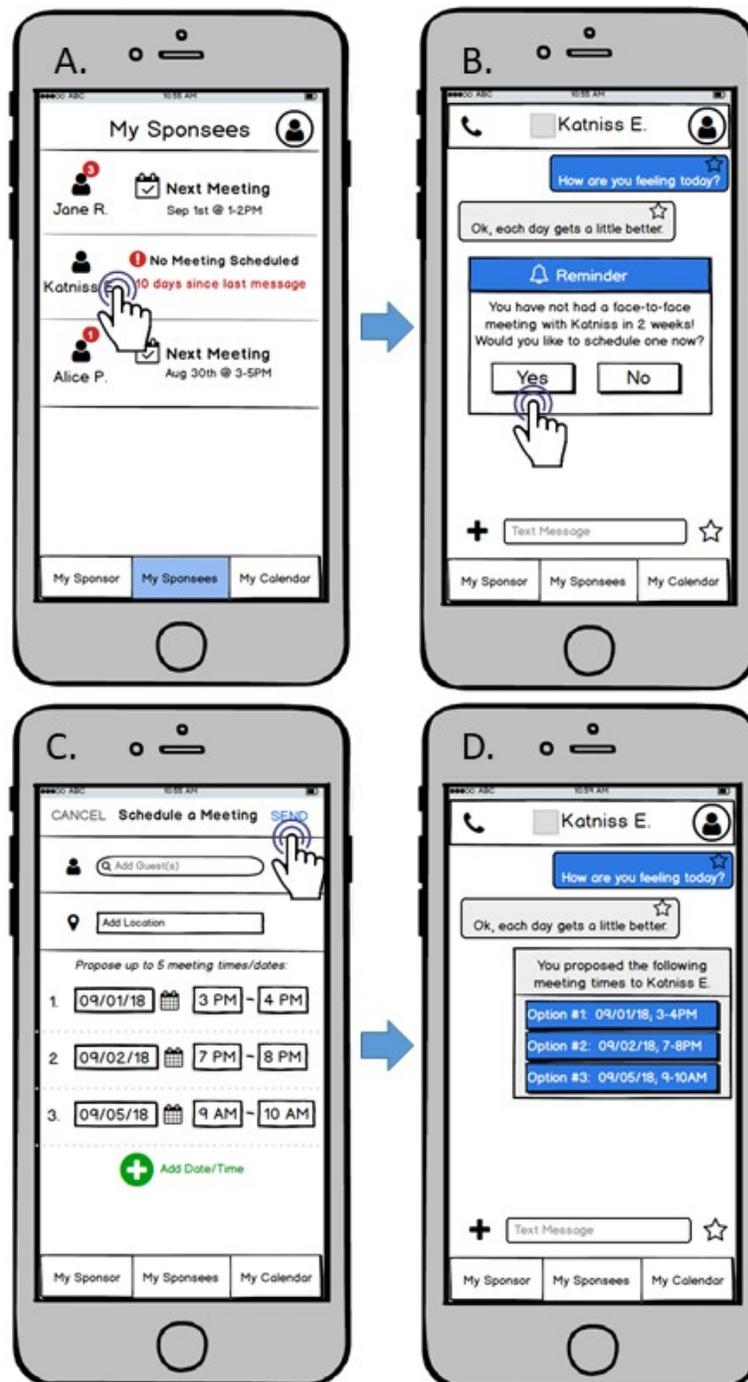
Figure 6.3: Images of the low-fidelity prototype. Images A and B show an alert if no meeting is currently scheduled with the sponsee. Images C and D show the ability to propose multiple dates and times for in-person meetings with the sponsor or sponsee.

Figure 6.4: Images of the low-fidelity prototype. Image A shows the list view of the upcoming in-person meeting calendar. Image B shows the grid view of the upcoming in-person meeting calendar.

the sponsee. Sponsors stated that this responsibility significantly drained their capacity to serve their sponsees in chapter five.
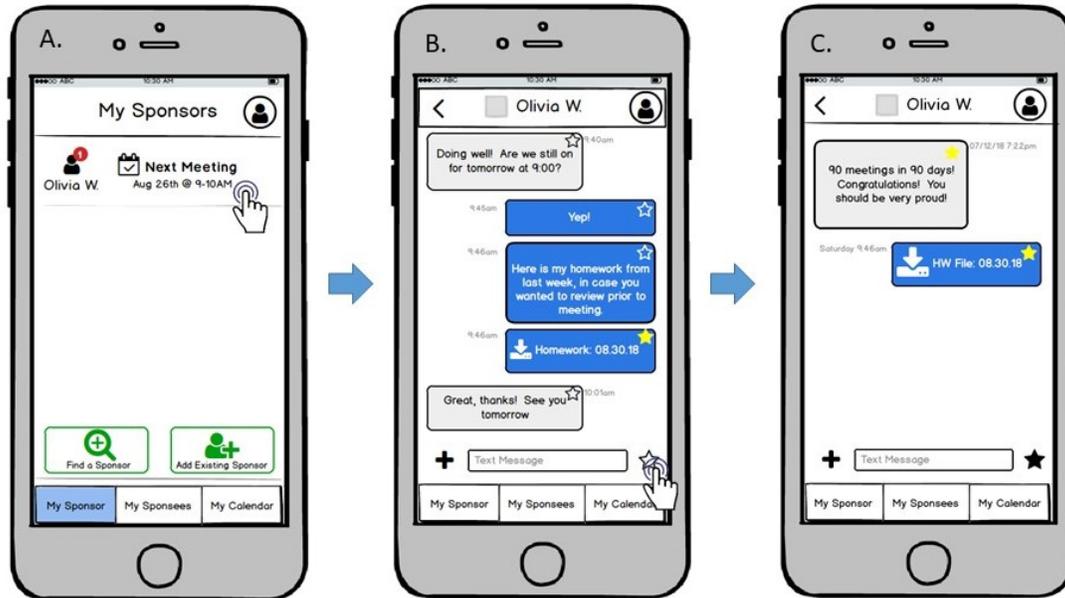
Figure 6.5: Images of the low-fidelity prototype. Image A shows a red alert if a new text message is received. Image A also displays the next scheduled meeting with the sponsor. Image B shows the ability to attach a homework assignment and "Star" important messages. Image C shows the ability to view only messages that have been "Starred."

6.2.2 Participants

We worked with eight residents of a women's sober living environment (SLE) in Minneapolis/St. Paul metropolitan area. The SLE provides a safe and drug-free residence where women support each other as they begin their recovery from SUDs. Generally, residents are in early recovery (*e.g.,* less than one year clean/sober) as SLE residency serves as a stepping-stone to independent living. It is important to note that this SLE was the same SLE I worked with in Chapter four; however, participants taking part in this low-fidelity prototype study did not participate in the study detailed in chapter four.

Participants were active in recovery from SUDs for an average of 13.5 months. They were in an active mentorship relationship with a sponsor for an average of 9.875 months (see
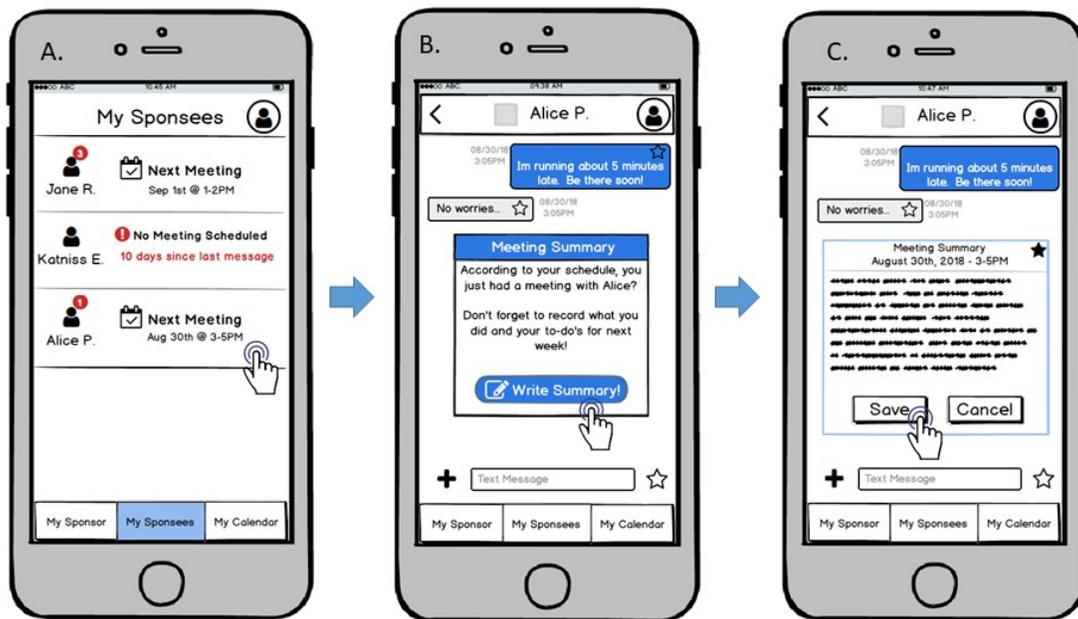
Figure 6.6: Images of the low-fidelity prototype. Image B displays an automated reminder sent to the sponsee asking them to write a meeting summary. This reminder appears immediately following an in-person meeting with a sponsor. Image C shows the completed meeting summary written by the sponsee. The completed meeting summary will remain in the text thread for both the sponsor and the sponsee to view.

figure 6.7). One participant in this study was an active sponsor, and another participant stated that she was a sponsor in the past. All eight participants were actively involved in an AA fellowship. Six were involved in NA. One participant was actively involved in Al-Anon, a fellowship for family and friends of individuals with AUD. Participants were provided consent forms before the study took place and received a $15 gift card to Target department store for their participation.
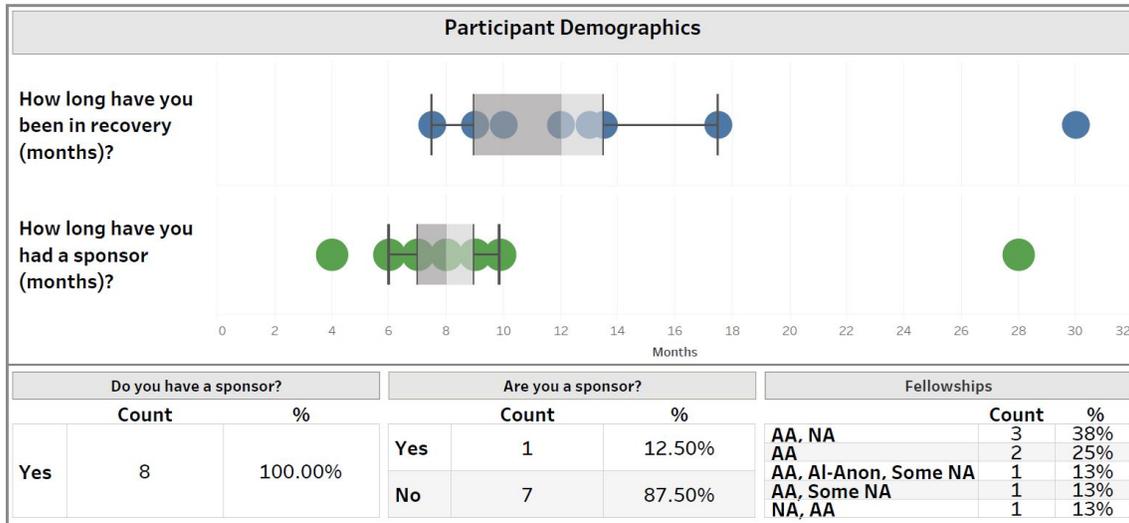
Figure 6.7: Participant demographics include time in active recovery, time with their current sponsor, if the participant currently has a sponsor, if the participant is a sponsor, and which fellowships participants attend. *Note: while only one participant was an active sponsor, two participants had sponsorship experience.*

6.2.3 Procedure

After consent procedures, which included a description of the research study's potential risks and benefits, the eight participants were divided into groups of two and assigned to work with a researcher. Each grouping, including two participants and a researcher, occupied a private area within the SLE's living room. Each group was provided a laptop with the low-fidelity prototype loaded. Each researcher read from a script to introduce the prototype's functions and the tasks the participants would be asked to complete on their own. A detailed procedure, script, and task list can be found in appendix B of this

proposal. While the participants completed the tasks, they were asked to "think aloud" (i.e., speak aloud what they were thinking and doing while using the prototype). The "think aloud" method is an oft-used procedure in prototype testing to better understand the features participants like, find confusing, and need to be redesigned for usability [195].

The first set of tasks that participants were asked to complete involved using the low-fidelity prototype to search for and find a compatible sponsor (see appendix B). Participants were also tasked with inviting an existing sponsor to use the prototype app. Finally, participants were tasked with creating and sponsor profile to allow potential sponsees to find and connect with them via the low-fidelity prototype (see table 6.1 for an overview of the three task phases and research goals).

After participants completed the first set of tasks, the researcher again read from a script to introduce the second set of tasks. In the second set of tasks, participants were asked to imagine that they had been using the low-fidelity prototype application for several months and had found a sponsor. Additionally, participants were to imagine they had three sponsees with whom they were communicating using the low-fidelity prototype application (see appendix B). Participants were asked to think aloud while they used the prototype to find their next meeting with their sponsor, check in on each of their three individual sponsees, view their full upcoming meeting schedule, and adjust custom reminder settings.

After participants finished all the assigned tasks, the researcher asked each participant four interview questions (see appendix B). First, participants were asked what the prototype should keep doing. In other words, what aspects of the app did they like and want to be included in the final version of the prototype app? Second, participants were asked what the prototype should stop doing. In other words, what aspects of the prototype app they disliked and feel out of place or confusing? Third, participants were asked what the prototype app should start doing. In other words, what potential features would increase the value of this app for the participant over and above using existing text message and email functionality on their smartphone? Finally, participants were asked, "If this prototype app existed today, would you use it to communicate and schedule meetings with your sponsor and sponsees?"

After the interview, participants completed a modified version of the system usability survey [196] along with demographic questions (see appendix B). Participants were thanked

for their participation and given a fifteen-dollar gift card for their time and efforts.

Table 6.1: Participants, prototype tasks, and goals for each prototype task.

Task	N	Participant Activities	Research Goals
1. Find a Sponsor and Create a Profile	8	Use the prototype to search for a compatible sponsor, read their profile, and initiate communication.	• Gather participant impressions on the acceptability and feasibility of using the prototype to search for a sponsor. • Gather participant impressions on the usefulness of the demographic, personality, and experience information provided for each potential sponsor candidate listed in prototype.
2. Communicate and Schedule a Meeting	8	Use the prototype to check in on their sponsor and sponsees, evaluate upcoming meeting schedules, and schedule a meeting with a sponsee.	• Gather participant impressions on the acceptability and feasibility of using the prototype to communicate with their sponsor and sponsees and schedule meetings. • Gather participant impressions on the usefulness of various features such as contact frequency alerts, meeting summary prompts, and meeting scheduler.

Table 6.1 – Continued from previous page

Task	N	Participant Activities	Research Goals
3. Post-Evaluation Interview and Usability Survey	8	Conduct a semi-structured interview with participants and have participants complete an app usability survey	• Participants were asked to reflect on the prototype as a whole, giving specific attention to the features of the prototype they liked and disliked, as well as what should be added to the next version of the prototype. • Participants completed a usability survey on the low-fidelity prototype.

6.2.4   Analysis

Both quantitative and qualitative data were collected during this study. Quantitative data was collected through the modified system usability survey. However, because of this study's low number of participants, I focus on general descriptive statistics rather than statistical significance. There were also numerous qualitative data, including audio recordings and field notes taken by researchers. Each audio recording was selectively transcribed, meaning all phrases and quotations were transcribed, but not every word and utterance. I performed a directed thematic analysis of the qualitative data, focusing on the features of the low-fidelity prototype that participants liked and disliked.

6.2.5   Results

Overall, participants rated the overall usability of the low-fidelity prototype as excellent. The mean score of the modified system usability scale was 95.25 (see figure 6.8). According to Bangor et al., [196], a score about 85.5 or higher is considered excellent. Participants consistently commented that they would use the low-fidelity prototype application in their recovery if it were available today. For instance, participant 6 (P6) stated that she would

use the application with her current sponsees. *"I would definitely use it with my sponsees. To have this all in one place and let me know what they are up to lately would be really nice."* Similarly, P1 stated, *"I would use it. I like this form of communication and how it's all in one place. It makes it easy to manage. I think it would be really helpful for new sponsees and new sponsors."* Conversely, some participants commented that the sponsor search interface was *"buggy"* (P3), stating that it was *"difficult to get back the search results"*(P4) once a sponsor was selected. Participants also made numerous suggestions regarding additional features they would like to see in future versions. I discuss those suggestions in the following paragraphs of this section.

In the following subsections, I highlight the features that participants consistently found helpful to their recovery. Additionally, I highlighted features that did not exist in the low-fidelity prototype, but participants commented that would help the overall usability of the low-fidelity prototype.

Feature #1: Share and store homework, documents, and pictures within the application

Consistent with participants in Study #1 (i.e., chapter 4) and Study #2 (i.e., chapter 5), participants in this study discussed the value of sharing homework, documents, and homework within the application. For instance, participant 1 (P1) stated, *"Whoa, cool! I like that you can share homework within the app"* when seeing the feature during phase 2 of the low-fidelity prototype evaluation. Similarly, P3 stated, "*I really like that you can share photos, documents, and homework.*" Additionally, P3 suggested an additional feature when she stated that she would like to be able to "*have a dedicated documents/homework subfolder to keep all those files shared through the app.*" The ability to share homework, photos, and other documents electronically was a consistent theme in all three studies in this proposal. Thus, this feature will be included in future versions of the computational system.
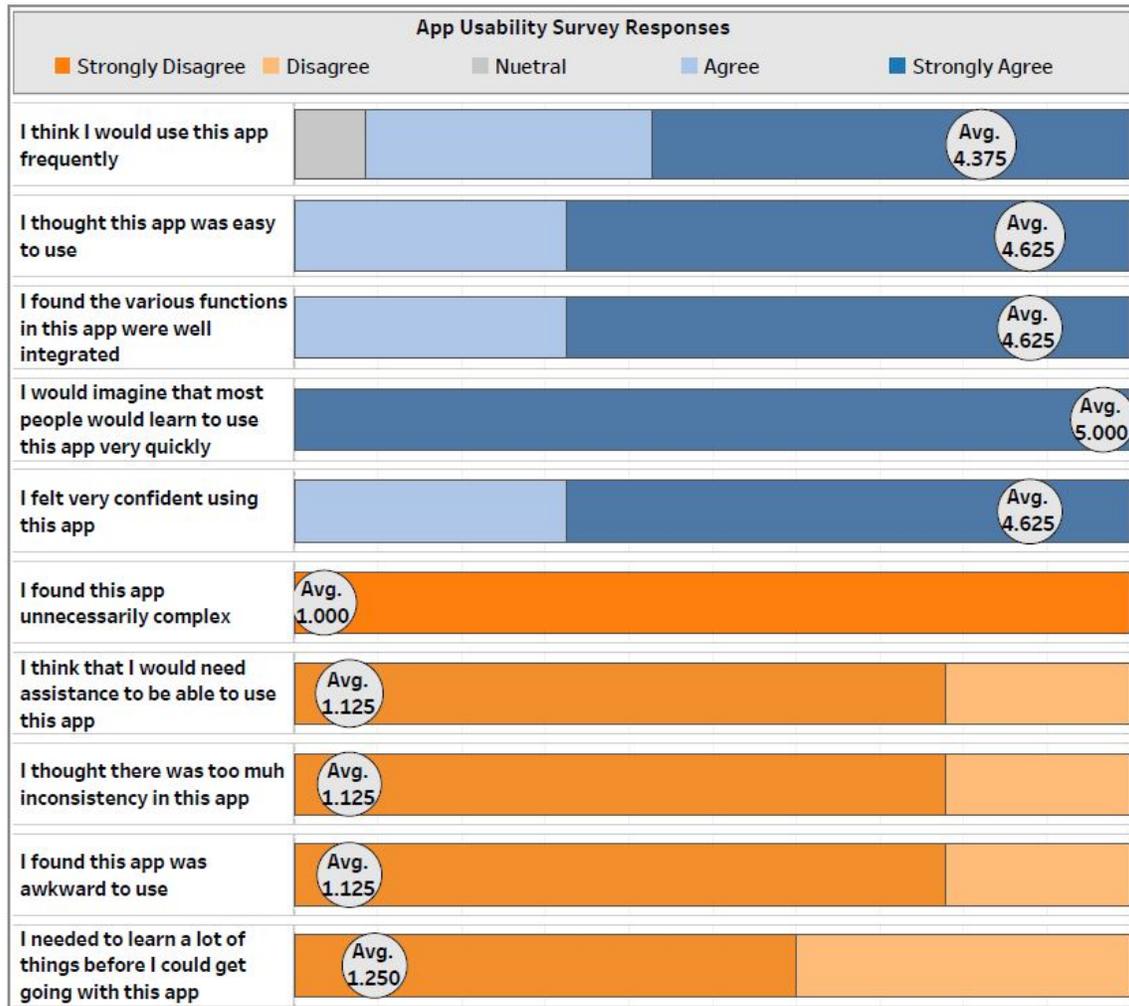
Figure 6.8: Aggregate results for each question of the modified system usability scale [196].

Feature #2: Sync the application with each individual's preferred electronic calendar (*e.g.,* Google Calendar, Apple Calendar, Outlook Calendar, etc.)

Participants in this study consistently commented that they liked the ability to see all upcoming meetings with their sponsor and sponsees. For example, P2, while seeing the ability to see all upcoming meetings with sponsees, stated, *"Very good idea! I like that I can see all of my recovery meetings."* After that statement, P2 quickly followed up with the question, *"Is there an option to sync these meetings with my existing calendar (i.e., Google calendar or iCalendar)?"* P4 had a similar request when seeing the ability to propose multiple meeting times and dates within the prototype. She asked, *"when you give options for meeting times, could the system just pull it from my existing calendar"* (*i.e.,* outlook calendar on iPhone)?" Given the consistent requests for this feature and its potential impact on usability, I will include this feature in future versions.

Feature #3: Custom application alert if and when a sponsor or sponsee plans to attend a local recovery meeting or event (*i.e.,* surreptitious meeting opportunities between sponsor and sponsee)

During the interview phase, researcher #1 (R1) made the following comment regarding how participants were attempting to use the prototype but could not do so. *"So one of the things I noticed while you were using the prototype was that you invented a new feature that we don't currently have in this prototype. Right now, we only have the meeting times between a sponsor and a sponsee; not included are AA meetings or service work to allow for spontaneous meetings with sponsees like 'oh, you said you were going to be here, so I just dropped in."'* P1 immediately agreed that the proposed feature would provide immense value to her recovery. She stated, *"Right! Or like I see you are going to a meeting on Wednesday night do you want to meet up 30 minutes beforehand."*

In a separate and independent grouping of researcher and participants, P4 requested a similar feature by asking, *"Is there a way I can get an alert if my sponsor is going to a meeting and I don't know about it?"* Additionally, P1 stated that scheduling AA meetings or other events within the application might add accountability to her actions, *"personally, for me, it would add a level of accountability like hey I said I would be at this meeting I can't then just peter out and not go, because my sponsor and sponsees know I will be at this*

meeting." Given that multiple participants asked for the ability to get alerts when their sponsor or sponsee is planning to attend a local recovery meeting or event; I will include this feature in future versions of the computational system.

Feature #4: Primary purpose of application to serve recovery

Most participants commented that they liked that the prototype was devoted solely to recovery. Having all recovery meetings and communications in one place was seen as an organizational benefit. For instance, P1 made the following statement when she was asked if she had access to this app today would she use it with your sponsor or sponsees, *"I would, I like this form of communication and how its all in one place. It makes it easy to manage."* Similarly, P2 stated, *"I would too. Right now I feel like my relationship with my sponsor right now is a little loosy goosy and the app would add some structure and accountability on both ends."*

In a separate researcher/participant grouping, P6 stated, *"I like that all of your recovery related messaging and scheduling is in one place. Once you have a sponsor it would be cool to have all this stuff in one place. Especially from the sponsors point of view. I typically don't have more than 3 sponsees so it would be nice to be able to see what they all are doing. I like to keep track on when I talked to them last."* In summary, several participants stated that they liked to have all communication and meeting schedules in one place. Thus, future versions of the computational system should eschew adding features unrelated to recovery as that would take away from the singular focus and purpose.

Feature #5: Custom reminders sent to sponsor and sponsee if they have not been in contact for a preset period of time (*e.g.,* 3 days)

A key finding from chapter 5 was the need to lessen the burden placed on sponsors by designing technology to support daily logistics. The custom alerts designed into the prototype were an attempt to lessen sponsors' daily responsibility to check in on sponsees. For example, if the sponsee has not contacted a sponsor in 3 days via phone call, text, or in-person meeting, an alert will be sent to both the sponsor and sponsee. Participants in this study consistently expressed that this feature has value. For instance, P7 stated that *"reminders would be super helpful"* because *"I know that I sometimes go several days*

without contacting my sponsor and It just slips my mind so reminders would be huge, I love that aspect." P6 expressed a similar sentiment from the perspective of a sponsor, *"Reminders would be very helpful because I ask my sponsees to call me every day (especially in the beginning) and my sponsees frequently forget so that would be good."* The custom alerts were very well received by participants. Thus, custom alerts regarding "no contact" time-lapses will be added to future versions of this computational system.

Feature #6: Create a virtual space for sponsors to exchange support and strategies with each other to grow their capacity to help their sponsees

In chapter 5, I found that sponsees may experience crises that sponsors may not have the experience, time, or capacity to handle. Sponsees often need to connect with people who have relevant experiences beyond their sponsor. This finding points to an opportunity to create spaces for sponsors to exchange support and sponsorship strategies to grow their capacity to meet these challenging needs. While this was not a feature designed into the prototype, participants independently echoed the need for a shared virtual space in future versions of this computational system. For instance, P1 stated, *"There are a lot of questions that sponsees have like 'what should I look for in a sponsor '...if they had a larger community to ask that would be cool to bounce issues off other people."* Similarly, P2 stated, *"I don't think that type of social network exists right now. A social networking site for sponsee issues in general. Maybe there could be a sponsor forum and a sponsee forum."*

In lock step with findings from chapter five, participants in this study stated that a virtual space for sponsees and sponsors to communicate with each other would be highly valued. This feature would extend the peer network beyond one's sponsorship family and reach geographically disparate sponsors and sponsees.

6.2.6   Conclusion

In **RQ3**, I asked, "How do peer dyadic mentorship pairs in SUD recovery perceive and utilize a computational system (*i.e.,* SponsorLens) that aims to support daily mentor logistics and promote frequent and consistent communication between mentor and mentee through behavioral nudging?" In this formative evaluation of RQ3, I developed a low-fidelity prototype system based upon key findings from study 2 (*i.e.,* chapter 5) of this dissertation.

I then tested the prototype with eight participants in active recovery from SUDs. Participants rated the low-fidelity prototype as highly usable and said it would add value to their recovery. Furthermore, through qualitative analysis of participant data, I determined that the following six specific technological features should be included in the next version of the computational system.

1. Share and store homework, documents, and pictures within the application

2. Sync the application with each individual's preferred electronic calendar (*i.e.,* Google Calendar, Apple Calendar, Outlook Calendar, etc.)

3. Custom application alert if and when a sponsor or sponsee plans to attend a local recovery meeting or event (*i.e.,* surreptitious meeting opportunities between sponsor and sponsee)

4. Primary purpose of application to serve recovery

5. Custom reminders sent to sponsor and sponsee if they have not been in contact for a preset time period (*e.g.,* 3 days)

6. Create a virtual space for sponsors to exchange support and strategies with each other to grow their capacity to help their sponsees

Chapter 7

Design and Development of SponsorLens: A High-Fidelity Prototype

7.1 Introduction

In the previous chapter, I conducted a formative evaluation of **RQ3** through the development of a low-fidelity prototype. I evaluated the usability of the low-fidelity prototype with eight participants in active recovery from SUDs. During the evaluation, participants consistently and independently identified six design requirements that would significantly support their sponsorship relationship and recovery.

In this chapter, I utilize those six design requirements to design and development SponsorLens, a high-fidelity prototype. SponsorLens is synchronous communication and scheduling system to increase sponsor capacity and the frequency of in-person contact between sponsors and sponsees. In chapter eight, I conduct a four-week field deployment study of SponsorLens with sponsor and sponsee pairs to assess its overall feasibility as an intervention for substance use disorder recovery.

7.2   Design of SponsorLens

The design of SponsorLens was based entirely upon participant feedback gathered via participatory design (*i.e.,* chapter 4), semi-structured interviews (*i.e.,* chapter 5), and low-fidelity prototype testing (*i.e.,* chapter 6). Participants independently and unanimously focused their designs on supporting the sponsorship relationship during the participatory design study (*i.e.,* chapter 4). In chapter 5, participants discussed how technology could lessen the burden of sponsorship logistics while simultaneously creating additional opportunities for in-person and virtual contact between sponsor and sponsee. Finally, during the evaluation of a low-fidelity prototype, participants highlighted six design requirements that would support their sponsorship relationship and recovery. In this section, I discuss how I operationalized each participant design requirement within SponsorLens.

To develop SponsorLens, I utilized two existing enterprise systems, Slack (*i.e.,* Slack.com) [17] and Cronify (*i.e.,* cronofy.com) [197]. Developing a prototype using a currently available enterprise system is called "unplatforming" and has precedence in HCI research [198]. Unplatforming provides SponsorLens the robustness necessary to function efficiently during a four-week field trial (see chapter 8). Additionally, each of the six participant design requirements either exists in Slack's base version or can be developed by writing custom code against the Slack and Cronify application programming interfaces (APIs). Thus, to create a robust system and save time, effort, and money, I developed SponsorLens on top of two currently available enterprise systems (*i.e.,* Slack and Cronify). In the following subsections, I discuss how I plan to operationalize each participant design requirement using the base version of Slack, the Slack API, and the Cronify API.

Design Requirement #1: System to enable the user to share homework, documents, and pictures

Throughout this dissertation, participants have consistently requested the ability to share homework, documents, and pictures with their sponsor or sponsee within a private channel. Slack enables users to attach documents and pictures saved to the device's hard drive or connected cloud service (see figure 7.1). After sharing, the document will permanently remain in the text thread between the sponsor and sponsee. Additionally, Slack allows

users to save messages in a dedicated folder within Slack, a feature that participants consistently requested during the low-fidelity prototype study (see figure 7.2). Thus, I met this participant design requirement with Slack's base features.
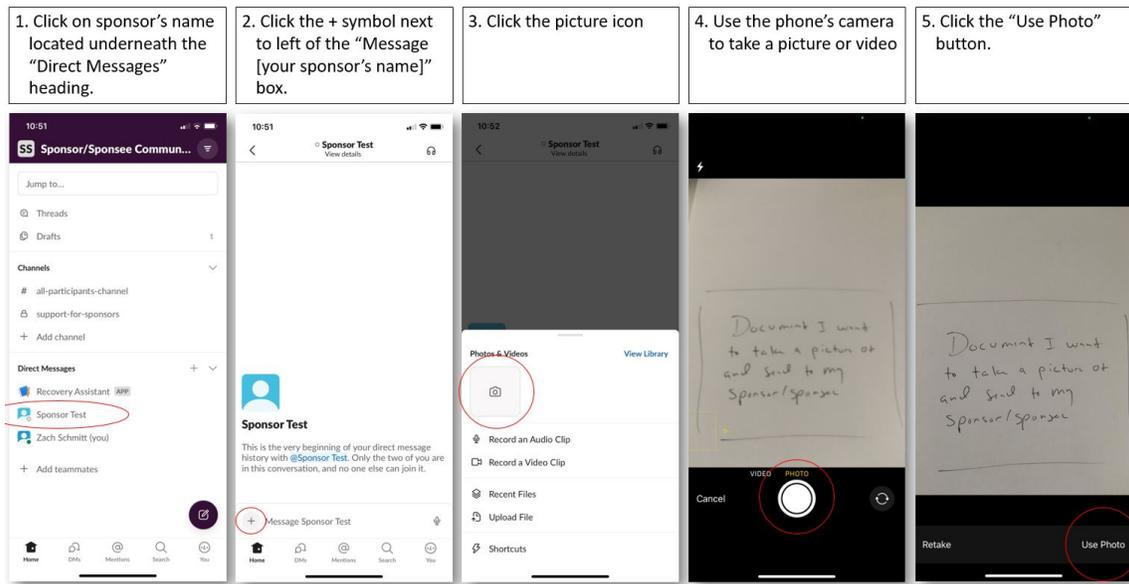
Figure 7.1: Images of SponsorLens. Participants can share homework, photos, and documents using Slack's attach feature. The message containing the attachment remains in the text thread between the sponsor and sponsee.

Design Requirement #2: System to sync meetings and meeting invitations with users' calendars

During the low-fidelity prototype study, multiple participants requested the ability to sync meetings and meeting invitations within SponsorLens with their calendar (*i.e.,* Google Calendar, iCalendar, Outlook). This feature is not included in Slack's base version; instead, it required custom code for both the Slack and Cronify APIs to enable SponsorLens to write and edit information on participants' calendars. As a result of this custom code, meetings scheduled using SponsorLens will instantaneously appear on the user's calendar - eliminating the need to remember the meeting or manually input the meeting into one's calendar.
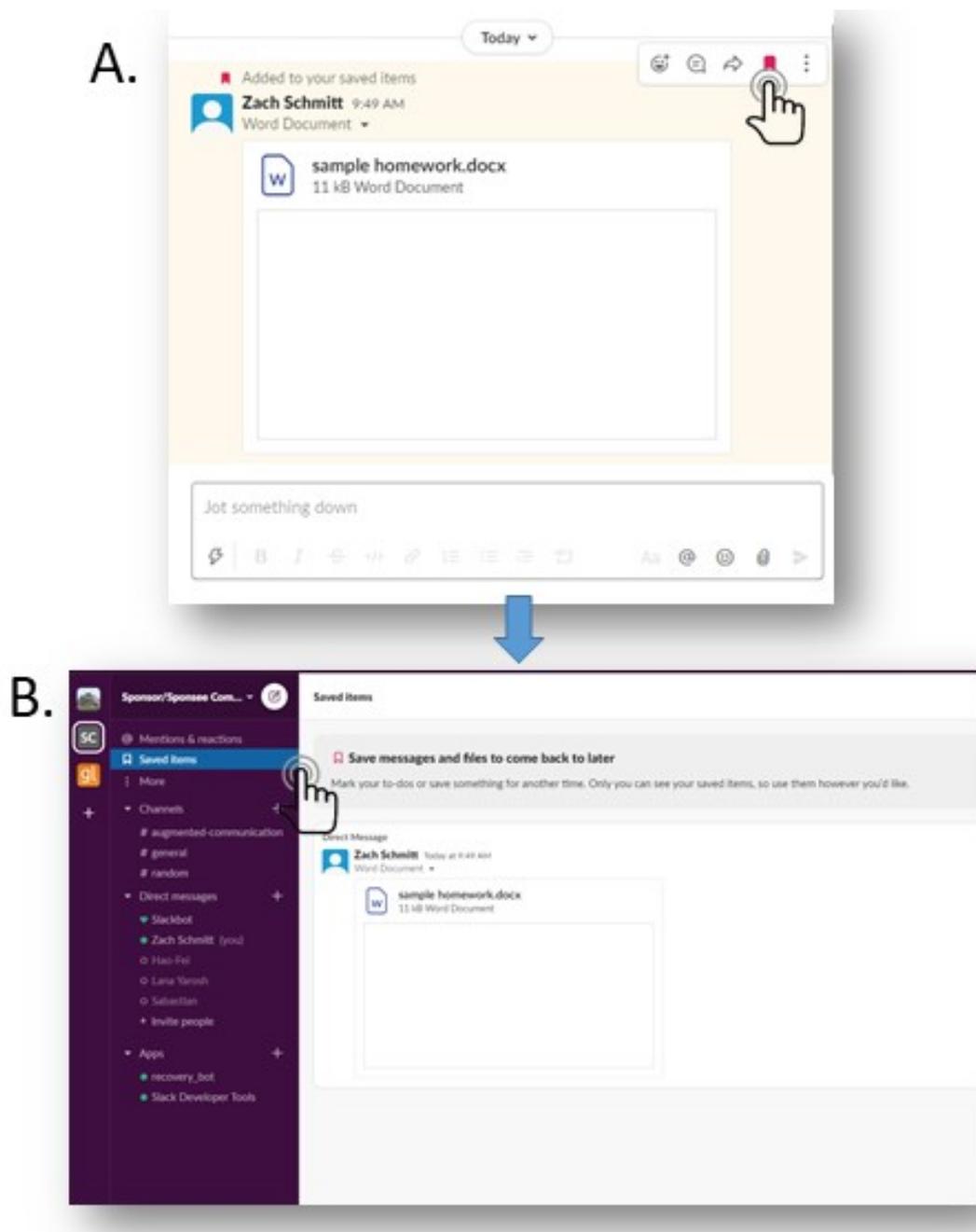
Figure 7.2: Images of SponsorLens. Participants can save (*i.e.*, bookmark) important messages in a dedicated folder.

Furthermore, SponsorLens's ability to write and edit information on personal calendars is necessary for two additional design requirements (*i.e.,* design requirements # 3, and #6). I cover those design requirements below.

Design Requirement #3: System to alert the user if their sponsor or sponsee is attending a local recovery meeting or event (*i.e,* "Event Nudge")

During the low-fidelity prototype study, participants requested a feature alerting them if their sponsor or sponsee plans to attend a local recovery event or meeting. This alert would allow users to accompany their sponsor or sponsee to the event and provide an additional opportunity for in-person contact. To produce this alert, I wrote custom code for both the Slack API and Cronify API. Additionally, I scheduled automatic administrator messages to be sent to participants weekly.

For example, I programmed SponsorLens to send the message displayed in figure 7.3 to participants once per week. If a participant selects the "Yes, I am" option in figure 7.3.1, they are sent figure 7.3.2, which asks questions such as the event name, address, date, time, as well as a question asking if they would like to invite their sponsor or sponsee to the event. Suppose the participant wishes to invite their sponsor or sponsee to the event. In that case, an invitation message will be sent to the other party, and if accepted, SponsorLens will write the event in their calendar. This feature is meant to increase the number of surreptitious meetings between the sponsor and sponsee. This automated message feature will be referred to as an "event nudge" for the remainder of this paper.

Design Requirement #4: System to be used for recovery purposes only

During the low-fidelity prototype study, most participants commented that they liked that the prototype was devoted wholly to recovery, eschewing features connected to other aspects of their lives, including work, school, or non-recovery socializing. To meet this design requirement, I customized Slack's security settings to restrict communication to sponsor and sponsee relationships only.
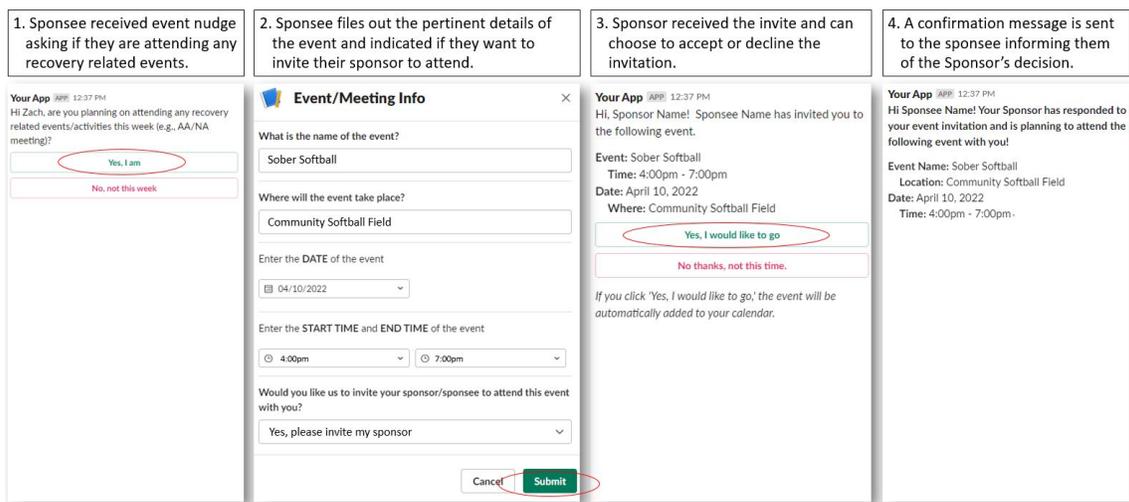
Figure 7.3: Images of SponsorLens. Image 1 displays the "event nudge" interface in which the sponsor or sponsee receives a message asking them if they are attending any recovery-related events. If the user selects "Yes, I am," the interface allows them to input details concerning the event and invite their sponsor or sponsee to attend. Participants could activate this interface (Image 2) at any time by typing "/event" into the text message box of the app.

Design Requirement #5: System to enable video chat

During the in-depth interview study (i.e., chapter 5), participants discussed their need for alternative means of communication, such as video chat, when in-person contact is impossible. Since that study, video chat has become even more vital to the sponsor/sponsee relationship as the COVID-19 epidemic has made in-person contact both risky and challenging. To accommodate virtual contact, SponsorLens enables easy-to-initiate video chat capabilities. Specifically, participants can initiate a video chat by using the "start a call" feature in the shortcuts menu (see figure 7.4). This video chat occurs within the SponsorLens interface and does not require external software.
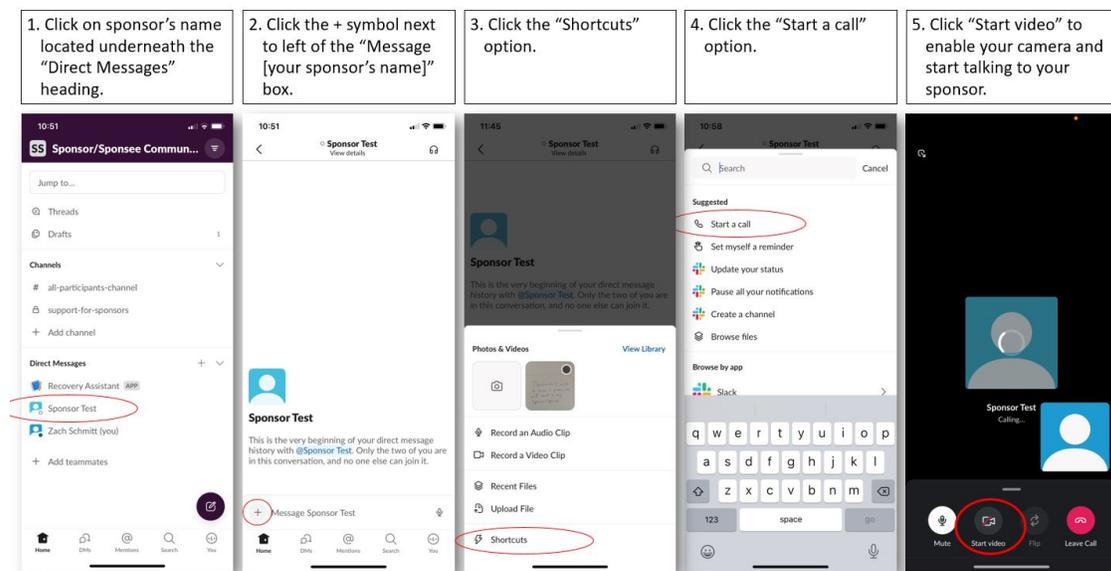
Figure 7.4: Images of SponsorLens. The process to initiate a video call within SponsorLens.

Design Requirement #6: System to send a reminder to sponsor and sponsee if they have not been in contact for a customized length of time (*i.e.,* "Contact Nudge")

Participants in the in-depth interview study (*i.e.,* chapter 5) and participants in the low-fidelity prototype study requested that an alert be sent to the sponsee if there has been no contact between the sponsor and sponsee for a customized length of time. This feature

is meant to help develop sponsors' capacity by eliminating the need to "follow up" with and keep "track of communication" with sponsees daily or weekly. To accomplish this, SponsorLens scrapes data from the SponsorLens usage logs to determine if the sponsee has recently communicated or scheduled a meeting with their sponsor. Specifically, Sponsor-Lens scrapes the date and time of the most recent interaction within SponsorLens (*e.g.,* text messages, video chats, meetings, etc.). Based upon those data points, I programmed SponsorLens to send a reminder to the sponsee, nudging them to contact their sponsor or schedule a meeting (see figure 7.5). The length of time necessary to trigger this reminder will be set by the sponsor and sponsee at the beginning of the study (*e.g.,* 3 days is the default length of time). This nudge will be referred to as the "contact nudge" throughout the rest of this paper.
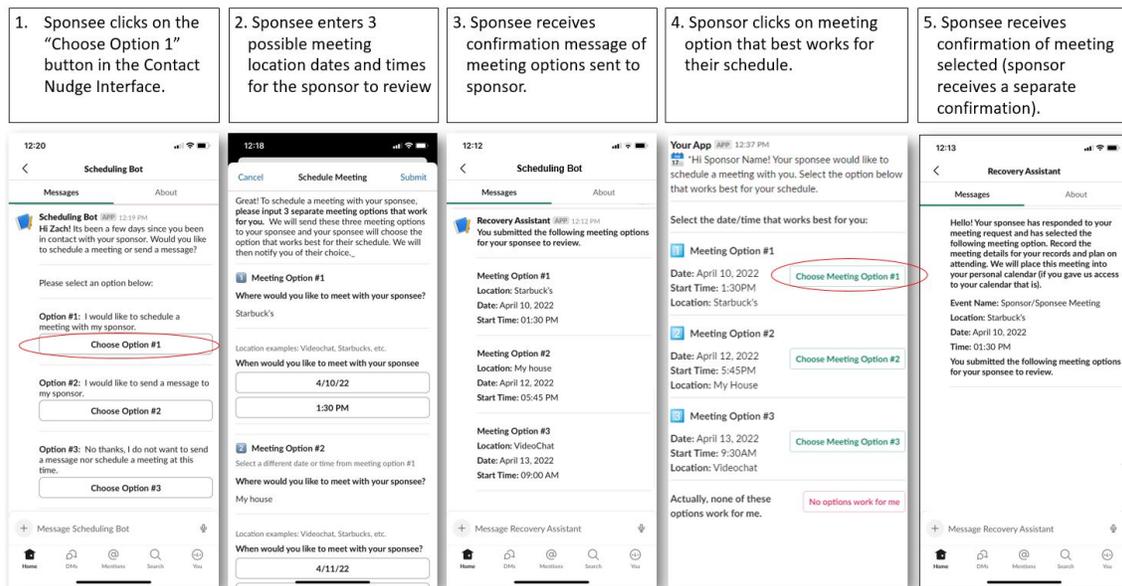
Figure 7.5: Images of SponsorLens. These images display how a sponsee sets up a meeting with their sponsor. Image 1 displays the "contact your sponsor" nudge message sponsees received if they had not contacted their sponsor in 3 days. Images 2-5 display the meeting scheduler interface. The sponsor and sponsee could activate the meeting scheduler interface by typing "/meeting" into the text message interface.

Design Requirement #7: System to create dedicated space for sponsors to exchange support and sponsorship strategies to grow their capacity

Participants in in-depth interview study and the low-fidelity prototype study requested a dedicated space for sponsors to exchange support and strategies with each other to grow their capacity. To create a dedicated space for sponsors, I developed a private channel within SponsorLens that only sponsor participants can access. Sponsors can message the channel, ask questions, seek support, and offer support to each other to increase their capacity (see figure 7.6). I developed an identical channel for sponsees to message one another for support.

Table 7.1: **Requirements Table for SponsorLens** (*PD = Participatory Design Study; INT = Interview Study; LFP = Low-Fidelity Prototype Study.*)

Requirement	Basis	Operationalization in SponsorLens
1. System to enable user to share homework, documents, and pictures	**PD, INT,** and **LFP**	Users can utilize the "attach file" and "take a photo" features with Slack to share homework, documents and pictures.
2. System to sync meetings and meeting invitations with users' personal calendars	**LFP**	Utilize Cronify API to Slack API connection. The "/meeting" command within the direct message interface enables users to schedule meetings and propose meeting times to their sponsor or sponsee. The API will automatically insert meetings scheduled in SponsorLens into the user's personal calendar.

Table 7.1 – Continued from previous page

Requirement	Basis	Operationalization in SponsorLens
3. System to alert user if their sponsor or sponsee is attending a local recovery meeting or event (*i.e.,* "Event Nudge")	**INT** and **LFP**	Utilize Slack API to Cronify API connection. SponsorLens sends weekly "Event nudges" to sponsors and sponsees asking if they will attend recovery-related events or meetings over the next week. If yes, the message collects the date and time of the event and sends an invite to their sponsor/sponsee asking if they would like to attend as well.
4. System to be used for recovery purposes only	**LFP**	Slack security settings ensure private communication between the sponsor and sponsee. No communication, texts, or emails from outside parties can be sent or received via SponsorLens.
5. System to enable video chat	**INT**	Utilize the Zoom app in Slack. The "Start call" feature within Slack enables users to create a video chat meeting instantaneously with their sponsor or sponsee.
6. System to send reminder to sponsor and sponsee if they have not been in contact for a customized period of time (*i.e., "Contact Nudge"*)	**INT** and **LFP**	Use Slack API and Cronify API to scrape messages and shared meetings in logs. SponsorLens sends an automated "Contact your sponsor nudges" to sponsees if they do not contact their sponsor within a customized period of time (*e.g.,* 3 days)

Table 7.1 – Continued from previous page

Requirement	Basis	Operationalization in SponsorLens
7. System to create dedicated space for sponsors to exchange support and sponsorship strategies to grow their capacity	**INT** and **LFP**	SponsorLens contains a private communication channel to enable all sponsor participants to write messages to each other.
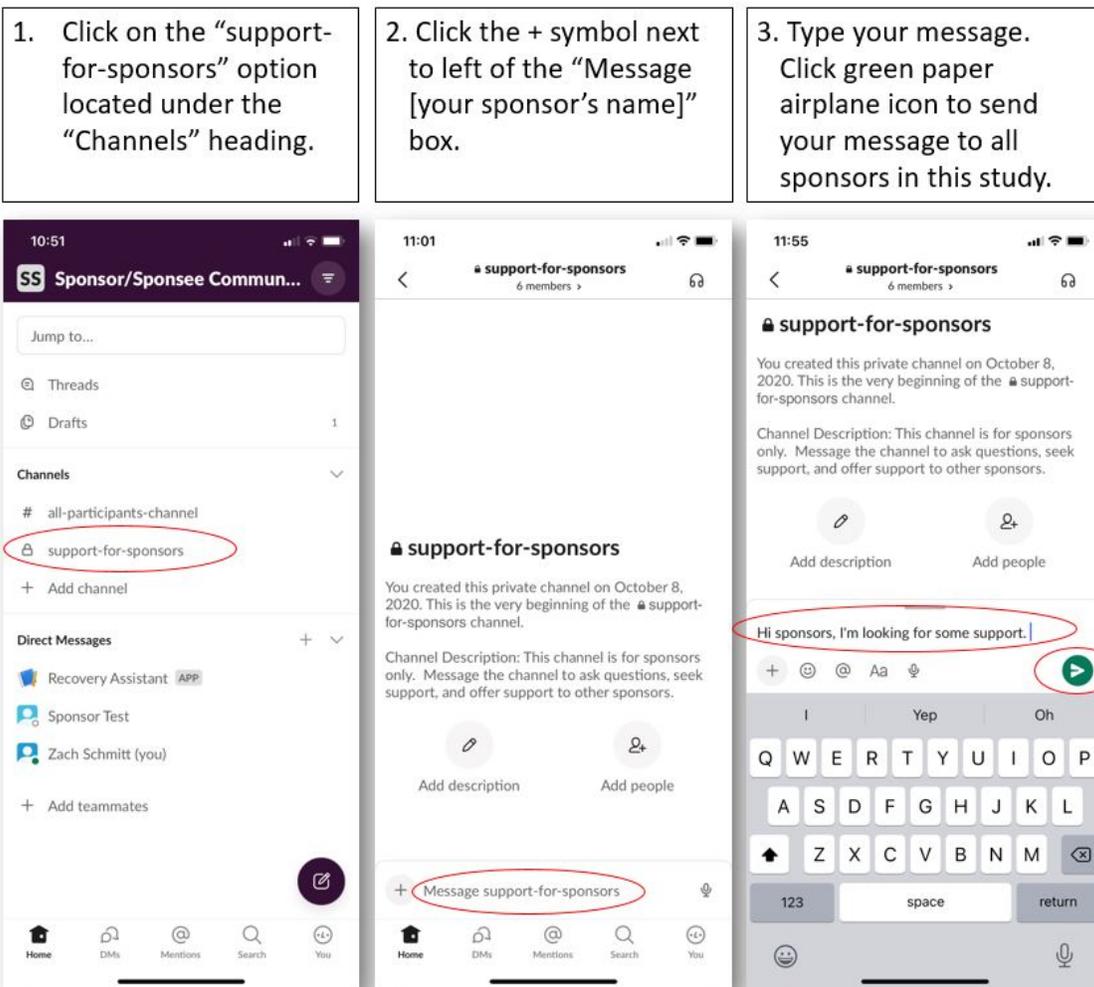
Figure 7.6: Image of SponsorLens. The "support-for-sponsors" channel provides a private space for all sponsor participants to ask questions, seek support, and offer support to each other throughout the study.

Chapter 8

Field Deployment of SponsorLens

8.1   Introduction

In previous chapters, I conducted a formative evaluation of **RQ3** through the development of a low-fidelity prototype based upon results from a participatory design study (*i.e.,* chapter 4) and an in-depth interview study (*i.e.,* chapter 5). I evaluated the low-fidelity prototype with eight participants in active recovery from SUDs (chapter 6). I utilized results from the low-fidelity prototype to design a high-fidelity prototype called SponsorLens (see chapter 7).

In this chapter, I rigorously investigate **RQ3** by conducting a four-week field deployment study of SponsorLens with four sponsor and sponsee dyads in active recovery from substance use disorders. **RQ3** asked, "How do peer dyadic mentorship pairs in SUD recovery perceive and utilize a computational system (*i.e.,* SponsorLens) that aims to support daily mentor logistics and promote frequent and consistent communication between mentor and mentee through behavioral nudging?" To analyze the participants' *"perception and utilization"* of SponsorLens, I use Bowen et al.'s [199] framework for conducting and analyzing feasibility studies concerning physical and mental health interventions. Feasibility studies are used to determine whether an intervention is appropriate for further testing; in other words, they enable researchers to assess whether or not the ideas and findings can be shaped to be relevant and sustainable [199]. In this chapter, I will utilize data from the field deployment study to assess whether SponsorLens is feasible and worthy of further

testing and investigation. Specifically, I will answer the following three questions suggested by Bowen et al. [199] concerning the feasibility of SponsorLens:

1. **Demand**: To what extent is SponsorLens likely to be used (*i.e.,* how much demand is likely to exist?)?

2. **Acceptability**: To what extent is SponsorLens judged as suitable, satisfying, and useful to participants?

3. **Practicality**: To what extent can SponsorLens be carried out with intended participants using existing means, resources, and circumstances and without outside intervention (*i.e.,* is the design of Sponsorlens usable and intuitive, or is it burdensome)?

This chapter begins with a detailed account of the study participants, research methodology, and data collection procedures used in the field deployment study of SponsorLens. I then report the deployment study's results in descriptive statistics and qualitative themes. Finally, I utilize those findings to discuss the extent to which SponsorLens was acceptable, practical, and in demand (i.e., feasible) among individuals in recovery from substance use disorders.

8.2 Methods

To investigate **RQ3** and determine SponsorLens's feasibility, I conducted a field deployment study (four weeks in length) with 4 pairs of connected sponsor and sponsee dyads (*i.e.,* eight total participants) in active recovery from substance use disorders. In this section, I detail participants, recruitment of participants, ethical considerations for participants, study procedure, data collection materials, and data analysis methodology.

8.2.1 Participants

Four pairs of connected sponsor and sponsee dyads (8 total individuals) participated in this field deployment study (see 8.1 and 8.2). To be eligible for this study, participants needed to have been in active recovery from SUDs, be in an active relationship with a sponsor or

sponsee, participate in this study alongside their sponsor or sponsee, and have access to an internet-capable device (*e.g.,* smartphone, laptop, tablet).

The number of participants recruited for this study was kept small (*i.e.,* eight participants) for two reasons. Primarily, feasibility studies often have a small number of participants in order to limit potential harm and risk associated with a new intervention. While there is no consensus, several studies recommend a sample size of approximately five to fifteen participants for an ethnographic feasibility study or field deployment study [200, 201]. Additionally, participants with highly stigmatized disorders have been historically challenging to recruit [202]. That difficulty is magnified when participants are recruited in pairs, as is the case in this study. Given these factors, the minimum number of participants needed to conduct this study was krpt small.

To aid recruitment, I partnered with a local sober living environment (*i.e.,* SLE) with which I had an existing partnership. The SLE manager agreed to disseminate a short recruitment flyer to other SLE managers within the state of Minnesota, members of AA meetings she attended, and individuals in her recovery network. The flyer contained pertinent details about the study as well as a link to a website that contained more detailed information about the study. Also contained in the website was a link to a participation sign-up form that collected contact information for the participant and their sponsor or sponsee, as well as questions to ensure study eligibility.

8.2.2 Ethical Consideration for Anonymity

I took several steps to safeguard participant anonymity during the study. First, I chose not to collect or report participant demographic data (*e.g.,* age, drug of choice, location, and other information which may identify a specific individual). Second, I received permission from the IRB to waive documentation of consent and permission from our departments to waive collecting signatures confirming compensation. By removing the requirements for documenting consent and compensation, I circumvented the need for participants to provide their full names at any point in the process. Third, I encouraged participants to use only a nickname or first name while using SponsorLens. Finally, all participant data was stored within encrypted environments to which only I had access. Data such as nicknames, emails, or phone numbers were stored separately from data collected via survey,

P#	Gender	Sober/Clean Time	Time w/ Sponsor	Fellowship
Sponsee 1	Female	1.8 years	1.6 years	AA, ACOA
Sponsee 2	Non-Binary	2.8 years	3 years	NA
Sponsee 3	Female	5.25 years	4.75 years	NA
Sponsee 4	Female	4.16 years	4.25 years	AA, CDA

Table 8.1: Sponsee demographics and fellowships. Fellowships included: AA, NA, HA (Heroin Anon.), ACOA (Adult Children of Alcoholics), CDA (Co-Dependents Anonymous.

P#	Gender	Sober/Clean Time	Time as Sponsor	Fellowship
Sponsor 1	Female	13 years	13 years	AA
Sponsor 2	Non-Binary	17 years	30 years	NA
Sponsor 3	Female	16 years	15 years	NA
Sponsor 4	Female	5 years	4 years	AA, AlAnon

Table 8.2: Sponsor demographics and fellowships. Sponsor 1 and sponsee 1 formed a connected dyad, as did sponsor 2 and sponsee 2, etc.)

questionnaire, and log usage.

8.2.3 Procedure and Data Collection

To investigate **RQ3** and determine SponsorLens's acceptability, practicality, and demand, I conducted a field deployment study (four weeks in length) with connected sponsor and sponsee dyads. I elected for a lengthy deployment (four weeks in length) to determine whether participants would elect to continue to engage with SponsorLens over an extended period and to determine if their engagement patterns would change over time.

Each participant was provided an individual tutorial regarding how to use the core features of SponsorLens. Participants were told how to use SponsorLens to send messages to their sponsor or sponsee, set up video chats, schedule meetings, and invite each other to a recovery-related event. Importantly, participants were explicitly told that the frequency and amount of time they chose to use SponsorLens throughout the four-week study was entirely at their discretion. There were no minimum usage expectations or usage requirements. Additionally, participants were informed that study compensation was not tied to

Week	Data Collection Schedule
Week 1	• Semi-Structured Interview • Questionnaire • Daily Craving Survey • Usage Logs • Participant On-boarding
Week 2	• Semi-Structured Interview • Daily Craving Survey • Usage Logs
Week 3	• Daily Craving Survey • Usage Logs
Week 4	• Daily Craving Survey • Usage Logs • Participant Off-Boarding • Questionnaire • Semi-Structured Interview

Table 8.3: Weekly schedule of study activities and data collection procedures for the field deployment study of SponsorLens

their usage of SponsorLens in any capacity (*i.e.,* participants could receive the full compensation amount offered to them even if they did not use SponsorLens at all). All participants received seventy-five dollars for their participation in the field deployment study.

During the four-week field deployment study, I collected data using four complementary methods, including 1) usage logs, 2) semi-structured interviews, 3) questionnaires, and 4) a daily craving survey sent via SMS text. See below for additional information regarding each data collection mechanism and a week-by-week breakdown of the data collection procedure (see table 8.3).

Usage Logs

First, SponsorLens logged all participant interactions while using the application, including text messages, video chats, meetings scheduled, documents shared, photos shared, and emoji reactions. Each interaction was stored within a SQL database with the respective participant ID, date, and timestamp. The content of participant messages was redacted prior to storage. In other words, The usage logs only stored the message's date, time, and sender – not the message's content.

Questionnaires

Before beginning the deployment study, sponsor and sponsee participants completed a questionnaire. The questionnaire given to sponsor participants asked demographic questions such as "How long have you been sober/clean?" Additionally, the questionnaire contained questions regarding the frequency of communication with their sponsee, such as, "Over the past two weeks, how often were you in contact with your sponsee (phone calls, texts, emails, in-person)?" Finally, the questionnaire contained questions from modified versions of Ragins and Scandura's expected costs and benefits to being a mentor instrument [158] and Allen and Eby's relationship quality questionnaire [203] (see appendix C to view the complete survey).

The pre-study questionnaire completed by sponsee participants was similar to but distinct from the sponsor questionnaire. The questionnaire asked sponsee participants demographic questions such as "How long have you been sober/clean?" Additionally, the sponsee questionnaire posed questions regarding frequency of communication with their sponsor, such as "Over the past two weeks, how often were you in contact with your sponsor (phone calls, texts, emails, in-person)?" Finally, the questionnaire asked questions taken from modified versions of Ragins and Cotton's satisfaction with mentor scale [204] and Ragins and McFarlin's mentor role instrument [205] (see appendix D to view the full survey).

Sponsor and sponsee participants completed a second questionnaire after the deployment study concluded (see appendices E and F). The post-study questionnaire featured the same questions as the pre-study questionnaire with the addition of a modified version of the system usability scale (SUS) [196] and a modified version of the user burden scale (UBS) [206].

Daily Craving Survey

I administered a daily one-question survey via SMS text message to all participants. The one-question survey asked, "Please rate how strong your desire was to use in the past 24 h" [207]. Participants responded on a scale from 1 to 10, with higher scores indicating greater craving.

I utilized Twilio [208], a HIPAA-compliant SMS text messaging software system, to send the daily survey to participants. Twilio has been used extensively within academic research settings and peer-reviewed research studies to conduct surveys with research participants (*e.g.,* [209, 210]). I chose to use SMS text messaging instead of the SponsorLens app interface to conduct this daily survey as to not artificially influence participants to log in and use SponsorLens to complete the survey.

Semi-Structured Interviews

Finally, I conducted three semi-structured interviews with each participant. The first interview occurred prior to the deployment of SponsorLens. I conducted the second interview at the end of the second week of the study. The third and final interview occurred after the deployment study was completed.

The first semi-structured interview was approximately 30 minutes long. The interview covered topics such as potential communication challenges during the COVID-19 epidemic and the quality of their current relationship with their sponsor or sponsee.

At the end of the second week of the deployment study, I conducted a 30-45 minute semi-structured interview with each participant. During the interview, I asked each participant what they liked and did not like about SponsorLens. I also asked if and how SponsorLens has helped or hurt their relationship with their sponsor or sponsee. Additionally, I utilized usage logs collected for each participant to ask specific questions about their usage of SponsorLens, such as, "We noticed that you only used this feature once, can you tell us about that?" or "We noticed that you used SponsorLens a lot during the first week of the study, but not as much the second week. Can you tell me why that was?"

Following the completion of the fourth and final week of the deployment study, I conducted the final semi-structured interview with each participant. The interview asked the same questions as the second-week interview. However, dissimilar to that interview, I asked

participants, "If you had a friend that was just about to start using SponsorLens with their sponsor/sponsee, what advice would you give them?" I also asked, "If SponsorLens was available for you to use from today forward, would you choose to use the SponsorLens with your sponsor or sponsee? Why or why not?" These questions were meant to explore the extent to which SponsorLens was usable or confusing and how likely participants would be to use SponsorLens in the future if it were made available to them.

8.2.4 Analysis

Each semi-structured interview was audio recorded, transcribed, and analyzed by the primary researcher. I used inductive thematic analysis characterized by the generation and constant comparison of open codes in order to reveal underlying themes (*e.g.,*[179, 180]). I began the analysis by performing line-by-line open coding and memoing the qualitative data collected from each interview. I identified short, individual units of meaning within the textual data [179]. I used the process of affinity diagramming to spatially cluster open codes based on similar meaning [180]. I then refined and combined these clusters to identify recurring and consistent themes across the sponsor and sponsee participants.

I performed descriptive analysis on usage logs, questionnaires, and surveys — the low number of participants recruited for this study disqualified statistical significance testing. Instead, I utilized data from logs, questionnaires, and surveys to capture potential significant trend shifts (via descriptive statistics) that may occur before and after the introduction of SponsorLens.

8.3 Results

In this section, I begin by performing a descriptive quantitative analysis of usage logs, questionnaires, and surveys. I then conducted inductive thematic analyses from the semi-structured interviews I conducted with sponsor and sponsee participants regarding their experience using SponsorLens. Later, in the discussion section, I utilize these results to determine whether SponsorLens is acceptable, practical, and in-demand among participants (*i.e.,* feasible).

8.3.1 Descriptive Quantitative Analysis

I performed descriptive analysis on usage logs, questionnaires, and surveys. The descriptive analysis of usage logs explores the extent to which participants used SponsorLens over the four-week deployment study. The analysis also details how participants reacted to and used behavioral nudges (*e.g.,* event nudges and contact nudges) sent via SponsorLens. Second, I analyze responses to questionnaires to explore the extent to which SponsorLens impacted relationship quality. Third, I detail participant responses to usability and user burden questionnaires regarding SponsorLens. Finally, I analyze responses to the daily craving surveys sent to participants.

8.3.1.1 Usage Logs

Participants used SponsorLens frequently and consistently throughout the four-week field deployment study (see figure 8.1). Participants communicated with their respective sponsor or sponsee via SponsorLens on 35 out of 36 days of the study. Communication in the context of this analysis includes direct messages, meetings scheduled, and event invitations. Sponsor and Sponsee participants sent 166 direct messages to each other; most of those were sent as text messages. Six of eight participants experienced sizable increases in their communication frequency (e.g., text messages, meetings, events) with their sponsor or sponsee while using SponsorLens compared to the two weeks prior to the start of the deployment study. For a detailed breakdown of usage logs by the individual sponsor and sponsee dyads, see appendices G through J.

In addition to communication, participants consistently utilized behavioral nudges sent by SponsorLens. Throughout the study, SponsorLens sent sponsees twenty-nine distinct "contact nudges," urging them to set up a meeting with a sponsor or contact their sponsor via direct message. SponsorLens sent those "contact nudges" if sponsees did not contact or schedule a meeting with their respective sponsor for three consecutive days. Of the twenty-nine contact nudges sent, Sponsees used seven of those nudges to schedule in-person or virtual meetings with their sponsors. Further, sponsees utilized ten of those contact nudges to send direct messages to their sponsors. Finally, sponsees dismissed or ignored twelve of the twenty-nine contact nudges sent to them (see figure 8.1).

In addition to contact nudges, participants were sent 33 "event nudges" throughout

# of Direct Messages Sent Between Sponsor and Sponsee	# of Contact Nudges Sent to Sponsees	# of Event Nudges Sent to Sponsors and Sponsees
166	29	33

Direct Message Breakdown	
text message	154
photo message	6
video call	4
audio message	2

Contact Nudge Results	
contact nudge dismissed	11
'I will message my sponsor' option selected	10
meeting with sponsor scheduled	7
contact nudge ignored	1

Event Nudge Results	
event nudge dismissed	16
event scheduled for sponsor & sponsee	8
personal event scheduled	5
no response to event nudge	3
event invitation sent and declined	1

Figure 8.1: SponsorLens usage among all participants over the 4-week deployment study

the study. In each event nudge, SponsorLens asked participants if they were attending any recovery-related events or meetings over the next week and if they would like to invite their sponsor or sponsee to attend the event alongside them. Of the 33 event nudges sent, participants utilized nine event nudges to invite their sponsor or sponsee to recovery-related events they were planning to attend - eight of which were accepted. Participants used five event nudges to schedule personal events such as naps, yoga, and meditation. The other 19 event nudges were dismissed or ignored (see figure 8.1).

As a result of these behavioral nudges (*i.e.,* contact nudges and event nudges), half of the participants experienced substantial increases in the number of in-person and virtual meetings and events they attended together compared to the two weeks before SponsorLens was introduced. The other half of the participants saw no change in their in-person meeting and event attendance frequency.

8.3.1.2 Relationship Satisfaction Questionnaires

Sponsee participants completed modified versions of the satisfaction with mentor scale [204] and mentor role instrument [205] before and after the deployment study to assess potential changes to their relationship satisfaction with their sponsor that may have occurred as a result of using SponsorLens. Eight of the twelve individual questions from the relationship satisfaction questionnaires elicited identical responses from sponsee participants pre and post-study. Three questions differed slightly from pre-study and post-study; however, the differences were minor. For instance, the average response to the question "My sponsor provides support and encouragement," was 5.00 (*i.e.,* "Strongly agree") post-study versus 4.75 pre-study, a difference of 0.25. Similarly, the question "My sponsor represents who I want to be," elicited an average response of 5.00 post-study versus 4.75 pre-study. Finally, the question "My sponsor is someone I identify with," elicited an average response of 4.00 after the study concluded and 4.50 before the study started. In addition, the total mean score among sponsees was nearly identical pre and post-study (pre-study = 4.75 vs. post-study = 4.77). Thus, despite some minor differences, sponsee participants answered questions related to relationship satisfaction similarly before and after the study suggesting that SponsorLens had a negligible impact on relationship satisfaction with their respective sponsors.

Question	Pre-Study	Post-Study	Difference
1. My sponsor is someone I am satisfied with.	5.00	5.00	0.00
2. My sponsor fails to meet my needs.	5.00*	5.00*	0.00
3. My sponsor disappoints me.	5.00*	5.00*	0.00
4. My sponsor has been effective in their role.	4.75	4.75	0.00
5. My sponsor is someone I can confide in.	5.00	5.00	0.00
6. My sponsor provides support and encouragement.	4.75	5.00	0.25
7. My sponsor is someone I can trust.	5.00	5.00	0.00
8. My sponsor serves as a role model for me.	4.75	4.75	0.00
9. My sponsor is someone I identify with.	4.50	4.00	-0.50
10. My sponsor represents who I want to be.	4.00	4.25	0.25
11. My sponsor serves as a sounding board for me to develop and understand myself.	4.75	5.00	0.25
12. My sponsor guides my personal development.	4.50	4.50	0.00
Total	4.75	4.77	0.02

Table 8.4: Sponsee responses to modified versions of the satisfaction with mentor scale [204] and mentor role instrument [205] pre-study and post-study. 1 = Strongly Disagree, 3 = Neutral, and 5 = Strongly Agree. Responses with an asterisk * have been flipped (*e.g.,* a 1 becomes a 5, a 2 becomes a 4, etc.). Blue text = Improvement and Red text = Decline.

Sponsor participants completed the expected costs and benefits of being a mentor instrument [158] and the relationship quality questionnaire [203] before and after the study to determine if any changes to their relationship satisfaction occurred as a result of using SponsorLens. Analogous to sponsee participants, the average sponsor response on the relationship satisfaction questionnaires was nearly identical pre and post study (pre-study = 4.40, post-study = 4.53) (see table 8.5). There were no large differences in individual questions except for the question, "My sponsee shared a lot of information with me that helped my recovery." The average response among sponsors regarding that question was 3.75 before the study, and 5.00 (*i.e.,* "Strongly agree") after the study concluded. All other differences in individual questions were 0.75 or less. Despite these minor differences, sponsor participants answered questions related to relationship satisfaction similarly before and after the study. This result suggests that SponsorLens had a negligible impact on relationship satisfaction with their respective sponsees.

8.3.1.3 Usability and User Burden

Participants completed the system usability scale (SUS) [196] after the deployment study concluded (see table 8.6). The SUS measures to extent to which an interface is usable and intuitive. The average participant usability score concerning SponsorLens was 75.00 (see Table 8.6). In an empirical study of ten year's worth of SUS scores collected from web and application interfaces, Bangor et al., [196] posits that a SUS score of 68.00 is "Average" and a score of 75.00 is "Above Average" and "Good."

In addition to measuring the usability of SponsorLens, I also measured the extent to which SponsorLens was burdensome to participants. To do so, I utilized the Suh *et. al.'s* [206] user burden scale (UBS) to assess the potential negative impact of SponsorLens across 4 different constructs: 1) difficulty of use burden, 2) time and social burden, 3) mental and emotional burden, and 4) privacy burden (see table 8.7).

The difficulty of use subscale measures the extent to which a computer system DOES NOT fit with the user's abilities and is challenging to use [206]. The mean difficulty of use subscale concerning SponsorLens was 0.38 (SD = 0.67) (see Table 8.7). A score closer to zero indicates that a system is NOT difficult to use, and a score closer to four indicates that a system is complicated to use. In an empirical study of 375 participant responses

Question	Pre-Study	Post-Study	Diff
1. The sponsorship relationship between my sponsee and I is very effective.	4.75	4.50	-0.25
2. I am very satisfied with the sponsorship relationship my sponsee and I have developed.	4.75	4.75	0.00
3. I am effectively utilized as a sponsor by my sponsee.	4.00	4.50	0.50
4. My sponsee and I enjoy a high-quality relationship	4.75	4.75	0.00
5. Both my sponsee and I benefited from the mentoring relationship	4.75	5.00	0.25
6. I learn a lot from my sponsee.	4.5	5.00	0.50
7. My sponsee gives me a new perspective on many things	4.5	5.00	0.50
8. My sponsee and I are "co-learners" in the sponsorship process	4.25	4.75	0.50
9. My sponsee shared a lot of information with me that helped my own recovery	3.75	5.00	1.25
10. Being a sponsor is more trouble than it's worth.	5.00*	4.75*	-0.25
11. Sponsoring takes more time than it's worth.	5.00*	4.50*	-0.50
12. There are more drawbacks to being a sponsor than advantages.	5.00*	4.75*	-0.25
13. Sponsoring takes too much time away from one's own job, responsibilities, and recovery.	5.00*	4.75*	-0.25
14. The sponsor/sponsee relationship can become unhealthy.	1.75*	2.50*	0.75
15. The major drawback of being a sponsor is the time commitment.	3.75*	3.50*	-0.25
16. Sponsoring is an energy drain.	3.75*	4.50*	0.75
17. Sponsors get a sense of fulfillment by passing their wisdom on to others	4.5	4.5	0
18. Serving as a sponsor can be one of the most positive experiences of one's recovery	4.75	4.75	0
19. Sponsoring makes one feel better about oneself.	4.25	4.5	0.25
20. The rewards that come from being a sponsor more than compensate for the costs.	4.75	5	0.25
21. Sponsees are an important form of support for sponsors.	4.5	4	-0.50
22. Sponsoring has a positive impact on the sponsor's recovery	4.75	4.75	0
23. Sponsors gain a sense of satisfaction by passing their insights on to others.	4.5	4.25	-0.25
Total	4.40	4.53	0.13

Table 8.5: Sponsor responses to modified versions modified versions of the expected costs and benefits to being a mentor instrument [158] and the relationship quality questionnaire [203] pre-study and post-study. 1 = Strongly Disagree, 3 = Neutral, and 5 = Strongly Agree. Responses with an asterisk * have been flipped (*e.g.,* a 1 becomes a 5, a 2 becomes a 4, etc.). Blue text = Improvement and Red text = Decline.

concerning 55 different systems, including Facebook, Netflix, Skype, and Fitbit, the mean difficulty of use subscale score was 1.22 (SD = 1.832) [206]. Thus, SponsorLens had a lower difficulty of use burden than similar web and application interfaces. However, I cannot determine statistical significance due to the low number of participants.

The mental and emotional burden subscale within the UBS assesses whether or not a system requires significant attention and concentration, is distracting, or makes the user feel bad or unnecessarily worry [206]. The mean mental and emotional subscale concerning SponsorLens was 0.094 (SD = 0.39) (see Table 8.7). A score closer to zero indicates that a system is NOT burdensome. The mean mental and emotional score amongst 55 distinct systems was higher than that of SponsorLens (Mean = 1.39; SD = 1.94) [206]. Thus, SponsorLens had a similar but lower mental and emotional burden than similar web and application interfaces.

The privacy subscale within the UBS measures the extent to which participants feel a system risks revealing information they would prefer not to share [206]. The mean privacy subscale concerning SponsorLens was 0.21 (SD = 0.51) (see Table 8.7). A score closer to zero indicates that a system is NOT burdensome. In comparison, the mean privacy score amongst 55 distinct systems was 2.59 (SD = 2.78) [206]. Thus, SponsorLens had a lower privacy burden than similar web and application interfaces.

Finally, The time and social burden subscale within the UBS assesses whether or not a system requires a significant amount of time to use or disrupts the user's ability to create and sustain social relationships [206]. The mean time and social subscale score concerning SponsorLens was 0.06 (SD = 0.25) (see Table 8.7). A score closer to zero indicates that a system is NOT burdensome. The mean time and social score amongst 55 distinct systems was noticeably higher (Mean = 4.57; SD = 1.832) [206].

8.3.1.4 Daily Craving Survey

I administered a daily one-question survey via SMS text message to all participants. The one-question survey asked, "Please rate how strong your desire was to use in the past 24 h" [207]. Participants responded on a scale from 1 to 10, with higher scores indicating greater craving.

Most participants self-reported a consistent and low level of craving throughout the

Question	Sponsees Avg.	Sponsors Avg	Total Avg.
1. I felt very confident using the system.	4.50	3.75	4.13
2. I found the system unnecessarily complex.	1.50	1.50	1.50
3. I found the system very cumbersome to use.	2.25	2.25	2.25
4. I found the various functions in this system were well integrated.	3.50	4.25	3.86
5. I needed to learn a lot of things before I could get going with this system.	1.50	2.50	2.00
6. I think that I would like to use this system frequently.	3.50	3.50	3.50
7. I think that I would need the support of a technical person to be able to use this system.	2.25	1.25	1.75
8. I thought the system was easy to use.	3.25	4.50	3.86
9. I thought there was too much inconsistency in this system.	2.25	1.50	1.86
10. I would imagine that most people would learn to use this system very quickly.	4.00	4.00	4.00
Total SUS Score*	72.50*	77.50*	75.00*

Table 8.6: Sponsee and sponsor responses to a modified version of the system usability survey (SUS) [196]. 1 = Strongly Disagree, 3 = Neutral, and 5 = Strongly Agree. *See citation for total score equation. Brooke [211] reports that a score of 68 is average and a score of 75 is "Good" and "Acceptable."

User Burden Subscale	Question	Sponsee Avg.	Sponsor Avg	Total Avg.
Difficulty of Use	1. I needed assistance from another person to use the app.	0.50	0.00	0.25
	2. It took too long for me to do what I wanted to do with the app	0.25	0.75	0.50
	3. The app demanded too much mental effort	0.50	0.50	0.50
	4. The app was hard to learn	0.25	0.25	0.25
	Subscale Avg.	0.38	0.38	0.38
Mental and Emotional	5. I felt guilty when I used the app	0.00	0.00	0.00
	6. The app presented too much information at once.	0.25	0.50	0.38
	7. The app required me to remember too much information.	0.00	0.00	0.00
	8. Using the app made me feel like a bad person	0.00	0.00	0.00
	Subscale Avg.	0.06	0.125	0.094
Privacy	9. I was worried about what information got shared by the app	0.25	0.25	0.25
	10. The app required me to do a lot to maintain my privacy within it.	0.00	0.50	0.25
	11. The app's policies about privacy were not trustworthy	0.00	0.25	0.13
	Subscale Avg.	0.08	0.33	0.21
Time and Social	12. I spent too much time using the app	0.00	0.00	0.00
	13. I used the app more often than I should have.	0.50	0.00	0.25
	14. The app distracted me from social situations.	0.00	0.00	0.00
	15. Using the app had a negative effect on my social life	0.00	0.00	0.00
	Subscale Avg.	0.13	0.00	0.06

Table 8.7: Sponsee and sponsor responses to the user burden scale [206]. 0 - 4 Likert scale. Depending on question, 0 = Never, 2 = Sometimes, 4 = All the time or 0 = Not at all, 2 = Somewhat, 4 = Extremely.

study, while three participants self-reported variable levels of craving (see figure 8.2). The low levels of self-reported craving across the majority of participants may have been due to the extensive experience in recovery across participants. Individuals new to recovery are more susceptible to high and variable craving levels than individuals established in recovery.

The descriptive analysis did not reveal any overt connection between the level of craving and utilization of SponsorLens. Future studies with a larger sample size are needed to determine a connection if one does indeed exist. These data will be used as a pilot study and will provide the expected mean and variance for future power analyses.

8.3.2 Qualitative Analysis

Through inductive thematic analysis of participant interviews, I identified five themes representative of participants' experience using SponsorLens. 1) *The Dyadic Focus of SponsorLens Meets Needs of Individuals New to Recovery*, 2) *Expanding SponsorLens to Meet the Needs of Individuals with Greater Experience in Recovery*, 3) *Singleness of Purpose Led to Increased Feelings of Security and Privacy*, 4) *Behavioral Nudges Increased Awareness and Mindfulness in Recovery*, and 5) *Tensions Between Usability and Discretionary Effort in digital communication.*

8.3.2.1 *The Dyadic Focus of SponsorLens Meets Needs of Individuals New to Recovery*

According to participants, the current dyadic focus of SponsorLens (*i.e.,* allowing communication to occur only between a sponsor and sponsee within SponsorLens) meets the needs of individuals new to recovery (*i.e.,* individuals in their first year of recovery). The beginning of one's recovery journey is often the most challenging and tumultuous as individuals need to adjust to changes in daily routine and social support structures. Because of this, the relationship with one's sponsor is crucial in the early stages of recovery. Participants consistently discussed how the current design of SponsorLens can help strengthen the sponsor and sponsee relationship in these early stages of recovery. First, participants stated that SponsorLens would help new sponsees feel more comfortable reaching out to their sponsor for help and guidance. Second, participants stated that SponsorLens would

Figure 8.2: Daily craving scores of all Participants for each day of the deployment study. The one-question survey asked, "Please rate how strong your desire was to use in the past 24 h" [207]. Participants responded on a scale from 1 to 10, with higher scores indicating greater craving.

help new sponsees establish consistent communication routines with their sponsor. Finally, participants discussed how SponsorLens would help spur new sponsees to action if they begin to neglect their relationship with their sponsor. I explore each of these three factors in greater detail below.

As stated above, several participants stated that SponsorLens would help individuals new to recovery feel more comfortable reaching out to their sponsor for help and guidance. For example, sponsee 3 and sponsor 4 discussed how SponsorLens would have made them more comfortable reaching out to their sponsors early in their respective recoveries. Sponsor 4 stated, *"When I was first starting out [in recovery], it was so scary to pick up the phone [to call my sponsor] the phone felt like it weighed a hundred pounds. But I think getting the reminder to contact your sponsor through SponsorLens would make the act of contacting your sponsor easier. Especially starting out. [SponsorLens] would be really really slick in that regard."* Sponsee 3 echoed that sentiment stating that for new sponsees *"it can be really hard for folks to start [the conversation]. Building that relationship and reaching out is really hard. You think [to yourself] that I don't want to bother [your sponsor]. But kind of having just those little nudges [from SponsorLens], I think I think it certainly would help a new relationship [get started]."*

In addition to making new sponsees more comfortable in reaching out to their sponsor, participants also discussed how SponsorLens would help individuals new to recovery by establishing a consistent communication routine with their sponsor. Sponsor 2 spoke about the importance of establishing a routine of consistent contact with one's sponsor at the beginning of recovery and how SponsorLens would support that process. She stated, *"especially early recovery when you have a lot more contact with your sponsor. Reminding [sponsees] to contact their sponsor could be really helpful because it does not always cross their mind and was not part of their life before. You know, it could possibly be very helpful."* Sponsee 2 also discussed how SponsorLens would help those new to recovery to establish a strong connection with their sponsor in the first months of their recovery, stating, *"if they were a newcomer I would encourage them to use the SponsorLens of every day to establish that connection with their sponsor and use the SponsorLens reach out daily."*

Finally, participants discussed how the nudges sent by SponsorLens could be the difference between a new sponsee reaching out to their sponsor and falling out of contact

altogether. Sponsor 3 stated, *"sometimes I might hear from a new sponsee for the first week, and after that I never hear from them again. You never know if that nudge [from SponsorLens] just might come at the right time and kind of snap somebody back into reality. So I think, yes, it would be definitely more helpful to somebody who's early in recovery versus somebody who's maintaining a recovery."* Sponsee 4 discussed how the nudges would be very helpful with some of her newer sponsees, *"So that nudge that says 'hey you don't have something set up with your sponsor maybe that's something you want to set up' would be really helpful with one of my sponsees. I'm thinking of one in particular where we've canceled a couple times and now I'm kind of waiting for her to be 'like hey I haven't seen you in like a few weeks, maybe we should schedule a time to read.'"*

In conclusion, participants stated that the current dyadic-focused design of SponsorLens is highly supportive of the needs of individuals new to recovery (i.e., individuals in the first year of their recovery). According to participants, the current design and features of SponsorLens would support new sponsees with establishing a communication routine with their sponsor and eliminate barriers preventing some new sponsees from reaching out for help. Finally, nudges sent by SponsorLens may help prevent new sponsees from falling out of contact with their sponsor. These results indicate that SponsorLens has the potential to garner high demand among individuals new to recovery. However, as I explore in the next section, a few additional features are needed to meet the needs of individuals with more extensive experience in recovery.

8.3.2.2 *Expanding SponsorLens to Meet the Needs of Individuals with Greater Experience in Recovery*

In the previous section, I detailed how all eight participants stated that the dyadic focus of SponsorLens is well-suited for individuals new to recovery. However, participants also stated that SponsorLens does not currently meet all of the needs of individuals with more extensive experience in recovery who also have an established relationship with their sponsor and sponsee. In order to meet the needs of individuals with established relationships with their sponsor or sponsee, participants suggested that SponsorLens integrate all members of the sponsorship family into the environment of the app (not just the sponsor and sponsee). A sponsorship family is an interconnected group of individuals in recovery that

share sponsors or sponsees. Participants discussed several benefits of potentially integrating the sponsorship family into the SponsorLens app. These benefits include expanding the peer support circle that attends recovery-related events, lessening the logistic load placed upon sponsors, and providing more holistic support to struggling individuals. Below, I explore these benefits as well as some potential drawbacks of changing the focus of SponsorLens from a dyadic focus (sponsor and sponsee only) to a group focus (i.e., integrating all members of the Sponsorship family into the environment of SponsorLens).

All eight participants in this study, all of whom have at least one and a half years of experience working with their sponsor or sponsee, stated that SponsorLens should incorporate their sponsorship family into the app's environment to meet their specific social support needs in recovery. Sponsee 2 stated, *"It would be great if there were features in the app to add sponsee siblings or like you know grand sponsors... that family structure, that would be really, really cool I mean I could throw out a meeting or event invitation to like five people or eight people at once."* Sponsor 4 also saw great value in changing SponsorLens to have a group-based focus, *"I feel like it [integration of sponsorship family] would be very cool. Like if I could send an invitation through the app to all the women I sponsor at the same time, it would give everybody an opportunity to say I'm free tonight, I'll go too. So almost like a group chat function, and I think it would be cool to just for that, especially the women I sponsor to just go to all of them.".*

In addition to enabling more inclusive event invitations, participants stated that a group focus would expand peer support from a single sponsor to a more extensive network - an aspect that can be very helpful if a member of the sponsorship family is struggling in recovery. For example, sponsor 3 stated that integrating the sponsorship family into the app would allow *"us all to communicate together. So if somebody in our group is really struggling, anyone can just chime in and offer support."* Similarly, sponsor 4 stated that having the sponsorship family in the app would add a more diverse set of experiences to peer support, *"expanding that circle is super important because what if I as the sponsor don't have experience with that specific problem? I can say here's somebody who does. The opportunity to be like this is what I'm struggling with this...does anybody else have experience with this that could talk to me would be super helpful."*

Sponsors in this study also stated that incorporating all of their sponsees into Sponsor-Lens would lessen the logistic load inherent in sponsorship. For example, Sponsor 4, who had 3 sponsees, wanted SponsorLens to send reminders and meeting nudges to all of her sponsees (not just one sponsee) to take that logistic load off her shoulders. *"Sometimes it is just hard for me to remind my sponsees that it's not my job to reach out for you, it's your job to reach out because really important for you. I forget to give those reminders and know it'd be nice to have that part taken care of by [SponsorLens]. Especially the scheduling days and times for meetings, because that can get hard to I guess we get our lives back and we're busy like being able to schedule, things can get tough."*

In addition to the benefits of integrating the sponsorship family into SponsorLens, participants also discussed two potential drawbacks. First, participants suggested that the app's overall number of sponsorship family members remain small. Sponsee 2 stated that it is essential to keep the group membership from becoming *"too large...would be really cool I mean to throw out an event to like five people or eight people [and not too many more than that]."* In addition to limiting the size of individuals, participants also warned of potential difficulty in persuading all members of a sponsorship family to use SponsorLens. Sponsee 4 stated, *"How I would get buy in from the people in my sponsorship family to use an APP like this, especially when there's varying ages and varying ways of doing things? There's a lot of autonomy and sponsorship so trying to get people to see the value in it might be a struggle."* This varying usage may create an imbalance within the sponsorship family, with members that use the app seeing more opportunities to connect than those who prefer not to use the app.

In conclusion, participants stated that SponsorLens's dyadic focus meets the needs of individuals new to recovery by supporting their relationship with their sponsor - an aspect crucial to early success in recovery. Specifically, participants stated that SponsorLens has the potential to help new sponsees establish a communication routine with their sponsor, eliminate barriers preventing some new sponsees from reaching out for help, and finally, prevent new sponsees from falling out of contact with their sponsor. While this dyadic focus is helpful to individuals new to recovery by supporting their relationship with their sponsor, it is less helpful to individuals with more extensive experience in recovery who have already established a strong relationship with their sponsor or sponsee. In order to meet the needs

P#	Sponsor and Sponsee *Dyadic Version*	Sponsorship Family *Many to Many Version*
Sponsor 1	Yes	Yes
Sponsee 1	Yes	Yes
Sponsor 2	No	No
Sponsee 2	No	Yes
Sponsor 3	No	Yes
Sponsee 3	Yes	Yes
Sponsor 4	No	Yes
Sponsee 4	Yes	Yes

Table 8.8: Participants Response as to Whether They Would Use SponsorLens in the Future

of these more experienced individuals, participants suggested that SponsorLens change to a group focus and integrate all members of one's sponsorship family. This change would benefit individuals in recovery by expanding the peer support circle that attends recovery-related events, lessening the logistic load placed upon sponsors, and providing more holistic support to struggling individuals.

I asked participants in this study, who had extensive experience in recovery and an established relationship with a sponsor or sponsee, whether they would choose to use SponsorLens in the future if it was available to them after the study. Half of the participants stated that they would choose to use SponsorLens as it is currently designed (dyadic focus). However, seven of eight participants stated they would choose to use SponsorLens in the future if they were allowed to integrate their sponsorship family into the app. They prefer to use an app with a group focus (see table 8.8). Therefore, to meet the evolving needs of those in recovery, SponsorLens will need to evolve to support individuals throughout their recovery journey. Participants stated that SponsorLens should focus on supporting the sponsor and sponsee relationship first and foremost and allow individuals to integrate their sponsorship family into the app if they choose to do so.

8.3.2.3 *Singleness of Purpose Contributed to Feelings of Security and Privacy*

Several participants discussed the benefits of a sponsor/sponsee communication app dedicated to recovery. Participants saw great benefit in excluding messages from work, family,

and friends and focusing solely on recovery. Sponsee 1 stated that this singleness of purpose engendered greater feelings of security and privacy while using SponsorLens compared to other messaging apps. *"I do not know why I feel this way, but I feel like it [SponsorLens] is a little bit more secure than just texting back and forth. I like that it is just us. There are no messages from work, friends or family."* Sponsor 1 echoed that sentiment, *"I wonder if it hasn't improved [our relationship] because of the dedicated nature of the app. It feels more secure and private for her. Our relationship has seemingly shifted a little toward the more intimate more trusting."* Sponsee 2 stated she appreciated immersing herself in recovery while using SponsorLens without the fear of getting disrupted, *"You know, I like that I can avoid disruption from work or friends. I like that it's dedication to recovery."*

The singleness of purpose inherent in SponsorLens may also help individuals in recovery by eliminating privacy fears present when reaching out for help. Sponsee 4 also said she would feel more secure reaching out for help using SponsorLens than through other communication channels. *"I could see that being a beneficial thing, especially because on like social media like for me anonymity on social media is super important. I don't post anything recovery related. But I would feel safe in something like this where it is just people in recovery. To be like, hey, I am struggling with this and feel okay to post about it."*

In conclusion, participants appreciated that SponsorLens is solely dedicated to recovery. In some cases, the singleness of purpose led to feelings of privacy and security. For some participants, the increase in security led to more intimacy and trust in the sponsor and sponsee relationship. For others, the increase in privacy eliminated barriers to asking for help.

8.3.2.4 *Behavioral Nudges Increased Awareness and Mindfulness in Recovery*

Throughout the interviews, participants consistently discussed ways SponsorLens helped increase their awareness and mindfulness in their recovery. Sponsee 3 talked about how the nudges were helpful to keep her relationship with her sponsor top of mind, especially when life gets busy. *"I like that you know I kind of get little nudges here and there. Like we all get busy and It can be easy to you know kind of fall out of contact. Just having those options of inviting your sponsor to attend this event, with you, is a helpful reminder."*

Sponsors also discussed how event nudges reminded them to stop and reflect on their

efforts to keep their recovery a priority in their weekly schedule. For instance, Sponsor 4 stated, *"It gives me a second to think of like well you know, maybe I didn't necessarily have something planned. So for me that's kind of helpful to be like you know what recovery-related things am I doing this week? It's kind of a nice little check-in with myself like I am I doing what I need to do for this week to take care of myself and my recovery".* Sponsee 1 echoed that sentiment but focused on how SponsorLens helps her maintain awareness of what she is doing for her recovery every week. She stated, *"You know, SponsorLens tends to remind you what you have you done for your own recovery this week, which can sometimes get lost in the midst of being busy. But it helps you make sure you're doing you know what you're supposed to be doing. Especially if I spent a couple of days and I haven't done anything at all, it reminds you to do something for yourself and your recovery like meditation."*

This increased awareness also increased feelings of accountability for sponsors and sponsees to commit to meeting regularly with each other. Sponsee 1 stated, *"The fact that I gotta think about this now, whether I had anything recovery-related scheduled this week. I like that feature a lot that made it. Sponsee 1 and I may or may not have had something scheduled… It was a nice reminder. We probably would have met anyway. But we may have put it off for a couple weeks."* Sponsor 1 also commented that nudges have helped keep her accountable in meeting regularly with her sponsee. She stated, *"I like that SponsorLens has has us being mindful of meeting regularly. Even though it hasn't significantly altered our schedules, it's making me more mindful of what we are doing and has led to more consistent scheduling."*

Finally, participants stated that the awareness of each other's schedules and upcoming events created additional opportunities to meet with their sponsor or sponsee. For instance, Sponsee 4 stated that through SponsorLens, her sponsor *"invited me to sober softball and she invited me to an Al anon meeting that she was going to. The Al anon meeting was something that like I knew that I should do, eventually, or at least just try out, but the APP did give me like hey remember this is happening at eight o'clock and you said you would go so now, you have to go kind of a thing."*

In conclusion, the behavioral nudges sent through SponsorLens led to increased feelings of mindfulness and awareness. Participants stated that SponsorLens increased their

awareness of the regularity of meetings with their sponsor and sponsee and led to increased consistency. Other participants reflected that SponsorLens led to increased mindfulness of actions that benefit their recovery. Finally, participants stated that SponsorLens led to increased opportunities to meet with their sponsor or sponsee and increased their accountability in attending events.

8.3.2.5 *Tensions Between Usability and Discretionary Effort in Digital Communication*

Throughout the interviews, participants expressed diverging opinions regarding the usability of the scheduling interface within SponsorLens. Most participants praised the scheduling interface, saying it was efficient and easy to use and allowed them to schedule meetings and events without excess time or effort. However, others stated that the interface's ease of use felt businesslike and sterile. These participants preferred to have an opportunity to invest additional effort when scheduling meetings.

For example, several participants stated that the usability of SponsorLens was helpful, stating that the interface saved time, especially when scheduling a meeting with their sponsor or sponsee. Sponsee 4 stated *"I really like the scheduling schedule a lot, I think it's super helpful. Especially that it goes right to my calendar. I'm a fan of that. I also like the option [of giving my sponsor] three different times to meet, it's just seems very efficient to me"*. Sponsee 1 echoed that statement saying, *"I like you can put every [meeting option] in one message, and the sponsor can accept or not. Yeah even if you're like you know, in a rush you can quickly stop and answer the text you can just hit the button and we can meet."*

Other participants stated that the interface was highly intuitive. Sponsor 3 stated, *"the APP was really easy to use, once you explained everything, it was self-explanatory. I do like the the prompts about events this week um and you know just the opportunity to invite someone."* Finally, when asked if she would have any advice for new users of SponsorLens, Sponsor 4 stated, *"I do not think I would have any advice because the app was very straightforward. Everything is right there on the main screen, I never had to go digging around."*

However, some participants stated that SponsorLens's time-saving and intuitive interface was counterproductive. They said the usability-focused design of the scheduling interface felt businesslike and bereft of interpersonal connection. Instead, they wanted an opportunity to put forth more effort while scheduling meetings in order to form personal connections with their respective sponsor or sponsee. For example, Sponsee 4 said the scheduling interface at times felt *"non-personal and businesslike when you are just pushing buttons rather than talking to your sponsee [to schedule a meeting]."* She recommended that *"when you schedule, you should be able to add a little message or an emoji or a picture you know, so it feels a little more...like hey we're just two people."* This response is not without precedence in HCI. Kelly *et al.,* [212] identified that people in close relationships value the effort invested into creating digital messages. Thus, the time-saving and easy-to-use scheduling interface of SponsorLens may be antithetical to creating meaningful personal connections via digital messages. Future versions should allow users to put forth discretionary effort when interacting with their sponsor or sponsee.

8.4   Discussion

In this section, I first discuss the principle feasibility results of this study. Second, I discuss the limitations of this study

8.4.1   Principle Feasibility Results

In this section, I utilize findings from the field deployment study to assess whether SponsorLens is feasible and worthy of further testing and investigation. Specifically, I discuss Sponsorlens through the lens of three critical tenants of feasibility: 1) demand, 2) acceptability, and 3) practicality [199].

Demand

Demand is the extent to which a new idea, program, process, or measure is likely to be used [199] and is a crucial measure of feasibility. Two key questions that help determine the level of demand include whether participants chose to use the computer system and whether they plan to continue using it in the future. Below, I utilize results from the deployment

study to answer those questions and determine if there is demand for SponsorLens as an intervention for individuals in recovery from substance use disorders.

According to usage logs (section 8.3.1.1), participants used SponsorLens frequently and consistently throughout the 4-week deployment study. Participants utilized SponsorLens to communicate, schedule meetings, or send event invitations on 35 of the 36 days in the study. Within those 35 days, participants sent 166 direct message and frequently utilized "contact nudges" and "event nudges" to schedule meetings to schedule fifteen individual meetings with their sponsor or sponsee and five personal events. Additionally, figure 8.1 illustrates that participants used SponsorLens as much in the final two weeks as they did during the first two weeks (except for the first day). This enduring engagement is highly representative of strong demand, especially considering there was no established requirement for participants to use SponsorLens. Instead, using SponsorLens was completely voluntary.

Participants also indicated their firm intention to continue to use SponsorLens in the future. All individual participants indicated that the current dyadic focus of SponsorLens would be in high demand amongst individuals new to recovery (if it was made available to them) (section 8.3.2.1). Participants stated that the dyadic focus of SponsorLens has the potential to help new sponsees establish a communication routine with their sponsor, eliminate barriers preventing some new sponsees from reaching out for help, and finally, prevent new sponsees from falling out of contact with their sponsor.

While this dyadic focus is helpful to individuals new to recovery by supporting their relationship with their sponsor, it is less helpful to individuals with more extensive experience in recovery who have already established a strong relationship with their sponsor or sponsee. In order to meet the needs of these more experienced individuals, participants suggested that SponsorLens change to a group focus and integrate all members of one's sponsorship family. Seven of eight participants stated they would choose to use SponsorLens in the future if the sponsorship family was integrated into the app (section 8.3.2.2). This change would be straightforward to implement for future versions.

In conclusion, participants used SponsorLens frequently and consistently throughout the study. Additionally, most participants stated they would continue to use SponsorLens if it is expanded to include the sponsorship family. These findings strongly indicate that

SponsorLens is in demand amongst participants in this study.

Acceptability

Acceptability, in the context of this study, is the extent to which a new idea, program, process, or measure is judged as suitable and satisfying to program recipients [199]? To assess acceptability, Bowen et al.,[199] recommend that a feasibility study measure an intervention's perceived positive and negative effects on an organization or community. Below, I explore how results from the deployment study suggest that SponsorLens positively impacted the sponsorship relationship without incurring adverse effects.

Primarily, usage logs suggest that SponsorLens positively impacted the frequency of communication and in-person contact between sponsors and sponsees (section 8.3.1.1). Usage logs showed that six of eight participants experienced substantial increases in their communication frequency with their sponsor or sponsee while using SponsorLens. Further, half of the participants experienced increases in in-person contact with their sponsor or sponsee (via in-person meetings or recovery events). The other four participants experienced no difference. Consistent in-person contact was a widely agreed upon goal amongst participants in chapter 5 of this manuscript.

Furthermore, interviews with participants indicated that SponsorLens's singleness of purpose led to increased feelings of privacy and security while communicating with their sponsor or sponsee (section 8.3.2.3). These feelings of privacy and security led to increased intimacy and trust between sponsors and sponsees. Participants also discussed how behavioral nudges sent through SponsorLens led to increased feelings of mindfulness and awareness in recovery (section 8.3.2.4).

While the above results indicated that SponsorLens had several positive impacts on the sponsorship relationship, the deployment study also indicated that Sponsorlens did not negatively impact or disrupt sponsorship - a key tenant of acceptability. For example, participant responses to relationship satisfaction questionnaire suggest that SponsorLens did not negatively impact their satisfaction with their sponsor or sponsee (section 8.3.1.2). Furthermore, all eight participants stated in interviews that SponsorLens did not distract from or hurt their core relationship with their sponsor or sponsee. For instance, sponsee 4 stated that she was skeptical of the idea of SponsorLens before the study began but liked

that SponsorLens was not a distracting or intrusive presence within her relationship with her sponsor. *"I actually liked the app a lot more than I thought I would. I was skeptical because when I'm working with sponsees I very much like them to take the initiative to call me. But this isn't as like pushy as I was expecting it to be, so I really like that."* Sponsee 1 commented that she appreciated that the app did not try to replace in-person communication. *"I like that It's not a replacement [for sponsorship] either, which I find very valuable. I've had sponsor relationships in the past, where more communication happens over messenger than anything else, I don't want in that in my relationship. I like that it encourages in-person meetings and events."*

In conclusion, SponsorLens positively impacted the sponsor relationship by increasing frequency of contact, privacy and security, and awareness and mindfulness in recovery. Those positive effects were achieved without adding additional disruption or distraction to the relationship. These findings strongly indicate that SponsorLens is acceptable.

Practicality

In the context of this paper, *practicality* is defined as the extent to which an idea, program, process, or measure is carried out with intended participants using existing means, resources, and circumstances and without outside intervention [199]. In assessing practicality, I discuss participants' perception of SponsorLens's usability and user burden - two critical concepts of the practicality standard set by Bowen *et al.* [199].

Primarily, participants rated the usability of SponsorLens as being "Above average" and "Good" compared to similar interactive systems (section 8.3.1.3). Participant discussions within interviews confirmed this finding. Participants consistently described SponsorLens as "intuitive" and "easy-to-use." In addition to usability, participants indicated that SponsorLens had a low user burden. Participants in this study rated SponsorLens's difficulty of use, privacy, and social burden dramatically lower than similar web applications (section 8.3.1.3). The high usability and low user burden of SponsorLens suggest that it can be used effectively without outside intervention - a key tenant of practicality.

However, some participants stated that the time-saving and intuitive interface could be limiting (section 8.3.2.5). They wanted an opportunity to put forth more discretionary effort while scheduling meetings. Research from Kelly et al., echoed this sentiment [212].

Their research posits that people in close relationships value the effort invested into creating digital messages. Thus, future versions of SponsorLens should allow users to put forth additional discretionary effort when interacting with their sponsor or sponsee if they desire to do so.

In conclusion, participants perceived SponsorLens to be highly usable while simultaneously carrying a very low burden of use - both crucial criteria for meeting the practicality standard set by Bowen *et al.* [199]. The field deployment study demonstrated that participants could utilize SponsorLens within their daily lives and recovery without outside intervention or support.

8.4.2 Study Limitations

The field deployment survey was limited in several ways. First, six of eight participants identified as women, and the other two identified as non-binary. This sample presents a gender imbalance as no men participated in this study. While not atypical, women are more likely to volunteer for research studies [184, 185]. While this imbalance allowed me to focus more on the needs and priorities of women (an often-overlooked population in SUD research [141]) and non-binary individuals in recovery, future work should investigate the perspectives of individuals that identify as men as well.

Second, participants had an average of eight years of sober/clean time in recovery. Thus, this study did not adequately capture the insights and experiences of individuals new to recovery. However, the studies in chapters 4, 5, and 6 did include individuals new to recovery. Those studies heavily influenced the design of SponsorLens. Future studies should seek recruit individuals new to recovery as well as individuals with experience in recovery.

Third, this study focused on peer mentorship in 12-step recovery. While this approach is considered controversial as a "treatment", 12-step approaches are currently considered best medical practice for long-term maintenance programs [186] and thus should be investigated and supported. Detractors cite the core religious elements of the program [143] as an argument for alternative evidence-based approaches (*e.g.,* SMART Recovery [187], Cognitive Behavioral Therapy (CBT) [188]). However, I found it valuable to focus on 12-step recovery, as this approach is the most widely used form of long-term maintenance

and social support for individuals with SUDs [31, 32], it contributes to positive recovery outcomes [35], and it is recommended as a best practice by the NIH [191]. Due to my focus on 12-step recovery, some of our findings may be specific to the practices in these programs (*e.g.,* "managing anonymity"), while others (*e.g.,* establishing boundaries, building peer support networks) may apply to peer support more broadly. Investigations with other forms of peer support may help articulate the generalizability of these findings. Additionally, while AA and NA are international organizations active in 180 nations [48], there are geographic differences in how AA and NA practices are enacted that may diverge from our Midwestern U.S. sample. Despite these limitations, I believe this work provides valuable insight on how design may support peer mentorship in SUD recovery.

Finally, while the small sample size of this study was appropriate for a feasibility study [201], future studies should include a larger sample size to enable significance testing.

8.5 Conclusion

In **RQ3**, I asked, "How do peer dyadic mentorship pairs in SUD recovery perceive and utilize a computational system (*i.e.,* SponsorLens) that aims to support daily mentor logistics and promote frequent and consistent communication between mentor and mentee through behavioral nudging?" To answer this question, I conducted a 4-week field deployment study of a high fidelity prototype called SponsorLens with four sponsor and sponsee dyads. Results indicate that participants perceived SponsorLens to have high levels of demand, acceptability, and practicality as an intervention to support individuals in recovery from substance use disorders. These findings strongly suggest that SponsorLens is a feasible intervention worthy of further testing and investigation.

In addition to investigating RQ3, this study also addressed acute limitations within relevant related work. Specifically, while many supportive technologies for SUD recovery exist in today's marketplace, few, if any, have sought to design technology to support and enhance social support mechanisms in SUD recovery (see chapter 3). Through the development and testing of SponsorLens, I showed that a computational system could enhance and support the sponsorship relationship without causing undue distractions or burdens.

Chapter 9

Discussion

This dissertation investigates how technology can provide additional support for individuals attempting to make the difficult transition from acute treatment to long-term recovery from SUDs. Prior research indicates that the design of such technologies must consider how these systems can complement, rather than replace or contradict, the practices, values, and traditions of existing approaches to recovery [15]. This value-sensitive design is best conducted in close collaboration with relevant participants [16]. Therefore, I worked with individuals in recovery from SUDs to design and test technological solutions to help individuals overcome barriers to long-term care and expand the accessibility and efficacy of traditional treatment options.

In this chapter, I summarize this dissertation's key findings, limitations, and future directions.

9.1 Summary of Key Contributions

In this section, I discuss four broad contributions of this dissertation. First, in chapter 4, I conducted a participatory design study that led to an empirical understanding of the challenges, practices, values, and traditions of individuals in recovery from SUDs. Second, in chapter 5, I conducted an in-depth interview study that led to an empirical understanding of the specific challenges, needs, and motivations that should be considered when designing technologies to support dyadic mentorship in SUD recovery. Finally, I discuss the findings

from the field deployment study of SponsorLens outlined in chapter 8. This study led to two contributions. Primarily, this study contributed an open-source set of tools and extensions to Slack and Cronofy suite of technologies that can be used to support dyadic mentorship in SUD recovery and reused for future research. Further, findings from this research study led to a robust empirical understanding of the feasibility of a computational system that aims to support and enhance peer mentorship in SUD recovery. I discuss each of these contributions in more detail below.

9.1.1 An empirical understanding of the challenges, practices, values, and traditions of individuals in recovery from SUDs.

In chapter 4, I conducted six participatory design workshops with women living in a sober home to design technology supportive of their recovery. This research contributed to a broad empirical understanding of the challenges, practices, values, and traditions of individuals in recovery from SUDs. Additionally, this study led to the discovery of several implications for the design of computational support for SUD recovery.

First, I worked with participants to identify their most prominent day-to-day challenges in recovery. Participants indicated the most significant recovery obstacles included the complex logistics surrounding 12-step participation, forming new "sober" relationships, managing maladaptive emotional states (*e.g.,* restlessness, low self-esteem, and anxiety), physical self-care, and maintaining anonymity while using supportive technology.

Findings from this study also informed several implications for the design of technology to support recovery from SUDs. For instance, participant designs and sketches focused on tools that would empower individuals to leverage the robust peer support network (e.g., peer sponsorship) made available through their engagement in 12-step fellowships, revealing the possible benefits that technologies may provide to 12-step practices.

9.1.2 An empirical understanding of the specific challenges, needs, and motivations to be considered when designing technologies to support dyadic mentorship in SUD recovery

During the aforementioned participatory design workshops, participants independently and unanimously chose to design technology to support their relationship with their peer mentor

(*i.e.,* sponsor). The unanimous belief in the value of dyadic mentorship among participants led me to investigate how social computing may support this critical aspect of recovery support. To investigate how social computing may support or hinder dyadic mentorship, I conducted twenty-seven semi-structured interviews with fifteen mentors (i.e., sponsors) and twelve mentees (i.e., sponsees). This work contributed to a robust empirical understanding of dyadic mentorship pairs' challenges, practices, needs, and motivations in SUD recovery. Additionally, this work resulted in several implications for the design of social computing technologies to support dyadic mentorship in SUD recovery.

This work expanded our understanding of the challenges, practices, needs, and motivations of individuals engaged in peer mentorship relationships while in recovery from SUDs. For instance, sponsors and sponsees had divergent priorities when assessing compatibility and setting boundaries. While sponsors established boundaries to protect their recovery and discourage co-dependence, sponsees wanted and sought additional peer support through their broader recovery community. Second, participants engaged in frequent in-person meetings with their sponsor or sponsee and were wary of replacing that physical connection with mediated communication. Finally, participants were vigilant in protecting others' anonymity to mitigate SUD stigma but could choose to break their anonymity to make themselves available to help others.

These findings resulted in two design implications for technology to support peer mentorship in SUD recovery. Primarily, findings suggest that technology be used to help develop a sponsor's capacity to meaningfully support multiple sponsees without negatively impacting their recovery. While participants strongly suggested that technology not replace valuable in-person contact between a sponsor and sponsee, that does not mean that technology cannot develop sponsors' capacity. Technology could be vital in supporting daily sponsorship logistics, such as scheduling one-on-one meetings, receiving step work assignments, and following up with sponsees. Furthermore, findings from this study reveal that sponsors and sponsees rely on peer support networks to provide complementary support to the sponsorship relationship. Thus, I recommend that technology design assist individuals in recovery by building a vetted and diverse peer support network to complement sponsorship support.

9.1.3 An Open Source Set of Tools and Extensions to Slack and Cronofy to Support Dyadic Mentorship

I operationalized design requirements discovered in chapters four, five, and six to develop SponsorLens, a high-fidelity prototype designed to support dyadic mentorship in recovery. To develop SponsorLens, I utilized two existing enterprise systems, Slack (*i.e.,* Slack.com) [17] and Cronify (*i.e.,* cronofy.com) [197]. Developing a prototype using a currently available enterprise system is called "piggyback prototyping" and has precedence in Human Factors, and HCI research [19]. Piggyback prototyping provided SponsorLens with the robustness necessary to function efficiently during a four-week field trial (see chapter 8). This set of open-source tools and extensions to the Slack and Cronofy suite of technologies has been published to a publicly available GitHub [20] repository to enable its reuse to support dyadic mentorship in SUD recovery and for future research studies.

9.1.4 Empirical understanding of the feasibility of a computational system that aims to support and enhance peer mentorship in SUD recovery.

In chapter eight, I conducted a 4-week field deployment study of SponsorLens with participants in active recovery from SUDs. This research contributed to a rich empirical understanding of the overall feasibility of social computing interventions for dyadic mentorship in SUD recovery. Specifically, findings stemming from this research strongly suggest that participants perceived SponsorLens to be in-demand, practical, and acceptable - three critical tenants of feasibility [199].

9.2 Limitations

The research methodology used in this dissertation carries inherent limitations that warrant additional discussion. This section describes the limitations that exist across all three individual research studies described in this dissertation.

First, all three research studies utilize qualitative research methodologies. These research methodologies allowed me to incorporate the experience, values, challenges, and priorities of individuals in recovery from SUDs into the design of supportive technology -

something that would not have been possible with quantitative methods. Further, Malagon-Maldonado [213] argues that qualitative research should be used in health design when the goal is to "generate new knowledge about evidence-based healthcare design." Despite these noted advantages, the results of these qualitative studies have low generalizability and low external validity. Future research should account for these limitations by utilizing quantitative methods and randomized controlled trials to establish the causal efficacy of the interventions suggested within this dissertation.

Second, due to substance use disorders' private and highly stigmatized nature, it is difficult to recruit and retain participants for longitudinal and qualitative studies. For this reason, I worked with managers of sober living environments (SLEs) to recruit participants. While this strategy was adequate for the research contained in this dissertation, future research will need to seek more diverse participant samples to avoid a systematic bias in recruitment. For example, individuals in the early to mid stages of their recovery are over-represented in SLEs - excluding those with experience in recovery from having an equal voice in the design of technology to support recovery. Additionally, recruiting participants from SLEs or other in-patient recovery services will exclude participants who may need help with their substance use disorder but may not be able to ask for help or dedicate themselves to recovery. Future research should also work to identify additional ways to recruit individuals that represent the many factions in substance use recovery.

A further limitation was the relatively small sample sizes used in the three research studies outlined in this dissertation. These sample sizes did not allow me to conduct significance testing or establish causal relationships in the results. However, small sample sizes do not invalidate these qualitative studies' results. Research by Caine [201] suggests that the samples sizes used in the participatory design study (N=16; chapter four) and the interview study (N=27; chapter five) were approximately average in size compared to similar studies published at top Human-Computer Interaction conferences.

The sample size for the deployment study (Chapter 8) was purposely kept small (*i.e.,* eight participants) for two reasons. Primarily, feasibility studies often have a small number of participants to limit potential harm and risk associated with a new intervention. While there is no consensus, several studies recommend a sample size of approximately five to fifteen participants for an ethnographic feasibility study or field deployment study [200,

201]. Additionally, participants with highly stigmatized disorders have been historically challenging to recruit [202]. That difficulty is magnified when participants are recruited in pairs, as was the case in this study. Given these factors, the minimum number of participants needed to conduct this study was small.

Additionally, this dissertation was limited by the homogeneity of participants' recovery practices. Specifically, all participants were members of a 12-step fellowship or maintenance program to support their recovery. While the 12-step approach is considered controversial as a "treatment," 12-step approaches are currently considered best medical practice for long-term maintenance programs [186] and thus should be investigated and supported. Detractors cite the core religious elements of the program [143] as an argument for alternative evidence-based approaches (*e.g.,* SMART Recovery [187], Cognitive Behavioral Therapy (CBT) [188]). However, I found it valuable to focus on 12-step recovery for three reasons. First 12-step fellowships are the most widely used form of long-term maintenance and social support for individuals with SUDs [189, 190]. Second, prior research has shown that 12-step fellowships contribute to positive recovery outcomes [35]. Third, 12-step fellowships are recommended as a best practice by the NIH [191]. To increase representation, future research studies should incorporate participants engaged in other SUD recovery treatments and long-term maintenance programs in addition to 12-step fellowships (*e.g.,* SMART Recovery).

Finally, 41 of our 51 participants were women, presenting a gender imbalance. This imbalance is not atypical, as women are more likely to volunteer for research studies [184, 185]. While this imbalance allowed me to focus more on the needs and priorities of women in recovery (an often-overlooked population in SUD research [141]), future work should investigate the perspectives of men and non-binary individuals in recovery.

9.3 Future Directions

In this section, I discuss future directions for research featured in this dissertation. First, I discuss future research concerning SponsorLens. Second, I discuss how methods used in this dissertation can be expanded to other areas of computational support for substance use disorders. Finally, I discuss expanding dyadic mentorship technologies to other domains.

9.3.1 Next Steps for SponsorLens

In chapter eight, participants stated that SponsorLens's current dyadic focus meets the needs of individuals new to recovery but is less helpful to individuals with more extensive experience in recovery or those who have already established a strong relationship with their sponsor or sponsee. In order to meet the needs of these more experienced individuals, participants suggested that SponsorLens change to a group focus and integrate all members of one's sponsorship family. This change would benefit individuals in recovery by expanding the peer support circle that attends recovery-related events, lessening the logistic load placed upon sponsors, and providing more holistic support to struggling individuals. Future research is needed to scope, design, and test this change to ensure that it meets the needs of participants in supporting their relationship with their sponsor or sponsee and their recovery form SUDs.

Additionally, the results from chapter eight's deployment study indicate that Sponsor-Lens is a feasible intervention to support the sponsorship relationship in SUD recovery. Given this result, a randomized controlled trial of SponsorLens is the next logical step to determine SponsorLens's overall efficacy. In this future study, researchers will randomly assign participants to experimental (*e.g.,* SponsorLens) and control trials (*e.g.,* no SponsorLens) to determine if SponsorLens significantly impacts sponsorship and recovery. An RCT of SponsorLens could focus on the following research questions. First, to what extent does SponsorLens improve consistency and frequency in sponsor and sponsee communication? Second, does SponsorLens impact the frequency and quantity of substance use (*e.g.,* alcohol consumption) in recovery? Third, to what extent does SponsorLens lessen the logistic load placed on sponsors? Fourth, to what extent does SponsorLens increase the frequency of in-person contact with a social support network? Finally, to what extent does SponsorLens increase the longevity and quality of sponsor and sponsee relationships?

9.3.2 Expanding Patient-Centered Research Methodologies to Computational Support for Substance Use Disorders

In this dissertation, I utilized HCI-focused research methodologies and participant recruitment techniques that differ from traditional medical and clinical approaches toward developing computational support for substance use disorders. Whereas HCI design research

focuses on user experience, clinical practitioners focus on the effectiveness of novel treatment interventions through clinical trials and randomized controlled trials (RCTs) [22]. Specifically, the research methodologies and participant recruitment strategies used in this dissertation filled three significant gaps that consistently appear in medical and clinical computation support interventions for substance use disorders. First, I sought to represent patient values and priorities in the design process - an aspect typically missing from medical and clinical computational support research. Second, through participant recruitment strategies used in this dissertation, I sought to design technology to support the transition to and maintenance of self-managed long-term SUD recovery. Medical and clinical research computational research typically focuses on the acute treatment phase. Finally, I sought to design technology to support and enhance social support mechanisms in SUD recovery. This research focus was participant-driven and is a critical aspect of recovery often overlooked in computational support for substance use disorder.

In summary, the research methods used in this dissertation could benefit traditional medical and clinical computational support interventions by placing the patient at the center of the design process. Future clinical and medical computation research for SUD recovery should utilize patient-driven research methodologies and feasibility testing prior to clinical trials to ensure the intervention being tested is aligned with the needs, challenges, and values of individuals recovering from SUDs.

9.3.3 Expanding Dyadic Mentorship Technologies to other Domains

This dissertation focused on developing supportive technologies for dyadic mentorship in SUD recovery. However, dyadic mentoring exists in several domains outside of SUD recovery. For instance, prior research has shown that peer mentoring and group mentoring have positively impacted youth development [156], individuals with chronic illness in a healthcare setting [214, 215], and career development [216]. The supportive technologies discussed in this dissertation have the potential to positively impact peer mentorship in these domains and several domains outside of SUD recovery. Results from chapter eight suggest that supportive technologies can support peer-mentor relationships without placing additional burden or disruption upon the relationship. Future research should focus on aligning these supportive technologies with individuals' needs, values, and traditions in

each of the domains they are applied (*e.g.,* youth development, chronic illness, and career development).

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Appendix A

Acronyms

Care has been taken in this thesis to minimize the use of jargon and acronyms, but this cannot always be achieved. This appendix contains a table of acronyms and their meaning.

A.1 Acronyms

Table A.1: Acronyms

Acronym	Meaning
AA	Alcoholics Anonymous
APA	American Psychological Association
API	Application Programming Interface
AUD	Alcohol Use Disorder
CA	Cocaine Anonymous
CBT	Cognitive behavioral therapy
CM	Contingency Management
EMA	Ecological Momentary Assessment
EMI	Ecological Momentary Intervention
HA	Heroin Anonymous
HCI	Human-Computer Interaction

Continued on next page

Table A.1 – Continued from previous page

Acronym	Meaning
HUD	Heroin Use Disorder
IRB	Institutional review board
MDMA	3,4-methylenedioxy-methamphetamine
MET	Motivation Enhancement Therapy
NA	Narcotics Anonymous
OUD	Opioid Use Disorder
PD	Participatory design
SLE	Sober living environment
SMART	Self-Management and Recovery Training
SUD	Substance use disorder
SUS	System Usability Scale
UBS	User Burden Scale

Appendix B

Low Fidelity Prototype Study: Procedure, Worksheets, and Interview questions

B.1 Full Research Protocol

1. Overall introduction (5-10 minutes)

    (a) Introduce ourselves, Introduce the project, discuss its origins (designed by residents of Aurora House over summer 2017), and discuss what we will be doing today.

    (b) Consent Forms - Distribute Consent Forms

    (c) Introduce what a paper prototype is and why it's important to get input at this phase of building an app. . . .Something like the following. . .

         i. *The app you will be interacting with is called a paper prototype. It is essentially drawings of what the app will look like. As you will see shortly, you can interact with the drawings by clicking on them. Clicking on certain buttons will let you interact and explore the app - even though it's just a series of drawings at this point. You can navigate around but you can't type anything in, we just have sample text in the drawing for when you need to*

type something in. Its important for us to get your input on these early designs before we spend a lot time coding and building the real app, because it is very easy to make changes to drawings and not so easy to make changes to software code. So we want very honest feedback from you today, even if you don't like something about the app, you definitely won't hurt our feelings. In fact, if there is a problem with the app or something you don't like, it will save us a lot of time if you tell us at this point in the app design rather than later. Ok, so enough of me talking, now I will ask you to please get into pairs of two people so you can start interacting with the low fidelity prototype app.

(d) Place participants into groups of two (at most). Each group should have 1 researcher and a laptop with the paper prototype loaded and ready to go. (wireless mouse would also be nice)

1. Phase 1: Finding a Sponsor and Creating a Profile (25-30 Minutes)

    (a) **Phase 1** - (15-20 minutes)

        i. Researcher to ask participants if they consent to being recorded (audio only). It will never be shared and will be destroyed as soon as we transfer it to text. Name will never be given or shared with anyone. (make sure all researchers are ok using their smartphone to record, I guess we can also use laptops).

        ii. Hand out worksheet (See Appendix B.2 at the end of this document) containing instruction and tasks to each participant.

        iii. Researcher to read instructions to participants and make sure they understand what they are to do and what think aloud entails. The participant(s) then will work through the tasks on their own while 'thinking aloud'.

        iv. Researcher to ensure the app is on the "landing page" and in full-screen presentation mode.

    (b) **Phase 1 interview Questions** (5-7 minutes)

        i. Following phase 1 prototype testing, the interviewer will ask the following interview questions while showing the participant images of the app that

correspond to the question(s) in order to prompt there memory and allow them to answer more confidently.

ii. **Question #1:** (prompt user with images of sponsor search form – Click on the "My Sponsor button at the bottom left of the screen and then click the "find a sponsor" button.)

    A. How would you use these options to find a sponsor to meet your needs? What important aspects are missing from the search options right now?

iii. **Question #2:** (prompt user with images of sponsor profile at end of search – from the sponsor search screen, scroll to the bottom and click on the large green 'Search for sponsor button, then click on "Olivia W's" name.)

    A. Do you feel like this profile gives you enough information for you to make an informed decision on whether or not you want to contact this person regarding a potential sponsor relationship? Please explain why or why not.

    B. Are there other aspects of their personality, experience, expectations, etc. that would help you that are not currently listed on their profile?

iv. **Question #3:** (prompt user with images of the profile creation form – click on the "my sponsees" button on the bottom middle of the screen and then click on "profile icon" button at the top right of the screen, finally click on the "create profile" button)

    A. Are there any fields in the profile section that you would feel uncomfortable filling out/sharing on the app? Please explain why or why not.

    B. Are there other aspects of yourself or experience as a sponsor that you would like to share in your profile but there is currently no place to do so in the profile page? Please elaborate.

2. **Phase 2: Communicating and Scheduling Meetings** (25-30 Minutes)

(a) **Phase 2 Testing**

i. Hand out worksheet (See Appendix B.3 at the end of this document) to participants.

ii. Researcher to introduce the phase 2 scenario, instructions, and tasks by reading the instructions section on the worksheet.

iii. Researcher to make sure participants understand what they are to do and what think aloud entails. The participant(s) then will work through the tasks on their own while 'thinking aloud'.

3. **Phase 3: General interview and app usability survey (10 − 15 minutes)**

   (a) After the participants complete all the tasks on the worksheet, the researcher will ask the following questions to each participant:

   (b) **Question #1:** Thinking back on the app as a whole, in other words, think back on your experience using the app to find a sponsor, communicate with your sponsor and sponsees, schedule meetings, etc., What are the things you think this app should **KEEP** doing? In other words, what aspects of the app did you like and want to be included in the final version of the app?

   (c) **Question #2:** What are the things you think this app should **STOP** doing. In other words, what aspects of the app that you didn't like or the felt out of place?

   (d) **Question #3:** What are the things you think this app should **START** doing. In other words, what things you would add to this app that would make it more useful to you and your relationship with your sponsor? What features would increase the value of this app for you over using exiting text message/email functionality on your phone.

   (e) **Question #4:** If this app existed today, would you use it to communicate and schedule meetings with your sponsor and/or sponsees?

      i. If so, why?

      ii. If not, why not?

4. **Demographic Questionnaire and Modified System Usability Scale** [196] - (5-10 minutes)

   (a) Researchers to instruct participant that their final task is to fill out a short questionnaire - one page in length. (see appendix B.4).

(b) Researcher to make sure to align the participant ID # on the questionnaire with the participant ID # they assigned to each participant during the interview sections and think aloud sections. For example, researcher to make a note of which participant spoke first and give that specific participant the questionnaire (appendix B.4) with participant ID #1 written on it. Give the participant that spoke 2nd the below form with participant id #2 written on it.

B.2   Phase 1: Finding a Sponsor and Creating a Profile

B.2.1   Instructions

This app is designed to allow you to find a sponsor in your area that meets your specific needs in recovery. As we said, this is a preliminary version of the app called a paper prototype, and is a series of drawings with which you can interact and click on. You will use this laptop and mouse to interact with the app. You can click on the buttons on each of the drawings using your mouse.

When you begin, you will see what a brand new user of the app will see when they first open the app. We want you to imagine that you are a new user of the app and that you want to use the app to find a local sponsor for your recovery. Another thing you want to do is to fill out your own sponsorship profile on the app to allow potential sponsees to find you and contact you.

Below, you will see a list of specific tasks we want you to complete using the app. While you are interacting with the app, we would like you to think aloud. In other words, we want you to say what you are thinking and doing while you use the app out loud so that we can hear what you are thinking while you are using the app. This will help us identify areas of the app that are confusing or need to be re-designed. Do you have any questions at this point?

B.2.2   Tasks to Complete

1. Click the **"Get Started"** button to sign up for the app.

2. Use the app to search for a sponsor (find and view Olivia W.'s sponsor profile).

3. Imagine you already have a sponsor and don't need to use the app's sponsor search feature. Instead, use the app to invite your current sponsor to use the app with you.

4. Fill out your user profile to allow potential sponsees to find and contact you via this app.

5. If you have completed all these tasks, feel free to explore the app on your own.

B.3 Phase 2: Communicating and Scheduling Meetings

B.3.1 Instructions

For this phase of app testing, imagine you have been using the app for a few months now and you have found a sponsor and you also have three sponsees. At this stage in using the app, the app is designed to help you communicate with your sponsor and sponsees. The app is also designed to allow you to schedule face-to-face meetings with your sponsor and sponsees and alert you if you have not contacted or met with your sponsor or sponsee for an extended period of time. Finally, the app will also in allow you to do things like share homework assignments, photos, and documents with your sponsor and sponsees.

Below is a list of tasks that we want you to accomplish using the app. While you are interacting with the app, we would like you to **think aloud**. In other words, please say aloud what you are thinking and doing while you use the app. This will help us identify areas of the app that are confusing or need to be re-designed.

B.3.2 Tasks to Complete

1. Click on the 'Sign In' button in order to login to the app.

2. Find when you are next meeting with your sponsor and view your last few text messages with your sponsor.

3. Imagine that you will be traveling next few days and you want to use this app to make sure all of your sponsees are doing well - check in on each of them using the app.

4. Check your upcoming meeting schedule with your sponsor and sponsees.

5. Check your custom reminder settings within the app.

6. If you have completed all these tasks, feel free to explore the app on your own.

B.4   Phase 3: App Usability Survey

Participant ID: _____   Researcher: _____

Sponsorship History

1) How long have you been in recovery? _____

2) Do you have a sponsor?   Yes / No (circle one)
        a. If yes, for how long? _____
        b. If no, have you had a sponsor in the past?   Yes / No (circle one)

3) Are you currently a sponsor? Yes / No (circle one)
        a) If yes, for how long _____ and how many sponsees do you currently sponsor? _____
        b) If no, have you ever been a sponsor in the past?   Yes / No (circle one)

4) Which fellowship meetings do you attend (examples: AA, NA, OA)? (Write in space provided below)

App Usability Scale

Instructions: For each of the following statements, mark one box that best describes your reactions to the app today.

	Strongly Disagree		Neutral		Strongly Agree
5. I think that I would like to use this app frequently.	☐	☐	☐	☐	☐
6. I found this app unnecessarily complex.	☐	☐	☐	☐	☐
7. I thought this app was easy to use.	☐	☐	☐	☐	☐
8. I think that I would need assistance to be able to use this app.	☐	☐	☐	☐	☐
9. I found the various functions in this app were well integrated.	☐	☐	☐	☐	☐
10. I thought there was too much inconsistency in this app.	☐	☐	☐	☐	☐
11. I would imagine that most people would learn to use this app very quickly.	☐	☐	☐	☐	☐
12. I found this app very awkward to use.	☐	☐	☐	☐	☐
13. I felt very confident using this app.	☐	☐	☐	☐	☐
14. I needed to learn a lot of things before I could get going with this app.	☐	☐	☐	☐	☐

Figure B.1: Survey given to participants at the end of low-fidelity prototype session [196].

Appendix C

Pre-Study Questionnaire: Sponsor

Pre-Study Survey (Sponsor)

Please answer the following questions to the best of your ability. Your answers to these questions are STRICTLY CONFIDENTIAL. Your sponsee will not see your answers (nor will anyone else besides the primary researcher of this study - Zach Schmitt).

Your name *

Your answer

How long have you been sober / clean (e.g., 2 months, 5 years, etc.)? *

Your answer

How long have you been a sponsor (e.g., 2 months, 5 years, etc.)? *

Your answer

How many sponsees do you currently have? *

Your answer

Figure C.1

To which fellowship(s) do you belong (select all that apply)?

- ☐ Alcoholics Anonymous
- ☐ Narcotics Anonymous
- ☐ Cocaine Anonymous
- ☐ Heroin Anonymous
- ☐ Overeaters Anonymous
- ☐ Gamblers Anonymous
- ☐ Alanon
- ☐ Naranon
- ☐ Sex and Love Addicts Anonymous
- ☐ ANARAA
- ☐ Co-Dependents Anonymous
- ☐ Eating Disorders Anonymous
- ☐ Emotions Anonymous
- ☐ Marijuauna Anonymous
- ☐ Crystal Meth Anonymous
- ☐ Dual Recovery Anonymous
- ☐ Women for Sobriety
- ☐ SMART Recovery
- ☐ Anorexics and Bulimics Anonymous
- ☐ Adult Children of Alcoholics
- ☐ None
- ☐ Other:

Figure C.2

Over the past two weeks, how many times have you met with your sponsee in-person (one-on-one meetings in the same room)? If you can't remember the exact number of times, please guess to the best of your ability. *

> Choose ▼

Over the past two weeks, how many times have you met one-on-one with your sponsee via video chat (e.g., Zoom, Facetime, Google Meet)? If you can't remember the exact number of times, please guess to the best of your ability. *

> Choose ▼

Over the past two weeks, please select the methods you have used to communicate with your sponsee (please select all that apply)? *

☐ In-person

☐ Phone call

☐ Text message

☐ Email

☐ Video chat (e.g., Zoom, Facetime, Google Meet).

☐ Other:

Figure C.3

Over the two weeks, which method have you used the most often when communicating with your sponsee (please select all that apply)? *

○ In-person

○ Phone call

○ Text message

○ Email

○ Video chat (e.g., Zoom, Facetime, Google Meet).

○ Other: _____

If the COVID-19 epidemic was resolved tomorrow, which method(s) would you most prefer to use when communicating with your sponsor (please select all that apply)? *

☐ In-person

☐ Phone call

☐ Text message

☐ Email

☐ Video chat (e.g., Zoom, Facetime, Google Meet).

☐ Other: _____

Figure C.4

Over the past two weeks, how often were you in contact with your sponsee *
(phone calls, texts, emails, in-person, etc.)?

○ Multiple times per day

○ Once per day

○ Multiple times per week

○ Once per week

○ Less than once per week

Figure C.5

Think about your relationship with your sponsee over the past month. Please *
indicate the extent to which you agree or disagree with the following statements.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The sponsorship relationship between my sponsee and I is very effective.	◯	◯	◯	◯	◯
I am very satisfied with the sponsorship relationship my sponsee and I have developed.	◯	◯	◯	◯	◯
I am effectively utilized as a sponsor by my sponsee.	◯	◯	◯	◯	◯
My sponsee and I enjoy a high-quality relationship	◯	◯	◯	◯	◯
Both my sponsee and I benefited from the mentoring relationship	◯	◯	◯	◯	◯
I learn a lot from my sponsee.	◯	◯	◯	◯	◯

Figure C.6

My sponsee gives me a new perspective on many things	○	○	○	○	○
My sponsee and I are "co-learners" in the sponsorship process	○	○	○	○	○
My sponsee shared a lot of information with me that helped my own recovery	○	○	○	○	○

Figure C.7

Think about your experience as a sponsor over the past month. Please indicate *
the extent to which you agree or disagree with the following statements.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Being a sponsor is more trouble than it's worth.	○	○	○	○	○
Sponsoring takes more time than it's worth.	○	○	○	○	○
There are more drawbacks to being a sponsor than advantages.	○	○	○	○	○
Sponsoring takes too much time away from one's own job, responsibilities, and recovery.	○	○	○	○	○
The sponsor/sponsee relationship can become unhealthy.	○	○	○	○	○
The major drawback of being a sponsor is the time commitment.	○	○	○	○	○
Sponsoring is an energy drain.	○	○	○	○	○

Figure C.8

Sponsors get a sense of fulfillment by passing their wisdom on to others	○	○	○	○	○
Serving as a sponsor can be one of the most positive experiences of one's recovery	○	○	○	○	○
Sponsoring makes one feel better about oneself.	○	○	○	○	○
The rewards that come from being a sponsor more than compensate for the costs.	○	○	○	○	○
Sponsees are an important form of support for sponsors.	○	○	○	○	○
Sponsoring has a positive impact on the sponsor's recovery	○	○	○	○	○
Sponsors gain a sense of satisfaction by passing their insights on to others.	○	○	○	○	○

Figure C.9

Appendix D

Pre-Study Survey: Sponsee

Pre-Study Survey (Sponsee)

Please answer the following questions to the best of your ability. Your answers to these questions are STRICTLY CONFIDENTIAL. Your sponsor will not see your answers (nor will anyone else beside the primary researcher in charge of this study [Zach Schmitt]).

Your Name *

Your answer

How long have you been sober / clean (e.g., 2 months, 5 years, etc.)? *

Your answer

How long have you worked with your current sponsor (e.g., 2 months, 5 years, etc.)? *

Your answer

Have you ever been a sponsor? Select the response that best describes you. *

○ Yes, I am currently a sponsor.

○ Yes, I am not currently a sponsor, but I have been a sponsor in the past.

○ No, I have never been a sponsor.

Figure D.1

To which fellowship(s) do you belong (select all that apply)?

- [ ] Alcoholics Anonymous
- [ ] Narcotics Anonymous
- [ ] Cocaine Anonymous
- [ ] Heroin Anonymous
- [ ] Overeaters Anonymous
- [ ] Gamblers Anonymous
- [ ] Alanon
- [ ] Naranon
- [ ] Sex and Love Addicts Anonymous
- [ ] ANARAA
- [ ] Co-Dependents Anonymous
- [ ] Eating Disorders Anonymous
- [ ] Emotions Anonymous
- [ ] Marijuauna Anonymous
- [ ] Crystal Meth Anonymous
- [ ] Dual Recovery Anonymous
- [ ] Women for Sobriety
- [ ] SMART Recovery
- [ ] Anorexics and Bulimics Anonymous
- [ ] Adult Children of Alcoholics
- [ ] None
- [ ] Other:

Figure D.2

Over the past two weeks, how many times have you met with your sponsor in-person (one-on-one meetings in the same room)? If you can't remember the exact number of times, please guess to the best of your ability. *

Choose ▼

Over the past two weeks, how many times have you met with your sponsor one-on-one via video chat (e.g., Zoom, Facetime, Google Meet)? If you can't remember the exact number of times, please guess to the best of your ability. *

Choose ▼

Over the past two weeks, please select all the methods you have used to communicate with your sponsor (please select all that apply)? *

☐ In-person

☐ Phone call

☐ Text message

☐ Email

☐ Video chat (e.g., Zoom, Facetime, Google Meet).

☐ Other:

Figure D.3

Over the two weeks, which method have you used the most often when
communicating with your sponsor (please select all that apply)? *

○ In-person

○ Phone call

○ Text message

○ Email

○ Video chat (e.g., Zoom, Facetime, Google Meet).

○ Other: _____

If the COVID-19 epidemic is resolved tomorrow, which method(s) would you most *
prefer to use when communicating with your sponsor (please select all that
apply)?

☐ In-person

☐ Phone call

☐ Text message

☐ Email

☐ Video chat (e.g., Zoom, Facetime, Google Meet).

☐ Other: _____

Figure D.4

Over the past two weeks, how often were you in contact with your sponsor (phone *
calls, texts, emails, in-person, etc.)?

○ Multiple times per day

○ Once per day

○ Multiple times per week

○ Once per week

○ Less than once per week

Figure D.5

Think about your relationship with your sponsor over the past month. Please indicate the extent to which you agree or disagree with the following statements. *

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
My sponsor is someone I am satisfied with.	○	○	○	○	○
My sponsor fails to meet my needs.	○	○	○	○	○
My sponsor disappoints me.	○	○	○	○	○
My sponsor has been effective in his/her role	○	○	○	○	○
My sponsor is some I can confide in.	○	○	○	○	○
My sponsor provides support and encouragment.	○	○	○	○	○
My sponsor is someone I can trust.	○	○	○	○	○
My sponsor serves as a role model for me.	○	○	○	○	○
My sponsor is someone I identify with.	○	○	○	○	○

Figure D.6

My sponsor represents who I want to be.	○	○	○	○	○
My sponsor serves as a sounding board for me to develop and understand myself	○	○	○	○	○
My sponsor guides my personal development.	○	○	○	○	○

Figure D.7

Appendix E

Post-Study Survey: Sponsor
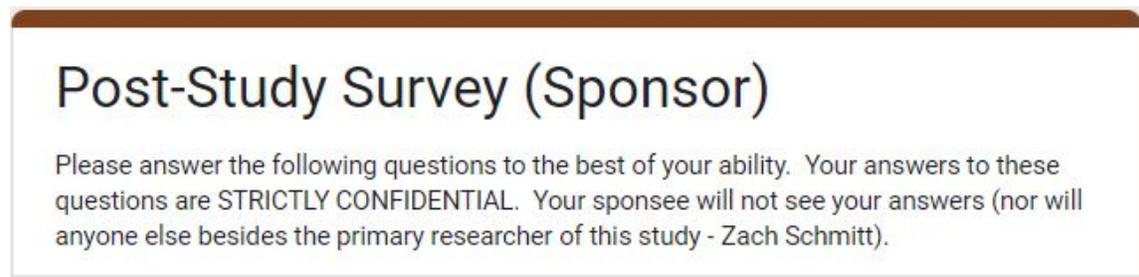
Post-Study Survey (Sponsor)

Please answer the following questions to the best of your ability. Your answers to these questions are STRICTLY CONFIDENTIAL. Your sponsee will not see your answers (nor will anyone else besides the primary researcher of this study - Zach Schmitt).

Figure E.1

Your name *

Your answer

Over the past two weeks, how many times have you met with your sponsee in-person (one-on-one meetings in the same room)? If you can't remember the exact number of times, please guess to the best of your ability. *

Choose ▼

Over the past two weeks, how many times have you met met one-on-one with your with your sponsee via video chat (e.g., Zoom, Facetime, Google Meet, Sponsorship app)? If you can't remember the exact number of times, please guess to the best of your ability. *

Choose ▼

Over the past two weeks, please select the methods you have used to communicate with your sponsee (please select all that apply)? *

☐ In-person

☐ Phone call

☐ Text message (includes messages sent via phone or sponsor app)

☐ Email

☐ Video chat (e.g., Zoom, Facetime, Google Meet, or sponsor app).

☐ Other:

Figure E.2

Over the past two weeks, which method have you used the most often when communicating with your sponsee (please select all that apply)? *

○ In-person

○ Phone call

○ Text message (includes written messages sent via smartphone or sponsor app)

○ Email

○ Video chat (e.g., Zoom, Facetime, Google Meet, or sponsor app).

○ Other: _____

If the COVID-19 epidemic was resolved tomorrow, which method(s) would you most prefer to use when communicating with your sponsee (please select all that apply)? *

☐ In-person

☐ Phone call

☐ Text message (includes written messages sent via smartphone or sponsor app)

☐ Email

☐ Video chat (e.g., Zoom, Facetime, Google Meet, or sponsor app).

☐ Other: _____

Figure E.3

Over the past two weeks, how often were you in contact with your sponsee *
(phone calls, texts, emails, in-person, video chat, etc.)?

○ Multiple times per day

○ Once per day

○ Multiple times per week

○ Once per week

○ Less than once per week

Figure E.4

Think about your relationship with your sponsee over the past month. Please indicate the extent to which you agree or disagree with the following statements. *

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
The sponsorship relationship between my sponsee and I is very effective.	○	○	○	○	○
I am very satisfied with the sponsorship relationship my sponsee and I have developed.	○	○	○	○	○
I am effectively utilized as a sponsor by my sponsee.	○	○	○	○	○
My sponsee and I enjoy a high-quality relationship	○	○	○	○	○
Both my sponsee and I benefited from the mentoring relationship	○	○	○	○	○
I learn a lot from my sponsee.	○	○	○	○	○

Figure E.5

Figure E.6

Think about your experience as a sponsor over the past month. Please indicate *
the extent to which you agree or disagree with the following statements.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Being a sponsor is more trouble than it's worth.	○	○	○	○	○
Sponsoring takes more time than it's worth.	○	○	○	○	○
There are more drawbacks to being a sponsor than advantages.	○	○	○	○	○
Sponsoring takes too much time away from one's own job, responsibilities, and recovery.	○	○	○	○	○
The sponsor/sponsee relationship can become unhealthy.	○	○	○	○	○
The major drawback of being a sponsor is the time commitment.	○	○	○	○	○
Sponsoring is an energy drain.	○	○	○	○	○

Figure E.7

Sponsors get a sense of fulfillment by passing their wisdom on to others	○	○	○	○	○
Serving as a sponsor can be one of the most positive experiences of one's recovery	○	○	○	○	○
Sponsoring makes one feel better about oneself.	○	○	○	○	○
The rewards that come from being a sponsor more than compensate for the costs.	○	○	○	○	○
Sponsees are an important form of support for sponsors.	○	○	○	○	○
Sponsoring has a positive impact on the sponsor's recovery	○	○	○	○	○
Sponsors gain a sense of satisfaction by passing their insights on to others.	○	○	○	○	○

Figure E.8

Please answer each question with regard to the Sponsorship app (i.e., Slack), the *
system you have been using with your sponsor/sponsee over the last 4 weeks.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I think that I would like to use this system frequently.	○	○	○	○	○
I found the system unnecessarily complex.	○	○	○	○	○
I thought the system was easy to use.	○	○	○	○	○
I think that I would need the support of a technical person to be able to use this system.	○	○	○	○	○
I found the various functions in this system were well integrated.	○	○	○	○	○
I thought there was too much inconsistency in this system.	○	○	○	○	○
I would imagine that most people would learn to use this system very quickly.	○	○	○	○	○

Figure E.9

I found the system very cumbersome to use.	○	○	○	○	○
I felt very confident using the system.	○	○	○	○	○
I needed to learn a lot of things before I could get going with this system.	○	○	○	○	○
I would continue using a similar technology to maintain communication with my sponsee	○	○	○	○	○
I found this app effective in getting me to contact my sponsee	○	○	○	○	○
I thought the timeline, or how often the app sent a reminder, was reasonable	○	○	○	○	○

Figure E.10

Please answer each question with regard to the Sponsorship app (i.e., Slack), the *
system you have been using with your sponsor/sponsee over the last 4 weeks.

	Never	A little bit of the time	Sometimes	Very Often	All of the time
I needed assistance from another person to use the sponsorship app.	○	○	○	○	○
The sponsorship app demanded too much mental effort	○	○	○	○	○
It took too long for me to do what I wanted to do with the sponsorship app	○	○	○	○	○
I used the sponsorship app more often than I should have.	○	○	○	○	○
The sponsorship app distracted me from social situations.	○	○	○	○	○

Figure E.11

Using the sponsorship app had a negative effect on my social life	○	○	○	○	○
The sponsorship app required me to remember too much information.	○	○	○	○	○
The sponsorship app presented too much information at once.	○	○	○	○	○
Using the sponsorship app made me feel like a bad person	○	○	○	○	○
I felt guilty when I used the sponsorship app	○	○	○	○	○
The sponsorship app required me to do a lot to maintain my privacy within it.	○	○	○	○	○

Figure E.12

Please answer each question with regard to the Sponsorship app (i.e., Slack), the *
system you have been using with your sponsor/sponsee over the last 4 weeks.

	Not at all	A little bit	Somewhat	Very much	Extremely
The sponsorship app was hard to learn	○	○	○	○	○
I spent too much time using the sponsorship app	○	○	○	○	○
I was worried about what information got shared by the sponsorship app	○	○	○	○	○
The sponsorship app's policies about privacy were not trustworthy	○	○	○	○	○

Figure E.13

Appendix F

Post-Study Survey: Sponsee

Figure F.1

Over the past two weeks, please select the methods you have used to   *
communicate with your sponsor (please select all that apply)?

☐ In-person

☐ Phone call

☐ Text message (includes messages sent via phone or Sponsorship App)

☐ Email

☐ Video chat (e.g., Zoom, Facetime, Google Meet, Sponsorship App).

☐ Other: _____

Over the past two weeks, which method have you used the most often when   *
communicating with your sponsor (please select all that apply)?

○ In-person

○ Phone call

○ Text message (includes messages sent via phone or Sponsorship app)

○ Email

○ Video chat (e.g., Zoom, Facetime, Google Meet, Sponsorship App).

○ Other: _____

Figure F.2

If the COVID-19 epidemic was resolved tomorrow, which method(s) would you *
most prefer to use when communicating with your sponsor (please select all that
apply)?

☐ In-person

☐ Phone call

☐ Text message

☐ Email

☐ Video chat (e.g., Zoom, Facetime, Google Meet, Sponsorship App).

☐ Other: _____

Over the past two weeks, how often were you in contact with your sponsor (phone *
calls, texts, emails, in-person, etc.)?

○ Multiple times per day

○ Once per day

○ Multiple times per week

○ Once per week

○ Less than once per week

Figure F.3

Think about your relationship with your sponsor over the past month. Please *
indicate the extent to which you agree or disagree with the following statements.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
My sponsor is someone I am satisfied with.	○	○	○	○	○
My sponsor fails to meet my needs.	○	○	○	○	○
My sponsor disappoints me.	○	○	○	○	○
My sponsor has been effective in their role	○	○	○	○	○
My sponsor is some I can confide in.	○	○	○	○	○
My sponsor provides support and encouragement.	○	○	○	○	○
My sponsor is someone I can trust.	○	○	○	○	○
My sponsor serves as a role model for me.	○	○	○	○	○
My sponsor is someone I identify with.	○	○	○	○	○

Figure F.4

My sponsor represents who I want to be.	○	○	○	○	○
My sponsor serves as a sounding board for me to develop and understand myself	○	○	○	○	○
My sponsor guides my personal development.	○	○	○	○	○

Figure F.5

Please answer each question with regard to the Sponsorship app (i.e., Slack), the *
system you have been using with your sponsor/sponsee over the last 4 weeks.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
I think that I would like to use this system frequently.	○	○	○	○	○
I found the system unnecessarily complex.	○	○	○	○	○
I thought the system was easy to use.	○	○	○	○	○
I think that I would need the support of a technical person to be able to use this system.	○	○	○	○	○
I found the various functions in this system were well integrated.	○	○	○	○	○
I thought there was too much inconsistency in this system.	○	○	○	○	○
I would imagine that most people would learn to use this system very quickly.	○	○	○	○	○

Figure F.6

I found the system very cumbersome to use.	○	○	○	○	○
I felt very confident using the system.	○	○	○	○	○
I needed to learn a lot of things before I could get going with this system.	○	○	○	○	○
I would continue using a similar technology to maintain communication with my sponsor	○	○	○	○	○
I found this app effective in getting me to contact my sponsor	○	○	○	○	○
I found the app respectful to my choice not to message my sponsor if I chose to do so	○	○	○	○	○
I thought the timeline, or how often the app sent a reminder, was reasonable	○	○	○	○	○

Figure F.7

Please answer each question with regard to the Sponsorship app (i.e., Slack), the *
system you have been using with your sponsor/sponsee over the last 4 weeks.

	Never	A little bit of the time	Sometimes	Very Often	All of the time
I needed assistance from another person to use the sponsorship app.	○	○	○	○	○
The sponsorship app demanded too much mental effort	○	○	○	○	○
It took too long for me to do what I wanted to do with the sponsorship app	○	○	○	○	○
I used the sponsorship app more often than I should have.	○	○	○	○	○
The sponsorship app distracted me from social situations.	○	○	○	○	○
Using the sponsorship app had a negative effect on my social life	○	○	○	○	○

Figure F.8

The sponsorship app required me to remember too much information.	○	○	○	○	○
The sponsorship app presented too much information at once.	○	○	○	○	○
Using the sponsorship app made me feel like a bad person	○	○	○	○	○
I felt guilty when I used the sponsorship app	○	○	○	○	○
The sponsorship app required me to do a lot to maintain my privacy within it.	○	○	○	○	○

Figure F.9

Please answer each question with regard to the Sponsorship app (i.e., Slack), the *
system you have been using with your sponsor/sponsee over the last 4 weeks.

	Not at all	A little bit	Somewhat	Very much	Extremely
The sponsorship app was hard to learn	○	○	○	○	○
I spent too much time using the sponsorship app	○	○	○	○	○
I was worried about what information got shared by the sponsorship app	○	○	○	○	○
The sponsorship app's policies about privacy were not trustworthy	○	○	○	○	○

Figure F.10

Appendix G

SponsorLens Log Analysis: Sponsor 1 and Sponsee 1

Sponsorship dyad 1 sent a total of 53 text messages and set up 4 video calls with each other over the four weeks of the study. Additionally, the pair used SponsorLens to schedule three in-person meetings throughout the study. The frequency of communication between sponsor one and sponsee 1 increased substantially while using SponsorLens compared to the two weeks prior to the start of the deployment study. Sponsor 1 and sponsee 1 indicated that over the two weeks before the study started (see appendices C and D) they contacted each other approximately once per week (*.e.g.,* text, phone calls, meetings) and met in-person approximately once per week. During the study, the pair contacted each other via SponsorLens approximately every other day (*i.e.,* they contacted each other in 17 of the 32 days), a substantial increase in communication frequency.

Interviews with sponsor 1 and sponsee 1 indicated that the increased frequency in communication was due to the privacy and security afforded by SponsorLens. Sponsee 1 stated, *"I don't know why I feel this way, but I feel like it [SponsorLens] is a little bit more secure than just texting back and forth. I like that it is just us. There are no messages from work, friends, or family."* Sponsor 1 echoed that sentiment by saying, *"I wonder if it hasn't improved [our relationship] because of the dedicated nature of the app. It feels more secure and private for her. Our relationship has shifted a little toward the more intimate more trusting."* In both previous remarks, participants spoke about how SponsorLens's singleness

of purpose led to increased feelings of security and privacy (see design requirement ???), resulting in a greater communication frequency.

In addition to increased communication frequency, sponsor 1 and sponsee 1 consistently utilized the behavioral nudges sent by SponsorLens. Sponsor 1 and sponsee 1 were sent ten total event nudges throughout the study (sponsor 1 was sent five, and sponsee 1 was sent five). In each event nudge, SponsorLens asked participants if they were attending any recovery-related events or meetings and if they would like to invite their sponsor or sponsee to attend the event alongside them. Of the five event nudges sent to sponsor 1, she utilized three event nudges to invite sponsee 1 to recovery-related events she was planning to attend (sponsee 1 attended two out of three of these events). The other 2 nudges sent to sponsee 1 were dismissed. Conversely, sponsee 1 utilized all five event nudges sent to her to schedule personalized recovery events for herself (*i.e.,* yoga, sleep, and meditation).

In addition to event nudges, SponsorLens sent sponsee 1 five nudges urging her to set up a meeting with a sponsor or contact her sponsor via direct message. SponsorLens sent those nudges if sponsee 1 did not contact or schedule a meeting with her sponsor for three consecutive days. Of the five nudges sent, sponsee 1 scheduled one meeting with her sponsor, twice indicated she would contact her sponsor via text, and twice dismissed the nudge. As a result, one meeting was scheduled, and eight total text messages were sent 24 hours after sponsee 1 selected the "I would like to send my sponsor a message" option within the nudge.

Figure G.1

Appendix H

SponsorLens Log Analysis: Sponsor 2 and Sponsee 2

Sponsorship dyad 2 sent a total of 11 text messages and 1 photo message to each other over the 4 weeks of the study. Additionally, the pair used SponsorLens to schedule two in-person meetings throughout the study. The pair contacted each other via SponsorLens in some capacity on 11 of the 32 days (34%).

Dissimilar to Sponsorship dyad 1, sponsor 2 and sponsee 2's frequency of communication remained unchanged after they began using SponsorLens. Sponsor 2 and sponsee 2 both discussed that it was difficult to change from using their established communication methods (*e.g.,* phone calls and iMessage) to using SponsorLens as a primary communication tool. For instance, sponsor 2 stated, *"You know, unfortunately we didn't really need that APP to communicate because we've already you know we've already established kind of how we do that. We are so used to the platforms that we consistently use (e.g., phone calls and iMessage). Those are just more familiar."* Sponsee 2 also stated that she did not use SponsorLens as their primary communication tool - preferring native apps on their smartphone such as iMessage and phone calls to communicate with their sponsor, *"Its just really easy for me to just text or call and that's what's been established for years."*

Sponsor 2 and sponsee 2 were sent 9 total event nudges throughout the study (sponsor 2 was sent four, and sponsee 2 was sent five). In each event nudge, SponsorLens asked participants if they were attending any recovery-related events or meetings and if they

would like to invite their sponsor or sponsee to attend the event alongside them. Of the four event nudges sent to sponsor 1, they utilized one event nudge to invite sponsee 2 to the recovery-related event they were planning to attend. The other 3 nudges sent to sponsee 2 were dismissed. Sponsee 2 utilized two of the five event nudges sent to them to invite sponsor 2 to recover related events they were planning to attend. The other three event nudges sent to sponsee 2 were dismissed.

In addition to event nudges, SponsorLens sent sponsee 2 six nudges urging them to set up a meeting with their sponsor or contact their sponsor via text. These nudges were sent when sponsee 2 did not contact or schedule a meeting with their sponsor for three consecutive days. Of the six nudges sent, sponsee 2 indicated they would contact their sponsor via text on one occasion and dismissed the nudge five times.

Figure H.1

Appendix I

SponsorLens Log Analysis: Sponsor 3 and Sponsee 3

Sponsorship dyad 3 sent a total of 46 text messages, 2 audio messages, and 1 photo message to each other over the 4 weeks of the study. Additionally, the pair used SponsorLens to schedule two in-person meetings throughout the study. The pair contacted each other via SponsorLens in some capacity in 13 of the 36 days (36%). Before the deployment study began, sponsor 3 and sponsee 3 indicated that they contact each other about once weekly via text or phone call and meet in person weekly. Thus, their frequency of communication underwent a slight increase while using SponsorLens.

Sponsor 3 and sponsee 3 were sent 10 total event nudges throughout the study (sponsor 3 was sent seven, and sponsee 3 was sent three). In each event nudge, SponsorLens asked participants if they were attending any recovery-related events or meetings and if they would like to invite their sponsor or sponsee to attend the event alongside them. Of the five event nudges sent to sponsor 3, she utilized one event nudge to invite sponsee 3 to a recovery-related event. The other four event nudges sent to sponsee 3 were either dismissed or ignored. Sponsee 3 utilized one of the three event nudges sent to her to invite sponsor 3 to an event. The other two event nudges sent to sponsee 3 were dismissed.

In addition to event nudges, SponsorLens sent sponsee 3 eight nudges urging her to set up a meeting with a sponsor or contact her sponsor via text. These nudges were sent when sponsee 3 did not contact or schedule a meeting with her sponsor for three consecutive

days. Of the eight nudges sent, sponsee 3 scheduled a meeting with her sponsor on one occasion, twice indicated she would contact her sponsor via text, and dismissed or ignored the nudge on five occasions.

Sponsee 3 stated that she appreciated receiving a nudge reminding her to contact her sponsor - even though she may not have acted upon each nudge. *"I think we are communicating a little bit more. Because we are generally kind of hands-off with each other, having those little reminders pop up is helpful and has led to more communication even if it's superficial type of communications."* Sponsor 3 agreed that the nudges to contact each other were beneficial, even if they did not lead to a substantial increase in communication frequency. She stated *"I like the fact that sponsees get the nudges you know because sometimes we do get um so like caught up with our lives and stuff that we have not touched base with our sponsor. I think those nudges are really cool and helpful, so I would just kind of let them know that then the nudges they're not necessarily like you don't have to reach out, but if you just send a hey I'm doing fine."*
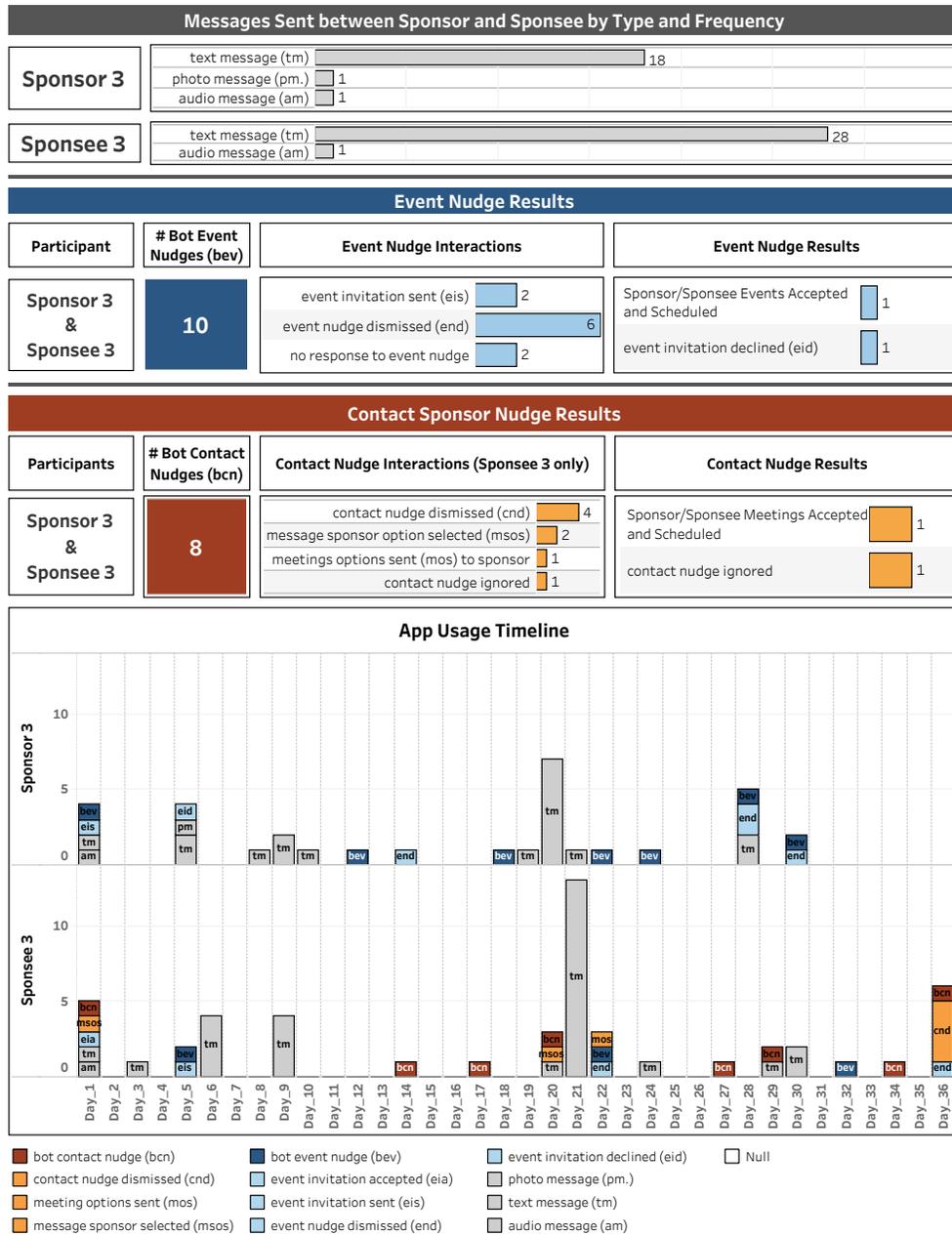
Messages Sent between Sponsor and Sponsee by Type and Frequency

Sponsor 3	text message (tm)	18
	photo message (pm.)	1
	audio message (am)	1

| Sponsee 3 | text message (tm) | 28 |
| | audio message (am) | 1 |

Event Nudge Results

Participant	# Bot Event Nudges (bev)	Event Nudge Interactions	Event Nudge Results
Sponsor 3 & Sponsee 3	10	event invitation sent (eis) 2	Sponsor/Sponsee Events Accepted and Scheduled 1
		event nudge dismissed (end) 6	event invitation declined (eid) 1
		no response to event nudge 2	

Contact Sponsor Nudge Results

Participants	# Bot Contact Nudges (bcn)	Contact Nudge Interactions (Sponsee 3 only)	Contact Nudge Results
Sponsor 3 & Sponsee 3	8	contact nudge dismissed (cnd) 4	Sponsor/Sponsee Meetings Accepted and Scheduled 1
		message sponsor option selected (msos) 2	contact nudge ignored 1
		meetings options sent (mos) to sponsor 1	
		contact nudge ignored 1	

Legend:
- bot contact nudge (bcn)
- contact nudge dismissed (cnd)
- meeting options sent (mos)
- message sponsor selected (msos)
- bot event nudge (bev)
- event invitation accepted (eia)
- event invitation sent (eis)
- event nudge dismissed (end)
- event invitation declined (eid)
- photo message (pm.)
- text message (tm)
- audio message (am)
- Null

Figure I.1

Appendix J

SponsorLens Log Analysis: Sponsor 4 and Sponsee 4

Sponsorship dyad 4 sent a total of 44 text messages and 4 photo messages to each other over the 4 weeks of the study. Sponsor 4 and sponsee 4 also used SponsorLens to schedule five one-on-one meetings and arranged to attend three recovery-related events together (eight total in-person meetings/events). The pair was in contact with each other via SponsorLens in some capacity in 15 of the 35 days (43%). Before the deployment study began, sponsor 4 and sponsee 4 indicated that they contact each other multiple times a week and typically meet in person once weekly. Thus, the frequency in which they met in person increased dramatically while using SponsorLens.

Sponsor 4 and sponsee 4 were sent 9 total event nudges throughout the study (sponsor 4 was sent five event nudges, and sponsee 4 was sent four). In each event nudge, SponsorLens asked participants if they were attending any recovery-related events or meetings and if they would like to invite their sponsor or sponsee to attend the event alongside them. Of the five event nudges sent to sponsor 4, she utilized two event nudges to invite sponsee 4 to a recovery-related event. The other three event nudges sent to sponsee 4 were dismissed. Sponsee 4 utilized three of the 4 event nudges sent to her to invite sponsor 4 to an event. The other event nudges sent to sponsee 4 were dismissed.

In addition to event nudges, SponsorLens sponsee 4 five nudges urging her to set up a meeting with a sponsor or contact her sponsor via text. These nudges were sent when

sponsee 4 did not contact or schedule a meeting with her sponsor for three consecutive days. Of the five nudges sent, sponsee 4 scheduled a meeting with her sponsor on all five occasions.

Sponsor 4 found that the event nudges encouraged her to invite sponsee 4 to events she may not have done so without the timely reminder. For instance, sponsor 4 stated *"I will say there's been opportunities to invite her to things that maybe I normally wouldn't think of. Like last Friday I was like I'm going to sober softball and I used the app to invite her. I wouldn't have thought of inviting her without it."* Sponsee 4 found that the app provided additional accountability to attend events that she had committed to attending. *"She [sponsor 4] invited me to an Al Anon meeting. The Al Anon meeting was something that like I knew that I should do, eventually, or at least just try out, but the APP did give me a remember this is happening at eight o'clock and you said you would go so now, you have to go kind of a thing."*

Figure J.1