Meeting Users Where They Are: User-centered Design of an Automated Text Messaging Tool to Support the Mental Health of Young Adults

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Abstract

Young adults have high rates of mental health conditions, but most do not want or cannot access formal treatment. We therefore recruited young adults with depression or anxiety symptoms to co-design a digital tool for self-managing their mental health concerns. Through study activities —consisting of an online discussion group and a series of design workshops—participants highlighted the importance of easy-to-use digital tools that allow them to exercise independence in their self-management. They described ways that an automated messaging tool might benefit them by: facilitating experimentation with diverse concepts and experiences; allowing variable depth of engagement based on preferences, availability, and mood; and collecting feedback to personalize the tool. While participants wanted to feel supported by an automated tool, they cautioned against incorporating an overtly human-like motivational tone. We discuss ways to apply these findings to improve the design and dissemination of digital mental health tools for young adults.

Keywords

mental health; young adults; automated messaging; co-design; digital mental health tools

1 INTRODUCTION

Mental health conditions like depression and anxiety are extremely common in young adults aged 18 to 25, and can cause significant distress and impact future education, employment, health, and social outcomes [71, 107]. The prevalence of mental health conditions was rising in this age group before the COVID-19 pandemic [39], and sharply accelerated in 2020, with data suggesting a tripling of depressive symptoms and a quadrupling of anxiety symptoms relative to 2019 [24]. However, while treatments like psychotherapy can help ameliorate symptoms, many young adults are uninterested in formal treatments or unable to access them, reflecting factors like costs, stigma, preferences for self-reliance, and beliefs that treatment is not needed [34, 110, 111, 132]. Many millions of young adults are therefore looking for ways to manage significant mental health concerns without professional help.

Digital mental health tools provide an avenue through which to deliver support outside of clinical settings, and they have become increasingly available through ubiquitous technologies such as personal computers and mobile phones [28]. Many young adults find digital tools—such as online therapy programs and smartphone apps—to be an acceptable option for managing their mental health [10, 43, 113], pointing to these tools' convenience and their alignment with preferences to address mental health issues independently [132]. However, more research is needed to understand how digital tools can address the substantial mental health concerns faced by young people [115]. While a number of digital tools have targeted young adults' mental health, many have not involved young adult stakeholders in the design process, leading to tools that are poorly matched to young people's needs and their preferred ways of getting support [2, 12, 115]. This is reflected in low adherence and high abandonment rates for most tools [2, 11, 31], such that users may not receive the needed "dose" of treatment to produce improvements in mental health symptoms [38]. Furthermore, where young adults have been involved in the design of digital tools, participants are often recruited from within the care system, with less research addressing the needs and preferences of young adults who are uninterested in or ambivalent about formal help-seeking [82].

This paper applies user-centered design methods to investigate how digital technologies can engage young adults in self-managing their mental health outside the formal care system. Given our interest in making tools widely available, we partnered with Mental Health America, a large non-profit mental health advocacy organization that provides free web-based screening surveys for mental health conditions. These screening surveys are accessed by upwards of 1 million users per year (and 2.5 million in 2020 during the COVID-19 pandemic). Those who self-screen are disproportionately young, with high levels of symptoms, and are generally not connected to formal mental health care services. We therefore recruited a group of non-treatment seeking young adults upon completion of these self-screening surveys for depression and anxiety, and sought—through an online discussion group and a series of co-design workshops—to deepen our understanding of how digital mental health tools can meet their needs. In particular, we were interested in the following three questions: 1) How would young adults make decisions about adopting an automated digital mental health tool?, 2) What sorts of content do they envision that such a tool could

deliver and how would they wish to navigate that content?, and 3) How should the tool deliver support and motivation to users?

Our findings point to the importance of technology-based interventions that provide young adults with low-stakes ways to explore eclectic content offerings while still retaining a sense of control of their experience. Young adults proposed that a tool might continually introduce novel and varied content, both in terms of the psychological strategies promoted (e.g., gratitude, self-compassion, behavioral activation) and the styles of interaction between the system and the user (e.g., reflection exercises, action prompts and reminders, stories, motivational messages). At the same time, the tool might allow for deeper or shallower engagement based on users' available time, interest, and motivation, and provide avenues for users to initiate some on-demand interactions. Participants also emphasized the importance of the tool continuously collecting user preferences and feedback to support personalization over time.

The remainder of this paper is as follows. In the next section, we describe related work informing our study. In Section 3, we describe the methods we employed to understand our participants' needs. In Section 4, we describe what we learned about the ways young adults wish to engage with a digital mental health tool. Our Discussion then considers the new insights surfaced through these activities and suggests implications for future design and dissemination of digital mental health tools.

2 RELATED WORK

Below, we situate our study in relation to prior work on the mental health concerns of young adults, how digital tools have sought to address these concerns, and efforts to make tools more accessible to young people outside the care system.

2.1 Young Adults' Mental Health

Mental health conditions commonly manifest in adolescence or young adulthood [44], and symptoms can be exacerbated by a number of developmental changes, social challenges, and new stressors young people face [60]. Neurodevelopment and brain-based structural changes during adolescence and young adulthood, in combination with psychosocial stressors, are associated with increased vulnerability to mental health conditions [89, 90]. Moreover, as they establish independence, young adults face pressure to make consequential decisions regarding education, employment, romantic relationships, and social groups with whom they identify [60].

In the past year and a half, a pandemic has been layered on top of the typical challenges of young adulthood. Millions of families have faced grief, stress, and financial uncertainty due to COVID-19. Furthermore, public health measures such as social distancing reduced the spread of the disease but have also negatively impacted young adults' mental health and well-being [24, 117]. As colleges and workplaces closed, many young adults moved back in with their families, delaying opportunities to establish independence, and losing access to face-to-face socialization with peer social networks [117]. These factors converged in 2020 to lead to a record level of mental health challenges reported by young adults, including

62.9% of young adults ages 18 to 24 who reported symptoms consistent with an anxiety or depressive disorder [24].

Early treatment can greatly improve the trajectories of mental health conditions [23]. Yet, despite the high burden of mental health symptoms among young adults, they have the lowest rate of utilization of mental health services of any adult age group [70]. While individuals of all ages can face barriers to treatment, cost barriers are very pronounced for young people [34]. In addition, attitudinal barriers are common, such as beliefs that mental health issues can be managed on one's own or that disclosing mental health struggles is a sign of weakness [34, 111].

2.2   Digital Mental Health for Young Adults

Digital mental health tools have potential to benefit young adults, not only due to this group's high level of unmet mental health needs, but also because they match the capabilities and preferences of this age group. For instance, young people turn to the Internet early in the process of recognizing and addressing mental health symptoms, often searching for information about the prevalence of symptoms, others' experiences with them, and options for treatment or self-management [77, 95, 96]. Young adults are also generally open to the idea of using digital mental health tools [10, 43, 113], in part reflecting that they routinely use many digital technologies [27, 56], which may allow for proficient and convenient engagement with these tools.

Despite rapid proliferation of digital mental health tools, it remains a significant challenge to identify and access effective tools that match an individual's needs and preferences [63, 65], with most tools having high attrition [2, 11, 31]. This reflects, in part, a "top-down" design process that has historically privileged clinical expertise over the input of end-users [84, 114]. Yet, whereas mental health treatment experts bring knowledge of mental illness and evidence-based treatment strategies, they may have gaps in their understanding of users' experiences of their health conditions, self-management approaches, goals and values, and habitual uses of technologies [48]. Top-down approaches may therefore fail to match users' needs or ft into their routines. For example, users tend to engage with mobile phones for short periods of time throughout the day, but many tools designed by experts require spending a long period of time with didactic content [73]. To address such mismatches, there have been increasing calls for integrating user-centered design methods into the development of digital mental health tools, alongside clinical expertise [94, 121]. These methods emphasize seeking input from users in an ongoing manner, such that users not only help researchers understand their needs, but also generate and respond to design ideas, and engage with and evaluate prototypes, guiding iterative refinements [87, 118]. Although the methods employed are diverse, at their core, user-centered design methods treat understanding the user as essential to designing useful and usable technologies, and thereby increasing the chances of successful deployment [58, 66, 130].

User-centered design methods have been applied to help understand and address specific needs and preferences of young adults that are not routinely met by available tools [64]. For instance, whereas professional support or coaching can be key to sustaining engagement with digital mental health tools [6], including for young adults [62], many young adults

have reservations about discussing their mental health concerns with others and prefer to use tools independently [105], which has potential to compromise engagement. Thus, one key challenge has been finding acceptable ways to integrate social support or coaching into digital mental health for young adults. Reflecting the outsized influence of these peers in young adulthood as a primary source of socialization and belonging [56], one approach is to facilitate communication between same-age peers. Discussing mental health with peers may present an important way to normalize mental health concerns among this important reference group, exchange effective coping strategies, and overcome ambivalence around formal help-seeking [99]. A number of tools therefore bring peers together for support exchange, such as via discussion forums, or one-to-one messaging [8, 58, 85, 108]. Other approaches have sought to fully automate the delivery of social support. Examples include chatbots like "Woebot" and "Tess" that emulate a supportive human-to-human relationship, while also potentially exceeding human companions in their ability to be non-judgmental and available on-demand [29, 30].

Studies also suggest a number of ways that the content delivered in digital tools may require adjustment to meet the specific needs of young adults. For instance, young people are often reluctant to use tools that primarily deliver didactic content [31], preferring interactive forms of engagement [102], and game-like experiences [31, 126]. While other studies suggest that psychoeducation can be successfully delivered to young people via digital tools, this may require closely working with users to find language and framing that resonate with them [102]. In addition, while novelty and variety can drive engagement for users in general [47, 97, 119], these can be especially important for young people [93, 101]. In part, this may reflect that young adults who have not connected to formal services have limited exposure to psychological concepts and strategies [110], and might benefit from experimenting with an array of content until they find what works for them. In addition, personalization and tailoring are endorsed by users of all ages [69], but may have particular appeal for young adults [64, 101].

2.3 Increasing Access to Digital Mental Health Tools

In addition to potential design issues, available digital mental health tools may not be meeting young adults' needs due to access issues, particularly for high quality and evidence-based tools. While social media and online discussion groups are widely accessible as a (generally free) avenue for seeking mental health support [74], some work suggests that they mainly benefit those willing to disclose their experiences to others [100]. Furthermore, the peer support participants receive via these forums is not consistently helpful [5, 78, 124]. While a growing number of dedicated digital mental health tools are also now available to consumers, including over 10,000 mental health-related smartphone apps [19], many high quality tools have financial costs [133]. Moreover, many of the existing high quality tools that specifically target young people have been designed to support those young people who are already receiving some form of mental health care [7, 10, 55]. This focus is reflected in designs that support monitoring of the user's progress by a provider, communication between a young adult and provider, or linking the young adult user to services (e.g., promoting use of college mental health services) [42, 43, 72].

Recently, recognizing that the majority of young adults with mental health challenges are not receiving care for their mental health concerns [70], some efforts have been made to extend access to digital tools outside existing care structures. These efforts often recognize that digital spaces tend to be entry points for young adults' information-seeking and help-seeking, and thus provide online information and resources appropriate for young people who may not be ready or able to access formal care [128]. One example is "Link," an online decision aid aimed at addressing specific barriers young adults face when considering mental health treatments [41, 42]. The tool refers individuals to recommended services while also proactively furnishing information about associated financial costs and clarifying potential benefits. Other digital decision aids seek to address the needs of young adults who might have low mental health literacy or face other structural and attitudinal barriers to engaging in mental health care [36, 96].

Other attempts to expand access to digital mental health tools focus on using more accessible technologies to deliver digital support. In particular, while text messaging is an older intervention modality relative to smartphone apps, some have argued for expanding its use, largely based on considerations of ease-of-use, access, and expense [131]. Whereas apps must be downloaded and opened to access content, texting is a pre-existing tool that is regularly used by almost all mobile phone users [80]. This includes lower income or otherwise disadvantaged individuals who may not own modern smartphones or reliably have access to a data plan [27]. Text messaging programs are also inexpensive to develop relative to smartphone apps and allow for long-term automated deployment with limited maintenance [54, 103]. Despite their simplicity, text messaging programs can also allow for interactivity, such that users can respond to system messages, receive tailored replies, and even launch on-demand interactions; however, these functionalities have not been fully utilized in the majority of youth-focused text messaging programs in clinical populations [93, 109].

In this study, we applied user-centered design methods to better understand how young adults wish to use technology to manage their mental health, addressing gaps in prior work by centering the needs of potential users who may be uninterested in or ambivalent about formal services, or unable to access them. To ensure the tool we design has potential to appeal to and be widely accessed and used by this population, we emphasized a highly accessible mode of delivery: text messaging (also known as short messaging service, or SMS). Our activities were designed to address a series of questions regarding how participants reason about adopting automated messaging tools, how they want to navigate content within these tools, and how they want the tools to relate to them socially. We partnered with a large mental health advocacy organization who can make such tools available to users of their website who self-screen for mental health conditions. The young adults who participated in this research are drawn directly from users of this organization's website.

3 METHODS

This section describes how we worked with young adult participants to understand their needs and preferences for a digital tool.

3.1 Participants and Procedures

Participants in all study activities were recruited upon completing free online mental health self-screening surveys, hosted by Mental Health America, a large mental health advocacy organization. Individuals whose survey results showed at least moderate levels of depression or anxiety symptoms—corresponding to scores of 10 or higher on the 9-item patient health questionnaire (PHQ-9) [52] or 7-item Generalized Anxiety Disorder scale (GAD-7) [122] —were invited to learn more about the study opportunity by following a link alongside their screening results. Interested individuals completed an additional survey to assess study eligibility, with inclusion criteria specifying that individuals should 1) be located in the United States, 2) be between 18 and 25 years of age (or 19 and 25 years of age in Nebraska, reflecting the state's age of majority), 3) have English language abilities sufficient to read, understand, and participate in study procedures, and 4) be willing to use a mobile phone. Given our interest in supporting young people who are not in formal treatment, participants were excluded if they were currently seeing a therapist, counselor, or psychologist, or taking medications for their mental health symptoms. Participants were additionally excluded if they reported a serious mental illness (e.g., bipolar disorder, schizophrenia), if they had visual, voice, hearing, or motor impairments that would prevent completion of study procedures, or if they reported suicidal ideation with a plan and intent.

3.1.1 Asynchronous Online Discussion Group.—Twenty-two participants first took part in an online text-based discussion group, based on Asynchronous Remote Community (ARC) methods [67, 68]. These methods seek to reduce barriers to participation by: allowing individuals to participate from home (versus traveling to a lab), to maintain anonymity, to engage at their convenience in asynchronous fashion, and to respond to and build on the contributions of their peers. Participants were asked to create a pseudonymous account on the study platform, FocusGroupIt.com. The platform was programmed to release a new prompt every three days for 24 days (eight total prompts), centering on understanding users' mental health needs, and generating ideas for how a digital tool might meet them. Each prompt posed a series of questions related to the same topic (e.g., automated messaging, content and tone of messages, deciding to sign up for a digital service). For example, the fifth prompt focused on the role of contextual factors in shaping responses to automated messages, reading:

- We'd like to know more about your feelings about text messaging. Specifically, imagine that you signed up for a program where you receive automated text messages on your phone several times a day to support your mental health.

- When you think about receiving text messages on your phone, are there things going on in your life that would change how receptive you would be to mental health-related text messages, or that might change the type of text messages you would want to receive?

- These factors might include things like the time of day, how busy you are, whether you're alone or with others, the activities you're engaged in, your mood, etc. Which of these factors is most important to think about when designing a text messaging program, and why?

Participants were asked to provide asynchronous text-based responses for each prompt. They were compensated based on the number of prompts to which they responded. They could also earn additional compensation by replying to at least one other participant's response to each prompt. Participants' demographic characteristics are represented in Table 1.

3.1.2   Synchronous Co-design Workshops.—Co-design workshops focused on further defining the features of a messaging-based digital mental health tool. Workshop participants had all participated in an online discussion group; six had participated in an earlier discussion group that followed the same format but covered different topics (e.g., experiences of mental health symptoms in day-to-day life; data not reported here), and three had participated in the discussion group reported here. Workshop participants were selected from the two discussion groups to roughly reflect the diversity of the user population who complete online self-screenings on the Mental Health America website in terms of gender, race, and ethnicity.

We held a total of five Zoom workshops over nine months, with nine total participants who were each invited to attend as many or as few workshops as they wished. Workshops ranged in size from two to five participants, and were facilitated by two members of the research team. The workshops lasted approximately 75 minutes each. Participants went by their first names only, and their Zoom display names were adjusted accordingly. Participants could also turn their video feed on or off based on their preference. Each workshop centered on getting feedback on current design decisions the researchers faced, including considerations for 1) promoting a digital tool, particularly one using automated messaging, 2) content to be delivered and navigated via automated messaging, and 3) potential for delivery of social support through the tool. The researchers used screensharing of Google slides to visually represent possible features of the messaging service (e.g., mock-ups of interfaces to collect messaging preferences), and possible dialogues between the program and hypothetical users, with participants asked to give feedback or to react to design features and messages, and to suggest their own ideas for alternative dialogue and interactions.

3.2   Ethical Considerations

Study activities were approved by the IRB of the researchers' institution. With participants' permission, all activities were recorded and transcribed. Consistent with prior work [82], we compensated young people as a means to engage a less motivated population, and to recognize the expertise and value they bring to the design process. In the discussion group, participants were compensated $8 for their response to each prompt, and $2 for up to one substantive response to another participant's reply to each prompt, for a total possible compensation of $90. Participants were compensated for participation in co-design workshops at a rate of $20/hour via an e-gift card (i.e., a $25 gift card for each 75 minute workshop). All design activities were remote, to keep participants and researchers safe during the COVID-19 pandemic, and to lower barriers to participation for our geographically dispersed user population.

Our research team includes two clinical psychologists, who gave input throughout the study to ensure participants' comfort and safety. Upon joining the discussion group, participants

were provided with a list of resources appropriate for accessing 24/7 mental health support (e.g., suicide hotline, crisis text line), if needed. Participants also agreed to a code of conduct and were advised not to share personally identifying information or any details about methods of suicide or self-harm, which might be triggering to other participants. Responses were monitored on a daily basis for compliance with the code of conduct and for risk and safety issues. Likewise, in co-design workshops, participants were provided with 24/7 mental health support resources and were asked not to share personally identifying information or details of self-harm or suicide methods. Across all activities, research staff had a risk management protocol in place in the event participants shared any information signaling they were at risk to themselves or other. No such risks emerged.

3.3 Data Analysis

Data analysis proceeded using a Thematic Analysis approach [22]. Two coders first became immersed in the data, independently reading all transcripts from the discussion group and co-design workshops, and performed open coding to identify themes emerging in the data. The coders then met to discuss these themes, and to prioritize a subset of these themes for further coding, guided by the research questions. Prioritized codes and their definitions were captured in a preliminary shared codebook. Using the qualitative data analysis software Dedoose, coders then completed approximately five rounds of coding where they overlapped in coding the same transcript(s), alternating between a complete co-design workshop transcript or responses to one or two discussion group prompts, thus allowing the codebook to encompass data from both studies. Coding results were discussed to guide codebook revisions prior to the next round, including removing codes not central to answering the research questions, consolidating overlapping codes, and adjusting code definitions to better match the data and resolve coding discrepancies. Most codes were applied across data from both studies, but since the co-design workshops built on and filled in some gaps not addressed in the discussion groups, we also retained codes that featured more heavily in the co-design workshop data. Coders repeated this process until they achieved a shared understanding of the codes such that they agreed in code applications and discussions of newly coded data did not result in further revisions to the codebook, a point that was reached after about half the data had been coded. The remaining transcripts were then divided between the two coders, and the final codebook was applied.

4 FINDINGS

Our discussion group and design workshops uncovered a number of key priorities for a digital mental health tool. Below, we highlight what these young adults were looking for in digital mental health tools at the point of self-screening, how they felt about specific content these tools might deliver, and the ways the tools would relate to users and offer support. In the Findings, Discussion Group participants are numbered DG1 through DG22, and Co-Design Workshop participants are numbered CD23 through CD31. CD29, CD30, and CD31 were also in the discussion group reported here, but quotes from these three participants only come from the co-design workshops.

4.1 Initial Assessments of Digital Mental Health Tools

In this section, we describe how these young adult participants think about the decision of trying a digital tool upon receiving mental health self-screening results. We discuss the need to appeal to users' interest in "self-help" and establish ease of use. We then discuss how "texting" and "automated messaging" have some unhelpful associations with socializing that must be overcome in order to establish initial acceptability.

4.1.1 Appealing to Motivation to Help Oneself.—Participants generally reported that they took their mental health seriously, particularly at the point they completed online screenings. Taking screening surveys for depression and anxiety reflected a growing level of concern. For example, CD24 stated, "*If I know I need help, that might be why I'm on the Mental Health America website.*" In some cases, screening results could also nudge participants to consider taking new steps to prioritize or care for their mental health. As one workshop participant stated, "*Usually when you're taking one of these tests, you kind of get a feeling that something's wrong and that you wanna fix it*" (CD29). These findings suggest that reviewing self-screening results may create a window of opportunity for offering resources. Many of these participants were also interested in digital programs, as an alternative to formal options. For example, one discussion group participant shared, "*This kind of help can be less daunting than full-on committing to therapy*" (DG17).

However, while many participants were open to using digital tools, they were also sensitive to how these resources were presented. For instance, they wanted to quickly establish that a tool was free, easy to use, credible (e.g., through association with a University or the partner organization), and anonymous or confidential. Participants were also looking for a tool to distinguish itself from a formal treatment, and to be presented as something they could use on their own and based on their own interest, as "*more of a self-help*" (CD24). Along these lines, CD24 recommended that promoting the tool should involve "*really touching base on your own ability to help yourself. I think that's a strong motivation for me… So, just be like, 'If you think you need help, try this new opportunity to help yourself.'*" Another participant suggested that she might click a link reading, "*Would you like to try this program for self-help, of leading through a journey of healing?*" (CD27). Therefore, participants were largely looking for tools to be connected to their existing motivation to improve their mental health, and that could be used in a self-directed manner.

4.1.2 Views of Text Messaging.—When asked during the discussion group how they might respond to a "messaging" or "texting" tool advertised on the screening website, many participants assumed its main function would be to provide companionship and social support, which suggests that mentions of "texting" introduced a reference point of interpersonal communication. Furthermore, while texts from friends and family were viewed as a gesture of genuine care, an automated service was not viewed as capable of providing similar care. For example, DG9 described, "*Automated messages don't feel…real? Like if a bot asks me how I'm doing, I ignore them. If someone I knew asks me how I'm doing, I'll actually reply to them.*" Referencing "automated messaging" could also evoke chatbots, about which participants had mixed responses. Some reservations were based around the belief that chatbots substitute for human connection. One participant (DG10) reported that

using such a tool would force them to face the fact that they lacked access to compassionate support from a real human, writing: "*I feel a little conflicted. Because ok one hand I might feel a little pathetic(?) that all I have is a robot to text me. But the good morning/night texts sound nice.*" Another described that his peers typically view chatbots as "*sort of as something you would have fun with, instead of actually something that would help you*" (CD29). This suggests the need to clarify specifically how automated text messaging could support self-help, and to differentiate this from social and recreational uses of texting. For example, DG17 wrote, "*I think sometimes stuff that's purely motivational… can feel alienating if I'm depressed… but focusing on something specific, like doing a breathing exercise or reflecting on a specific question, would be cool.*"

If its self-help application was clarified, participants were open to texting and could see its benefits, particularly given the ways texting was already integrated into daily technology use. One participant (CD30) described: "*It's not something that you need to download on your phone… I'm always on the texting app. I don't have to open something else.*" Similarly, another contrasted use of an app to texting, noting that texting was a more reliable way to ensure messages were read: "*I've tried downloading apps in the past that were supposed to help with either meditation or staying on track with chores and daily life. But if you don't follow through with them there's really no point to it. I think if there was an app that refused to let you forget about it that would be awesome! Like if it sent you texts.*" (DG19). DG17 also described, "*I'm way less likely to ignore a text notification than I am one for an email or an app.*" Therefore, on the whole, participants recognized that texting would offer a convenient way to reach them throughout the day and to keep them engaged.

4.2   Delivery of Content within a Messaging Tool

This section describes the types of content and interactions participants envisioned within an automated messaging tool, emphasizing the benefits of variety and experimentation. Participants also highlighted the importance of providing input and feedback, such that their patterns of engagement and responses would help shape the content delivered.

4.2.1   Diverse Psychological Strategies and Interaction Types.—In our design workshops, we presented participants with a number of psychological strategies as possible avenues for managing their mental health, and asked about their interest level in each. These strategies included evidence-based ones derived from cognitive behavioral therapy (CBT), Acceptance and Commitment Therapy (ACT), and positive psychology (e.g., gratitude, relaxation exercises). In general, participants expressed curiosity and interest in nearly all of them. Furthermore, while they had familiarity with some of these strategies already, they recognized that it would still be helpful to be reminded to put them into practice. For example, CD28 was familiar with the importance of gratitude, but described that they would still welcome reminders to practice it, sharing, "*Sometimes, I forget that stuff because I'm so stuck in my mindset.*" Therefore, participants showed openness to encountering a relatively large and eclectic set of self-management strategies. As CD24 described, this would also allow for rolling out new strategies over time to maintain engagement:

"It's nice to have things reserved in the bank, if you will. So, if a person's getting similar responses day one and day two, then they're like, 'Okay, then why do I

need this texting program anymore if I already did that already?' Or, 'That's not nothing new.' And I think a huge part of how this helps is that it offers new ideas and suggestions."

Diversity was also appreciated as far as the manner of interacting with the system. While our initial discussions centered on didactic content and self-management guidance (e.g., messages from the system that might describe a strategy or suggest ways to enact it in their lives), participants suggested the importance of also learning indirectly, such as through stories from peers, often drawing on the positive experiences they had in the discussion group. For instance, CD27 described, "*I like hearing other people's stories and what they did, and it kind of helps me feel a little better. And I kind of like bounce off it and do what they did and try these new things that they're doing.*" Therefore, delivering stories through the messaging program was seen as a way to connect to others, normalize experiences, and draw inspiration.

Participants additionally emphasized the importance of moving beyond one-way communication (from the system to the user), and positioning themselves as more active participants through bi-directional communication. For example, drawing on previous positive experiences with "journaling" several participants emphasized the value of writing down their thoughts and reflections in response to brief prompts. CD28 elaborated on why such reflection prompts would help, suggesting that the act of writing could help them learn more effectively: "*I have this habit of seeing something, but I've never actually connected. And it kind of just - I read it, but there's no meaning to it. So, I feel like if I can connect it back to something in my personal life, it'll have more meaning and therefore I'll remember it better.*" Furthermore, just as they would benefit from hearing others' stories, some participants also imagined that sharing their own stories and support could be helpful to others. Expanding on this idea, CD31 explained, "*Personally, I find it easier to help like a friend in need, who's going through similar things. It's like easier for me to encourage them rather than encourage myself.*"

4.2.2 Personalization: Giving Input to Shape the Content Received.—While participants were open to receiving a variety of content types, with the specific schedule generally being unpredictable, they also recognized that there were some contexts where they would want to set their preferences more actively.

Participants noted several contexts that might limit their ability or willingness to engage fully with the messaging program, such as busyness and mood. Many thought that alerting the system to these contexts could be helpful, in order to adjust the frequency and type of interactions the system would launch. For example, CD30 envisioned challenges with availability, such as for "*someone who was on vacation even or just had a really busy week and didn't really have time to engage or be fully present in the activity,*" and suggested the importance of "*just having the option to take a break for a couple days and then coming back to it.*" CD24 agreed, and added that non-response to messages should not be used to infer disinterest. She suggested finding a quick response through which the user could communicate, "*I would be interested in learning about this or hearing about this another day. It's just not a good day.*" Additionally, low mood was recognized as introducing a number

of constraints on how users might interact, including with regard to writing messages for others. This was viewed as potentially too burdensome, as CD28 described: "*for someone who may be severely depressed, or someone who needs help, [writing messages] is almost like hard to do. Because if they're having a hard time motivating or encouraging themselves, they might not feel like this is something they could do.*" However, participants thought they would generally welcome lower-burden interactions with the system when in those states. Beyond receiving one-way messages from the system, one participant proposed that she might like to initiate spontaneous interactions to obtain extra support: "*I would start off saying I'm feeling a certain way, like in a mood. And then they text me back whatever advice they have regarding what I'm feeling*" (CD27).

Beyond initiating interactions or inputting their moods, participants were interested in giving ongoing feedback that could contribute, over time, to the system learning their preferences. If the system was responsive to feedback, participants felt that giving feedback could be a way to better help themselves. One participant described, "*I think maybe at the end of the day or the end of the week, you guys could send a survey link, like 'which message did you guys like the best?' … And the next week, send more personalized messages based on what we like the most*" (CD27). Some also wanted the option to offer open-ended feedback to further clarify what they liked, such as CD24, who said, "*I think a 'yes' or 'no' is good, but also just like giving the option of like, 'type any feedback you have.'*"

As far as making active decisions about what type of content to view in a given moment, participants had mixed feelings. For example, they generally stated that they would welcome opportunities to choose between story topics. As one described, "*I think that'd be really helpful. And also a lot more fun*" (CD31). However, while it was seen as engaging and important to make some choices, participants also recognized the potential for too many choices to overwhelm them. Drawing inspiration from her Alexa, CD24 explained the importance of constraining the number of options presented at one time: "*So, I do something called Sound Jars, and there are different sounds. And [Alexa] lists three. And then she's like, 'If you want more, just say 'more'.' And she'll list another four. And it'll keep going until you find one that you really like. And I think I appreciate not feeling too overwhelmed with the different options.*"

Participants also suggested that they would sometimes welcome system recommendations as a way of maintaining momentum or moving out of their comfort zones. One participant suggested that inputting her mood should be enough of an indication for the system to "*pick for me*" (CD27). Similarly, CD24 explained, "*I wanna try what it offers me, instead of being closed-minded and being like, 'Yeah, I know what I like.' If I did, then I wouldn't need help with that.*" Another envisioned the system as gently challenging them to keep an open mind to content. They described, "*I think it should be a soft encouragement. If - if you're getting Social Rhythms messages and you're thinking, 'it's… not really helping my depression' then you should be able to say, 'Yeah, this isn't working, can we try something else?' Maybe the system goes, 'Well, let's try one more day. And if you still feel that way, then we'll switch to a different type of message'*" (CD23). Thus, while actively making choices was valued, participants also recognized limits to their motivation and ability to select the most

appropriate content, suggesting that the ideal configuration would allow the user and system to find a balance in determining the content delivered.

4.3   Finding the Right Motivating Tone

Human support can be a key to engagement with digital mental health tools, and some work suggests that fully-automated support can work similarly, allowing for development of rapport between the system and user over time [14, 15]. This section therefore explores how participants thought a system should relate to them as a source of support and motivation. We found that, overall, participants had reservations about human-like support from a messaging system, and they therefore laid out a number of constraints for sending supportive messages, as well as suggesting alternative ways the system might sustain their motivation.

4.3.1   Problematic Forms of Support: Subjective and Social.—Across our discussion groups and workshops, participants expressed hesitation about statements from a messaging system that were inappropriately person-like, and perceived as disingenuous. This scrutiny emerged, in particular, around statements that implied the system was making subjective evaluations of the user, or had emotional experience, as described below.

When workshop participants were shown a number of possible messages that the system might send to affirm their competence and ability, several of them reported that they would feel skeptical receiving such messages, largely because a fully-automated messaging tool was perceived as lacking a credible capacity to assess them. As one participant described, "*Affirmation doesn't necessarily feel right coming from a program because it's like, 'oh, you're just saying that'*" (CD23). In some cases, generic expressions of confidence in the user (e.g., "You can do it if you try!") were even viewed as potentially harmful, with one participant suggesting that erasure of structural barriers that individuals faced could lead to self-blame: "*I try to stay away from things that emphasize like, 'Oh, like happiness is a choice,' just because for a lot of people, it's really not*" (CD24).

Skepticism was also extended to emotional expressions from the system, as participants felt that these did not come across as believable, and risked being patronizing. One participant described that reaction emojis (e.g., a smiling face or laughing face in response to a user's message), could be "*too subjective*" for a computer program (CD27). Another (CD23) relayed that emojis "*should have utility and nothing else,*" such as flagging when the user was requested to respond or take some action, therefore acting more as a bookmark or cue to action. Negative views also extended to verbal professions of affection or caring. For example, CD23 went on to describe that, "*[If] the computer texts, 'Hey, I'm proud of you' that doesn't really do anything for me. I'd rather have that from my mom or my dad.*" Similarly, when we shared a potential script where the user reports feeling depressed, and the system responds, "Sorry to hear you feel depressed," the four workshop participants unanimously and strongly rejected this phrasing, with one explaining "*Like, basically, it's having pity on us*" (CD28).

4.3.2   Desirable Forms of Support: Meeting Users Where They Are.—While they had reservations regarding certain relational styles, participants clarified that they were still seeking support from an automated messaging system. For example, while *generic*

affirmations were often rejected, affirmations could be appropriate if the system had a clear basis for making them. One participant (CD25) therefore suggested messages could draw from the user's personal data to provide encouragement based on a credible assessment of their capability: "*Affirming messages might be better like later on in the process, because then they could point back to 'look at what you've already done' especially if you are using some sort of logging system to track your progress.*" Also, some affirmations were recognized as universally true, which made them more acceptable for an automated system to send. For example, CD23 proposed sending "*a text that says something with an objective truth like, 'You have inherent worth, because you're a human being.'*"

Validation, in particular, was recognized as a highly promising and almost universally applicable strategy, wherein messaging helps to recognize and normalize participants' experiences, and the challenges they face. One participant explained, "*I love the idea of validation because I like being reminded that it's normal to be struggling with things*" (CD23). Another described that it was important "*for people to meet me where I'm at and not for them to expect me to meet them where they're at…. 'it's okay that you're struggling.' That's you guys are coming down to meet me instead of you trying to bring me up to meet you*" (CD24).

Participants also expressed that the system could help build their motivation simply by connecting any actions it proposed to a meaningful rationale. One participant described that the system should "*justify my efforts*" if asking the user to do something (CD23). Similarly, new activity suggestions could be accompanied by one sentence explanations: "*I think one sentence would be nice. So, for me, I didn't ever take breathing seriously until someone said to me, 'Oh, but the reason why it helps is because it brings you back to the present. And it helps you concentrate or prevent anxiety.' So, that makes me take it more seriously*" (CD24).

Thus, while participants wanted the program to be motivating, the ways an automated system should motivate a person were seen as quite distinct from the ways another person might. Participants wanted messages that were validating and sensitive to their emotions and the barriers they faced, but they drew a line at implausible claims of subjective experience or unrealistic expectations about a recipient's progress.

5   DISCUSSION

Widely available digital mental health tools do not reliably address the mental health challenges young adults face, or match their preferred styles of getting help, particularly for young adults who are not connected to formal treatment. This study sought to better meet the needs of young adults in self-managing common mental health concerns by informing design of automated messaging tools that can be made widely available after online self-screening. To facilitate participation despite the sensitive research context, we used a combination of an online discussion group and online co-design workshops, both of which allowed remote participation and anonymity. The discussion group also allowed flexibility and convenience through its asynchronous and text-based nature [13, 67, 68], with brief prompts allowing for contributions from a broader set of participants than might be willing to participate in more intensive, synchronous activities. The methods used here

also allowed participants to engage socially with one another, building on and responding to one another's contributions and ideas, highlighting areas of consensus or disagreement, and providing insights about the social considerations involved in discussing and managing mental health conditions. Group-based or "community" methods can also offer a more engaging experience for participants, potentially sustaining participation and increasing the depth of participants' contributions [67, 68]. The methods employed here therefore likely played a role in obtaining candid and detailed information about how users think about digital mental health tools, which will be applied to support the design of tools that can meet users' needs outside the care system. Our findings suggest, in particular, that despite feeling ambivalent about or uninterested in help-seeking, individuals could generally see the value of learning and applying self-management strategies through an eclectic set of interactions delivered via text message.

In this Discussion, we explore how our findings relate to existing literature on young adults' treatment preferences, highlighting the various ways in which young adult users sought to exercise independence through their uses of a digital mental health tool. We also lay out key design implications of our findings, including that a messaging system for this population need not present as explicitly person-like to be perceived as supportive, and that the act of providing ongoing feedback can be a valuable part of the user experience, so long as this informs effective personalization. Finally we offer future directions, emphasizing the importance of considering how programs are promoted and disseminated to achieve large-scale impact.

5.1 Connecting to Young Adults' Needs for Independence

In this section, we situate our findings in relation to the literature on young adulthood. Specifically, we suggest that a common thread across our findings is young adults' strong desire to experience independence in managing their mental health, which we define as feeling free and uncoerced in making choices that reflect personal needs and preferences [127]. In digital health, a number of studies have emphasized a need to design for "autonomy" [18, 37], a related concept from self-determination theory wherein an individual actively endorses the decisions made about their life [26]. However, whereas self-determination theory conceives of autonomy as a basic human need, present across all individuals, age groups, and cultures [20, 26], the desire to exercise independence can be heightened in particular contexts, such as in young adulthood, where individuals are seeking to establish themselves outside their childhood roles and constraints [132]. Therefore, we emphasize independence in this paper to capture how these young adults sought to take charge of their own mental health management. Throughout our findings, young adults' preferences around independence influenced how they thought about initial acceptability of a tool, the ways they wanted to navigate content, and how they thought about the tool as a social actor.

In the most straightforward sense, the need for independence is reflected in the fact that our participants were self-screening for mental health conditions outside of a clinical context, and were generally looking for steps they could take on their own to improve their mental health. This preference for self-directed strategies is consistent with findings

from other studies in this age group [10, 132]. Participants also reported that, at the point of self-screening, they were looking for tools to be promoted in ways that speak directly to their goals of self-managing their mental health concerns. In contrast, some had negative responses to the idea of promoting tools on the basis of enjoyment, relationship building, or other rewards. Importantly, our findings also suggest that references to "text messaging" may have had unhelpful associations with recreation and socializing that obscure these programs' potential for self-management support, requiring proactive clarification.

Desires for independence also shaped how young adults envisioned engaging with content. Our findings point to the importance of building variety into a system, encompassing both psychological strategies and types of interactions (e.g., prompts, reminders, stories, etc.). This approach has potential to lower the stakes of engaging with new content and to keep users engaged long enough that they can find the most successful approaches for them. Such "eclecticism" has also been successful in other digital health interventions where individuals are encouraged to try one tool or strategy at a time, and to continue using those that suit them best [53, 73]. Similarly, self-experimentation frameworks encourage users to systematically trial several strategies, and support users in making decisions about longer-term adoption of strategies based on their personal data [25, 59]. In addition, whereas the majority of messaging tools for young adults have employed one-way communication [93], system interactivity emerged as a crucial feature among these participants. On the whole, they wanted to establish a balance of push and pull between themselves and the system, wherein the system might gently introduce new content, but they could also choose the extent to which they would engage, send feedback, share their own perspectives via open-ended prompts, and sometimes make explicit choices.

We finally note the importance of supporting users' independence through the ways a system presents itself socially. In particular, participants asserted that overtly person-like interactions from an automated system could feel insincere and potentially manipulative. Instead, participants identified a number of alternative approaches for offering support and motivation, such as by recognizing barriers and challenges that were universal (e.g., "Everyone goes through rough times") [35], or providing encouragement that is clearly justified by available data about a particular user's abilities or constraints (e.g., "You've been practicing your self-compassion, so here's an activity you might be good at" versus "You'll be great at this").

5.2 Design Implications

This section makes some recommendations about how our findings could inform the design of tools to support non-treatment seeking young adults. We emphasize areas where our findings challenge core assumptions within HCI about designing digital mental health tools. Specifically, we describe that, at least in the context of non-treatment seeking young adults, there may be under-appreciated tradeoffs involved when automated tools explicitly adopt a human-like demeanor. We also describe how our findings offer a new perspective on collecting user feedback, suggesting that it has potential to be an enriching aspect of the user experience.

5.2.1 Tradeoffs in Deploying Cues of Humanness within Messaging Systems.

—The "computers as social actors" (CASA) paradigm is based around the idea that, if a computer displays cues of humanness, users will relate to the computer as though it were a person [104]. This paradigm has been supported in numerous studies showing that the more cues of humanness a computer displays (e.g., an embodied representation, a name, a voice, a backstory, informal language, empathy), the greater the likelihood that people will think about and respond to that computer socially [76, 79, 112]. Given that individuals can benefit greatly from positive social contact, CASA has been the foundation of a number of "relational agents" and "chatbots" seeking to build a human-like rapport with the user [14, 33, 125]. Notably, past studies have embraced the CASA framework through development of a number of chatbots and relational agents seeking to support those with depression [1, 16, 17, 29, 30, 32, 51, 91], with some focusing on young adult users in particular [29, 30].

Somewhat unexpectedly given this literature, we found that many participants were wary of a messaging tool presented as a social agent or companion. This was especially apparent when discussing how they might initially respond to a tool, with human-like characteristics being perceived as silly and inauthentic or, more seriously, as belittling. A few participants also felt that foregrounding a personal relationship with the system might draw attention to the user's lack of supportive relationships with real people. Relatedly, when considering specific messages they might receive from an automated system, participants had some negative responses when the system relayed first-hand emotions or subjective evaluations. This set of findings contrasts with past studies in behavioral health that suggest that users welcome empathic expressions, emojis, and "friend-like" dialogue [40], including in the context of automated tools for mental health conditions [75], and related areas like stress management [32, 92]. However, there are also some past findings consistent with ours, wherein users prefer less human-like agents [21], or disclose more candidly to them [116, 123], including in sensitive contexts [86, 116]. For example, one study of avatar-delivered motivational interviewing for perinatal drug use found that users preferred a less human-sounding voice [86], which may relate to the greater "social presence" activated by human-like agents [116]. Our findings suggest that similar concerns may manifest in relation to mental health tools, including when humanness is established solely through message content and tone.

A few factors may contribute to the discrepancy between our findings and the general pattern favoring human-like digital tools. In part, individuals may simply have a hard time predicting how they will respond to a computer system. Afterall, the premise of CASA is that we respond to social cues unconsciously or "mindlessly," regardless of whether they are coming from a computer or a person [79], and people may simply tend to underestimate their tendency to accept computers as social actors [15]. Therefore, it is possible that some users would overcome skepticism about human-like cues within messaging tools simply through using and appreciating these tools in daily life. However, given our focus on a tool that would have mass appeal to non-treatment seeking young adults at the point of self-screening, it is important to anticipate the scrutiny to which these potential users would hold a tool during a period of adoption and initial evaluation [69]. Some work also suggests that responses to computers' social cues are shaped by individual characteristics

like introversion/extroversion [32], and self-esteem [106]; it therefore warrants further investigation whether the skepticism described here might reflect characteristics of this study population of non-treatment seeking young adults, including the stigmatized nature of mental health conditions, which may make users more sensitive to social judgment.

Encouragingly, our findings also highlight that an automated messaging program can still be supportive without presenting as overtly human-like. Participants pointed us to alternative strategies of building their motivation, including through validation, offering rationales for new actions, and affirming users in ways that were well-justified. Similarly, past work has shown that users can build alliances with automated, interactive systems that are not explicitly person-like [57] [3] [129]. For example, when disclosing concerns to one automated messaging service, adolescent users reported a sense that "someone" was listening to their concern, even though they knew the system was automated [102].

5.2.2 Collecting and Deploying User Feedback to Improve the User Experience.—Our findings also suggest some new ways to think about the role of user feedback in automated messaging systems. Feedback is central to many messaging systems, especially adaptive systems where user responses help to improve the delivery of content in the future [4, 45, 46, 61]. In some instances, responses to content can be inferred through behaviors that are passively sensed (e.g., the number of steps a user takes the next day, the use of communication features of the mobile phone, future engagement with the digital tool) [4, 46, 97]. However, there are a number of challenges in mapping available sensed data onto users' mental health states [81], such that directly querying users about messages they have received remains an important way to understand preferences [61, 98]. While obtaining ongoing user feedback is typically conceived of adding significantly to user burden [98], our findings also suggest that—consistent with their interest in being actively involved in shaping their experience with a tool—participants often welcomed opportunities to give feedback, hoping to improve how well a tool would support them in the future. We focus here on two considerations for collecting feedback that may help to make giving feedback a more enriching aspect of the user experience: 1) developing effective personalization algorithms that balance user preferences and novelty, and 2) allowing users to make explicit choices about some content.

In recent years, there has been an increasing recognition that one-size-fits-all automated digital tools are not up to the task of sustaining user engagement long enough for digital mental health tools to reliably benefit their users [3]. This has spurred an increased focus on understanding and deploying "tailoring" within digital mental health tools [36, 45, 120]. While tailoring takes many forms, at its core is the assessment of user characteristics, and the delivery of content to match those assessed characteristics. While many early tailored computer-based health support tools tailored content only at baseline (e.g., delivering content matched to a user's stage of change, gender, or cultural group) [50], some recent tools seek to gather ongoing feedback to adapt to users over time, such as by using data about how users respond to particular content types to determine what sorts of content a user should receive in the future. Our findings suggest that, while learning and applying user-level preferences is important, this should not displace variety and novelty. Even though many participants preferred certain psychological strategies and interaction types, they also

relayed that a major driver for using a messaging system would be the opportunities it provides to be surprised or have their expectations exceeded by content types outside their initial preferences. These findings suggest a risk of tailoring or adaptation that is too rapid or heavy-handed, such that a system comes to focus on the "best" performing sort of content for a user, at the expense of maintaining choice and variety. Therefore, as some past work has also noted [88, 97], an important direction will be to find ways that user preferences can be defined and used to shape content, while balancing this against the risk of habituation.

In addition to the risks of prematurely limiting novelty and variety, our findings also suggest potential benefits of offering more and less direct means by which users can personalize a system, such that their preferences are accommodated both through tailoring (where preferences are inferred based on users' characteristics, behaviors, and assessments) and customization (where users explicitly choose between content offerings). Some past work has highlighted that customization (versus tailoring) may be a preferred strategy in some instances despite requiring more effort from users, as it allows them to feel more active and empowered [49, 134]. Our findings suggest that, to these participants, both tailoring and customization strategies had appeal. For example, customization might allow users to browse the system and explore content offerings (e.g., selecting between story topics), or occasionally to completely omit a content type to which they have a strongly negative reaction (e.g., a particular self-management strategy). Overall, however, there was an appreciation that not every content-related decision can or should be made by participants, who were sensitive to the potential they might be overwhelmed or under-prepared. As such, one promising potential avenue to balance customization and tailoring is to leverage the multidimensional nature of messaging. For example, a system might ask users to make selections along a single dimension of messaging, such as picking the self-management strategy they want messages to focus on, whereas an algorithm might tailor other elements of messages, such as the interaction style (e.g., peer story, prompt, reflection question), or other elements like the inclusion/omission of a rationale or an affirmation of the user.

5.3 Limitations

This work has limitations that warrant consideration. First, we attempted to lower barriers to participation throughout these studies (e.g., facilitating remote, asynchronous, and pseudonymous contributions during the discussion groups, and offering flexible attendance at workshops); however, those who engage in research may still have been more motivated than individuals who self-screen for mental health conditions but choose not to sign up for research. It is therefore unclear how well resulting tools would meet the needs of less motivated users, and what refinements could help make the tool appeal more broadly. An additional limitation is that data were collected at the beginning of the COVID-19 pandemic, and participants' needs and preferences may relate to the specific disruptions they were facing at that time.

5.4 Future Directions

Our findings suggest some noteworthy future directions. In the next stage of this project, it will be important to assess how users respond to a messaging tool that reflects the needs and preferences captured here and how they interact with that tool over time, including through

assessing engagement, future mental health help-seeking behavior, and clinical outcomes (i.e., symptoms of depression and anxiety) [28]. It will also be crucial to understand which features of the tool are central to achieving desired outcomes. For example, some features of the tool may help to maintain user engagement without contributing to symptom reduction, whereas other features may help with symptom reduction without being the most engaging. A crucial but challenging endeavor is to find the appropriate balance, such that tools are both engaging and also efficacious. It is also unclear how regular introduction of novelty should be balanced against sustained engagement with a particular type of content; such sustained engagement may be needed to master certain self-management skills.

We suspect that an effective and engaging automated messaging tool will also require sophisticated personalization. A high priority research avenue is therefore to develop and integrate algorithms by which user behavior and feedback can improve the delivery of content over time. Algorithms might learn from aggregate data so that low quality content can be excluded from the program entirely, as well as from individual-level data (e.g., if specific users have strong preferences for certain psychological strategies and interaction types) and contextual data (e.g., mood, busyness, time of day), and an ideal approach would likely account for all three. However, as the sections above suggest, we do not see such tailoring as fully displacing active customization, as individuals seem to find it engaging and empowering to make some explicit choices [49]. Future research should seek to clarify the optimal balance.

Our findings also suggest that more attention is needed to how a tool is initially presented to young adults to establish acceptability. A number of studies speak to the importance of appropriately framing digital mental health tools to appeal to young people, highlighting the importance of non-stigmatizing language and, in some cases, avoidance of clinical terminology [56, 101]. Our landings also highlight the importance of establishing tools as a pathway to independent self-management. Furthermore, for automated text messaging tools, our findings suggest that promotional efforts must make it clear that texting can be an independent activity (versus a social one), does not seek to displace caring interpersonal relationships, can provide practical guidance and support of self-management tasks, and allows for interactivity and choice. Future work should therefore build on our findings by developing and testing recruitment strategies that can be deployed after self-screening.

Finally, some considerations in developing a functional automated messaging system pertain to the SMS medium. Our emphasis on SMS reflects our interest in making a tool broadly accessible to mobile phone users, including those without smartphones. However, app-based communication would have some benefits, such as facilitating multimedia, allowing users to respond to messages out of sequence, and reducing the effort needed to give feedback, such as through one-tap responses. It is also important to recognize that while SMS is extremely widespread, it is not universal, with some users experiencing barriers to texting related to disability and literacy [83]. Furthermore, some individuals use mobile phones without a cellular plan, by engaging with the phone when connected to wi-fi; these patterns of use, often seen in low-income individuals, allow for use of messaging apps (e.g., Whatsapp, Facebook Messenger) but not SMS [9]. It is therefore worth considering whether multiple versions of an automated messaging program could be introduced, with one version

being limited by the basic affordances of SMS, whereas an app-based version might have additional functionalities and potentially reach different users.

6 CONCLUSION

In this study, we applied user-centered design methods to better understand the needs of young adults who have mental health symptoms but who may not be seeking formal treatment. Findings from a series of design activities suggest that these participants are interested in digital mental health tools that are easy-to-use and that center their independence. SMS likely represents a promising modality through which to reach these users and keep them engaged, especially if used to deliver content that provides an appropriate balance of system recommendations and user selections. It will also be essential to deploy a motivational tone that users perceive as supportive but also authentic to an automated system. Future work can build on our findings by examining how users respond to an automated tool developed based on these findings, and how engagement and outcomes can potentially be improved by integrating personalization algorithms. Ultimately, if designed appropriately, interactive SMS-based messaging tools have potential for broad deployment at the point of self-screening, helping to reduce a massive treatment gap in young adults' mental health.

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REFERENCES

[1]. Abd-Alrazaq Alaa A, Alajlani Mohannad, Alalwan Ali Abdallah, Bewick Bridgette M, Gardner Peter, and Househ Mowafa. 2019. An overview of the features of chatbots in mental health: A scoping review. International Journal of Medical Informatics 132 (2019), 103978. 10.1016/j.ijmedinf.2019.103978 [PubMed: 31622850]

[2]. Achilles Melinda R, Anderson Melissa, Li Sophie H, Subotic-Kerry Mirjana, Parker Belinda, and O'Dea Bridianne. 2020. Adherence to e-mental health among youth: Considerations for intervention development and research design. DIGITAL HEALTH 6 (2020). 10.1177/2055207620926064.

[3]. Aguilera Adrian and Berridge Clara. 2014. Qualitative Feedback From a Text Messaging Intervention for Depression: Benefits, Drawbacks, and Cultural Differences. JMIR Mhealth Uhealth 2, 4:e46 (2014). 10.2196/mhealth.3660 [PubMed: 25373390]

[4]. Aguilera Adrian, Figueroa Caroline A, Hernandez-Ramos Rosa, Sarkar Urmimala, Cemballi Anupama, Gomez-Pathak Laura, Miramontes Jose, Yom-Tov Elad, Chakraborty Bibhas, Yan Xiaoxi, Xu Jing, Modiri Arghavan, Aggarwal Jai, Williams Joseph Jay, and Lyles Courtney R. 2020. mHealth app using machine learning to increase physical activity in diabetes and depression: clinical trial protocol for the DIAMANTE Study. BMJ Open 10, 8 (2020). 10.1136/bmjopen-2019-034723

[5]. Andalibi Nazanin and Flood Madison K. 2021. Considerations in designing digital peer support for mental health: Interview study among users of a digital support system (Buddy Project). JMIR Mhealth Uhealth 8, 1 (2021). 10.2196/21819

[6]. Andersson Gerhard, Cuijpers Pim, Carlbring Per, Riper Heleen, and Hedman Erik. 2014. Guided Internet-based vs. face-to-face cognitive behavior therapy for psychiatric and somatic disorders:

A systematic review and meta-analysis. World Psychiatry 13, 3 (2014), 288–295. 10.1002/wps.20151 [PubMed: 25273302]

[7]. Aryana Bijan and Brewster Liz. 2020. Design for mobile mental health: Exploring the informed participation approach. Health Informatics Journal 26, 2 (2020), 1208–1224. 10.1177/1460458219873540. [PubMed: 31566470]

[8]. Bailey Eleanor, Robinson Jo, Alvarez-Jimenez Mario, Nedeljkovic Maja, Valentine Lee, Bendall Sarah, D'Alfonso Simon, Gilbertson Tamsyn, McKechnie Ben, and Rice Simon. 2021. Moderated online social therapy for young people With active suicidal ideation: Qualitative study. J Med Internet Res 23, 4 (2021). 10.2196/24260

[9]. Bailey Shannon KT, Schroeder Bradford L, Whitmer Daphne E, and Sims Valerie K. 2016. Perceptions of mobile instant messaging apps are comparable to texting for young adults in the United States. In Proceedings of the Human Factors and Ergonomics Society Annual Meeting, Vol. 60. SAGE Publications Sage CA: Los Angeles, CA, 1235–1239.

[10]. Batterham Philip J and Calear Alison L. 2017. Preferences for Internet-based mental health interventions in an adult online sample: Findings from an online community survey. JMIR Ment Health 4, 2 (2017). 10.2196/mental.7722

[11]. Baumel Amit, Muench Frederick, Edan Stav, and Kane John M. 2019. Objective user engagement with mental health apps: Systematic search and panel-based usage analysis. Journal of Medical Internet Research 21, 9 (2019).

[12]. Bergin Aislinn D, Vallejos Elvira Perez, Davies E Bethan, Daley David, Ford Tamsin, Harold Gordon, Hetrick Sarah, Kidner Megan, Long Yunfei, Merry Sally, et al. 2020. Preventive digital mental health interventions for children and young people: a review of the design and reporting of research. npj Digital Medicine 3 (2020). 10.1038/s41746-020-00339-7

[13]. Bhattacharya Arpita, Liang Calvin, Zeng Emily Y, Shukla Kanishk, Wong Miguel ER, Munson Sean A, and Kientz Julie A. 2019. Engaging teenagers in asynchronous online groups to design for stress management. In Proceedings of the 18th ACM International Conference on Interaction Design and Children. Association of Computing Machinery, 26–37.

[14]. Bickmore Timothy and Cassell Justine. 2001. Relational agents: A model and implementation of building user trust. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (Seattle, Washington, USA) (CHI '01). Association for Computing Machinery, New York, NY, USA, 396–403. 10.1145/365024.365304

[15]. Bickmore Timothy and Gruber Amanda. 2010. Relational agents in clinical psychiatry. Harvard Review of Psychiatry 18, 2 (2010), 119–130. 10.3109/10673221003707538. [PubMed: 20235777]

[16]. Bickmore Timothy W., Mitchell Suzanne E., Jack Brian W., Paasche-Orlow Michael K., Pfeifer Laura M., and O'Donnell Julie. 2010. Response to a relational agent by hospital patients with depressive symptoms. Interacting with Computers 22, 4 (2010), 289–298. 10.1016/j.intcom.2009.12.001 [PubMed: 20628581]

[17]. Burton Christopher, Tatar Aurora Szentagotai, McKinstry Brian, Matheson Colin, Matu Silviu, Moldovan Ramona, Macnab Michele, Farrow Elaine, David Daniel, Pagliari Claudia, et al. 2016. Pilot randomised controlled trial of Help4Mood, an embodied virtual agent-based system to support treatment of depression. Journal of Telemedicine and Telecare 22, 6 (2016), 348–355. 10.1177/1357633X15609793. [PubMed: 26453910]

[18]. Calvo Rafael A., Peters Dorian, Johnson Daniel, and Rogers Yvonne. 2014. Autonomy in technology design. In CHI '14 Extended Abstracts on Human Factors in Computing Systems (Toronto, Ontario, Canada) (CHI EA '14). Association for Computing Machinery, New York, NY, USA, 37–40. 10.1145/2559206.2560468

[19]. Carlo Andrew D., Ghomi Reza Hosseini, Renn Brenna N., and Areán Patricia A.. 2019 By the numbers: Ratings and utilization of behavioral health mobile applications. npj Digital Medicine 2 (2019). 10.1038/s41746-019-0129-6

[20]. Chirkov V, Ryan RM, Kim Y, and Kaplan U. 2003. Differentiating autonomy from individualism and independence: A self-determination theory perspective on internalization of cultural orientations and well-being. Journal of Personality and Social Psychology 84, 1 (2003), 97–110. 10.1037/0022-3514.84.1.97 [PubMed: 12518973]

[21]. Ciechanowski Leon, Przegalinska Aleksandra, Magnuski Mikolaj, and Gloor Peter. 2019. In the shades of the uncanny valley: An experimental study of human–chatbot interaction. Future Generation Computer Systems 92 (2019), 539–548.

[22]. Clarke Victoria and Braun Virginia. 2014. Thematic analysis. In Encyclopedia of critical psychology. Springer, 1947–1952.

[23]. Colizzi Marco, Lasalvia Antonio, and Ruggeri Mirella. 2020. Prevention and early intervention in youth mental health: Is it time for a multidisciplinary and trans-diagnostic model for care? International Journal of Mental Health Systems 14, 1 (2020). 10.1186/s13033-020-00356-9 [PubMed: 31921334]

[24]. Czeisler Mark É, Lane Rashon I, Petrosky Emiko, Wiley Joshua F, Christensen Aleta, Njai Rashid, Weaver Matthew D, Robbins Rebecca, Facer-Childs Elise R, Barger Laura K, et al. 2020. Mental health, substance use, and suicidal ideation during the COVID-19 pandemic — United States. Morbidity and Mortality Weekly Report 69, 32 (06 2020), 1049–1057. 10.15585/mmwr.mm6932a1 [PubMed: 32790653]

[25]. Daskalova Nediyana, Yoon Jina, Wang Yibing, Araujo Cintia, Beltran Guillermo, Nugent Nicole, McGeary John, Williams Joseph Jay, and Huang Jeff. 2020. Sleep-Bandits: Guided flexible self-experiments for sleep. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, New York, NY, USA, 1–13. 10.1145/3313831.3376584

[26]. Deci Edward L. and Ryan Richard M.. 1985. Intrinsic Motivation and Self-Determination in Human Behavior. Plenum Press, New York, NY, USA.

[27]. Duggan Maeve. 2016. Cell phone activities. Pew Research Center Internet and American Life Project. Washington, DC.

[28]. Fairburn Christopher G. and Patel Vikram. 2017. The impact of digital technology on psychological treatments and their dissemination. Behaviour Research and Therapy 88 (2017), 19–25. 10.1016/j.brat.2016.08.012 [PubMed: 28110672]

[29]. Fitzpatrick Kathleen K., Darcy Alison, and Vierhile Molly. 2017. Delivering cognitive behavior therapy to young adults with symptoms of depression and anxiety using a fully automated conversational agent (Woebot): A randomized controlled trial. JMIR Mental Health 4, 2 (2017). 10.2196/mental.7785

[30]. Fulmer Russell, Joerin Angela, Gentile Breanna, Lakerink Lysanne, and Rauws Michiel. 2018. Using psychological artificial intelligence (Tess) to relieve symptoms of depression and anxiety: Randomized controlled trial. JMIR Mental Health 5, 4 (2018). 10.2196/mental.9782

[31]. Garrido Sandra, Millington Chris, Cheers Daniel, Boydell Katherine, Schubert Emery, Meade Tanya, and Nguyen Quang Vinh. 2019. What works and what doesn't work? A systematic review of digital mental health interventions for depression and anxiety in young people. Frontiers in Psychiatry 10 (2019). 10.3389/fpsyt.2019.00759

[32]. Ghandeharioun Asma, McDuff Daniel, Czerwinski Mary, and Rowan Kael. 2019. Towards understanding emotional intelligence for behavior change chatbots. In 2019 8th International Conference on Affective Computing and Intelligent Interaction (ACII). 8–14. 10.1109/ACII.2019.8925433

[33]. Gratch Jonathan, Lucas Gale M., King Aisha Aisha, and Morency Louis-Philippe. 2014. It's only a computer: The impact of human-agent interaction in clinical interviews. In Proceedings of the 2014 International Conference on Autonomous Agents and Multi-Agent Systems (Paris, France) (AAMAS '14). International Foundation for Autonomous Agents and Multiagent Systems, Richland, SC, 85–92.

[34]. Gulliver Amelia, Griffiths Kathleen M., and Christensen Helen. 2010. Perceived barriers and facilitators to mental health help-seeking in young people: A systematic review. BMC Psychiatry 10 (2010), 113. 10.1186/1471-244X-10-113 [PubMed: 21192795]

[35]. Hardcastle Sarah J., Fortier Michelle, Blake Nicola, and Hagger Martin S.. 2017. Identifying content-based and relational techniques to change behaviour in motivational interviewing. Health Psychology Review 11, 1 (2017). 10.1080/17437199.2016.1190659.

[36]. Iorfino Frank, Cross Shane P., Davenport Tracey, Carpenter Joanne S., Scott Elizabeth, Shiran Sagit, and Hickie Ian B.. 2019. A digital platform designed for youth mental health services

to deliver personalized and measurement-based care. Frontiers in Psychiatry 10 (2019). 10.3389/fpsyt.2019.00595

[37]. Jansen Arne, Van Mechelen Maarten, and Slegers Karin. 2017. Personas and behavioral theories: A case study using self-determination theory to construct overweight personas. In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, New York, NY, USA, 2127–2136. 10.1145/3025453.3026003

[38]. Kadera Scott W., Lambert Michael J., and Andrews Alison A.. 1996. How much therapy is really enough?: A session-by-session analysis of the psychotherapy dose-effect relationship. The Journal of Psychotherapy Practice and Research 5, 2 (1996), 132. [PubMed: 22700273]

[39]. Kalb Luther G., Stapp Emma K., Ballard Elizabeth D., Holingue Calliope, Keefer Amy, and Riley Anne. 2019. Trends in psychiatric emergency department visits among youth and young adults in the US. Pediatrics 143, 4 (2019). 10.1542/peds.2018-2192

[40]. Kang Jin and Wei Lewen. 2020. Enter your dinner now! Uncovering persuasive message attributes in tracking reminders that motivate logging. In Proceedings of the 14th EAI International Conference on Pervasive Computing Technologies for Healthcare (Atlanta, GA, USA) (PervasiveHealth '20). Association for Computing Machinery, New York, NY, USA, 122–132. 10.1145/3421937.3422014

[41]. Kauer Sylvia, Buhagiar Kerrie, and Sanci Lena. 2017. Facilitating mental health help seeking in young adults: the underlying theory and development of an online navigation tool. Advances in Mental Health 15, 1 (2017), 71–87. 10.1080/18387357.2016.1237856

[42]. Kauer Sylvia D., Buhagiar Kerrie, Blake Victoria, Cotton Sue, and Sanci Lena. 2017. Facilitating mental health help-seeking by young adults with a dedicated online program: A feasibility study of Link. BMJ Open 7, 7 (2017). 10.1136/bmjopen-2016-015303

[43]. Kauer Sylvia D., Mangan Cheryl, and Sanci Lena. 2014. Do online mental health services improve help-seeking for young people? A systematic review. Journal of Medical Internet Research 16, 3 (2014). 10.2196/jmir.3103

[44]. Kessler Ronald C., Berglund Patricia, Demler Olga, Jin Robert, Merikangas Kathleen R., and Walters Ellen E.. 2005. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. Archives of General Psychiatry 62, 6 (2005), 593–602. 10.1001/archpsyc.62.6.593 [PubMed: 15939837]

[45]. Klasnja Predrag, Hekler Eric B, Shiffman Saul, Boruvka Audrey, Almirall Daniel, Tewari Ambuj, and Murphy Susan A. 2015. Microrandomized trials: An experimental design for developing just-in-time adaptive interventions. Health Psychology 34(Suppl) (2015), 1220–1228. 10.1037/hea0000305

[46]. Klasnja Predrag, Smith Shawna, Seewald Nicholas J, Lee Andy, Hall Kelly, Luers Brook, Hekler Eric B, and Murphy Susan A. 2018. Efficacy of Contextually Tailored Suggestions for Physical Activity: A Micro-randomized optimization trial of HeartSteps. Annals of Behavioral Medicine 53, 6 (09 2018), 573–582. 10.1093/abm/kay067

[47]. Kocielnik Rafal and Hsieh Gary. 2017. Send me a different message: Utilizing cognitive space to create engaging message triggers. In Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing (Portland, Oregon, USA) (CSCW '17). Association for Computing Machinery, New York, NY, USA, 2193–2207. 10.1145/2998181.2998324

[48]. Kornfield Rachel, Mohr David C., Meyerhoff Jonah, Ranney Rachel, Williams Joseph J., Lattie Emily G., and Reddy Madhu. In press. Involving crowdworkers with lived experience in content-development for digital mental health tools: Lessons learned from crowdsourcing mental health Messages. In Proceedings of the 2022 ACM on Human-Computer Interaction (CSCW).

[49]. Kornfield Rachel, Zhang Renwen, Nicholas Jennifer, Schueller Stephen M., Cambo Scott A., Mohr David C., and Reddy Madhu. 2020. "Energy is a finite resource": Designing technology to support individuals across fluctuating symptoms of depression. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, New York, NY, USA, 1–17. 10.1145/3313831.3376309

[50]. Krebs Paul, Prochaska James O., and Rossi Joseph S.. 2010. A meta-analysis of computer-tailored interventions for health behavior change. Preventive medicine 51, 3-4 (2010), 214–221. [PubMed: 20558196]

[51]. Kretzschmar Kira, Tyroll Holly, Pavarini Gabriela, Manzini Arianna, Singh Ilina, and NeurOx Young People's Advisory Group. 2019. Can your phone be your therapist? Young people's ethical perspectives on the Use of fully automated conversational agents (Chatbots) in mental health support. Biomedical Informatics Insights 11 (2019). 10.1177/1178222619829083.

[52]. Kroenke Kurt, Spitzer Robert L., and Williams Janet B. W.. 2001. The PHQ-9. Journal of General Internal Medicine 16 (2001), 606–613. 10.1046/j.1525-1497.2001.016009606.x [PubMed: 11556941]

[53]. Kwasny Mary J., Schueller Stephen M., Lattie Emily, Gray Elizabeth L., and Mohr David C.. 2019. Exploring the use of multiple mental health apps within a platform: Secondary analysis of the IntelliCare field trial. JMIR Mental Health 6, 3 (2019). 10.2196/11572

[54]. Larsen Mark Erik, Shand Fiona, Morley Kirsten, Batterham Philip J., Petrie Katherine, Reda Bill, Berrouiguet Sofian, Haber Paul S., Carter Gregory, and Christensen Helen. 2017. A mobile text message intervention to reduce repeat suicidal episodes: Design and development of reconnecting after a suicide attempt (RAFT). JMIR Mental Health 4, 4 (2017). 10.2196/mental.7500

[55]. Lattie Emily G., Adkins Elizabeth C., Winquist Nathan, Stiles-Shields Colleen, Wafford Q. Eileen, and Graham Andrea K.. 2019. Digital mental health interventions for depression, anxiety, and enhancement of psychological well-being among college students: Systematic review. Journal of Medical Internet Research 21, 7 (2019). 10.2196/12869

[56]. Lattie Emily G., Kornfield Rachel, Ringland Kathryn E., Zhang Renwen, Winquist Nathan, and Reddy Madhu. 2020. Designing mental health technologies that support the social ecosystem of college students. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, 1–15.

[57]. Lederman Reeva, Gleeson John, Wadley Greg, D'alfonso Simon, Rice Simon, Santesteban-Echarri Olga, and Alvarez-Jimenez Mario. 2019. Support for carers of young people with mental illness: Design and trial of a technology-mediated therapy. ACM Transactions on Computer-Human Interaction (TOCHI) 26, 1 (2019). 10.1145/3301421

[58]. Lederman Reeva, Wadley Greg, Gleeson John, Bendall Sarah, and Álvarez-Jiménez Mario. 2014. Moderated online social therapy: Designing and evaluating technology for mental health. ACM Transactions on Computer-Human Interaction (TOCHI) 21, 1 (2014), 1–26.

[59]. Lee Jisoo, Walker Erin, Burleson Winslow, Kay Matthew, Buman Matthew, and Hekler Eric B.. 2017. Self-experimentation for behavior change: Design and formative evaluation of two approaches. In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, New York, NY, USA, 6837–6849. 10.1145/3025453.3026038

[60]. Leebens Patricia K. and Williamson Edwin D.. 2017. Developmental psychopathology: Risk and resilience in the transition to young adulthood. Child and Adolescent Psychiatric Clinics of North America 26, 2 (2017), 143–156. 10.1016/j.chc.2016.12.001 [PubMed: 28314447]

[61]. Legler Sean, Celano Christopher M., Amador Adela, Novis Austen, Ebrahim Senan, and Huffman Jeff C.. 2018. Development and theoretical approach to an adaptive text message program to promote well-being and health behaviors in primary care patients. Primary Care Companion for CNS Disorders 20, 5 (2018). 10.4088/PCC.18br02353

[62]. Lehtimaki Susanna, Martic Jana, Wahl Brian, Foster Katherine T., Schwalbe Nina, et al. 2021. Evidence on digital mental health interventions for adolescents and young people: Systematic overview. JMIR Mental Health 8, 4 (2021). 10.2196/25847

[63]. Levin Michael E, Stocke Krista, Pierce Benjamin, and Levin Crissa. 2018. Do college students use online self-help? A survey of intentions and use of mental health resources. Journal of College Student Psychotherapy 32, 3 (2018), 181–198. 10.1080/87568225.2017.1366283

[64]. Liverpool Shaun, Mota Catarina Pinheiro, Sales Célia M. D., uš Anja, Carletto Sara, Hancheva Camellia, Sousa Sónia, Cerón Sonia Conejo, Moreno-Peral Patricia, Pietrabissa Giada, et al. 2020. Engaging children and young people in digital mental health interventions: systematic review of modes of delivery, facilitators, and barriers. Journal of Medical Internet Research 22, 6 (2020), e16317. 10.2196/16317 [PubMed: 32442160]

[65]. Lupton Deborah. 2021. Young people's use of digital health technologies in the global north: Narrative review. Journal of Medical Internet Research 23, 1 (2021), e18286. 10.2196/18286 [PubMed: 33427684]

[66]. Lyon Aaron R., Munson Sean A., Renn Brenna N., Atkins David C., Pullmann Michael D., Friedman Emily, and Areán Patricia A.. 2019. Use of human-centered design to improve implementation of evidence-based psychotherapies in low-resource communities: Protocol for studies applying a framework to assess usability. JMIR Research Protocols 8, 10 (2019), e14990. [PubMed: 31599736]

[67]. MacLeod Haley, Jelen Ben, Prabhakar Annu, Oehlberg Lora, Siek Katie, and Connelly Kay. 2016. Asynchronous remote communities (ARC) for researching distributed populations. In Proceedings of the 10th EAI International Conference on Pervasive Computing Technologies for Healthcare (Cancun, Mexico) (PervasiveHealth '16). ICST (Institute for Computer Sciences, Social-Informatics and Telecommunications Engineering), Brussels, BEL. 10.5555/3021319.3021320

[68]. Maestre Juan F., MacLeod Haley, Connelly Ciabhan L., Dunbar Julia C., Beck Jordan, Siek Katie A., and Shih Patrick C.. 2018. Defining through expansion: conducting asynchronous remote communities (ARC) research with stigmatized groups. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems. 10.1145/3173574.3174131

[69]. Materia Frank T. and Smyth Joshua M.. 2021. Acceptability of intervention design factors in mHealth intervention research: Experimental factorial study. JMIR mHealth and uHealth 9, 7 (2021), e23303. 10.2196/23303 [PubMed: 34309563]

[70]. McCance-Katz Elinore F.. 2019. The national survey on drug use and health: 2018. Substance Abuse and Mental Health Services Administration. https://www.samhsa.gov/data/sites/default/files/nsduh-ppt-09-2018.pdf. Accessed May 7 (2019).

[71]. Mehta Nisha, Croudace Tim, and Davies Dame Sally C.. 2015. Public mental health: Evidenced-based priorities. The Lancet 385, 9976 (2015), 1472–1475. 10.1016/S0140-6736(14)61400-8

[72]. Melcher Jennifer, Hays Ryan, and Torous John. 2020. Digital phenotyping for mental health of college students: a clinical review. Evidence-Based Mental Health 23, 4 (2020), 161–166. 10.1136/ebmental-2020-300180 [PubMed: 32998937]

[73]. Mohr David C., Tomasino Kathryn Noth, Lattie Emily G., Palac Hannah L., Kwasny Mary J., Weingardt Kenneth, Karr Chris J., Kaiser Susan M., Rossom Rebecca C., Bardsley Leland R., et al. 2017. IntelliCare: an eclectic, skills-based app suite for the treatment of depression and anxiety. Journal of Medical Internet Research 19, 1 (2017), e10. 10.2196/jmir.6645 [PubMed: 28057609]

[74]. Moreno Megan A., Jelenchick Lauren A., Egan Katie G., Cox Elizabeth, Young Henry, Gannon Kerry E., and Becker Tara. 2011. Feeling bad on Facebook: Depression disclosures by college students on a social networking site. Depression and anxiety 28, 6 (2011), 447–455. 10.1002/da.20805 [PubMed: 21400639]

[75]. Morris Robert R., Kouddous Kareem, Kshirsagar Rohan, and Schueller Stephen M.. 2018. Towards an artificially empathic conversational agent for mental health applications: system design and user perceptions. Journal of Medical Internet Research 20, 6 (2018), e10148. 10.2196/10148 [PubMed: 29945856]

[76]. Mumm Jonathan and Mutlu Bilge. 2011. Designing motivational agents: The role of praise, social comparison, and embodiment in computer feedback. Computers in Human Behavior 27, 5 (2011), 1643–1650. 10.1016/j.chb.2011.02.002

[77]. Murphy J. Michael, Nguyen Theresa, Lucke Cara, Chiang Cindy, Plasencia Natalie, and Jellinek Michael. 2018. Adolescent self-screening for mental health problems; demonstration of an internet-based approach. Academic Pediatrics 18, 1 (2018), 59–65. 10.1016/j.acap.2017.08.013 [PubMed: 28870650]

[78]. Naslund John A., Aschbrenner Kelly A., Marsch Lisa A., and Bartels SJ. 2016. The future of mental health care: peer-to-peer support and social media. Epidemiology and Psychiatric Sciences 25, 2 (2016), 113–122. 10.1017/S2045796015001067 [PubMed: 26744309]

[79]. Nass Clifford and Moon Youngme. 2000. Machines and mindlessness: Social responses to computers. Journal of Social Issues 56, 1 (2000), 81–103. 10.1111/0022-4537.00153

[80]. Newport Frank. 2014. The new era of communication among Americans. Gallup.com 11, 10 (2014).

[81]. Ng Ada, Kornfield Rachel, Schueller Stephen M., Zalta Alyson K., Brennan Michael, and Reddy Madhu. 2019. Provider perspectives on integrating sensor-captured patient-generated data

in mental health care. In Proceedings of the ACM on Human-Computer Interaction, Vol. 3. Association for Computing Machinery, New York, NY, USA. 10.1145/3359217

[82]. Nicholas Mariesa, Hagen Penny, Rahilly Kitty, and Swainston Nathalie. 2012. Using participatory design methods to engage the uninterested. In Proceedings of the 12th Participatory Design Conference: Exploratory Papers, Workshop Descriptions, Industry Cases-Volume 2. Association for Computing Machinery, New York, NY, USA. 10.1145/2348144.2348183

[83]. Nouri Sarah S., Avila-Garcia Patricia, Cemballi Anupama Gunshekar, Sarkar Urmimala, Aguilera Adrian, and Lyles Courtney Rees. 2019. Assessing mobile phone digital literacy and engagement in user-centered design in a diverse, safety-net population: mixed methods study. JMIR mHealth and uHealth 7, 8 (2019), e14250. [PubMed: 31469083]

[84]. Nunes Francisco, Verdezoto Nervo, Fitzpatrick Geraldine, Kyng Morten, Grönvall Erik, and Storni Cristiano. 2015. Self-care technologies in HCI: Trends, tensions, and opportunities. ACM Transactions on Computer-Human Interaction (TOCHI) 22, 6 (2015).

[85]. O'Leary Kathleen, Schueller Stephen M., Wobbrock Jacob O., and Pratt Wanda. 2018. "Suddenly, we got to become therapists for each other": Designing peer support chats for mental health. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems. Association of Computing Machinery.

[86]. Ondersma Steven J., Chase Sara K, Svikis Dace S., and Schuster Charles R.. 2005. Computer-based brief motivational intervention for perinatal drug use. Journal of Substance Abuse Treatment 28, 4 (2005), 305–312. [PubMed: 15925264]

[87]. Pagliari Claudia. 2007. Design and evaluation in eHealth: challenges and implications for an interdisciplinary field. Journal of Medical Internet Research 9, 2 (2007), e614.

[88]. Paredes Pablo, Gilad-Bachrach Ran, Czerwinski Mary, Roseway Asta, Rowan Kael, and Hernandez Javier. 2014. PopTherapy: Coping with stress through pop-culture. In Proceedings of the 8th International Conference on Pervasive Computing Technologies for Healthcare. 109–117.

[89]. Paus Tomáš, Keshavan Matcheri, and Giedd Jay N.. 2008. Why do many psychiatric disorders emerge during adolescence? Nature Reviews Neuroscience 9 (2008), 947–957. 10.1038/nrn2513 [PubMed: 19002191]

[90]. Pfeifer Jennifer H. and Allen Nicholas B.. 2020. Puberty initiates cascading relationships between neurodevelopmental, social, and internalizing processes across adolescence. Biological Psychiatry (2020). 10.1016/j.biopsych.2020.09.002

[91]. Philip Pierre, Dupuy Lucile, Auriacombe Marc, Serre Fushia, de Sevin Etienne, Sauteraud Alain, and Micoulaud-Franchi Jean-Arthur. 2020. Trust and acceptance of a virtual psychiatric interview between embodied conversational agents and outpatients. NPJ Digital Medicine 3, 1 (2020). 10.1038/s41746-019-0213-y

[92]. Picard Rosalind W. and Liu Karen K.. 2007. Relative subjective count and assessment of interruptive technologies applied to mobile monitoring of stress. International Journal of Human-Computer Studies 65, 4 (2007), 361–375. 10.1016/j.ijhcs.2006.11.019

[93]. Pisani Anthony R., Wyman Peter A., Gurditta Kunali, Schmeelk-Cone Karen, Anderson Carolyn L., and Judd Emily. 2018. Mobile phone intervention to reduce youth suicide in rural communities: field test. JMIR Mental Health 5, 2 (2018), e10425. 10.2196/10425 [PubMed: 29853439]

[94]. Poole Erika S.. 2013. HCI and mobile health interventions: how human–computer interaction can contribute to successful mobile health interventions. Translational Behavioral Medicine 3, 4 (2013), 402–405. [PubMed: 24294328]

[95]. Pretorius Claudette, Chambers Derek, and Coyle David. 2019. Young people's online help-seeking and mental health difficulties: Systematic narrative review. Journal of Medical Internet Research 21, 11 (2019), e13873. 10.2196/13873 [PubMed: 31742562]

[96]. Pretorius Claudette, McCashin Darragh, Kavanagh Naoise, and Coyle David. 2020 Searching for mental health: A mixed-methods study of young people's online help-seeking. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, New York, NY, USA, 1–13. 10.1145/3313831.3376328

[97]. Rabbi Mashfiqui, Aung Min Hane, Zhang Mi, and Choudhury Tanzeem. 2015. MyBehavior: Automatic personalized health feedback from user behaviors and preferences using smartphones.

In Proceedings of the 2015 ACM International Joint Conference on Pervasive and Ubiquitous Computing (Osaka, Japan) (UbiComp '15). Association for Computing Machinery, New York, NY, USA. 10.1145/2750858.2805840

[98]. Rabbi Mashfiqui, Philyaw-Kotov Meredith, Lee Jinseok, Mansour Anthony, Dent Laura, Wang Xiaolei, Cunningham Rebecca, Bonar Erin, Nahum-Shani Inbal, Klasnja Predrag, et al. 2017. SARA: A mobile app to engage users in health data collection. In Proceedings of the 2017 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2017 ACM International Symposium on Wearable Computers. 781–789.

[99]. Radovic Ana, DeMand Alexandra L., Gmelin Theresa, Stein Bradley D., and Miller Elizabeth. 2017. SOVA: Design of a stakeholder informed social media website for depressed adolescents and their parents. Journal of Technology in Human Services 35, 3 (2017), 169–182. 10.1080/15228835.2017.1347552 [PubMed: 29743822]

[100]. Rains Stephen A. and Wright Kevin B.. 2016. Social support and computer-mediated communication: A state-of-the-art review and agenda for future research. Annals of the International Communication Association 40, 1 (2016), 175–211. 10.1080/23808985.2015.11735260

[101]. Ranney Megan L, Choo Esther K, Cunningham Rebecca M, Spirito Anthony, Thorsen Margaret, Mello Michael J, and Morrow Kathleen. 2014. Acceptability, language, and structure of text message-based behavioral interventions for high-risk adolescent females: a qualitative study. Journal of Adolescent Health 55, 1 (2014), 33–40. 10.1016/j.jadohealth.2013.12.017

[102]. Ranney Megan L., Freeman Joshua R., Connell Gerianne, Spirito Anthony, Boyer Edward, Walton Maureen, Guthrie Kate Morrow, and Cunningham Rebecca M.. 2016. A depression prevention intervention for adolescents in the emergency department. Journal of Adolescent Health 59, 4 (2016), 401–410. 10.1016/j.jadohealth.2016.04.008

[103]. Ranney Megan L., Pisani Anthony R., and Chernick Lauren S.. 2018. The Role of Texting in Addressing Mental Health. In Technology and Adolescent Mental Health. Springer, 207–215. 10.1007/978-3-319-69638-6_15

[104]. Reeves Byron and Nass Clifford. 1996. The media equation: How people treat computers, television, and new media like real people. Cambridge University Press, Cambridge, United Kingdom.

[105]. Renn Brenna N., Hoeft Theresa J., Lee Heather Sophia, Bauer Amy M., and Areán Patricia A.. 2019. Preference for in-person psychotherapy versus digital psychotherapy options for depression: survey of adults in the US. NPJ Digital Medicine 2, 1 (2019). 10.1038/s41746-019-0077-1

[106]. Resnik Paula V. and Lammers H. Bruce. 1985. The influence of self-esteem on cognitive responses to machine-like versus human-like computer feedback. The Journal of Social Psychology 125, 6 (1985), 761–769. 10.1080/00224545.1985.9713550

[107]. Richards Derek. 2011. Prevalence and clinical course of depression: A review. Clinical Psychology Review 31, 7 (2011), 1117–1125. 10.1016/j.cpr.2011.07.004 [PubMed: 21820991]

[108]. Ridout Brad and Campbell Andrew. 2018. The use of social networking sites in mental health interventions for young people: systematic review. Journal of Medical Internet Research 20, 12 (2018), e12244. 10.2196/12244 [PubMed: 30563811]

[109]. Riley William T., Rivera Daniel E., Atienza Audie A., Nilsen Wendy, Allison Susannah M., and Mermelstein Robin. 2011. Health behavior models in the age of mobile interventions: are our theories up to the task? Translational Behavioral Medicine 1, 1 (02 2011), 53–71. 10.1007/s13142-011-0021-7 [PubMed: 21796270]

[110]. Robards Fiona, Kang Melissa, Usherwood Tim, and Sanci Lena. 2018. How marginalized young people access, engage with, and navigate health-care systems in the digital age: systematic review. Journal of Adolescent Health 62, 4 (2018), 365–381. 10.1016/j.jadohealth.2017.10.018

[111]. Robb C, Haley WE, Becker MA, Polivka LA, and Chwa H-J. 2003. Attitudes towards mental health care in younger and older adults: Similarities and differences. Aging & Mental Health 7, 2 (2003), 142–152. 10.1080/1360786031000072321. [PubMed: 12745392]

[112]. Roubroeks Maaike, Midden Cees, and Ham Jaap. 2009. Does it make a difference who tells you what to do? Exploring the effect of social agency on psychological reactance. In Proceedings of the 4th International Conference on Persuasive Technology (Claremont,

California, USA) (Persuasive '09). Association for Computing Machinery, New York, NY, USA. 10.1145/1541948.1541970

[113]. Ryan Megan L., Shochet Ian M., and Stallman Helen M.. 2010. Universal online interventions might engage psychologically distressed university students who are unlikely to seek formal help. Advances in Mental Health 9, 1 (2010), 73–83. 10.5172/jamh.9.1.73

[114]. Ryu Hyeyoung, Kim Soyeon, Kim Dain, Han Sooan, Lee Keeheon, and Kang Younah. 2020. Simple and steady interactions win the healthy mentality: Designing a chatbot service for the elderly. Proceedings of the ACM on Human-Computer Interaction 4, CSCW (2020).

[115]. Scholten Hanneke and Granic Isabela. 2019. Use of the principles of design thinking to address limitations of digital mental health interventions for youth. Journal of Medical Internet Research 21, 1 (2019), e11528. 10.2196/11528 [PubMed: 31344671]

[116]. Schuetzler Ryan M., Giboney Justin Scott, Grimes G. Mark, and Nunamaker Jay F. Jr. 2018. The influence of conversational agent embodiment and conversational relevance on socially desirable responding. Decision Support Systems 114 (2018), 94–102.

[117]. Settersten Richard A. Jr, Bernardi Laura, Härkönen Juho, Antonucci Toni C., Dykstra Pearl A., Heckhausen Jutta, Kuh Diana, Mayer Karl Ulrich, Moen Phyllis, Mortimer Jeylan T., et al. 2020. Understanding the effects of Covid-19 through a life course lens. Advances in Life Course Research 45 (2020). 10.1016/j.alcr.2020.100360

[118]. Shneiderman Ben, Plaisant Catherine, Cohen Maxine S, Jacobs Steven, Elmqvist Niklas, and Diakopoulos Nicholas. 2016. Designing the user interface: Strategies for effective human-computer interaction. Pearson.

[119]. Sillice Marie A., Morokoff Patricia J., Ferszt Ginette, Bickmore Timothy, Bock Beth C., Lantini Ryan, and Velicer Wayne F.. 2018. Using relational agents to promote exercise and sun protection: Assessment of participants' experiences with two interventions. Journal of Medical Internet Research 20, 2 (2018), e7640. 10.2196/jmir.7640

[120]. Smit Eline S., Linn Annemiek J., and van Weert Julia C. M.. 2015. Taking online computer-tailoring forward: The potential of tailoring the message frame and delivery mode of online health behaviour change interventions. European Health Psychologist 17, 1 (2015), 25–31. http://www.ehps.net/ehp/index.php/contents/article/download/762/pdf_38

[121]. Neilsen Amalie Søgaardand Wilson Rhonda L.. 2019. Combining e-mental health intervention development with human computer interaction (HCI) design to enhance technology-facilitated recovery for people with depression and/or anxiety conditions: an integrative literature review. International Journal of Mental Health Nursing 28, 1 (2019), 22–39. [PubMed: 30133096]

[122]. Spitzer Robert L., Kroenke Kurt, Williams Janet B. W., and Löwe Bernd. 2006. A Brief Measure for Assessing Generalized Anxiety Disorder: The GAD-7. Archives of Internal Medicine 166, 10 (2006), 1092–1097. 10.1001/archinte.166.10.1092 [PubMed: 16717171]

[123]. Sproull Lee, Subramani Mani, Kiesler Sara, Walker Janet H., and Waters Keith. 1996. When the interface is a face. Human-Computer Interaction 11, 2 (1996), 97–124.

[124]. Tan Yi Tong, Rehm Imogen C, Stevenson Judith L, and De Foe Alexander. 2019 Social media peer support groups for obsessive-compulsive and related disorders: Understanding the predictors of negative experiences. Journal of Affective Disorders 281 (2021), 661–672. 10.1016/j.jad.2020.11.094

[125]. ter Stal Silke, Kramer Lean Leonie, Tabak Monique, op den Akker Harm, and Hermens Hermie. 2020. Design features of embodied conversational agents in eHealth: A literature review. International Journal of Human-Computer Studies 138 (2020), 102409. 10.1016/j.ijhcs.2020.102409

[126]. Tunney Conall, Cooney Patricia, Coyle David, and O'Reilly Gary. 2017. Comparing young people's experience of technology-delivered v. face-to-face mindfulness and relaxation: Two-armed qualitative focus group study. The British Journal of Psychiatry 210, 4 (2017), 284–289. [PubMed: 27765773]

[127]. Turnbull Ann P. and Turnbull H. Rutherford III. 1985. Developing independence. Journal of Adolescent Health Care 6, 2 (1985), 108–119. 10.1016/S0197-0070(85)80035-8 [PubMed: 3156827]

[128]. Uhlhaas Peter and Torous John. 2019. Digital tools for youth mental health. NPJ Digital Medicine 2 (2019). 10.1038/s41746-019-0181-2

[129]. Van Tiem Jen, Moeckli Jane, Suiter Natalie, Fuhrmeister Lindsey, Pham Kassi, Dindo Lilian, and Turvey Carolyn. 2021. "A link to the outside:" Patient perspectives on a mobile texting program to improve depression self-management. Patient Education and Counseling 104, 9 (2021), 2154–2158. 10.1016/j.pec.2021.02.018 [PubMed: 33627234]

[130]. Waller Annalu, Franklin Victoria, Pagliari Claudia, and Greene Stephen. 2006. Participatory design of a text message scheduling system to support young people with diabetes. Health Informatics Journal 12, 4 (2006), 304–318. [PubMed: 17093001]

[131]. Willcox Jane C., Dobson Rosie, and Whittaker Robyn. 2019. Old-fashioned technology in the era of "Bling": is there a future for text messaging in health care? Journal of Medical Internet Research 21, 12 (2019), e16630. 10.2196/16630 [PubMed: 31859678]

[132]. Wilson Coralie J., Rickwood Debra J., Bushnell John A, Caputi Peter, and Thomas Susan J.. 2011. The effects of need for autonomy and preference for seeking help from informal sources on emerging adults' intentions to access mental health services for common mental disorders and suicidal thoughts. Advances in Mental Health 10, 1 (2011), 29–38. 10.5172/jamh.2011.10.1.29

[133]. Wisniewski Hannah, Liu Gang, Henson Philip, Vaidyam Aditya, Hajratalli Narissa Karima, Onnela Jukka-Pekka, and Torous John. 2019. Understanding the quality, effectiveness and attributes of top-rated smartphone health apps. Evidence-Based Mental Health 22, 1 (2019), 4–9. 10.1136/ebmental-2018-300069 arXiv:https://ebmh.bmj.com/content/22/1/4.full.pdf [PubMed: 30635262]

[134]. Zhang Renwen, Ringland Kathryn E., Paan Melina, Mohr David C., and Reddy Madhusudhana C.. 2021. Designing for emotional well-being: Integrating persuasion and customization into mental health technologies. In Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery.

CCS CONCEPTS

• Human-centered computing → Empirical studies in HCI.

Table 1:

Demographics of participants in the discussion group and co-design workshops

	Discussion Group (n=22)	Co-Design Workshops (n=9)
Age	M (SD)	M (SD)
	21.5 (2.0)	23.1 (1.5)
	N (%)	N (%)
Gender		
Female	17 (77.2)	7 (77.8)
Male	3 (13.6)	2 (22.2)
Non-binary	1 (4.5)	0 (0)
Not reported	1 (4.5)	0 (0)
Race		
White	15 (68.5)	2 (22.2)
More than one race	3 (13.6)	2 (22.2)
Black or African American	3 (13.6)	1 (11.1)
Asian	0 (0)	3 (33.3)
American Indian or Alaskan Native	0 (0)	0 (0)
Not reported	2 (9.1)	1 (11.1)
Ethnicity		
Hispanic	6 (27.3)	3 (33.3)