

Emergent Self-Regulation Practices in Technology and Social Media Use of Individuals Living with Depression

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ABSTRACT

Much human-computer interaction work related to depression focuses on the population level (e.g., studying social media hashtags related to depression) or evaluates prototypes for digital interventions to manage depression. However, little is known about how people living with depression perceive and manage technology use, such as time spent on social media per day. For this study, we interviewed 30 individuals living with depression to explore their technology and social media use. We find that these individuals demonstrated emergent practices related to self-regulation, such as learning to monitor and adjust technology use to improve their emotional, cognitive, and behavioral health. Our findings add a human-centered viewpoint to the relationship between living with depression and technology and social media use. We present design implications of these findings for better empowering individuals with depression to encourage their natural inclinations to self-regulate technology and social media use.

Author Keywords

Depression, self-regulation, qualitative, social media

CSS Concepts

• Human-centered computing~Human computer interaction (HCI)

INTRODUCTION

Depression is the world's leading cause of disability, affecting more than 300 million people [24]. In 2015, 16 million US adults experienced a major depressive episode, yet only 65% of these individuals received any form of treatment during the following year [54], and much of the treatment received was not adequate for improvement [58]. Furthermore, depression is not necessarily well-understood outside of the mental health field, or by people who have not managed depression personally [56] (p.6). Consequently, the lay conception of depression can contain many misconceptions about the nature of depression symptoms and

experiences [38]. In fact, depression is a medical disorder comprised of many symptoms, which include persistent sadness or loss of motivation. Depression is often a chronic, relapsing disorder, frequently resulting in impaired work and social functioning, as well as increased health problems.

Previous Human-Computer Interaction (HCI) studies investigating the technology use of individuals managing depression largely focus on the use of a specific technology (e.g., an app [3, 19, 39], online community [29, 35, 63], or social media site [1, 2, 8, 20, 25, 55]). Some prior work also focuses specifically on individuals' "problematic" use: for instance, social comparison via social media [62] or symptoms of depression [14].

While understanding the benefits and negative impacts of singular technologies is certainly important, in this study we wanted to understand how individuals managing depression made decisions about their technology use *across the variety of technologies they use in everyday life*. Throughout our data collection—unsurprisingly—study participants did not make a fine distinction between technology use (e.g., hardware such as a phone, or passive watching of a video stream) versus social media use (e.g., content creation, interaction with others online). To this point, we use the phrase "technology and social media use" throughout the paper to accurately reflect the range of experiences that our participants shared with us.

The contribution of this paper is to enhance the scant HCI research that has previously examined lived experiences—both positive and negative—of living with depression and thinking about, managing, or changing technology use behavior from the individual's point of view. To shape our insights in this inquiry, we use the framework of *self-regulation* [52, 53] from psychology to make sense of the behaviors and choices our participants described in their interviews. Using the framework of self-regulation gives an illuminating structure to the thoughts and actions of our participants, while drawing from psychology—a domain that necessarily understands the emotional, cognitive, and behavioral backdrop of depression.

Specifically, the self-regulation framework describes a process of improving cognitive, emotional, and behavioral habits for individuals with depression by focusing on personal goals in the short- and long-term [52]. In this study, we describe emergent self-regulatory practices in using technology and social media from the point of view of our 30

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interview participants. This study provides qualitative data about the practices of people living with depression.

Our participants represented a mix of people, some who were currently or had previously been in clinical treatment programs (e.g., intensive outpatient or inpatient therapy), as well as those who managed depression without clinical help. We found that participants' technology and social media use was not addressed in most clinical programs. Yet, regardless of clinical support, participants came to understand that managing technology use was essential to their mental hygiene and daily routines over time and with experience. Specifically, many participants detailed narratives of becoming more intentional with their technology use over time (e.g., deleting apps, limiting time of use, or seeking positive content) as an important aspect of self-management.

In our results, we describe our participants' strategies for self-regulating technology use to achieve goals in terms of emotional, cognitive, and behavioral health. This study contributes findings and insights about work that individuals living with depression are accomplishing on their own, typically without clinical intervention. In our discussion, we contribute a narrative focus on empowerment that can be fostered for individuals living with depression to self-regulate their technology and social media use ("power-to" help oneself; [48]), rather than describing our participants as passive individuals who are subject to the influence of technology and social media platforms.

Although this work on the part of these individuals is not meant to supplement or replace clinical treatment for depression, our observations point to (1) opportunities to enhance health care interventions with discussions of technology use and (2) implications for the design of technology interventions for depression care, such as mobile applications. With this work, we re-center individuals living with depression, who can be empowered to understand and self-regulate their own technology and social media use.

RELATED WORK

Much of the preceding HCI work in this space has studied problematic use through surveys [36] or surveillance and patterning data from social media artifacts, such as Twitter posts [21]. Here, we give context to our work in two ways. First, we summarize the cognitive state and experiences associated with depression (an important aspect of understanding users' sociotechnical context; [4, 34]). Second, we describe previous findings about the relationship between technology and/or social media use and depression.

The cognitive state of depression

Understanding the cognitive factors related to depression is important to enable empathy in design regarding the experiences of users who manage depression [34]. Beck [5] was first to describe the "cognitive triad" (or the "negative triad") related to depression. Beck outlined the three key elements of a person's belief system, which is comprised of

(1) self-image, (2) image of the world, and (3) expectations of the future.

In terms of *self-image*, an individual experiencing depression will tend to view themselves negatively (e.g., as unlovable, worthless, or a failure in life). Depression can affect a person's *image of the world* by reducing the friendliness and acceptance of one's social and environmental surroundings to magnify perceptions of an unfriendly and rejecting world. Finally, depression is associated with feelings of hopelessness in terms of an individual's *expectations of the future*. These three elements of the cognitive triad of depression describe a particular *cognitive state* of depression, which impacted how our participants used technology, and on which we elaborate further below.

Building on Beck's original work, Beck and Bredemeier [6] explain that the "thought loops" resulting from depression's impacts on the cognitive triad have emotional (anger, sadness), biological (sleep disruption, weight gain or loss from disordered eating), and behavioral (crying, decreased activity, social withdrawal) effects that can feed a vicious cycle of negative cognitive bias. The negative cognitive biases can lead to problematic behavior responses to stimuli, such as avoidance [10]. Related to these negative biases, cognitive effects of depression may result in poorer executive function (i.e., less ability to "self-regulate" behavior), a heightened sense of social threat, or increased suicidal ideation [9].

Social media use and depression

The effects of depression, and related emotional, cognitive, and behavioral changes (e.g., social withdrawal, or bouts of anger)—described above—can lead to deteriorating interpersonal relationships and an increasing sense of loneliness. This loneliness can manifest in two forms: emotional, in which a person lacks intimacy with another significant person; and social, where a person lacks a network of social support [47]. Importantly, both brands of loneliness are a cognitive state, rather than an objective one: "*Loneliness is defined as a distressing feeling that accompanies the perception that one's social needs are not being met*" [28]. That is, whether an individual has one or many friends, they can still perceive a feeling of social disconnection and loneliness.

Researchers have previously studied the cause-and-effect of "problematic" technology or Internet use correlating with higher levels of negative cognitive bias (e.g., [18, 27]). Much of this prior work on technology use and cognitive bias related to depression has been conducted in the context of social media use (e.g., Facebook, Instagram). Specifically, in previous work, individuals who reported higher levels of loneliness tended to use Facebook more frequently [51]. In terms of social media use more broadly (i.e., not just Facebook, but a range of such applications), Lin et al. [36] found a "strong and significant" association between depression indicators and heavier social media use. Additional prior studies have found that individuals

experiencing loneliness might seek out social stimuli via the Internet, or social media apps [15, 44, 64].

At its most extreme, impairment related to social interactions from the cognitive state of depression can catalyze problematic use of social technologies, which has recently been dubbed “Internet Communication Disorder” [59]. Individuals exhibiting this type of behavior are susceptible to a cycle of social withdrawal and increasingly frequent use of social media, which leads to a “downward spiral” of substituting virtual contact with rich, in-person social contact—and this cycle can ultimately amplify an individual’s feelings of isolation in the long term [59–61].

Clearly, there are many factors involved in the relationship between technology/social media use, cognitive state, and mental health. However, researchers examining the potential for eHealth tools in detecting and managing mood disorders (such as depression) have recently called for greater examination of the role of social media as it relates to depression awareness and self-care [43, 45]. Given that seven in 10 U.S. adults use Facebook [50] and that social media use is increasingly incorporated in day-to-day life and technology use, we interviewed 30 individuals managing depression to ask about the role of technology, including social media, in their daily routines. Our guiding research questions were as follows.

How do people living with depression use technology in their day to day lives? What are some opportunities for helping people to use technology in a healthy way in the context of depression?

METHODS

The Institutional Review Board (IRB) of our institution approved all procedures described herein. We recruited participants using a combination of strategies: (1) emailing eligible individuals from a patient registry through a partner research group in clinical psychology; (2) posting on local Facebook pages (e.g., neighborhood announcement groups); (3) posting flyers in libraries and other public spaces, and (4) partnering with a local Meetup group to recruit individuals who engaged in a weekly, in-person peer-counseling session.

Participants

Recruitment criteria for this interview study were simple: we advertised the study to identify individuals who could speak English fluently, were aged 18 and over, and who were currently managing depression *or* had received a diagnosis of depression within the last 12 months. We required current, active management of depression symptoms because we wanted to discuss the role of technology in participants’ lives, particularly as it pertained to depression management. Thus, this criterion was important to understand the environment of technology availability and capability, as well as to reduce recall bias in the data. In the following sections, we discuss the participants, procedure and analysis, and ethics of this study in detail.

All participants lived or worked in the general geographic area of the large, Midwestern U.S. city where our institution is located. Participants were asked to self-characterize their races and ethnicities (57% white; 43% mixed race or people of color; 30% Hispanic origin). Participants indicated binary gender characterization (27% male / 67% female), with the exception of two participants who declined to fill in the blank “gender” field on the intake form.

The average age of our participants was 34.7 years (min 18; max 72; SD 13.1). Forty percent were employed full-time, with the balance of the sample indicating that they were a full-time student (20%), working part-time (17%), unemployed or underemployed (13%), or indicated “other” (retired, on disability; 10%). One participant reported having a high school diploma/GED and the balance of the sample had some college (37%) or had completed college or more (60%).

Participants were all actively managing depression symptoms but had a range of years of experience with depression (the sample averaged 7.5 years since diagnosis; min 1 year; max 25 years; SD 7.8 years). Our participants engaged with a range of treatment activities, some overlapping: 70% indicated they were currently taking prescribed medication; 53% were attending in-person, one-on-one therapy regularly; one participant relied on regular group therapy. One participant self-managed with nutrition and herbal remedies. Participants also reported experiencing comorbid medical and psychiatric conditions, such as chronic fatigue syndrome (P20), traumatic brain injury (P05), multiple sclerosis (P21), PTSD (P02), anxiety (P03, P04, P08), eating disorders and/or body dysmorphic disorder (P11, P14), and dermatillomania (P23).

Finally, we asked about confidence in filling out medical forms, to give a sense of participants’ health literacy levels [12]. Only 53% of participants indicated they were “always” confident in filling out medical forms. Sixty percent reported “never” needing help to fill out or understand medical forms. Overall, responses to these two questions indicated a range of health literacy levels in the sample.

Procedure and analysis

Thirty individuals met in person with one of two researchers who conducted interviews at a location of each participant’s choice, which ranged from their homes, to private offices located on the University campus, to study rooms at local public libraries. During the procedure, participants were asked to complete (1) a consent form that detailed the study activities and (2) an intake form that inquired about demographics and other background information. Then, researchers used a semi-structured interview protocol to guide the conversation, to ask questions about the participant’s depression diagnosis, self-management strategies, routine use of technology, their social support system, and experiences with various treatment activities. Interviews were audio recorded. The average length of the

interviews was 70 minutes. Participants were compensated \$25 cash at the conclusion of the interview.

The two researchers conducting interviews met periodically to discuss themes to investigate during interviews, to ensure that the research questions (*How do people living with depression use technology in their day to day lives? What are some opportunities for helping people to use technology in a healthy way in the context of depression?*) were being addressed sufficiently using the semi-structured protocol. Example questions from our protocol include the following:

- What are some of your goals for your quality of life and how you want to feel?
- How do you think using technology like your phone helps with quality of life?
- What kinds of information do you keep track of related to your moods or emotions? How do you use technology to track this information?
- What are some times that you think it's important to avoid technology, like your phone, computer, or television? Why is it important to avoid technology?

The two interviewing researchers also met with one of the principal investigators—a clinical psychologist—who was able to validate the construct validity [11] of themes emerging in ongoing data collection.

All interviews were transcribed by a HIPAA-compliant vendor, redacted for any identifying information, and loaded into qualitative coding software (dedoose.com) for thematic analysis [26]. The two interviewing researchers then worked to code all 30 transcripts, using an iterative process of open coding, revision of codes, and convergence on a codebook containing themes to address the guiding research question. The themes reported in the results section were synthesized from this iterative process, with the goal of systematically describing technology use among our participants.

Ethics of study

Considerations regarding trust and comfort for participants were a priority in designing and carrying out the study (for an extended discussion of depression, its cognitive effects, and research design, see [31]). We arranged the required in-person meetings with prospective participants at a time and place of their choosing, and both interviewers employed an ethics-as-process [49] approach at all points of participant contact. We experienced several instances of cancellations, in cases where the prospective participant felt too anxious to follow through with completing the study. Both interviewers were careful to express understanding in these circumstances. Finally, the research team included an experienced clinical psychologist, who was able to (1) look over the research design and make suggestions for improvement prior to field work deployment, and (2) offer clinical guidance when needed.

RESULTS

In the following section, we describe participants' *own* solutions to addressing technology and social media use in

the context of depression. Our participants' lived experiences often aligned with depression symptoms cited in psychology literature (e.g., [56]; p. 3-4). Specifically, we use the framework of **self-regulation**, a "*theory-based, empirically supported framework for developing psychotherapeutic interventions that complement and extend current cognitive-behavioral models*" [53]. The self-regulation framework describes a process of improving cognitive, emotional, and behavioral habits for individuals with depression by focusing on personal goals in the short- and long-term [52]. Self-regulation involves three aspects of mental health; we defined these three aspects in the context of technology and social media use as follows:

Emotional self-regulation practices: Participants' work to formulate and/or maintain healthier emotional states related to technology and social media use, such as managing moods.

Cognitive self-regulation practices: Thoughts that participants expressed about technology and social media use, including metacognition (thinking about thought patterns when using technology), and efforts to address negative thought patterns, such as rumination.

Behavioral self-regulation practices: Participants' efforts to design new behavioral habits around technology and social media use, which can lead to a positive feedback loop in maintaining all three elements of self-regulation.

We detail these three aspects of self-regulation in the following three sections. We thematically categorized findings to describe participants' reported practices in emotional, cognitive, and behavioral contexts. Given the interconnectedness of these practices, we acknowledge that there may be overlap among the three sections below.

Emotional self-regulation practices

Managing moods and emotions is an important part of mental health interventions. For instance, hundreds of targeted smartphone applications have been designed to support mood management (for example, [41]). Among our participants, about half reported using mental health-focused applications either currently or at some point in the past (e.g., Calm, Calm Harm, and Headspace). However, our participants described using these apps as just *one* part of a broader strategy for using technology and social media to self-regulate their emotions. Participants were thoughtful and resourceful in building self-regulation routines. They employed "bundles" of technology and social media tools (e.g., combinations of apps, online streaming videos, cell phone games, and music) to do so.

Here, we focus on participants' process of learning to achieve an intentional mental "reset" when using technology or social media. In this process, participants described learning that their technology and social media use habits could be not only controlled, but could also facilitate a mental reset to positive effect. These mental reset habits were used by all

participants, with no detectable disparities in behaviors among genders, age groups, or education levels.

Specifically, participants achieved *mental reset* using technology and social media (e.g., streaming content, funny videos or gifs, or music) when winding down after feeling stressed, or to transition from one activity to another. A mental reset was generally a solitary activity, and participants reported using a “unit of consumption” approach, such as watching one episode of a favorite show, to achieve this mental reset.

Mental resets also occurred in smaller “chunks,” in very brief spurts, particularly at work. P02 often watched cat videos to re-center herself when she felt irritable at work:

It's also good if I'm getting frustrated or overwhelmed to just sort of like, take two minutes, take a break, look at something else—laugh at a kitten video or something, and then get back to what I was doing, because I think eight straight hours of the craziness I deal with at work, [I] would not last for very long, without the occasional break. P02

P02 shows that sometimes a small distraction, like a cat video or a mobile game, is enough to pull a participant out of a negative emotional spiral. For participants who were in situations where they had limited time for emotional self-regulation, especially while at work, technology which could be accessed quickly in these limited time chunks was particularly appealing to enable a mental “reset.”

In addition to visual content like videos or gifs, music offered a reset or mood-altering function for many of our participants. Listening to music was particularly valuable as a strategy to feel calm, in particular focusing on the music to soothe moods (P01, P18, P20). P01 wore a single earbud during his interview with us, explaining that listening to music helped him to focus on a conversation (i.e., music helped with attentional issues as well as mood).

In a potent example of using technology to change one's environment for depression self-care, P13 described using music to avoid “pitfalls” of negative mood loops by using an Alexa to control the ambience of inhabited spaces:

I know that going to my room is generally where I'll go downhill and where I'll go into negative spirals and negative thoughts and where pitfalls can happen easily, so having Alexa in my room and playing music...has helped avoid those a lot more consistently because it's exactly where I generally would go downhill. P13

Another way for our participants to achieve mental “reset” was to engage with online support groups. In lieu of clinical, in-person therapy, in-person or online groups for depression or anxiety support were helpful for a few participants who could not or would not seek out professional therapy. Five of our participants (P07, P08, P16, P18, P23) reported participating in online support groups, but only two of these online support groups focused specifically on depression.

For example, P07 found comfort in a parent-to-parent support group on Facebook, where she could talk about her daily challenges to her mental well-being without having to explicitly identify as a person managing depression:

I'm on a couple of different Facebook groups for parents with anxiety...it just helps me to connect with other parents who are experiencing the same issues with their kids or with themselves, sort of like a message board situation, being able to respond or ask questions and have them be responded to by people who understand. P07

In another example of a type of peer support for mental reset work, P16 conducted regular Meetup groups for people with depression in her neighborhood. In meeting with the group—despite feeling extremely isolated from the world after her divorce—P16 had assembled a varied group of supporters from support groups and friends: “I know that they're there if I needed [them],” P16 told us. The weekly meeting served as an anchor point for her week, an important “reset” moment.

Instead of using phrases like “zoning out,” participants described their emotional reset activities as *discrete tasks* to prevent negative mood or halt a spiraling negative mood. P30 described using a daily contemplation resource to both reset her emotions and reflect on the source of her emotions, a process of learning that helped her to better manage her emotions:

There's a website called DailyOM. I really like them. I read them every single day. And I think that they are very spot on when it comes to managing your emotions, and just kinda tapping into some of those deeper things that we're unaware of. Like where is this feeling and emotion coming from? You may be depressed, right? But that's a symptom of something else. Or that's a feeling from something else. Where does that come from? And trying to get to the root of the problem. P30

From the emotional self-regulation practices we identified, we can see that participants had not only linked technology and social media use to their mood patterns but had also worked to find more positive feedback loops through technology use. This attitude regarding mental “resets” proved to be an important “aha!” moment for our participants, wherein they started to connect cause and effect from technology and social media use to their mental health states. In the following section, we describe how this “aha!” moment leads to further cognitive self-regulation practices.

Cognitive self-regulation practices

In their daily life, participants described feeling “separate” from other people, or fundamentally different from “healthy” peers or coworkers. These feelings often became amplified in the context of technology use. Feelings of “otherness” and the attendant cognitive states of depression can lead to problems such as addictive consumption of digital content [61], and are often connected to social media use for distraction or procrastination [27] and/or comparison to friends and peers on social media [62].

Participants often viewed negative technology or social media use (e.g., leading to negative self-comparison; or used for long periods of distraction) as problematic. However, most participants had over time realized this link between their mood and technology and social media habits. Accordingly, most participants in our sample had reached a point in their self-regulation where they were working to curtail, or stop, such problematic behaviors.

Here, we describe participants' cognitive self-regulatory practices; that is, we describe *how participants thought about their technology use and how it impacted their thought patterns*. These include (1) identifying undesirable patterns of technology and social media use, and (2) formulating strategies to positively regulate their moods in the context of these technologies.

Identifying undesirable patterns of use. Lack of participant intent, or passive use, played a substantial role in problematic use of technology. P25 described learning about the importance of intent in consuming digital content:

There's a difference between taking time to yourself, [or] watching stupid television for an afternoon and not moving off your couch because you're depressed and have no motivation. So, I think the intent is the big thing. P25

However, not all participants had reached a consistency of awareness as described by P25. Several participants noted that negative patterns of technology and social media use tended to increase when they experienced low motivation or fatigue. When faced with a bad day, P20 told us that “*I could just let [social media] dominate my day*”—technology or social media use becomes problematic or addictive.

Addiction-like technology use also occurred as a distraction from negative thought patterns. Distraction is a natural response to the cognitive effects related to depression, such as rumination (as P22 told us, “*I don't love to be alone with my thoughts*”).

However, this does not necessarily mean distraction is a healthy response to such cognitive effects. Participants described negative technology and social media use as undesirable *because* such use prevented them from processing feelings or completing self-care routines. Participants were often aware of the negative impacts of such technology use for distraction; P19 struggled primarily with mindless Facebook use:

I'm searching for that hedonic pleasure instead of understanding that going on Facebook for hours might feel better than exercising in the moment, but on the whole I'll feel so much better to exercise versus go on Facebook. Sometimes it's hard to give up this short-term pleasure for a longer-term pleasure. P19

Here, P19 points to the process of identifying unhelpful technology use patterns and substituting better habits for distraction-related technology use. Our participants' awareness underlines the challenges to essential self-

regulation practices that emerged regarding technology and social media use.

In a related finding that was specific to our younger participants, participants under 25 described distinctions of “good” and “bad” influences among social media platforms. In short, some apps affected participants' thoughts and disposition more negatively than others. Participants in their college years were particularly affected by seeing peers' content on Snapchat, citing the combination of “in the moment” video content and carefully staged “fun scenes” that contrasted so sharply with their feelings of low mood. Snapchat “*stressed me out*” P13 told us. P24 described the difference between content presented on Instagram and Snapchat:

Usually, Instagram's just a few pictures or one picture that portrays a good image and also, it's not usually live. [But] Snapchat's happening live...whereas Instagram isn't live so it's like I don't feel like I'm missing out. Yeah, I think that's a good distinction to make. P24

At an extreme, undesirable technology use led to thought loops of comparisons of self with others, sometimes obsessively so. For example, P06 used Facebook to stalk former friends several times a day in her lowest moods:

I mean I've got obsessive with checking people's profiles or accounts. People who don't like me, people who I don't like...It feels like punishing. Because it's never good, it never makes me feel better. I don't know...I still check on people who are not in my life. I just want to know what they are doing. I go and make a round like once a month or something of people. It used to be where I would do it multiple times a day. P06

P06 went on to say that medication helped reduce her urges to track people on Facebook, leading to a more desirable, regular pattern of use. Without the help of therapy and medication, she would not have had the coping tools to control her social media use.

The principles we have described here, where participants endeavored to understand long-term mental health benefits related to (sometimes difficult) personal goal-setting and self-care activity is central to self-regulation theory [53]. In the following section, we describe how participants moved from merely understanding their technology and social media use to formulating helpful strategies to explore possible long-term changes in use patterns.

Strategies to manage technology and social media use. Participants described two main strategies to manage undesirable technology use patterns: limiting or controlling access to certain technology platforms (keeping the bad *out*) and seeking positive content (inviting the good *in*).

In response to their self-perception of addiction-like technology or social media use in daily life, participants often described a blunt approach to solve the problem: they deleted certain social media applications they found too distracting or

time-consuming. For example, P13 deleted Snapchat after noticing anxiety related to watching peers' stories; P11 told us *"I deleted all my social apps like Facebook, Twitter from my phone. I still use them sometimes through the browser or through a computer."*

Unfortunately, even if participants had intentions to delete social media accounts or applications that stemmed from a cognitive awareness of harm, the option was not always feasible. This was true, we found, particularly for college-aged participants and their socialization needs. P12 reported that *"Everyone uses Facebook [Messenger]."* P13 was in a similar situation to P12; she needed to retain her Facebook account to conduct business and plan events for her sorority. Facing this realization, P13 set personal limits for using Facebook, and tracked her use in a Google document:

I definitely have a distinct decision to try not to use Facebook extraneously. And I have it on my habit tracker that I keep track of all my habits of when I use Facebook extraneously, which days I do and which I don't...I have a spreadsheet on Google Sheets with a bunch of different habits and then all the different days. And I give myself a green checkmark [for a good day] or red one [for a bad day]. P13

Similarly, participants also reported reducing their use of Snapchat after observing its propensity to invite social comparison thoughts, moving their attention to other social media platforms (e.g., Instagram). This approach of limiting or controlling access to applications was only one of the strategies we observed to curb undesirable technology engagement.

The second of two strategies we observed in cognitive self-regulation practices among participants was curating content encountered via technology or social media use (e.g., [17]). Here, participants described seeking out good, positive, or helpful content and stimulation, rather than blocking unwanted content and stimulation (i.e., inviting the good *in*, rather than keeping the bad *out*).

We encountered several examples of participants curating positive content for themselves to influence thoughts and thought patterns. Curation of social media content in particular helped to avoid comparisons with other people, as well as feelings of low self-esteem. P30 limited herself to Pinterest and sites for promoting positive thinking:

I mean [Pinterest] makes me feel good because it makes me—because one thing about Pinterest is that you're pinning what you like, you're pinning what inspires you, so you have control over the situation...You may feel like you're a strong person, but you are affected by technology. You are affected by what you see on Facebook and Instagram, even if you're unaware of it. P30

Similarly, P18 focused on positive content sources on Facebook, "liking" certain pages or groups so he could see more positive and inspirational pictures or quotes (*"You find these little gold mines. You follow them, like them, and you*

get postings from them on a regular basis"). Similarly, P11 had reduced her time on platforms like Instagram and Facebook to seek out positive content from alternative applications (e.g., Upworthy, Happify) instead.

Some apps facilitated content curation better than others. For instance, P21 perceived that it was easier to curate content on Instagram, rather than Facebook. P05 agreed:

A lot of [my Instagram feed] is like, super positive shit that I wouldn't think of on my own. So like, they're kinda putting it in your face. Some of it pisses me off, like "be grateful" I'm always like [brandishes middle finger]. But it can't hurt to see it—the positive stuff.

In their learnings from cognitive self-regulation, we found out participants became more adept at determining how they wanted their *behavior*, or regular use and habits, around technology and social media use to change. We describe resultant behavior change in the following section.

Behavioral self-regulation practices

Behavioral self-regulation practices among our participants included planning time for self-care, forging new patterns in use, tracking activities important for mental health maintenance (e.g., frequency of eating, drinking, exercising, and hours slept), reflecting on changes in mood or response to certain stimuli, and regulating behaviors in formal mental health care settings. Here, we describe tasks related to (1) planning and tracking behavior and (2) engaging with formal (or clinical) mental health care.

Tasks related to planning and tracking. At a high level, structure and planning are important goals for individuals living with depression [53]. Several of our participants adapted tools or used dedicated calendaring apps to plan their work, time, and social lives. P06 designed multiple calendars for herself using a Google Docs template; P04 described using a bullet journal to track activities and tasks. P19 used their calendar to motivate action to avoid procrastination or inactivity, which could exacerbate their depression:

[I routinely plan to] get a good amount of sleep, exercise, block out time for myself to do homework. I know that I'm the type of person who needs to have a pretty clear-cut schedule. So, if I have a whole day on my calendar that's blank, I can spend that day doing nothing and then I feel shitty afterwards. So, even if it's just drawing out a four-hour chunk where I'm like, "Go to Starbucks and do homework." P19

Participants also described adapting non-mental health related tools to record personal information, such as a goal-tracking application, to check off daily goals (P23) or native health applications on smartphones (P05). P06 and P28 found that tracking their menstrual cycles helped them understand changes in mood, and P21 noted that *"it was interesting to go back and see hormonally what was going on"* through her period tracker.

In another example of planning and tracking behavior, P22's therapist encouraged tracking meals as a method for learning self-compassion:

[My therapist] had to explain to me what self-compassion was...I told him things I do and he points them out so he said eating healthy would be something to take care of yourself. P22

Tracking was especially important to understand causes of mood changes or challenges; this is related to self-knowledge described in previous “quantified self” studies (e.g., [23]). Individuals managing depression often experience difficulty in moderating eating and drinking (e.g., forgetting to do so, which can exacerbate mood issues; overeating; or eating unhealthy food or drinking too much alcohol). P04 found that tracking her eating helped to respond to anxiety attacks on her own, without the use of medications for acute episodes:

I went up to my car, sat down, and I realized, I had medication for anxiety and I take it only as needed...I just kind of sat down, got some fresh air, and went “I had coffee today.” Like, I kind of just re-told myself what's been going on, why am I feeling like this? I need to pull myself together. So, I was like, I've only had coffee, maybe that's spiking my anxiety. So I went back downstairs, got water, and got something to eat. It didn't take too long before I felt better. P04

Regarding tracking behavior, social media (versus solitary or individual technology) proved to serve an unexpected use: some participants reported using Instagram to assess their mood changes over time. Specifically, participants found Instagram to be a valuable journaling and reflection tool. P29 had two Instagram accounts: a Rinsta, or real Instagram, for her “public personae,” as well as a Finsta, or fake Instagram, for sharing deep, dark feelings [22]. P21—who only had a Rinsta—similarly tracked her mood, and reflected on her post history, using Instagram. This practice effectively blurred cognitive regulation and led to a positive feedback loop through behavioral regulation through use of Instagram:

I think [I track moods] indirectly through Instagram...if I look back through Instagram because I've been doing it for a while now, I could probably go back and see the different moods or times in my life what was going on based on my artwork, what I posted or what I didn't post. P21

This use of a social media application for tracking of and reflection on mood underlines to the creativity of our participants in their work to understand, and manage, changes in mood and subsequently to adjust behavior through reflection.

The value of specific tracking, planning, and reflecting on behavior will necessarily vary for every individual managing depression. In addition, as noted previously, our participant sample reflected a range of sophistication in self-regulation practices. Not all participants were actively engaged in behavioral self-regulation. For example, P01's attention

issues prevented him from setting up a scheduling system for self-care (“*It would never stick!*”). In another example, P09's therapist dissuaded him from tracking personal information, due to P09's tendency to dwell on negative experiences.

Despite the similarities of self-regulating practices of our participants, we found these individuals were largely designing and accomplishing these practices on their own. That is, we found that behavioral self-regulation was most often present when participants had experience managing depression, a helpful social support system, or access to formal mental health care. However, behavioral self-regulation through technology was *not* addressed routinely in formal mental health care, as we detail below.

Formal (or clinical) mental health care. Technology and social media use for self-regulation was generally *not* discussed or promoted in the context of the formal clinical treatment our participants had received/were receiving. The extent of participant technology use in connection to clinical treatment was for one of two aspects: communication through email or text to coordinate in-person sessions with their therapists, or as a memory aid through referring to notes taken in their phone to recall topics to cover during therapy appointments.

Only two participants (P28, P29) described using any online content within therapy sessions. P29 shared some of her online writings about her feelings with her therapist. P28 was coached on finding good content for supporting emotional self-regulation:

My second therapist, he was using his iPad and his laptop ready to show me videos or show me lectures or show me anything...He'd tell me this website will help with something, this video is on YouTube, if you search for them, they will help you, things like that. He would use that. He would make me do breathing exercises during therapy. He would have his playlist during sessions as well. P28

While therapy and other clinical care was clearly important to our participants who sought out these resources, our findings point to a gap between formal clinical support and emergent self-regulatory practices regarding technology use. Specifically, very few participants discussed their technology and social media usage with their therapist(s). Despite this gap, participants spoke at length in their interview about the effects of technology and social media use on their mood, and the creative strategies they had developed over time to adjust their use patterns to meet their needs.

In sum, we found that our participants are creative, and largely proactive, in learning how to self-regulate their technology and social media use. Moreover, many of the technology tools participants report using in self-regulation practices are not designed specifically for mental health or mood management. Instead, we found individuals apply a custom “bundle” of tools that facilitate emotional, cognitive, and behavioral self-regulation practices. In the following section, we outline implications for designing technology

tools and supportive services that can foster self-regulation practices for this population.

DISCUSSION

In our findings, we describe emergent self-regulation practices among a diverse sample of individuals living with depression. We spoke with participants who had a wide range of treatment experiences, technology and social media use patterns, and varying degrees of social support. One unifying aspect of their experiences was a pointed recognition of the importance of thinking about and self-regulating technology and social media use in day-to-day life. In this section, we discuss the implications of our findings for (1) supporting self-regulation practices and (2) designing interventions for clinical or therapeutic environments.

We emphasize self-regulation for the purpose of learning from individuals' daily practices to design more helpful supportive interventions at the intersection of depression management and technology or social media use. These suggestions are not meant to shift the burden of care to the individual as a "patient with depression," but to use insights from the individuals [57] to distill useful implications for supporting self-regulatory practices and formal care for individuals managing depression.

Implications for supporting self-regulation practices

For researchers and technology designers, the most important aspect of supporting emergent self-regulation practices is to understand the cognitive state of depression, and its impact on attitudes toward technology. Drawing from our participants' experiences, we suggest that individuals living with depression do not necessarily have a preexisting positive relationship with technology, as many app designers might assume.

For example, the current design of many targeted mental health applications afford a one-size-fits-all user experience [46] that can assume that the application's user has largely positive attitudes about using technology. That is, the application's design has built in the assumption that a potential user accepts that the Smartphone is a powerful, but *controllable*, tool for engaging in everyday life. However, participants in our study generally did *not* have this assumed positive attitude about technology and social media. For example, our participants often referred to their own Smartphones as a type of "temptation" or "trap."

Therefore, we advocate for a design solution regarding technology-based, targeted mental health applications that would help users assess their own technology use and reflect on their attitudes about technology to promote metacognition around its use. In this way, targeted mental health applications can assist users to start thinking about their devices as powerful, personalized tools for improving mental health and augmenting self-regulatory instincts for technology use. In sum, technology-based, targeted mental health applications must convey a sort of self-awareness that the mode of intervention—technology—can be part of the

problem *and* part of the solution for individuals living with depression.

This first step of assessment and reflection can better support future engagement with applications for depression management. For example, a targeted mental health application could offer reflection exercises to help users understand cause-and-effect cycle of technology use patterns, thoughts, and mood. (Notably, platforms like Facebook have begun offering "dashboards" to users to track technology use patterns [40], which could be a powerful data input to support this reflection process.)

By assisting users in linking causes and effects of technology use—which encompasses the technology ecology surrounding mental health app use—these tools can facilitate a move toward incorporating intent and self-regulation in technology use more broadly. An example of such an assistive feature would be to have users rate the effect of apps they use on their mood, helping them to reflect on which technology or social media use has positive, versus negative, effects.

Technology-based solutions could also go further in adopting the self-regulation point of view, by assisting users in setting *new* goals for technology use. Setting goals associated with technology use will encourage intentionality—an important aspect of managing daily technology routines among our participants. Intentionality and its connection to greater well-being has been studied in great detail previously [14, 16, 33].

With new goals for technology use, individuals managing depression can try out different strategies to attain these goals, deciding what will or will not work based on their needs, preferences, and abilities. The process of setting goals, working to meet them, and reflecting on failure and/or success is a central aspect of self-regulation theory that can assist individuals in building resilience, and changing thought patterns (e.g., ruminating less after failing to reach a goal, and reflecting on factors that led to failure; [52, 53]).

An example of a goal designed to curtail undesirable technology use might be: *use Snapchat less*. As described in the results, the individuals can enact practices to fulfill this goal. A user might delete Snapchat from their phone, block certain people on the application, or restrict use to a certain amount of time per day, using manual or automatic tracking (e.g., through a third-party application that controls access to certain applications on a given device).

Alternatively, in an example of a goal that can promote desirable technology use, an individual managing depression might set a goal to *establish a "support network."* This support network—usually comprised of close friends or family—are people that an individual can reach out to for help (usually via technology) daily, or as needed. The support network that our participants described was generally small (2-3 people). Smartphones were used heavily in maintaining these support networks and contributed to greater capacity for coping with stress and improving mood.

Implications for formal mental health care & peer support

Our study surfaced and contributed an important dimension to our understanding of participant interactions with formal mental health care (e.g., clinical therapists) and peer support, and how they might support an individual's self-regulation practices regarding technology.

Formal mental health care. Due to our methods in this study, we are able to address only the values, needs, and preferences of individuals with depression; insight as to clinical or therapeutic professionals' work is not in the scope of the paper. However, we can speak to the dearth of support through clinical or therapeutic treatment related to self-regulation of technology use that our participants described.

A significant amount of participants' social engagement occurred through texts, Facebook messenger, or other social media. However, participants were not routinely discussing technology use with therapists or clinicians, despite spending several hours a day engaged online. This presents an opportunity for clinicians to assist individuals with depression to assess their technology use from a therapeutic standpoint, perhaps through a "mindfulness" lens [14, 33].

For example, clinicians could ask about technology use, thought patterns, and mood, or suggest individuals with depression track technology use and feelings about it for a period of time. If individuals' moods are affected by technology use, this aspect of daily life should not be neglected in depression treatment. There are also opportunities for clinicians to assist individuals with establishing technology use related goals described above.

Peer support. HCI studies have shown the promise of peer-support for a variety of health conditions. For mental health, researchers have shown that disclosures on social media [2], and peer-to-peer texting [42] to offer helpful social support [7]. However, these studies, focused within the online technology support context, missed the perspectives of individuals who cannot or will not use technology for support in these ways. Many of our participants did not wish to connect or "hang out" with others who had depression, online or offline. This attitude was primarily fueled by a belief that depression is "contagious" (which is supported by psychology research; [32]).

Participants' general lack of interest in connecting with depression "peers" is unusual in the context of illness management [13, 30, 37]. For most participants in our study, depression peer support was not desired. We argue that, rather than prescribing peer support specifically, a better approach would be to provide resources for this population from a technology ecosystem perspective. That is, the best self-regulation support strategy would be to provide a broad bundle of technology tools, including online communities and social support tools (e.g., texting). We posit that informal social support is an essential complement to peer-to-peer/online-based mental health tools among individuals

living with depression, as supported by our prior related work [7].

LIMITATIONS

We conducted this interview study in English only. Our participants worked or lived in a single, large Midwestern U.S. city. As a result, the conclusions drawn in this paper may not abductively apply to different contexts or cultures. In addition, self-selection bias of our sampling method resulted in speaking with individuals who were managing depression well enough to participate in such a study, effectively yielding a subset of our population of interest.

CONCLUSION

This work shows the breadth of self-regulatory practices individuals with depression use to manage their technology use. We found that few of the technology applications or tools participants reported using were explicitly designed to support mental health. Instead, participants described a range of practices for emotional, cognitive, and behavioral self-regulation through technology. Drawing from these self-regulation practices, we presented implications for the design of both technology tools and supporting services that would better facilitate emergent self-regulation practices. By incorporating these design implications, technology tools and supportive services for individuals managing depression can better assist members of this population to become active, intentional, and empowered users of technology.

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