

Modeling the Engagement-Disengagement Cycle of Compulsive Phone Use

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ABSTRACT

Many smartphone users engage in compulsive and habitual phone checking they find frustrating, yet our understanding of how this phenomenon is experienced is limited. We conducted a semi-structured interview, a think-aloud phone-use demonstration, and a sketching exercise with 39 smartphone users (ages 14–64) to probe their experiences with compulsive phone checking. Their insights revealed a small taxonomy of common triggers that lead up to instances of compulsive phone use and a second set that end compulsive phone use sessions. Though participants expressed frustration with their lack of self-control, they also reported that the activities they engage in during these sessions can be meaningful, which they defined as transcending the current instance of use. Participants said they periodically reflect on their compulsive use and delete apps that drive compulsive checking without providing sufficient meaning. We use these findings to create a descriptive model of the cycle of compulsive checking, and we call on designers to craft experiences that meet users' definition of meaningfulness rather than creating lock-out mechanisms to help them police their own use.

CCS CONCEPTS

• **Human-centered computing** → **Empirical studies in HCI**.

KEYWORDS

Smartphone, compulsive phone use, interview, habits, self-regulation

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1 INTRODUCTION

The ubiquitous adoption of smartphones has enabled a plethora of previously unimaginable opportunities for users, from easily navigating a foreign city to sharing photos of meaningful events in real-time. Despite this value, the pervasive and routine use of phones in nearly every niche of daily life has produced widespread societal anxiety about overuse and dependence on devices [31, 41, 47].

Determining the validity of such anxiety is not straightforward. Across a number of studies, researchers have found broad frustration among users with the way they use their phones [6, 41, 52, 58, 65, 67, 69], particularly with respect to high-reward, low-demand experiences like browsing social media and playing casual games. Yet, other work explains that smartphone users are faced with larger social narratives that condemn them as distracted addicts [28, 48], and that these narratives lead users to express concern about their own usage behavior and that of others [47, 60]. This complexity makes it difficult to disentangle when users' frustration with habitual phone use comes from lived experience and when it comes from internalized ideologies that depict phone users as addicts who neglect the (superior) physical world. Prior work has called for more nuanced narratives that examine these phenomena more closely [28].

In this study, we examined how 39 smartphone users—ranging from early adolescence to older adulthood—make sense of their habitual phone use. Participants engaged in interviews, a think-aloud demonstration of the apps they check regularly, and a sketching exercise to design their own media experiences in light of their reflections on personal checking habits. Through these methods, we probed the antecedents that lead them to check their phones, the factors that shape whether these habitual uses are meaningful, the triggers

that are likely to end a checking session, and participants' reflections on these patterns.

Participants reported that habitual phone checking fills every moment of downtime, and that they engage in these checking behaviors automatically and with minimal awareness. A small set of common triggers lead participants to pull out their phone to check in, and a second small set of common triggers lead them to put it away. One contribution of this work is to model the engagement-disengagement cycle of compulsive phone use.

Participants also shared a common sense of what makes an instance of phone use “meaningful,” and reported that it only meets this bar if it transcends the specific moment of use and ties in with their larger life in some way. Though participants expressed frustration with their checking habits, they primarily directed this frustration at experiences they find meaningless. Participants reported abandoning apps that propel them into compulsive usage habits while failing to deliver meaningful experiences.

Phone use has cemented itself as a staple activity of daily life. We seek to understand the extent to which this pervasiveness and continuous use is born out of the broad value phones offer their users and the extent to which it is born out of developers' interest in monetizing the attention of their users. Given that both lived experience and internalized social narratives may contribute to users' frustration with compulsive use, we seek a close-up look at participants' experiences with compulsive use. By developing a more precise understanding of why habitual phone use occurs and how it is experienced, we seek to replace vague collective anxiety over phone use with an evidence-based understanding of the process, aiding in larger research efforts to differentiate between moral panics and credible threats.

2 RELATED WORK

2.1 The Addiction Debate

Although the mainstream media and the every-day speech of phone users reflect language portraying smartphones and other Internet-connected technologies (ICTs) as “addictive” [47], this idea is debated among scholars. A number of studies are built on the assumption that ICTs are addictive [18], and researchers have developed a variety of instruments to assess Internet and technology addiction, such as the Internet Addiction Test (IAT) [76], the Smartphone Addiction Scale (SAS) [46], the Smartphone Addiction Inventory (SPAI) [56], and the Facebook Addiction Scale [5].

A large body of work reports on the ways in which these instruments predict struggles for users. For example, Turel and colleagues document the ways in which email addiction increases family conflict [73], Al-Manayes and colleagues

demonstrate that social media addiction undermines academic performance among college students in Kuwait [3], and Sahin and colleagues demonstrate that sleep quality decreases as mobile phone addiction increases. And a number of studies have shown that weaker impulse control predicts heavier smartphone use, consistent with the addiction hypothesis (e.g., [27, 75]).

However, other work pushes back on this conceptualization and argues against pathologizing everyday leisure activities like smartphone and social media use. Kardefelt-Winther and colleagues argue that frequent, prolonged activities that distract an individual from daily life should not be considered “addictions” unless they also lead to distress and functional impairment [38]. Billieux and colleagues explain that there is currently no evidence to support the claim that neurobiological mechanisms underlie problematic mobile phone use the way they do in recognized chemical and behavioral addictions [7].

2.2 Compulsive Phone Checking

Although it remains unclear whether technology usage habits ever meet a clinical definition of addiction (and unlikely that they do in the common case), there is wide support for the claim that many users engage in compulsive and habitual smartphone checking [44, 58, 65]. Prior work has shown that smartphones are particularly conducive to compulsive habits (as compared to other technologies) because of their portable nature and the fact that they support many different activities [30, 45]. Other work documents that users engage in routine “checking” behaviors and shows that apps that offer high information rewards are habit-forming [65].

Further, a large body of evidence documents that compulsive checking habits can have a negative impact on daily life. The extent to which romantic partners interrupt shared activities to engage in phone-checking predicts not only interpersonal conflict about technology use but also relationship satisfaction, life satisfaction, and the incidence of depressive symptoms [49, 61]. A meta-analysis of studies on texting while driving concludes that this common behavior [26] dramatically compromises an individual's ability to drive safely [11]. Prior studies have linked compulsive phone habits to poor sleep quality (e.g., [55, 68]), and ground-truth phone use predicts decreases in academic performance, even after controlling for past academic performance [23]. An experimental study manipulating parents' smartphone use found that parents felt less connected to their children and more distracted if they checked their phones during a shared family activity [45]. Smartphone users feel these impacts and report frustration with their own usage patterns [4, 6, 41, 63, 66, 69].

Here, we seek to understand users' experiences with compulsive checking in their own words. By taking a detailed

look at the the process of engaging in a habitual session of phone use, we are able to better understand the conditions that lead to these sessions, the conditions that cause them to end, and how they are experienced by users.

2.3 Designing for Compulsive Use

Users' sense of compulsively engaging with technology out of habit is no accident, and many commercial products are designed to promote habitual experiences that capture and hold users' attention as often as possible for as long as possible. "User engagement" is a guiding principle in software design and a common metric for evaluating products [53]. As many products benefit from users' continued engagement (e.g., pay-to-play games and services, websites and apps that profit from ad impressions or click-through rates, etc.), designers are often incentivized to work against the usage boundaries users might otherwise set for themselves.

Prior work has documented a variety of *dark patterns* in existing commercial technologies, that is, design approaches that serve the product and the company at the expense of the user [10]. Research in HCI has documented that dark patterns and malicious design are a pervasive problem [14], and some of these patterns seek to erode users' ability to self-regulate their use of a system or application. For example, prior research has identified systematic dark patterns in video games that intentionally erode players' self-efficacy, leading them to invest more time and labor into gameplay than they enjoy or would choose to engage in without coercive design elements [77]. And people who use their smartphone to engage with games, social media, and passive entertainment are more likely to display evidence of problematic and compulsive use than people who use their phones for other purposes [37], suggesting that common design elements of these experiences foster these problematic usage patterns.

Users' reports that they habitually engage in patterns of technology use that they later regret or feel are a waste of their time [4, 24, 41, 63, 67] are consistent with the idea that design practices at times seek to break down people's self-defined usage boundaries and intentionality. Many commercially available books for practitioners offer advice and act as how-to guides for building products that users find hard to put down (e.g., [22, 54]).

Here, we seek to understand how compulsive use is experienced in the context of the design decisions in which occurs. By capturing a high-fidelity representation of moments of compulsive use, we expand on existing evidence which shows that people feel they use their phones compulsively. We contribute a more nuanced understanding of the relationship between design decisions and compulsive habits by describing these instances within the situated app experiences where they arise.

2.4 Phone Use Across the Human Lifespan

Finally, we conducted our study not only with adults over age 18, but also with adolescents. Our decision to include teens in the sample was motivated by the recognition that adolescents may display different patterns of smartphone behavior than adults due to their developmental stage, which is marked by a heightened focus on oneself and one's social standing [19, 20, 29, 43]. A large body of prior work has explored adolescent digital media use as a distinctive phenomenon influenced by developmental and generational factors [9, 16, 17, 25, 36], though recent evidence points to many similarities between adolescents and adults in their use of networked technologies [8, 47, 51]. Moreover, we wanted to contribute empirical evidence to the ongoing public debate about whether the current generation of teens is markedly different from previous generations with respect to their relationship to networked technologies [12, 74].

3 METHOD

3.1 Participants

We conducted semi-structured interviews with 39 participants, intentionally recruiting from a mix of three different subpopulations: high school students ($N = 13$), college students ($N = 13$), and post-graduation adults ($N = 13$). Participants were recruited through word-of-mouth, convenience sampling, and snowball sampling, and all participants lived in the larger metropolitan area surrounding our institution. Though not an explicit exclusion criteria, our recruiting methods did not reach young adults of college age who are unable to or disinterested in attending college.

Our sample included 21 participants who self-identified as female and 18 who self-identified as male. Across all three groups, 76% of participants identified as Asian, 12% identified as multiracial, and 6% identified as white. Average age was 21.9 years ($sd = 8.9$ years). All participants currently lived within driving distance of a mid-sized, highly educated, American coastal city with a large tech industry presence. Throughout our results, we use the subscripts "HS," "C," and "A" next to participant IDs to denote our high school, college, and adult participant groups.

3.2 Procedures

All participants completed a three-part, in-person study session composed of a background interview, a think-aloud phone demonstration, and a sketching exercise. On average, interviews lasted 22m26s ($sd=9m2s$); all interviews and were conducted between the fall of 2017 and the spring of 2018.

At the conclusion of the study session, adult participants received a gift card to Amazon worth US\$10 as a token of our appreciation. Because of the added burden on adolescents to coordinate the informed consent process with their parent

and the added logistical challenges of securing transportation to our institution, high school students received a gift card of US\$20.

Part 1: Background Interview. We first conducted a background interview to probe participants' experiences with habitual phone use and phone-checking. Using a grounded-theory approach [70], we iteratively analyzed data as we interviewed participants and refined the protocol based on emergent themes. In the final version of the protocol, we asked participants about the times when they are likely to use their phones out of habit and the physical and social contexts in which habitual use occurs. Example questions included: *"Do you ever find that you use your phone out of habit? If so, can you tell me about what this is like?"* and, *"What kinds of scenarios might lead you to use your phone habitually or just to check in?"* To better understand social contexts, we then asked questions such as: *"When spending time with friends your age, how do you see them engaging with their phone around you? How do you feel about that?"* We asked college students and adults about how their usage habits have changed since they first got a smartphone. We asked high school students about how their phone use is affected by parental or guardian control.

Part 2: Think-Aloud Phone Demonstration. We then conducted a modified version of a think-aloud protocol [35], in which participants were asked to walk us through their experience of using phone applications out of habit, demonstrating these behaviors on their phone as they described them. During this time, participants went through each application on their smartphone and, if the participant felt the application was one they used out of habit, they briefly demonstrated how they use it. The researcher then asked several follow-up questions about the participant's use of and experience with that specific app. These questions began by exploring the app in the context of the participant's daily life, such as: *"When do you find you use this application?"* and *"When you're using this app, what causes you to stop?"* We then asked participants how they feel about these behaviors, asking, for example: *"Do you wish you used this app more, less, or about the same?"* and *"When using this app, does it feel meaningful to you?"* We then asked about frequency and duration of usage. After walking through all apps, we ended this portion of the study session by asking each participant how they define what makes something "meaningful" to them.

Part 3: Co-Design and Sketching. Third, we asked participants to identify one thing they would like to change about their habitual phone usage. They were given as much time as they needed to define the change they would like to make, and then asked to share this goal aloud. We asked several follow-up questions, including: *"Why do you want to make*

this change?" *"How important is making this change to you?"* and *"Have you tried to make this change before? If so, what happened?"* These questions were included to contextualize the meaning and importance of the goal for the participant. After answering these questions, participants were then asked to sketch a design concept of their own invention depicting how their phone or an app could help them facilitate making this change. Once done sketching, the participant briefly explained what they drew.

3.3 Data Analysis

All interviews were transcribed by a professional transcription service or a member of the research team. As we conducted our study sessions, we iteratively transcribed and analyzed our data using an open-coding approach. The team met weekly as a group to review data collaboratively. This consisted of reviewing transcripts and identifying emergent codes individually, coming together to share codes collaboratively and compare notes, reviewing video footage of the phone demonstration, and reviewing participant sketches. All materials were reviewed by at least two members of the research team and all codes were discussed collaboratively with shared examples.

Consistent with a grounded-theory approach [15], we performed this analysis as we conducted data collection, and we iteratively revised our interview protocol as themes solidified to gain more targeted insight into emerging themes and to improve the quality and depth of the data. The final set of codes included categories such as: triggers that start compulsive phone use, triggers that end compulsive phone use, phone-use norms, meaningfulness, autonomy, and apps users abandon, each of which had several subcategories. We reviewed all transcripts and extracted vivid exhibits [32], which we used to develop analytical memos.

4 RESULTS AND ANALYSIS

4.1 Triggers that Start Compulsive Phone Use

Participants reported a small, common set of causes leading them to engage in compulsive phone checking (see Table 1), each of which we describe here.

Downtime. The most commonly mentioned trigger for compulsive phone checking was having a moment of downtime with no obvious alternative source of stimulation or demand on a participant's time. As one participant explained, she compulsively checks her phone, *"any time I'm in a car not driving, on the bus... in between classes, or when there's a lull in conversation, or there's just any down time"* (P20_{HS}). Using the phone to fill moments of downtime was nearly universal, and participants told us they typically turn to their phones:

"In between seeing patients at work" (P16_A)

"If I'm heating up frozen food" (P26_{HS})

Table 1: Triggers that Start Sessions of Compulsive Phone Use

Trigger	Description	Example
Unoccupied moment	Any moment of downtime with no obvious alternative stimuli	<i>“I feel like whenever I’m bored, I just check if I have any notifications or texts or I go on Instagram and I just scroll through even though there’s no real purpose... If I’m not around friends or if I’m laying down in bed and I can’t fall asleep or I’m walking to class or if I’m in class and I don’t want to pay attention anymore, things like that.”</i>
Tedious task	Any effortful activity	<i>“You get into the video, and then you realize you don’t want to go back to homework. You just keep watching the videos even if they’re not good, because it’s more fun than homework.”</i>
Social awkwardness	Situations that deviate from social norms or leave the user feeling uncomfortable	<i>“You probably think more about what other people must be thinking about you, instead of thinking about what you’re seeing on your phone screen. Instead you’re like, ‘Oh people probably think I’m a loser sitting over here all alone.’”</i>
Anticipation	An expectation of social or informational rewards	<i>“If I’m talking to someone on Snapchat or if I’m texting them and they haven’t responded, I’ll continuously check up on that.”</i>

“During passing period” (P27_{HS})

“If I have to wait for a friend” (P28_{HS})

“Waiting for my drink at Starbucks” (P31_{HS})

“When I’m driving and there’s a stoplight” (P17_A)

“If I watch a Netflix show and the intro is long” (P5_C)

Participants often referred to this usage pattern as, “killing time” and said that the phone occupies any moment when they might otherwise be bored, consistent with prior work in other domains [57]. One described it as occurring “in the spaces of in between” (P40_A). As participants reflected on this behavior, some hinted at self-doubt or critique, saying things like, “Now that I think about it, if there is a down moment, I will automatically pull out my phone just to occupy myself. And I don’t really just sit in that moment” (P30_A). However, others explained that they are very glad to have this option, as it enables them to avoid the alternative of, “staring at a wall.” Most participants explained that compulsive phone checking fills all of their empty time.

Tedious Tasks. Participants also told us that they often check their phones compulsively and continuously when attempting to engage in taxing or tedious tasks. For example, they said things like, “After school when I’m doing homework, I find myself getting very bored when I’m doing it, so it’s a big habit of mine to take a pause and then check my phone like every five to ten minutes” (P33_{HS}). Other participants mentioned compulsively checking their phone when listening to a lecture or talk, when doing repetitive tasks at work, or simply, “If I don’t want to do something, then to not have to do it, I’ll go on my phone” (P14_C).

Social Awkwardness. Separately, participants reported turning to their phones as a knee-jerk reaction to social awkwardness. They told us, “It’s very common, where, if something really awkward happened, or if you’re in a conversation and no one’s really talking, you just pull out your phone and scroll through Instagram or something” (P34_{HS}). Others explained they check in with go-to apps, “if I want to look cool in public, because no one likes to be standing around doing nothing” (P21_A), and described instances like, “[one] morning when... everyone was talking, and then I just felt awkward, and I’d pull out my phone, so I don’t look like a total loser” (P5_C).

When discussing phone use as a reprieve from social awkwardness, participants most frequently cited moments when they had nothing to say to someone and moments when they felt embarrassed about appearing idle. But they also mentioned a long tail of other awkward situations, all of which prompt them to check in with low-demand apps. They described scenarios like, “even walking my dog I look at my phone cause it’s sort of awkward to say, ‘Hi,’ to my neighbors” (P31_{HS}) and, “if I’m walking a direction and I realize I had to go the opposite way, I’ll pull out my phone and pretend like I just got a text” (P20_{HS}). Participants described the act of turning to their phone to relieve feelings of awkwardness as a powerful and well-established habit. They explained, “whenever I’m standing in a social situation and have no one to talk to, I instantly pull out my phone out of instinct” (P5_C).

Anticipation. Participants explained that they feel this habitual urge to check intensify when they are expecting some kind of social or informational reward. Whether expecting

a phone call, text message, social media likes, or notification from an application, participants explained that they check more frequently when expecting something new. For example, one participant mentioned that his phone checking habits increase when, *“I might be waiting for an email from a company I interviewed for, so I’ll check my phone every 15 minutes to see if I got the email”* (P5_C). Participants said this sense of expectation draws them back after fairly short intervals, saying things like *“Even if only a couple of minutes have passed, I still find myself checking my phone to see if maybe someone’s messaged me,”* said one participant.

Nothing. Finally, participants told us that the well-worn track of habitual phone checking does not always require a trigger. They explained that they often check in with their phones for no reason of which they are aware. When asked what conditions are likely to lead them to check in, some participants said things like, *“Nothing really specific. I just check it to see if someone posted something new that I didn’t really see. Yeah, nothing really specific”* (P12_C). Others called this *“an instinctive grab,”* (P4_C) and that they enact this behavior *“even if I’m not going to do anything with it [the phone]”* (P23_{HS}), emphasizing an urge to check that is persistent in all contexts of life and does not stem from a specific need or envisioned use case. Participants said that at times they enacted their checking routine, despite a low-grade awareness that nothing will have changed and that they have no reason to check in, saying things like, *“I’m not even sure sometimes when I pull out the phone what I’m going to do with it”* (P19_A).

4.2 Triggers that End Compulsive Phone Checking

In addition to probing how sessions of compulsive phone use start, we also asked participants what causes these sessions to end. Here again, a small set of themes encapsulated their responses (see Table 2).

Competing Demands. The most common reason participants cited for ending habitual phone sessions was being pulled back into the real world by other demands. Much like they reported checking in with their phone as soon as they were unoccupied, they explained that the session ends as soon as outside factors dictate that they should be occupied again. They said that they put the phone down:

“If I can’t do something one handed or with both of my eyes, then I’ll take my attention away from the phone.” (P20_{HS})

They also said they end their sessions, for example, *“when I need to drive,” “if I have class,”* and *“when the person I’m waiting for comes.”* Across groups, participants explained that they are pulled back to the non-digital world as a result of task demands, co-present companions, structured activities,

or physical constraints, all of which demand attention that precludes phone use.

The 30-Minute Ick Factor. Many participants described a recurring sense of disgust after spending time habitually checking their phone. They described the experience of putting down the phone, saying things like:

“And then 30 minutes later, I’m thinking, ‘What am I doing? I just wasted 30 minutes just going through what I went through 15 minutes ago.’” (P30_A)

These statements often implied that participants were startled to notice they were using their phones or that they had used them for so long, saying things like, *“I see that I’ve wasted a lot of time, I’m like, ‘Whoa’”* and *“I just tell myself, ‘What are you doing with your life?’”* These statements also often implied that in this moment of realization, the user became aware that the usage experience lacked sufficient meaning, explaining the reason for stopping by saying things like:

“Usually [I stop using my phone] because I’m like, ‘Wow, you just spent 45 minutes or an hour watching random videos and looking at other people; reading things you don’t really need to know. Get your life together!’” (P4_C)

Many participants spontaneously cited *“like half an hour”* or *“15, 20 minutes consecutively,”* and other durations close to 30 minutes as the natural cadence for moments of self-reflection that interrupt their habitual use, highlight the mismatch between the time investment and sense of meaning, and lead them to break the session.

Recycled Content. Participants also reported that they regularly end sessions because they notice they are viewing items they have already encountered:

“When I start seeing stuff I’ve already seen, that’s when I’ll stop going through Instagram. Same with Snapchat too” (P37_A).

They said that they end their checking session, *“when I’ve already saw the last post from the last time I’ve checked my phone”* and *“when I refresh and there’s nothing.”* Although participants described spending time with content that, upon reflection, did not seem worth their time, they explained that unlike new but meaningless content, recycled content immediately reminds them that they would rather invest elsewhere and promptly ends their session.

4.3 Experiencing Compulsive Phone Checking

But during the time between these starting triggers and ending triggers, what is the experience of compulsive checking like? Participants explained that the most important aspect

Table 2: Triggers that End Sessions of Compulsive Phone Use

Trigger	Description	Example
Competing Demands	Something outside of the participant's control (such as another person or a physical task) that demands the user's full attention	<i>"Gosh. Like if someone is trying to talk to me and demanding my full attention. Yeah really, like I need something else to pull my attention away completely."</i>
The 30-Minute Ick Factor	Recognizing an internal sense of dissatisfaction after spending some time on the phone (many people cite 30 minutes)	<i>"I think usually if I'm like, 'Oh crap I need to go back to what I was doing,' or I see that I've wasted a lot of time, I'm like, 'Whoa, I've been kind of in the worm hole of my phone for too long. I need to put it away.'"</i>
Recycled Content	Seeing previously viewed content reappear	<i>"When there's nothing else to check, when on social media or something, like, I'm scrolling through, like, a page or something, or like, Instagram when there's, like, no other pictures to look at. Or like, when you refresh and there's nothing, then I'm just like, 'Okay, I'm done.'"</i>

of their experience as they used their phone was not whether they did so compulsively, but whether these compulsive uses felt meaningful.

As participants walked the interviewer through the experiences they check compulsively, participants explained that these activities could be quite meaningful at times. The common thread that tied together their diverse examples of meaningful experiences was that each one connected back to something outside the phone and served as a kind of investment in the user's future or larger life.

The most common form of investment cited by participants was in relationships. They explained that as they are drawn back to their phones, quick bursts of checking become meaningful when they involve connecting with others, engaging in acts of social reciprocity, or otherwise building relationships. As one participant explained, reflecting on her checking habits broadly:

"I think human connection is something that I find joy in. And usually—whether that's through a message or through facetime-ing or through a meme tag—it's always kind of, 'Oh, this person was thinking of me.' And that to me is really meaningful." (P29_A)

But meaningful usage experiences that transcend the specific instance of interaction extend to domains beyond relationship-building as well. One college student explained that these connections back to his larger life could come in many forms, and that he finds meaning in checking his phone whenever:

"You're learning new things that will help you ...or doing things that isn't just out of repetition, and helping you to be productive, being better at

achieving your goals, being better at being a moral person in society." (P4_C)

Participants explained how their quick checking habits, at times, support investing in their relationships, moral development, education, and more. They told us that these meaningful bursts of use, *"get me moving," "help me become a better nurse,"* or *"change what I think of something."* One participant explained that she fills spare moments by reading stories on her Kindle app, which she finds meaningful, because her father reads the same books and habitually keeping up with the plot line is an investment in conversations she will have with him later. Another described her routine around checking a Bible app for curated verses each day, saying:

"I get the notification at 7:25 every morning...I set it for 7:25 because that's the time I arrive at school, and it's kind of just a good way to start my day, it just gives me hope throughout the day, so it helps me along." (P33_{HS})

However, although many participants pointed out specific instances in which their checking habits draw them into experiences they find meaningful, participants spent more time describing checking behaviors that find meaningless and that lack a connection to aspects of their life that transcend phone use. As one participant explained:

"[Habitually checking] is kind of annoying...it's just really distracting. It's like you wake up and it's like, oh, I'm checking my phone, but then that's it. You just don't feel satisfied, y'know? There's something more, you know?" (P21_A)

Participants told us that the ratio between the amount of time they spend checking in compulsively and the amount of meaning they derive from the experience is not always satisfying. They told us things like, “I feel like I check it [Instagram] a lot for me not caring that much” (P28_{HS}) and, “I think it [phone checking] keeps me from doing what I need to do sometimes. Especially if I don’t want to do it” (P4_C), suggesting that compulsive phone checking is not always the way they want to be spending their time, even as they do it.

Participants also explained that the design of an app is an important factor in both the extent to which they check it compulsively and the extent to which the experience is meaningful. For example, one participant described two apps he ultimately deleted, because he spent more time with them than he wanted to:

“YouTube felt more meaningful than Clash of Clans. Clash of Clans was just something to go to when you’re bored. It doesn’t really mean anything. But YouTube, that can inform you if you’re watching the right videos.” (P35_{HS})

Though neither app ultimately provided enough meaning to be worth the time it consumed for this participant, YouTube came closer to achieving an acceptable balance, because at times it offered information rewards that persisted beyond the specific moment of usage. Similarly, another participant explained:

“[Instagram] gave me, like, temporary satisfaction. Like, ‘Oh yeah, all these people like my photo,’ or ‘All these people think my story is funny.’ And yeah, it’s great in that moment, but then after it dies down, you’re just kind of just like, ‘What’s the point?’” (P29_A)

She explains that the social rewards she receives from Instagram feel fleeting rather than lasting. And without a social investment that persists, the experience feels empty upon reflection.

4.4 The Downstream Effects of Compulsive Use

Many participants told us that upon reflection, they had deleted, stopped using, or cut back on their use of certain apps. They connected these decisions to cycles of compulsive engagement that either did not deliver sufficiently meaningful experiences or undermined other more meaningful experiences they might have had otherwise. For example, one high school student described changing the apps he used because they led to compulsive usage that replaced other activities he valued more:

“Clash of Clans and YouTube used to be the apps I would use to procrastinate. So that’s the main reason I got rid of YouTube and stopped playing Clash

of Clans so much, because when I’d have homework, I would want to do something else ... and I found out I would often miss opportunities to do stuff, like going to the gym, because I spent like an hour and a half on my phone and then I did homework. Whereas if I just did the homework, I’d have time to go to the gym.” (P35_{HS})

Other participants told us that they stopped using Twitter and Instagram because, “I realized I was just there spending a lot of time on it” (P4_C) or that, “it was really just kind of a rabbit hole, and there was no point to it at the end of it. I just got less sleep” (P29_A). These and many other participants reported that as they gradually develop a track record of compulsive use and low meaning with a certain app, they build up a sense of frustration with their usage behavior and ultimately delete it.

Some pointed to specific design features that they linked to compulsive and meaningless experiences, saying things like, “[I deleted] Instagram. I used to have Pinterest. I used to have Tumblr ... I think all those sites are meant for infinite scroll. It’s meant for you to go on there forever and ever and waste your time” (P29_A). For this participant, the bottomless feed of a social media app is an intentional mechanism for holding her attention, and in saying it, “wastes your time,” she implies that the time she spends with the app is not an investment that transcends the particular instance of use. Another participant described her decision to stop playing games, saying:

“I don’t play games anymore... maybe when it involves more intellectually and maybe a little bit of social, like playing with your friends... maybe that will keep me longer.” (P18_A)

For this participant, social features and a design that demands intellectual challenge would allow her to invest in something that persists beyond the moment of use, making her more likely to value the experience and return to it.

However, a few people mentioned that their attempts to delete apps and curb compulsive use did not persist. A minority of participants said that they eventually re-downloaded apps that they had previously deleted, saying things like:

“It was pretty good. I did more things outside and I went out more. I hung out with people. I talked more to other people. And I seemed more social I guess ... I don’t know. It was just because everybody’s doing it, I felt kind of like—I’d just sit there and people would go on their phones. And then I’m just sitting there trying to talk to people. But it didn’t work.” (P28_{HS})

Thus, although these participants felt that deleting the experience was the right personal choice, larger structural factors

(such as an ecosystem of friends who use the app) stand in the way.

In contrast to descriptions of compulsively using apps that felt meaningless, a few people described habitually checking apps they find meaningful and described patterns of checking with which they were fully satisfied. One participant described the routine she had set up to check in with a Bible app saying:

“I use it [the Bible app] daily, but I don’t use it too much, and I don’t use it too little, where I’m able to engage with the app, but not get distracted by it, so I think it’s the perfect amount.” (P33_{HS})

Thus, across participants, we heard smartphone users say they engage not only in compulsive phone use but also in regular self-reflection, wherein they notice and attend to their internal self-evaluations of their behavior. Though much of this self-reflection focused on behaviors they wanted to change, participants also said that they notice when phone use feels good and falls into habitual patterns they want to maintain.

4.5 Designing in Response to Compulsive Checking

When sketching design concepts to help them make behavioral changes with respect to the way they use their phones, participants almost universally designed lock-out mechanisms to prevent them from enacting their regular phone routines. These designs were often extreme and antithetical to a positive user experience. As one participant explained:

“This is bad, but honestly, I feel like if it locked me out... if it crashed, I’d probably be less prone to use it... I’d probably be like, ‘That experience was so bad, I never want to go through it again.’ Creating bad experiences around that would probably help me.” (P7_C)

Other participants designed tools to make the phone “turn off after like 10 minutes or something... your apps and stuff would kind of shut down” or “an option for some specific applications to be locked for a certain amount of time.” They explained that in creating such tools, they were looking for things to: “make me use my phone less or just have it not around me as much.” Participants described phones that would not turn on, apps that would not open, and a battery that drains quickly. They drew sketches of phones in jail and apps with padlocks, using visual metaphors of extreme confinement.

Yet, when we asked participants how interested they were in following through on the changes they wanted to make or adopting the designs they had sketched, their responses were tentative. In response to the question, “Have you tried to make this change before?” one participant explained that he had not, “because I don’t want to as well.” They explained that despite their interest in making these changes, they also felt

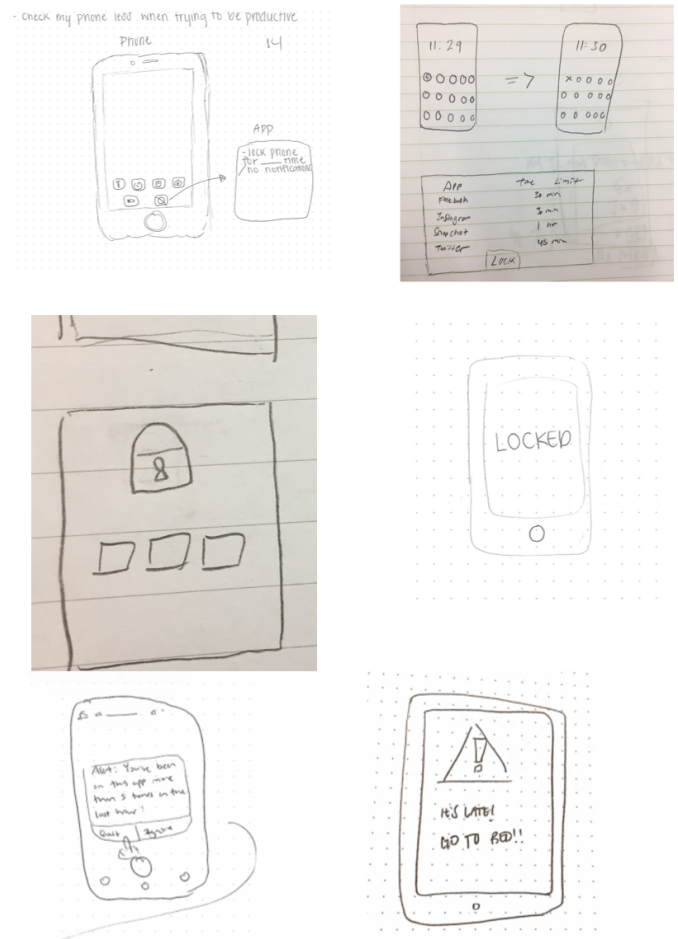


Figure 1: Sample design concepts from participants.

a strong sense of ambivalence. For example, they told us both that: “I’d probably just get rid of all social media. I don’t really need it,” and that, “you sort of need to stay up with technology” (P31_{HS}), explaining that as much as they want to be locked out of their phones, they also want to continue using them. Other participants said that making these changes were, “kind of important,” “not very [important],” or important but impractical because, “I don’t think I’m capable.”

Thus, despite near-universal agreement that the most useful design to support phone-related behavior change is some variant of a lock-out mechanism (see Figure 1), participants’ interest in this solution felt hollow. Participants of all ages were dissatisfied with their own use and described an adversarial relationship with their phone so extreme that it required virtual incarceration. But they also explained needing and valuing their phones, resulting in a tension wherein they clung to the very thing they locked up.

5 DISCUSSION

5.1 A Descriptive Model of Compulsive Use

Our participants' experiences robustly show that compulsive phone checking has a predictable shape. A small set of common triggers lead them to pick up their phones, which they use until one of a few common triggers leads them to end the session. They internalize a sense meaningfulness (or lack thereof) from the experience.

Further, these findings are consistent with a descriptive model of compulsive phone use that involves two separate cycles: compulsive habits and longer-term reflections. If an app leads the user to regular compulsive checking and provides insufficient meaning, their more reflective, longer-term behavioral arc leads them to abandon the experience. Although these were not categories we thought to probe *a priori*, nearly all participants described a short-term cycle of routine, habit-driven checking, and a longer-term cycle of self-awareness and deeper reflection about these habits.

These two types of behavior are consistent with prior work in cognitive science documenting fast, habitual cognitive processes and slower, simultaneous intentional processes that calculate the rewards and costs of performing an action [62]. Together, these two pathways allow an individual to engage in self-regulation, one responding quickly to stimuli and making decisions accordingly, and the other making sense of this response and calculating whether it was the appropriate one. Prior work has suggested that this model is a useful lens for understanding how people self-regulate their use of ICTs [59].

Participants described a reflective pathway that alerts them to the fact that compulsively checking an app lacks sufficient meaning to be worth the return on investment, ultimately leading them abandon the experience (e.g., delete the app). Our findings suggest that this should be a mainline concern for designers, as nearly all participants mentioned deleting at least one app that failed to deliver sufficient meaning for the time they invested, indicating that users are often able to actualize their desire to quit.

5.2 A Design Agenda for Meaningful Use

Participants made clear that their frustration with compulsive phone use was not about their behaviors *per se*, but about the lack of meaning (as a function of time) that they derived from experiences they engaged in compulsively. Although participants primarily described their phone use as meaningless in the context of compulsive checking, all participants were able to articulate a definition of what meaningful phone use looks like and to point to examples from their own lives of meaningful use. For these participants, meaningful phone use is staple of daily life, and we claim that a design agenda in this space should foreground questions of meaningfulness

rather than questions of habits or “addiction.” These findings lead us to the following recommendations for designers and researchers:

1. Move Beyond Lock-Out Mechanisms. We asked participants to sketch design concepts that would support them in making the one behavioral change related to their phone use they would be most interested in. Their design ideas were dominated by lock-out mechanisms that would prevent them from engaging in their typical patterns of use. However, even as they explained these concepts, they seemed reluctant to want to try their own designs. Upon closer scrutiny, and with the lens of a two-path model of metacognitive self-regulation, we can view the goals underlying these sketches in a new light. Our findings suggest that what users are really seeking may be mechanisms to bring their habitual behavioral processes (i.e., the compulsive checking cycle) into alignment with the reward calculations of their reflective processes (i.e., the self-reflection cycle).

But the shortest path to doing so—that is, a lock-out mechanism that blocks their current habitual behaviors—may not be the only or most effective solution, and prior work has shown that lock-out tools are often frustrating and likely to be abandoned [13, 21, 78]. Our participants felt pulled in two directions simultaneously, and their sketches showed how these tools address one need (preventing compulsive use) while undermining another (all that they value about using their phones and the reasons they adopted smartphones in the first place). This demonstrates the need for designers to address this tension holistically rather than to address compulsive use narrowly.

This is worth noting, as research interventions in this space have primarily focused on lock-out style supports for reducing phone use (e.g., [31, 39–41, 52, 64]). Similarly, current commercial solutions to address compulsive phone use—such as stand-alone tools like RescueTime, Moment, and Disney Circle, and internal features like Facebook and Instagram's tools for time management [1] and YouTube's digital wellbeing dashboard [2]—focus on using tools to self-police compulsive habits. But researchers and product designers alike may serve users better by guiding them toward experiences they will find meaningful and promoting a design agenda to create more meaningful experiences in the first place.

2. Transcend the Current Session. Participants described in detail a number of scenarios in which they found phone use to be a meaningful and worthy use of their time, ranging from intellectually challenging video games to regular meme-tagging with a loved one. Participants shared a common understanding that “meaningfulness” should be defined as the extent to which the particular usage instance is an investment in the future and transcends the specific moment of

use, a phenomenon that past work has called *boundary crossing* [71]. This investment can take many forms, including connecting with others, learning something new, coordinating logistics, developing as a person, or thinking about something in a new way.

This suggests a need for designs and product metrics that promote tasks that transcend the current moment of use and also fit the usage scenarios participants described (such as moments of downtime and brief, socially awkward interludes). Microproductivity designs [33, 72] and other short-burst tasks that enable the user to make some kind of investment that persists beyond the isolated phone session might help users create habits that align with behaviors their reflective self finds satisfying. More broadly, designers should consider and measure the larger meaning users find in their usage experience and pinpoint the ways in which this use connects to something larger and more lasting.

3. Design for Satisfying Portion Sizes. Participants' satisfaction with the apps they used compulsively was a function of both the meaning they derived and the time they invested. The fact that participants reported filling every moment of downtime with phone use, the prevalence of how-to guides and dark patterns for capturing and holding users' attention, and the extent to which users were frustrated with the amount of low-yield time they spend with their phones, together suggest that designers actively instill compulsive checking habits in users of all ages, and that users find this use of their time to be frustrating. Our findings suggest a need for designs that consider both inputs to participants' equation for satisfaction: How meaningful is the experience likely to be? And how much time they are likely to spend.

5.3 Phone Use and Development

Finally, we found remarkably few differences across age group; aside from high school students' greater tendency to mention social awkwardness, the taxonomy applies equally well to adolescents and adults. This result contributes to ongoing scholarly and public discussions about what is and is not distinctive about young people's use of networked technologies [9, 12, 25, 36, 74]. Our analysis revealed that teens and adults engage in similar patterns of compulsive phone checking, from initial motivation through to disengaging from their phone. These findings corroborate prior work showing similarities in teens' and adults' phone-related behaviors and attitudes [47, 50]. What our findings cannot answer is how, if at all, compulsive phone checking affects aspects of adolescent development, such as the development of personal identity and intimate relationships [19, 20, 29, 43]. Future work should explore the interaction between adolescent development (e.g., developing sense of identity, empathy, and morality) and compulsive phone checking behaviors.

5.4 Limitations and Future Work

This study was conducted with a small qualitative sample from a single geographic region, and the young people we interviewed were biased toward those in college or likely to be college-bound in the future. Patterns of compulsive ICT use differ around the world [34]. Although these findings may not generalize, as rich, qualitative design insights, we expect them to be transferable [42]. Future work remains to further develop this descriptive model of phone use across a larger population and to evaluate the predictive utility of the taxonomies we describe.

6 CONCLUSION

Through a three-part qualitative study with 39 smartphone users, we show that a small set of common triggers—including moments of downtime or social awkwardness—lead individuals to habitually check their phones. These sessions last until an outside factor intrudes. At times, this outside factor is their own self-reflection and recognition that their investment of time in the phone does not pay dividends (at other times, this factor is seeing recycled content from yesterday's newsfeed).

Despite participants' shared sense that most of their compulsive phone use feels meaningless, they also share a definition of what meaningful phone use looks like and can all point to examples of meaningful phone use from their own life. We call for a design agenda to move away from an arms race between meaningless experiences and lock-out mechanisms and toward the experiences participants find meaningful: those that serve as an investment in their larger life and transcend the specific instance of use.

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