Addressing problematic smartphone use with a personalized, goal-based approach

ABSTRACT

Researchers have long-studied the negative effects of excessive smartphone use and proposed ways to reduce screen time. However, studies suggest restriction-only techniques may cause additional mental health burden. In this paper, we present our findings from semi-structured discussions with 38 college students on their perception of healthy and problematic smartphone behaviors. Generally, users' responses suggested that when smartphone use was perceived as healthy, it helped the user achieve an individualized purpose of primary value. Yet, problematic use did not serve a purpose of primary value. This paper summarizes the key findings from this qualitative study. It also provides an update on our current work, making the case for creating tools focused on helping users achieve their personalized goals in relation to smartphone use or non-use. Our data and theory argue against merely restricting screen time, which is often unsustainable and triggers negative emotions.

CCS CONCEPTS

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

KEYWORDS

smartphone, problematic phone use, user study, focus groups

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1 INTRODUCTION

Increase in smartphone adoption has led to concerns of smartphone overuse and its negative effects on the smartphone user's well-being [18]. Popular media examples of excessive smartphone use have influenced people's perspectives of smartphone overuse, and have resulted in the terms "excessive" and "problematic" being used interchangeably. At times, these negative perceptions of smartphone use lead users to experience aversive thoughts and emotions (such as guilt, shame, and frustration), even when they have used a smartphone for a useful task [12]. Similarly, users also often experience negative emotions when monitoring and attempting to limit their smartphone use [16]. Because of the focus on "excessive" phone use, most tools for smartphone use management solely attempt to reduce screen time [1, 3, 9, 10, 15]. Focus on restricting screen time exacerbates negative emotions, and the resulting negative emotions and lack of reinforcing states often makes the restrictions unsustainable. Furthermore, these approaches may not be addressing the core problems of problematic smartphone use that have been shown to negatively affect a person's wellbeing [18]. In fact, Harwood et al. discovered that problematic smartphone use was not determined by the *extent* of use, but by the nature and content of use – what people were specifically doing on their phones during a particular situation [8]. We conducted a qualitative study to better understand how to help users build better phone habits to improve their well-being. Our findings highlight that an individual's values and their personal goals affect their view of healthy and problematic smartphone use. In this paper, we present the findings from our initial qualitative study as well as an update on our current work. This work includes 1) a randomized controlled trial to test the findings from the initial study and 2) the design and development of a smartphone application to address problematic smartphone use.

2 QUALITATIVE STUDY

2.1 Methods

We conducted 15 semi-structured focus groups and one-on-one interviews with 38 college students, recruited via email. We chose this mixed approach to get a wider range of answers. The inclusion criteria required participants to be 18 years of age and use a smartphone daily for purposes beyond texting and voice calls. Out of the 38 participants, nine self-identified as male and the remaining twenty-nine self-identified as female. All participants were undergraduate students between the ages of 18 and 25. Even though the participants used their phones regularly for activities other than phone calls and text, most of them did not consider their overall phone use to be excessive. Even so, they were able to identify some aspects of their phone use habits that they wished to change. Due to the COVID-19 lockdown and social distancing guidelines, all focus group discussions and interviews were conducted over group calls on the Zoom videoconferencing platform. The study protocol and materials used were all approved by an Institutional Review Board.

The discussions followed a semi-structured interview format, based on the following questions:

(1) Do you wish to change your smartphone behavior? If so, how do you wish to change your behavior?
(2) Give an example, if any, of how your phone use has positively and negatively affected your relationship with family or friends.
(3) Give an example, if any, of when someone in your life indicated that you exhibited good or problematic smartphone behavior.

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(4) Give an example, if any, of a time when your phone use helped you do or kept you from doing something important or meaningful.

All focus group and interviews were recorded. The discussions were later transcribed and anonymized by the researcher who conducted the sessions. Two other researchers independently familiarized themselves with and coded the transcripts. To avoid familiarity bias, the researcher who conducted the sessions did not participate in the coding. Glaser and Straus' Grounded Theory was used to guide qualitative analysis of focus group data [6]. Each researcher first reviewed the transcript data, identifying and gathering responses relevant to study questions, although not guided by a priori hypotheses. They then formed inductive themes from data germane to study questions. We used the constant comparative method throughout analyses: Data were coded and analyzed into conceptual domains simultaneously [17]. 75 resulting sub-themes emerged and were refined continually throughout the process by each researcher separately. Finally, the separate coders merged themes to generate the final analysis as described below.

2.2 Findings

Personal values, purpose and intention of use shape perceptions of phone use and affect emotions. Users perceived phone use as healthy when the phone was 1) used intentionally for a specific, primary purpose, and 2) with awareness of their use. Stated differently, the use was perceived as positive when the phone use task was the primary valued task in which the user intended to engage at that time, such as connecting with family and friends or completing work. For example, one participant (FG9, P2) said: "I travel back and forth to homes a lot and I have been able to do work on the plane, and just tools like reminders and email all add up to make a difference."

Even free, unstructured recreational use without a noted goal led to positive emotions if that use was the primary valued task at the time (usually during "free time"). The purpose this use served appeared to be a mechanism for reducing boredom when no other task was required of them. As one example, a participant (FG4, P2) said, "On days where I have nothing to do, I feel fine using my phone a lot." Participants also used smartphones for relief ("escape") when they were experiencing anxiety, consistent with findings from prior work [4, 13, 16].

Similarly, if unplanned phone use was not interfering with other tasks, users did not experience negative emotions. For example, smartphones were useful in times of crisis, to call someone for help, or to get help through an app. One participant (FG2, P2) used a navigational app for safety when they got lost during a hike.

Yet phone use was considered problematic when 1) the phone was not used for an intentional or primary task of value and was used "mindlessly," and/or 2) if it distracted from, postponed or altogether prevented a more primary valued task. Our qualitative analysis revealed several such themes marking users' perceived problematic use. Problematic smartphone use often distracted people from a more primary activity in which they intended to participate. Some examples of primary activities were attending lectures, driving, watching a movie, and interacting with other people. Phone use was also considered problematic when it led them to postpone an activity that they were supposed to do until a later time. Provided examples included spending time with others, completing work or homework, starting their day, or going to sleep. For example, one participant (FG1, P1) said, "Sometimes at night I want to spend more time with my parents, but I will get so caught up with my phone that I don't realize how much time has passed. And then they're already sleeping, so I miss out on spending time with them."

Individuals may also form views about what constitutes problematic smartphone behavior based on examples provided by popular media that imply *excessive* smartphone use was problematic [12]. Two participants mentioned being disappointed with their excessive phone use. We expect their disappointment was a response to the ScreenTime report [16] and perhaps, if they were productive and feeling positive, they may not have experienced negative emotions about using their phone for 8 hours that day.

Perceptions of phone use vary across contexts and between individuals. While some participants considered mindless use during free time to be healthy, others experienced negative emotions for attending to their phone without a purpose or for using their phone mindlessly (without awareness). A few examples would be to scroll through social media posts or "binge-watch" shows. As one participant (FG1, P3) stated, "I feel like if I'm in a situation where I don't know what to do with myself, my phone is what I default to. I would like to not default to my phone."

Individuals often used their personal values to set their expectations of others regarding phone use. They also altered their own priorities to meet expectations of others. For example, one participant said "I'll try to multitask. Like, if I'm using my phone and somebody asks me a question or tries to start a conversation and I'll try to keep doing whatever I'm doing on my phone like scrolling or searching or whatever. And then like, you know it's happened where my mom's said like, 'hey can you disengage and actually speak to me for a second?' So that's something I'm actively trying to work on." In this quote, note that the participant actively values speaking with her mother and seeks to do so, yet perceived undesirable phone use interferes with this goal. It does so while the participant is unaware of their level of phone use, as well as being unaware of its consequences at the time of use. Cueing from the mother returns the user to awareness of the task at hand and away from the distracting phone use. Thus, "mindless" phone use hinders the participant's individual relational goals. These goals can change based on the current primary task and context.

Many participants also expected others to share their same values or the perception of the task they considered primary. Users were disappointed when others did not do so. Some participants mentioned being annoyed when someone *else* used a phone in the participants' presence instead of interacting with them.

2.3 Limitations

We only recruited college students for our initial study, since most studies on problematic smartphone use are focused on college student population. We expect the role of smartphones during the pandemic might also have influenced participants' perceptions of healthy and problematic smartphone use, and could lead to additional research questions that were not addressed in our preliminary study, but are of interest to the WellComp community.

3 CURRENT AND FUTURE WORK

Since the completion of the above-described study in December 2020, we designed a randomized controlled trial and an iOS smartphone app, which we describe in this section. We look forward to feedback from the WellComp community on these ongoing projects.

3.1 Randomized Controlled Trial

We are currently running an intensive, longitudinal randomized controlled trial to compare the effects of goal-based smartphone use with time-restricted phone on the user's mental health and ability to effectively manage their smartphone use. This trial is being conducted as an "in-the-wild" user study; it uses a smartphone app called Paco to deliver in-situ ecological momentary intervention (EMIs) [2]. We hypothesize that participants who use their phones to meet the personal phone use goals they set for themselves (the goal-based approach) will report greater success managing their phone use and superior mental health outcomes than those who use time limits to manage their use (the time-based approach), as indicated by the findings from our initial qualitative study.

The study has three phases and lasts over 8 days.

Initial Zoom session: Participants meet with the research assistant over Zoom, sign consent forms and complete a series of questionnaires on emotions and technology use, administered via Qualtrics. The questionnaires include: The Perceived Stress Scale (PSS), The Positive Affect Negative Affect Scale (PANAS), The Positive Affect Negative Affect Scale Expanded – Joviality Scale (PANAS-X Joviality), The Depression Anxiety Stress Scale 21 (DASS-21), The Penn State Worry Questionnaire (PSWQ), Problematic Use of Mobile Phones Scale (PUMP) and Media and Technology Usage and Attitudes Scale (MTUAS). The participant is randomly assigned to either the goal or time-based condition. The research assistant then helps the participant install the Paco app on the participant's own phone, trains them to use Paco, and describes the tasks they have to complete in the next seven days.

Prompts: Every day for the next seven days, participants receive four prompts by notications via the PACO app on their phone.

(1) In the morning at a time chosen by the participant, participants will receive a notification to set at least one goal or time limit for their phone use that day. It will also ask participants to rate a variety of psychological experiences on a 9-point Likert scale, including: Motivation to meet goal, expectation that they will meet their goal, stress, anxiety, worry, sadness, happiness, frustration, how productive they feel, and how discouraged they feel.

(2) Once in the early afternoon and again in late evening, participants will receive notifications to stick to their goal or time limit. They will be asked how well they believe they are doing in working toward their goal or time limit they set that day (rated on a 9-point scale) and to estimate the total time they have spent on the phone by this point. The participants will rate the same psychological experiences on a 9-point Likert scale.

(3) Finally, at night, at a time chosen by the participant right before going to bed, participants will receive a notification, asking them to reflect on and write about their experiences working toward their goal(s) and time limits they had set for that day. Participants answer yes/no questions to whether they met their goals. On a 9 point Likert scale, participants will rate how well they believe they did in managing their phone use that day, how difficult it was to manage their phone use that day and the degree to which they believe their phone use interfered with more important tasks they had during the day. They will then estimate how much time they spent using their phone during the day; participants may use an app (such as ScreenTime) to track their screen time if they wish to. Participants will also rate the same psychological experiences on a 9-point Likert scale that they had rated at the earlier three prompts.

Final Zoom session: In the final session with the research assistant over Zoom, participants complete the same series of questionnaires they were given during the initial Zoom session. Additionally, they will complete 3 questions on the usability of the intervention: The Acceptability of Intervention (AIM) measure, the Feasibility of Intervention (FIM) measure, and selected subscales of the Unified Theory of Acceptance and Use of Technology 2 measures (UTAUT-2).

The study was approved by an Institutional Review Board. Participants are being recruited through campus-wide email and flyers posted around the campus and in the neighbourhood where the college is located. The participants will be compensated up to $25.00 for their participation, pro-rated based on their percentage of study task completion (i.e., prompt response).

3.1.1 Study so far. We have recruited 18 participants so far, 9 assigned to the time condition and the remaining 9 to the goal condition. As the study is currently highly underpowered for multilevel longitudinal analysis, we are unable to examine differences in change between the two conditions at this point.

3.2 Design of the ScreenAware app

Based on our findings, optimal tools to help people reduce problematic smartphone behavior should account for user's goals of use (or non-use) and may best help by enabling the the user to create personal, measurable goals for their phone use based on their own values. We created an iOS app called ScreenAware that can be used in conjunction with ScreenTime to get a better sense of the purpose and the context in which the different smartphone apps were used.

ScreenAware allows the user to manage phone use or non-use goals. Each goal has a title, the name of the associated app, and a measure of how important it is for the user to complete the goal. Figure 1 shows the goals tab for the current day. The user has already added two goals, and is in the process of adding a new goal. To add a new goal, user taps on the '+', then can either tap on the "New Goal" item to add details to create a new goal, or on the search icon to choose from previously added goals. Goals, once added, are sorted in order of importance to the user; the most important goal for the day will appear at the top of the list. When a goal is met, the user can tap on the circle next to the goal. Once marked

as complete, the goal moves to the bottom of the list and appears with a checkmark next to it. The streamlined, open nature of the ScreenAware app design ensures support of all types of phone use and non-use goals that reflect the user's individual values, even goals that are based on time limits (as indicated by the goal not yet completed). Additional features not shown include ways for long-term user engagement, including earning badges for completing goals and tracking goal completion over time.

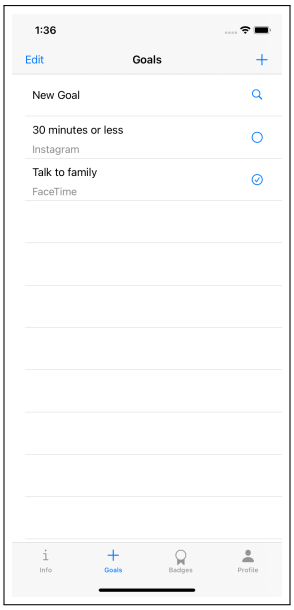

Figure 1: App screenshot

Next, we plan to conduct two in-the-wild studies with the app. The first study will provide us with feedback on the app's usability and its effectiveness in helping the user manage their phone use. The second study will compare the effects of the goal-based approach (using ScreenAware) with the time-based approach (using ScreenTime) on the user's mental health and well-being and their ability to manage their smartphone use.

3.2.1 Limitations of the current app design. When using the current design of the ScreenAware app, users manually add goals, and follow an honor code system to mark the goals as completed. Without app-specific APIs, it is challenging to determine if the user actually completed their goals. However, allowing the user to add and mark goals as complete manually is sufficient as a proof-of-concept for now, since we plan to use this version of the ScreenAware app to compare the effects of a goal-based approach with a time-based approach. After completing the two studies, we plan to extend the ScreenAware app to incorporate data from the phone's in-built sensors to also allow users to account for context of use, such as the activity the user is engaged in and the presence of other people.

4 KEY TAKEAWAYS

The findings from our initial qualitative study indicate that a goal-based approach might be more effective than a time-based restrictive approach in helping people manage their smartphone use with better mental health outcomes. Additionally, a one-size-fits-all solution is very unlikely, since perceptions on healthy and problematic smartphone usage change depending on the context of the use (e.g., the activity they are engaged in) and user goals. Prior work described innovative ways to use the sensors on smartphones to predict users' mental states [7, 14], determine the activity they are engaged in [5, 11] and sense the presence of other people [9, 11, 15]. By incorporating a feedback loop that takes into account a user's context and emotions (such as the apps they are using at the time, the activity they are engaged in, their location, and presence of others), the smartphone could personalize the participant's phone management experience, rewards, and goals. We invite the WellComp community to join our effort in developing such tools for helping the user develop better smartphone habits by helping them achieve personalized goals in relation to smartphone use and non-use and focus on individual values to improve their well-being.

REFERENCES

[1] 2019. Flora. https://flora.appfinca.com
[2] 2020. Paco. http://www.pacoapp.com
[3] 2020. Use Screen Time on your iPhone, iPad, or iPod touch. https://support.apple.com/en-us/HT208982.
[4] Sarah Diefenbach and Kim Borrmann. 2019. The Smartphone as a Pacifier and Its Consequences: Young Adults' Smartphone Usage in Moments of Solitude and Correlations to Self-Reflection. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems* (Glasgow, Scotland Uk) *(CHI '19)*. Association for Computing Machinery, New York, NY, USA, 1–14. https://doi.org/10.1145/3290605.3300536
[5] Arindam Ghosh and Giuseppe Riccardi. 2014. Recognizing Human Activities from Smartphone Sensor Signals. In *Proceedings of the 22nd ACM International Conference on Multimedia* (Orlando, Florida, USA) *(MM '14)*. Association for Computing Machinery, New York, NY, USA, 865–868. https://doi.org/10.1145/2647868.2655034
[6] B. G. Glaser and A. L Strauss. 1967. *The discovery of grounded theory: Strategies for qualitative research.* New York, NY: Aldine.
[7] Yun Huang, Ying Tang, and Yang Wang. 2015. Emotion Map: A Location-Based Mobile Social System for Improving Emotion Awareness and Regulation. In *Conference on Computer Supported Cooperative Work & Social Computing (CSCW)*. ACM. https://doi.org/10.1145/2675133.2675173
[8] Harwood J, Dooley JJ, Scott AJ, and Joiner R. 2014. Constantly connected–The effects of smart-devices on mental health. 34 (2014), 267–272.
[9] Minsam Ko, Chayanin Wong, Sunmin Son, Euigon Jung, Uichin Lee, Seungwoo Choi, Sungho Jo, and Min H. Kim. 2015. Lock N' LoL: Mitigating Smartphone Disturbance in Co-located Social Interactions. In *Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems* (Seoul, Republic of Korea). ACM, 1561–1566. https://doi.org/10.1145/2702613.2732819
[10] Minsam Ko, Subin Yang, Joonwon Lee, Christian Heizmann, Jinyoung Jeong, Uichin Lee, Daehee Shin, Koji Yatani, Junehwa Song, and Kyong-Mee Chung. 2015. NUGU: A Group-Based Intervention App for Improving Self-Regulation of Limiting Smartphone Use. In *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing* (Vancouver, BC, Canada) *(CSCW '15)*. Association for Computing Machinery, New York, NY, USA, 1235–1245. https://doi.org/10.1145/2675133.2675244
[11] Nicholas D. Lane, Mu Lin, Mashfiqui Mohammod, Xiaochao Yang, Hong Lu, Giuseppe Cardone, Shahid Ali, Afsaneh Doryab, Ethan Berke, Andrew T. Campbell, and Tanzeem Choudhury. 2014. BeWell: Sensing Sleep, Physical Activities and Social Interactions to Promote Wellbeing. *Mobile Networks and Applications* 19 (2014), 345–359.
[12] Simone Lanette, Phoebe K. Chua, Gillian Hayes, and Melissa Mazmanian. 2018. How Much is 'Too Much'? The Role of a Smartphone Addiction Narrative in Individuals' Experience of Use. *Proc. ACM Hum.-Comput. Interact.* 2, CSCW, Article 101 (Nov. 2018), 22 pages. https://doi.org/10.1145/3274370
[13] Kai Lukoff, Cissy Yu, Julie Kientz, and Alexis Hiniker. 2018. What Makes Smartphone Use Meaningful or Meaningless? *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.* 2, 1, Article 22 (March 2018), 26 pages. https://doi.org/10.1145/3191754
[14] Abhinav Mehrotra, Fani Tsapeli, Robert Hendley, and Mirco Musolesi. 2017. MyTraces: Investigating Correlation and Causation between Users' Emotional States and Mobile Phone Interaction. In *Interactive, Mobile, Wearable and Ubiquitous Technologies.* https://doi.org/10.1145/3130948
[15] Sanghoo Park, Been Jeon, Jaewon Cho, Byung-Chull Bae, and Jun-Dong Cho. 2015. Experiment on Emotional Exchange Method through Phone Stack Game. In *Proceedings of the 18th ACM Conference Companion on Computer Supported Cooperative Work & Social Computing* (Vancouver, BC, Canada) *(CSCW'15 Companion)*. Association for Computing Machinery, New York, NY, USA, 25–28. https://doi.org/10.1145/2685553.2702677
[16] Aarathi Prasad and Asia Quinones. 2020. Digital Overload Warnings - "The Right Amount of Shame"?. In *Human-Computer Interaction. Human Values and Quality of Life*, Masaaki Kurosu (Ed.). Springer International Publishing, Cham, 117–134.
[17] S. Taylor and R. Bogdan. 1998. *Introduction to qualitative research methods.* New York, NY: Wiley.
[18] Claire A. Wolniewicz, Mojisola F. Tiamiyu, Justin W. Weeks, and Jon D. Elhai. 2018. Problematic smartphone use and relations with negative affect, fear of missing out, and fear of negative and positive evaluation. *Psychiatry Research* 262 (2018), 618 – 623. https://doi.org/10.1016/j.psychres.2017.09.058