"You Can Find a Part of my Life in Every Single App": An Interview Study of What Makes Smartphone Applications Special to Their Users

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ABSTRACT

In the 1979 book "The Meaning of Things" Csikszentmihalyi and Rochberg-Halton studied people's perception of the significance of things in the home. They emphasized how things influence the self, and vice versa. We propose that their method and analytical framework can help to understand the analogous question for smartphones: Why are some apps special to users? Using the framework, we conduct and analyze 60 interviews with people aged 21 to 41; with participants' consent, we made the anonymized transcripts publicly available. The analysis of the interviews shows that participants find apps special because they are convenient, support personal goals and social communication, help them remember, and serve emotional functions. Participants report that their identity is intertwined with certain apps, even if they are annoying or cause dependency. Importantly, we also find that participants actively regulate their use of apps through their organization and particular use strategies.

CCS CONCEPTS

• **Human-centered computing** → **Mobile devices**.

KEYWORDS

Smartphones, user experience, meaning

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1 INTRODUCTION

Since the launch of the iPhone in 2007, smartphones have changed patterns of mobility, communication, and social relationships at all levels of society. In particular, these changes have been driven by the availability of complex and adaptive functionality in the form of applications (or apps). As a result, a growing body of human-computer interaction (HCI) research—and research outside HCI—focuses on the use and adoption of smartphones and apps. This research has shown how smartphones are used and how users experience them. For example, we know that they are often used in bursts [46] and that social situations shape and are shaped by the way phones are used [1, 5, 11]. We also know that smartphones can be a source of meaning [32, 55] and integrate with what people do to such an extent that they are considered part of the self [4].

Fundamentally, research is shaped by the frameworks that are brought to the collection and analysis of data. For example, researchers have studied smartphones based on Belk's theory of extension of the self [4]. According to this framework, people incorporate possessions into their concept of self and form significant psychological and emotional connections with possessions. The framework shapes what researchers ask participants about their smartphones (e.g., "*Using my smartphone is something... 1. I do automatically, 2. I do without having to consciously remember, etc.*" [53]) and how they analyze the data. Smartphone apps have also been seen as sources of meaning [32]. In Lukoff et al. [32], participants were asked "*How much do you feel like you have spent your time on something meaningful*". Thus, the frameworks that drive research on smartphones shape the questions that are asked of participants in empirical studies and the findings that such studies might uncover.

We propose a particular methodological and analytical approach to the study of smartphone apps that Csikszentmihalyi and Rochberg-Halton [16] used in their 1970s study of things people keep at home. They used a semi-structured interview protocol to gather information on what makes things special to participants and what active choices participants have made about things in their home. Csikszentmihalyi and Rochberg-Halton [16] used the results to discuss the mechanisms of how people shape their home, for instance, the tension between the need to differentiate yourself from others while

integrating socially, but also how people can direct their energy and pursuits by organizing their home in a particular manner.

We argue that this approach may advance our understanding of smartphones in three ways. First, it conceptualizes smartphone use as a series of active choices, similar to how a person furnishes a home. This complements frameworks that focus on a snapshot of smartphone use [46] or view users as passive organisms addicted to smartphones [2]. Second, it focuses on the value of smartphones as personally perceived, defined in whatever way participants find important. This offers an alternative to fixed conceptions of the importance of smartphones as meaningful [32] or pacifying [43]. Third, the approach locates the app as the main unit of analysis because that is what people can install, delete, move, and furnish their smartphones with. This avoids the issues surrounding studying smartphone use as an indivisible whole [22].

Based on the work of Csikszentmihalyi and Rochberg-Halton [16], we conducted a large-scale interview study with 60 participants aged 21 to 41 about their smartphones and what makes apps special to them. We recruited participants through the crowdsourcing platform Prolific and interviewed them online using a semi-structured approach. Based on transcribed interviews, we describe the apps that people find special and why. The latter is answered by a thematic analysis that results in five themes, highlighting the use of apps to (i) remember and relive, (ii) stay socially connected, and (iii) create and maintain personal identity. In addition, the themes show (iv) the participants' love-rate relationship with their apps and (v) the crucial role of the active organization of one's apps.

In summary, our contributions are as follows. (1) A methodological approach to studying the use of smartphones, adapted from Csikszentmihalyi and Rochberg-Halton [16]. This includes an interview protocol and a framework for thinking of smartphones as analogous to homes. We discuss how to use this approach for other studies and the benefit of defining special bottom-up. (2) Findings on what makes smartphone applications special to people. The central point here is the active choices made in furnishing one's phone. (3) An open-source qualitative data set comprising the interview protocol and the transcribed interviews of the 60 participants that span about 325,000 words, available at OSF. The interview data can be used to analyze other questions relating to smartphones, as well as to explore analytic approaches besides the one we pursue.

2 RELATED WORK

Smartphones are portable devices that allow people to make phone calls and access the Internet. There exists a vast literature on smartphone use, from micro-interactions to how people feel attached to their phones. Next, we briefly survey the methodological approaches and findings in this literature. Then we use the survey to illustrate how different frameworks result in different methods for studying smartphones and different foci in the analysis.

2.1 Usage Patterns for Smartphones

Numerous studies on smartphones have covered different types of use, and previous studies have focused on describing access times, as well as patterns in how and why smartphones are used. Initially, it was noticed that the use differs greatly between individuals. Falaki et al. [22] presented an early quantitative study of how 255 people engaged with their phones and which applications they used. They found great diversity between individuals; for example, the average number of interactions per day ranged from 10 to 200. Similarly, van Berkel et al. [57] studied the interaction gaps of smartphone users using experience sampling methods and data logging with 17 people. They found that in the majority of cases where users return to their smartphone, for example, after unlocking their phone, participants would begin a new session rather than continue an existing session. In the Human Screenome project on smartphone experiences, Reeves et al. [50] collected screenshots (N > 6 million) every five seconds for several weeks for 132 smartphone users. Screenshots were processed using text and image extraction tools into content-, context-, and temporally-informative "screenomes" to examine individuals' digital experiences. Their analysis highlights extreme heterogeneity between and within individuals in how they switch among content and titrate their engagement.

For smartphone use, habits play an important role. Oulasvirta et al. [46] showed that brief interactions with smartphones, which they called checking behavior, were frequent. Such checking behavior seems to be triggered by a particular context and seems to lead to longer overall engagement with phones. Hiniker et al. [27] used the theory of uses and gratifications to explain that the use of smartphones is made up of instrumental episodes and ritual episodes. The latter comprised in particular news, social media, games, and browsing. Tran et al. [55] cataloged some of the triggers that start what they call compulsive phone use (such as tedious tasks or social awkwardness) and some that help users stop them (such as recycled content or a sense of dissatisfaction).

Other studies of smartphones have shown the role of physical and social context in smartphone usage patterns. Böhmer et al. [5] reported on more than 4,000 smartphone users using a dedicated Android tracking application. Their findings show that news apps are used first in the morning and games mainly at night; communication apps are almost always used first after the device is picked up. Brown et al. [11] collected video from more than 100 days of actual device use. They showed that device use is often social, not only in content but also in how the phone is used with others. Furthermore, Allaby and Shannon [1] studied adolescents' experiences with having and using smartphones and how smartphones influenced their leisure. They found that smartphones were central in the lives of adolescents and were often used to alleviate boredom. Smartphones also offer low-commitment opportunities to interact with friends.

Reactions to notifications on smartphones have been extensively studied. Pielot et al. [47] studied 15 mobile phone users in depth over a week. Participants received more than 60 notifications per day, typically reviewed within minutes. The consequences of notifications to users appear non-negligible. For example, Kushlev et al. [30] found that having notifications turned on was associated with higher levels of inattention and hyperactivity. An important finding is that smartphones are disruptive primarily because users check them, not because they notify users [e.g., 26].

2.2 Qualities of Smartphone Use

Studies of smartphone use have also been concerned with qualities of use, both as experienced by the user (e.g., gratifying uses) and by changed attitudes toward the smartphone (e.g., attachment).

Lukoff et al. [32] studied smartphone meaningfulness involving 45 participants in a two-week study, combining logged app use on the smartphone and experience sampling. They found that users consider productivity and communication with others meaningful, but argued that the unit of analysis is important when trying to understand the meaning of the smartphone because the same app (e.g., Facebook) could be found to be meaningful for communication, while being found meaningless for passively scrolling through content. Tran et al. [55] examined what they refer to as compulsive phone checking. Through a study with 39 participants, their findings highlighted the start and end of compulsive checking triggers, but also when compulsive use was found meaningful. Meaningful use is generally connected to something outside the smartphone, where smartphone use serves as an investment in the user's future or life, such as building relationships with others or personal development.

Addiction is a characteristic that has been extensively studied for smartphone use. This often involves aspects like fear-of-missing-out (FOMO) or no mobile phobia (nomophobia). Aranda and Baig [2] conducted a mixed-method study involving 19 participants, trying to understand the excessive use of smartphones and the desire to disconnect. They found that smartphones are deeply integrated into people's lives and that smartphones have replaced other technologies, say, watches. But they also discovered that smartphones have introduced or accelerated new forms of expectations such as reciprocity in social communication and interaction. Rodríguez-García et al. [51] conducted a literature study on nomophobia for adolescents and university students integrating 42 articles and concluded that smartphone use, and in particular nomophobia, can negatively affect people's health, including lower self-esteem or increased anxiety.

Smartphones have also been shown to be comforting or sometimes pacifying [27, 43]. Melumad and Pham [43] studied the smartphone as a pacifying technology in a large-scale field study and three laboratory experiments and found that in moments of stress, participants were more likely to seek their smartphone. They further found that engaging with one's smartphone provided greater stress relief than engaging in the same activity with, for example, a laptop. Similarly, Diefenbach and Borrmann [17] studied the psychological roles of smartphone use during alone time of young adults (N = 399). They illustrated the pacifying role of smartphone use as a way of coping with negative emotions. Furthermore, they showed that the smartphone would occasionally be perceived as an attachment object, in particular for participants with certain personality dispositions, such as high proneness to boredom.

A final group of work has focused on identity and the extent to which smartphones serve as an extension of the self. This work is inspired by Belk's idea that certain possessions, including technological possessions, are a part of us and extend our identity [4]. When we lose such possessions, or they are destroyed, we consider it an injury to our self. As an example, Ross and Bayer [53] found a two-dimensional structure of self-extension that was about the extent to which the smartphone work to (a) further personal goals and (b) express identity. Marchant and O'Donohoe [36] characterized smartphone users as homo prosthetics, which means that people treat smartphones as extensions of their minds and a part of their selves.

2.3 The Influence of Frameworks

The departure point for the present paper is that the methodological and analytical perspectives used in studies of smartphone use shape their results. For methodology, the most prominent example of how frameworks shape findings can be seen in the questions that participants are asked. For instance, many papers have asked participants directly about the qualities they were interested in, such as meaning [32] and extension of the self [53]. In those cases, the wording of the question obviously influences the data collected. For analysis, the focus of the papers reviewed above also influences their results. If smartphone use is conceptualized as attachment [17] or eudaimonia [40], then the way results are analyzed and reported is shaped by these conceptualizations.

These remarks may be seen as reflecting a fundamental, yet very basic, insight from the philosophy of science. However, we want to argue that the search for new frameworks for how we study smartphones is important to how we build theory. This echoes Feyerabend's idea of theoretical pluralism [48]. His idea is that to maximize our chances of falsifying existing theories (say, in our case, the extension-of-self view of smartphones), we should continuously strive to develop alternative theories. The methodological and analytical approach of Csikszentmihalyi and Rochberg-Halton [16] presented next provides such an alternative to the literature just reviewed.

3 "THE MEANING OF THINGS"

This paper proceeds from the approach used by Csikszentmihalyi and Rochberg-Halton [16] to study the things people have in their homes. Next, we explain their reasoning and why we think their approach would bring a fresh methodological and analytical perspective to the study of smartphones.

3.1 Things Shape People and Vice Versa

The first part of the book of Csikszentmihalyi and Rochberg-Halton [16] explains their assumptions about the role of objects in the home and how objects create meaning for people. They contend that people are fundamentally makers and users of objects. Therefore, a person's self is "to a large extent a reflection of things with which he interacts. Thus, objects also make and use their makers and users" (p. 1).

Moreover, objects reflect what Csikszentmihalyi and Rochberg-Halton [16] called *cultivation*, the "process of investing psychic energy so that one becomes conscious of goals operating within oneself, among and between other persons, and in the environment" (p. 13). Therefore, the choice of objects that surround us helps select what to pay attention to and stabilize what we think about. Ultimately, they help to give meaning not only to ourselves ("who am I?") but also shape our social relationships ("who are you and we?") and our relations to the environment ("what and why is it?").

Csikszentmihalyi and Rochberg-Halton [16] further distinguished the ways in which objects can shape us. Even purely functional objects "serve to socialize a person to a certain habit or way of life and are representative signs of that way of life" (p. 21). Naturally, objects may be signs of status but also of *individual differentiation* as well as *social integration*.

3.2 Focus on "Special" Things

Based on these high-level considerations, Csikszentmihalyi and Rochberg-Halton [16] provided an account of what makes objects special to people. They focused on objects that people have in their home, based on interviews carried out in 1977–78 with members of 82 families living in the Chicago Metropolitan Area (315 interviewees in total, including parents, children, and grandparents). The key question was "What are the things in your home which are special to you?". The interviews also included more general questions about the home (e.g., "Could you describe your home to me, as if I were someone who had never seen it?") as well as open follow-up questions. It was assumed that the answers to the question about "special" were important (p. 56):

> The interviewer used the word 'special' throughout the interview to mean significant, meaningful, highly used, useful, and so on. It is less precise than those other words and therefore imposes on the respondent the task of defining what constitutes the meaning of an object.

Based on the 1694 objects mentioned by participants, the authors did a series of content analyses, resulting in a set of categories for special object (e.g., Furniture, Visual Art, Books, Musical Instruments, Plants, Plates) as well as explanations why those objects were special. For the latter, 37 meaning categories were constructed (grouped into 11 meaning classes). The meaning classes included Self, Immediate Family, Kin, and Non-family, as well as Memories, Associations, Experiences, Intrinsic Qualities, Style, Utilitarian, and Personal Values.

The authors explain in detail how the special objects with which people surrounded themselves reflected their intentions, structured their attention, and thus cultivated their individuality. Objects became special by embodying those intentions and goals that give direction to our self. At the same time, they reinforced those goals. For example, for young people, the object mentioned most frequently was a stereo. By carefully selecting and combining components (speakers, amplifier, turntable, etc.), people can uniquely express themselves in ways that both depict and reinforce their sense of self.

The authors observed age-related differences, where special objects for young people were mostly *action objects* (e.g., a stereo) with practical functions. By adulthood, most special objects were *contemplation objects* (e.g., photographs, art) that derive their meaning from what one has done in the past and how one is connected to other people. Therefore, the study of objects in the home becomes a study of how people create themselves, their social relations, and the relation to the world at large.

3.3 Are Smartphones Similar?

Our idea in the rest of the paper is that this approach—both in terms of the interview method and in data analysis—could bring benefits to the study of smartphones by focusing on apps (rather than the phone in general), their meaning to people described in their terms (rather than derived top-down), and the active creation by users of their digital surroundings (rather than as passive entities).

4 METHODS

Our interview process was inspired by Csikszentmihalyi and Rochberg-Halton [16] and by the general interview guidance and process developed by Kvale [31]. Next, we describe the conceptualization of the interviews, the practicalities of conducting them, and our approach to transcription and analysis. Our interview guide and other materials are available at OSF. The study was granted ethics approval by the Ethics Committee of the first author's institution.

4.1 Conceptualization

Our interviews focus on the smartphone and its significance in the lives of the interviewees. We take 'smartphone' to mean any mobile phone with functionality for connecting to the internet. We consider an app any separate piece of software on smartphones, be it native or downloaded. We consider apps analogous to household objects in the study by Csikszentmihalyi and Rochberg-Halton [16]. Continuing this analogy, people's organization of apps on different screens, folders, and so on might correspond to rooms in Csikszentmihalyi and Rochberg-Halton's study and reflect some intention to structure attention.

This perspective leads to several questions:

4.1.1 Which apps do participants consider 'special'? Following Csikszentmihalyi and Rochberg-Halton [16], we take "special" as a focus. The idea is to depart from an open-ended conception of what users perceive is important about their apps. As discussed in our review of earlier work, there is a plethora of such conceptions, including addiction [2], comforting [43], meaningfulness [32], and eudaimonic value [40]. The focus on "special" aims to derive those categories from data in an open-ended manner, learn about their interrelations, and identify reasons to consider an app special that previous work has not touched upon.

4.1.2 What makes smartphones and the apps on them special? We do not focus on the smartphone's physical appearance, covers, or accessories; this is similar to Csikszentmihalyi and Rochberg-Halton [16]'s focus on the things in the home, not the exterior of the home. Apps might be considered special for many reasons. We follow the conceptualization in Csikszentmihalyi and Rochberg-Halton [16] and inquire about special aspects in relation to oneself, other people (e.g., friends, family), and the world (e.g., work, leisure). Previous work has covered some of these, for example, the symbolic value of technology [44], and the social context of use [19]. A particularly interesting aspect is the equivalent of feeling at home; this is prominent in the study of Csikszentmihalyi and Rochberg-Halton [16]. Interestingly, recent work on smartphones has discussed the feeling of refuge [43] and a device to feel secure when away from your home setting [23]. We are interested in whether these descriptions or related concerns will emerge bottom-up from asking about the relation between the self and apps.

4.1.3 Which active choices have people taken about their apps? In Csikszentmihalyi and Rochberg-Halton [16], objects channel attention (which they often refer to as 'psychic energy') and thereby help support particular goals, intentions, and aspirations. Therefore, the objects people have in their homes reflect, at least in part, people's choices about how to direct their attention and behavior. We look for that choice for smartphone apps too. Thus, we investigate the

active choices people have made in selecting apps, how they use them, and how they organize them. The goal of inquiry differs from a focus of addictive use of smartphones [2] as well as habits in smartphone use [46] by centering intentionality and goals in smartphone use. We focus on active decisions in the content and use of functionality: These decisions may be both about installing and setting up apps and about deciding to use the app.

4.2 Participants

We used the online research platform Prolific to recruit participants for a study on "how people use and feel about their smartphone", and "which apps people think are special and important in their daily life". The recruitment ad highlighted that anonymized interview transcripts would be made openly available to researchers and the public after the study. Whereas Csikszentmihalyi and Rochberg-Halton [16] interviewed both children, parents, and grandparents of the same 82 households, to include age and generational differences in their analysis, a similar sample size was not feasible for our study. Therefore, we focused our recruitment on individuals aged 21 to 41 years and did not include age or generational differences as an explicit focus. This cut-off included common age ranges for 'Millenials', in addition to more mature members of 'Gen Z' [18]. We focus on this age group for two reasons. First, we wanted participants to be frequent users of smartphones and use their phones for many things beyond calling. Second, we wanted to reduce the heterogeneity in the familiarity of participants with smartphones by choosing a relatively narrow range.

We first recruited a pool of 154 potential interviewees, through a prescreening survey (compensated with £0.7) asking for basic information on demographics and smartphone use. For this survey, we set the following inclusion criteria on Prolific: (1) located in the USA, UK, Australia, or Canada (as the interviews would be conducted in English), (2) age between 21 and 41 years, (3) mobile phone owner, and (4) willing to participate in video call interview. From this initial pool of participants, we iteratively invited randomly selected subsets to the interview study.

We chose to conduct a large number of interviews (65)—relatively close to the number of households interviewed by Csikszentmihalyi and Rochberg-Halton [16]—for two reasons. First, the study by Csikszentmihalyi and Rochberg-Halton [16] spanned 82 households. This allowed the authors to explore individual differences, peculiarities in objects that are special, and the interplay between personal characteristics and what is special. Second, while we aim to understand our data in a manner similar to Csikszentmihalyi and Rochberg-Halton [16], multiple other approaches could be applied to the analysis of the data, including concepts of meaning [32, 40], uses and gratifications [27], or self-control [33]. We wanted the data to be sufficiently rich and extensive that these—as well as particular ideas about smartphone use—could be investigated using the open dataset.

Of the 65 interviewed participants, five did not respond to our requests to review and approve their interview transcripts (P12, P17, P30, P39, and P65). We excluded these participants from the analysis, leaving 60 participants in the final data set. In the results section, we refer to participants by the identifier they were assigned at the time of the interview, which is why the numbering of participants in the present paper goes to 64 (or P64).

4.3 Interviewing

Four researchers and research assistants conducted the interviews (each interview was conducted by a single interviewer). The interviews were conducted online using Zoom, between July 2021 and June 2022. An interview lasted on average 39 minutes (SD: 10m 18s, range: 20m to 1hr 2m). Participants received a compensation of £13.40 based on Prolific guidelines, where we originally estimated that an interview would take a maximum of 80 minutes, in which case the participant would receive an hourly rate of £10. The interviews were conducted in English and video recorded.

Our interview guide included a total of 28 questions which we developed based on the interview procedure described in Csikszentmihalyi and Rochberg-Halton [16]'s appendix A and B. The questions covered four themes:

(1) general information about participants' smartphone and its use (e.g., *"Could you please describe your smartphone to me?"* and *"Does anyone else use your smartphone(s)?"*),
(2) organization of apps and screens (e.g., *"How do you organize the apps on your smartphone (e.g., on screens, folders)?"* and *"Why do you organize your apps in these ways?"*),
(3) mood and atmosphere of smartphone and apps, (e.g., *"Are you trying to give your smartphone a certain atmosphere, style or mood?"*),
(4) which apps are considered 'special' and why (the main part of the interview; e.g., *"What are the apps on your smartphone that are special for you?"*, *"Why is this app special for you? Which parts of it make it special?"*, and *"What do all your special apps, taken together as a whole, mean to you?"*).

Immediately after the interview, we saved the recorded interview using Zoom functionality, and the interviewer wrote memos on key observations, open questions, and similarities to other interviews.

4.4 Transcription and Analysis

We used a GDPR-compliant tool[1] to automatically create transcriptions of the interviews. We manually corrected the transcripts against the recording, and anonymized them by replacing information that could identify a participant on its own or combined with other parts (e.g., replacing names and exact geographic locations with generic tokens such as "[participant name]" or "[major UK city]").

We shared the anonymized transcript with each participant for approval. The participants could edit the transcript before deciding to approve it.

After finishing all interviews, the analysis of the interviews was done collaboratively among the four authors of this paper using Thematic Analysis [7–9], while attempting to avoid common pitfalls of thematic analysis in HCI [12]. Thematic analysis is flexible in that it enables a combination of inductive and deductive approaches to developing codes. Although our study and interview conceptualization was based on Csikszentmihalyi and Rochberg-Halton [16], we worked inductively when developing our codes

[1] https://www.konch.ai/

and themes. In the discussion, we will return to Csikszentmihalyi and Rochberg-Halton [16] and reflect on the relation between our results and their work.

Thematic analysis consists of six steps [10]: (1) familiarizing yourself with the data, (2) generating initial codes, (3) searching for themes, (4) reviewing potential themes, (5) defining and naming themes, and (6) producing the report. While collecting interview data, each interviewer did (1) and (2) immediately after each interview; in addition, they took notes about prominent themes, ideas, or tensions in the interview (following the memo approach of grounded theory [13]). Analysis steps (1) to (5) were carried out over 12 months, with frequent meetings among all authors. In these meetings we first discussed in depth a set of six interviews (which all authors coded); the remaining interviews were each coded and discussed by at least two persons. We used the software Delve to support our qualitative analysis.

5 RESULTS

5.1 Participants and their smartphones

Participants were residents of the UK (77%), the US (18%), or Canada (5%). According to Prolific's demographical information on 'simplified ethnicity', 65% of our participants were White, 17% Asian, 8% Black, 8% Mixed, and one participant 'Other'. 55% identified as women, 43% as men, and one participant as non-binary. The average age was 30 years (SD = 5.7, range = 21 to 41 years), and most lived in two- (35%), three- (22%), or four-person households (16%). Most participants were full-time (47%) or part-time employed (22%), or full-time students (14%). In terms of education, most held graduate (22%) or undergraduate (45%) degrees, or had completed high school diploma/A-levels (14%) or technical/community college (10%, Figure 1).

All participants used only one smartphone as their primary phone. A slight majority used an Android (57%), while the rest used an iPhone (43%). 15% of participants (N = 9) had two phones, either because one was a work phone (N = 4), or because they had an older or spare phone (N = 5). Two-thirds of participants never shared their phones with anyone else. The remaining third occasionally let their partner, child, or parent use it. The most frequent self-estimated daily amount of active smartphone use was 4-5 hours (24%), followed by 5-6 hours (19%, see Figure 1)

In interviews, participants commonly said they had their smartphones with them at all times. They described using their phones for a wide range of things, including wake-up alarms, sending emails, participating in video meetings, writing notes or to-do lists, shopping, online banking, social media, texting or calling friends, listening to music and podcasts, watching videos, taking photos, playing games, maps and transportation, looking up information on everything from upcoming movies to the species of nearby plants, and more (*"I guess I probably got an app for every aspect of my life"*, P36).

They typically arranged their apps based on how frequently they were used (78% of participants), or based on which apps they perceived as similar or 'going together' (77%). Thus, participants typically placed more frequently used apps on earlier screens or in the 'dock' at the bottom of the screen, or grouped similar apps in folders, such that they were easier to find.

Participants frequently mentioned that they used their phones mindlessly, especially when they felt bored, and a third mentioned that they felt that they used their phones too much. As we shall return to, 70% of the participants mentioned that they used specific strategies to self-regulate their use of smartphones. This included limiting notifications but also changing the arrangement of apps so that apps that were deemed too distracting were *less* convenient to find.

5.2 What apps are special?

The median number of special apps we spoke with participants about was 4 (interquartile range = 3 to 6, min = 1, max = 13). Almost all participants readily articulated what apps they considered special. Only two participants were reluctant to use the term 'special' about any of their apps. These participants proceeded to tell us about the apps they found most important in their life, and we included those in our coding of 'special apps'.

The categories of apps mentioned are shown in Table 1. Within the 18 categories we coded, participants mentioned a total of 94 different apps (22% of which were pre-installed on either iPhone or Android, such as FaceTime or Google Maps). The three most frequent categories were *Photos* (77% of participants mentioned special apps related to this category), *Messaging & calling* (50%), and *Social media* (37%). Whereas some apps were mentioned by a fair number of participants (the most frequent was *WhatsApp*, which was mentioned by 32% of participants, followed by *Instagram* at 23%, and *Spotify* at 22%), about two-thirds (63 apps) were only mentioned by a single participant. Thus, about half of the participants (53%) mentioned an app that was unique to them, ranging from a privacy-preserving VPN app to the *IMDB* movie app and the *Lightroom* photo editing app.

5.3 Why are apps special?

Table 2 gives an overview of the main categories of codes we developed for *why* an application was special. Our most common codes for why apps were special included capturing or revisiting memories (mentioned by 80% of participants), connecting and communicating with significant others or groups with shared interests (63%), participating in hobbies and other activities that support identity or personal goals (63%), regulating mood and emotional states (60%), and simply making life easier (58%).

Perhaps surprisingly, special apps were not necessarily the ones that participants used frequently or the ones they had used for a long time. For example, P2 kept an app on her phone that no longer worked, but which she found special because it was developed by a friend: *"I kept it just because it reminds me of him, and it's just kind of fun to have it because it's like my friend's app [...] it doesn't even open. But I still have it."* Similarly, P22 had a horoscope app that she downloaded three weeks before the interview, which quickly became special to her because it told her about her personality and she could relate to it.

In the following, we describe the five interconnected themes by which we tried to capture recurrent patterns of meaning around why apps were special. Themes 1-3 were directly constructed from the positive reasons why the apps were special, as summarized in Table 2. Themes 4-5 captured some conflicts that participants

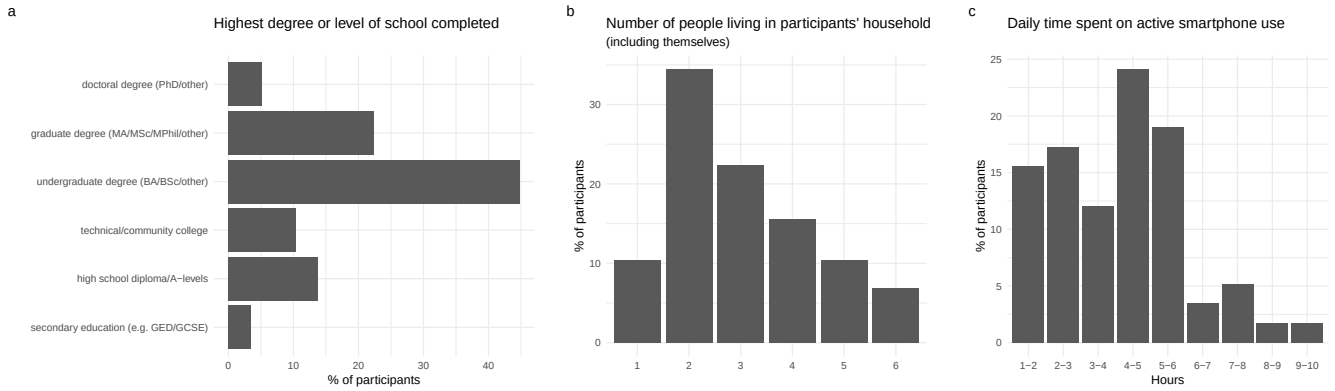

Figure 1: Participants' education level (a), the number of people living in their households (b), and self-assessed daily time spent using their smartphone (*"In the past week, on average, approximately how much time PER DAY have you spent actively using your smartphone?"*), as provided in the screening survey (N = 60).

experienced around their use of special apps and how they actively attempted to manage this by organizing their phone.

The coded text excerpts and marked-up transcripts, which underlie our construction of these themes, are available at OSF.

5.3.1 ***Theme 1: Special apps are used to remember and relive.*** One of the most common reasons why apps were special was that they provided ways to revisit memories from the past (80% of participants). This was expressed primarily in the coded excerpts related to Memories as well as Emotional functions (see Table 2). As P15 explains, when asked what his special apps as a whole mean to him:

> The special app primarily is a timeline of my life, pretty much. So it means quite a lot to me and it's just— its just like, it's good memories [...] when I'm older, if I lose my memory or anything, at least I've got something documented.

Remembering and reliving obviously related to ordinary camera or photo apps, but participants also used purpose-built apps to reminisce about the past. One app, which was mentioned as special by three participants, was *1 Second Every Day*, which encourages users to record a daily one-second video, then stiches those snippets together into a personal movie. Another was *TimeHop*, which P46 used to revisit the past (*"it links to your photos and your Facebook and your Twitter and stuff, and it'll tell you what you were doing on this day [...] I do check that most days, to be honest"*). Similarly, social media apps like *Facebook* were sometimes said to be special because they stored important photographical memories that participants did not keep elsewhere. Remembering and reliving was also a way for messaging apps to be special because they allowed participants to go back over past conversations. Here, P33:

> I don't really delete conversations, so I just have like years of message history with, like, friends, family and, you know, people I have relationships with and group chats as well. So, yeah, sometimes I might actually just go back and read things to kind of reflect on my past.

This included revisiting conversations with friends or relatives who had passed away or with whom participants were otherwise unable to speak. One heart-wrenching example was given by P63, whose partner became brain damaged after a disease. For this participant, *Telegram* was special because it stored key interactions with her partner from before his illness (*"I've got all my chats with him going back for years, which are in Telegram and will be there as long as I've got Telegram. So obviously I want to keep those and they've got lots of photos and voice messages and all sorts of that. So yeah, that would be the most special one I think"*).

A perhaps more surprising example of apps that were found to be special for this reason were traveling and transportation apps. P49 explained how the *FlixBus* app was special to him because it helped him remember past travels:

> I am also kind of almost proud of how many trips, like very long trips I've done with, with buses. And so here is the list of all the trips. You can see all the trips that you have done with FlixBus, right? And there are a lot. [...] So in a sense, it's a kind of memory app about trips that I've done in the past.

As hinted at in this quote, one of the reasons that going over the past made apps special was that it served valued emotional functions. This was typically related to feeling positive emotions and relieving stress and worry by reliving good memories. For example, the ability to make voice recordings was special to P1, who explained that *"I have some random recordings that sometimes you come across and this makes you happy. Like I have this one recording of my husband reciting the numbers in Hindi and you come across, it just makes you smile. So that's really special"*. Quotes such as these relate to the Emotional functions mentioned in Table 2.

Even without engaging with any of its functionality, apps could be found special for reasons due to memory. For example, P57 kept the dating application through which they met their partner, and P1 kept a transportation app from their hometown:

> It's like a piece of home for me. There is nothing else that can replace it. Like, I will... When I check that app and I see it, it reminds me of home. Every time

App category	% of participants	Examples of specific apps mentioned
Photos	77 (n=46)	Android's Gallery app, Apple Photos, Google Photos, TimeHop
Messaging & calling	50 (n=30)	WhatsApp, FB Messenger, Snapchat, Email, iMessage/Facetime
Social media	37 (n=22)	Instagram, Facebook, Twitter, TikTok, Discord
Music	25 (n=15)	Spotify, Apple Music
Productivity	25 (n=15)	Notes, Calendar
Video watching & recording	20 (n=12)	YouTube, One Second Everyday, Vine, Cinema HD
Lifestyle	18 (n=11)	Shopping (Amazon, Depop, Target), Deliveroo, dating (Tinder, Bumble), Fabulous (habit-formation), Zoopla (housing), pedometer widget
Banking & investing	17 (n=10)	Discover, Monzo, Robinhood, Coinbase, Freetrade
Info & reference	17 (n=10)	Book catalogs/trackers (Goodreads, Handy Library), Reddit, Pinterest, IMDB, app to identify plant species
Utilities	17 (n=10)	Voice recording, web browser, contacts, settings, screen recording, VPN, RSS feed, document scanner
Games	13 (n=8)	Pokemon Go, Animal Crossing, Candy Crush, June's Journey, Sudoku app
Travelling & transport	10 (n=6)	Google Maps, InfoPrior, Places Been, Waze, Bike rental app, FlixBus
Learning and development	8 (n=5)	Duolingo, Podcasts, BBC Sounds, Ankidroid (flash card study)
Workout	8 (n=5)	Nike Run Club, MapMyRun, MyFitnessPal, Fitnotes
E-readers	3 (n=2)	Kindle, Medium, Comixology (comic books)
Health	3 (n=2)	Patient Access, NHS
Creativity	3 (n=2)	Lightroom, Paint-the-Numbers
Micro-income	3 (n=2)	Google Rewards, Meerkat, Missed Play

Table 1: Categories of apps mentioned as 'special'. Apps that are pre-installed are underlined (YouTube and Google Maps are half-underlined as they are usually pre-installed on Android, but not on iPhone).

> I see it, it reminds me of home. I don't think there's anything else I can replace it with.

In these cases, the applications themselves do not actually do anything practical for the participants; instead, they carry memories and help connect with the past.

5.3.2 ***Theme 2: Special apps are used to stay socially connected and be part of a community.*** Thirty-eight out of 60 participants (63%) mentioned apps that they found special because they allowed them to connect or communicate with other people; this relates to the code Communication/Social in Table 2. Participants mentioned that apps could be special not only because they connected them with people they know, but also when they connected with communities of people with shared interests that they would never meet in real life (*"ones that connect you with, like your friends and family and things like that, or just to humans in general, it's like like-minded interests and that sort of stuff. Those are the things that are special"*, P35; "*that was a music community that would serve like a songwriting challenge and where you could work with other musicians. So, I was into that for a while*", P48 about the *Discord* app).

Some participants described messaging apps as special because they allowed them to stay socially connected despite geographical distance, or pandemic-related lockdowns. For example, P35 "*started using WhatsApp because I was studying abroad in England*", and P52 described how *Facetime* had become special to her *"since, sort of, lockdown and COVID-19 and everything happened"*. Similarly, apps could be special because they helped maintain past relationships. For example, P22 stated that social media apps made it possible for her to stay in touch with people that she would not see that often ("*my social media app, that is like connections and being able to connect with people, whether it's from my high school or college or before I moved states...*").

The specific apps used for social connectivity often changed over time. Therefore, 17 participants (28%) mentioned social or messaging apps that used to be special to them, but no longer were. Some apps appear and replace old ones simply because of "*the passage of time and new technology coming out so, Skype that I mentioned, obviously WhatsApp coming and even before Skype there was something called Nimbers Nimbuzz*" (P45). In other cases, the apps considered appropriate to use changed with age ("*I had Snapchat when I was younger, but then that, kind of, I feel like when you reach a certain age Snapchat is not cool anymore (laughs)*", P60). Alternatively, participants would outgrow communication apps by lacking time to use them: "*I still have Snapchat and I haven't replaced it. It's still there. It's just that I am not in the habit of posting stuff anymore or even checking up. It's just been, I don't know, a different life really, job hunting and working. And I just don't have enough time*" (P01).

5.3.3 ***Theme 3: Special apps are used to create and maintain personal identity.*** Participants often found the apps special because they supported their *personal interests, goals, or hobbies* (63% of participants). This could be reading, watching movies, keeping up with football, photography, second-hand clothing, or software development. In particular, special apps facilitated activities that were important to participants' life goals. For example, P3 explained why a financial savings app was special to him:

> I guess it's special because I want to... I don't know, accumulating wealth is kind of a, you know, a priority to me. You know, saving for retirement, stuff like that. So stuff like that's always on my mind.

By supporting such activities, special apps became intimately connected with participants' self-image, because they reflected the personally valued activities that made up their lives. As P9 explains:

Code category	% of participants	Explanation	Example quotes
Memories	80 (n=48)	Allows capturing and/or revisiting memories about past events.	*"Google Photos because it has all my memories and photos in it"* (P29); *"1 Second Every Day is nice when you just have a little snippet of what you did that day. So just keep your memories together in one place"* (P21)
Communication / social	63 (n=38)	Enables connection with significant others or groups with which one shares interests.	*"Ones that connect you with, like your friends and family and things like that, or just to humans in general, it's like-minded interests and that sort of stuff"* (P35)
Supports or reflects personal identity/goals	63 (n=38)	Facilitates hobbies and activities important for one's self-understanding or life goals.	*"They're an extension of stuff that I do or stuff that I want or stuff that I think. They are part of me, like most apps that I like and still use"* (P10); *"I really like goal-orientated things and to be able to be like 'I wanna read this many books this year'"* (P60)
Emotional functions	60 (n=36)	Helps regulate mood, emotional, or motivational states.	*This one tells you how the beach, how full or empty the beaches are [...] It makes me feel happy thinking I have that on my phone* (P31); *"iPhotos [...] if I was feeling sad or bored of anything then looking through that is quite special"* (P64)
Convenience	58 (n=35)	Makes life easier or more flexible.	*"It can be easier to get together with friends, because you can, you know, quickly say you wanna meet up here"* (P35); *"They make my life much more portable. I feel like I can do anything from anywhere"* (P31)
Practical importance	50 (n=30)	Holds important or necessary information or functionality for carrying out daily tasks.	*"I rarely delete text messages and stuff like that because I have so much info on there that I'm going to need"* (P03); *"[name of bank] I don't even have like a physical card [...] I don't even know how to access my [name of bank] account unless it's on my phone"* (P16)
Information and learning	25 (n=15)	Allows sharing or looking up/learning new information.	*"You could sort of find anything you need, kind of, within these apps like Instagram, you know, if you're looking for like a recipe for something"* (P52); *"if I'm having a walk, and I see like a tree or a plant that I like and I don't know what it is I would use it to, to, to know which plant it is"* (P49)
Source of income	18 (n=11)	Allows the user to make money.	*"I sell on Amazon, and it's basically my seller account tells me how much I've sold that day, how much inventory I have left and like advertising things like that. So I can do all of that on that app if I need to"* (P26); *"To put it bluntly, it's my favorite app to make money"* (P37)
Other	28 (n=17)	Various other reasons including privacy, personal freedom, anti-distraction, and self-logging.	*"It's very private and transparent and doesn't follow you around really. So yeah, I like it. It does everything that WhatsApp does, basically, but better. And not owned by Facebook"* (P63)

Table 2: Main categories of codes developed to capture participants' reasons why apps are special (N = 60).

> It is something that's basically my whole life. Because I feel like you can find a part of my life in, a little bit, in every single app. Like, my bank account have something about my life. My photos, basically my memories. [...] If you try to combine every single app I have on my iPhone it's basically just me.

In addition to simply *reflecting* personal identity, special apps also helped participants create and maintain it. Thus, participants mentioned that special apps *"keeps me on track"* (P10) or were used for *"personal growth"* (P38). Similarly, participants mentioned that deleting or stopping to use an app sometimes reflected active choices about how apps could help or hinder them become the person they wanted to be.

For example, P13 explained that

> Me deleting Facebook, for example, and going on Instagram less and downloading like business apps rather than using my phone for social media and the personal things. I feel like that was just kind of me maturing as a person.

Another participant explained how he stopped using dating apps because *"I guess my values have changed a bit as I've gotten older"*. The intertwining of apps and identity was also expressed by a handful of participants who described how deleting an app could be a way to dissociate themselves from a previous state of being. For example, P45 deleted *Tumblr* because of its strong associations with a negative period in his life:

> I gave it up because I used that when I was not so happy. So I had written a load of like, really depressing things, and I didn't want to be reminded of it, so I just deleted it. I was like, I don't want this. I don't want to be associated with this. I don't wanna be able to see it. I don't want other people be able to see it. So I just got rid of it completely.

Finally, participants also described how special apps helped them maintain a particular identity in social interactions. For example, P38 described how his special app *Fotmob* — with which he follows live football scores — helps him connect with other football lovers, while also enabling him to stand out as someone with special football knowledge (*"I would show them something which they don't know, which I have access to and they maybe haven't had access to it before me"*). Similarly, P24 described how her special app *Goodreads* allowed to maintain her identity as an avid reader both to herself and others:

> I've always been a really quick reader. So, like this year I think I've read like 24 books already in three months, and I think it makes me feel good because if I if I told someone I read 24 books this year, they're like 'wow okay that's a lot' (laughs)

Somewhat surprisingly, similar use of social media apps to 'show off' a desirable identity to others was mentioned only by four participants. For instance, P62 mentioned in relation to *Instagram "I guess you could say that when someone wants to look at my profile, they would think, oh my God, this guy has such an exotic travelling lifestyle"*.

5.3.4 ***Theme 4: People can have a "love-hate relationship" with special apps.*** In many cases, special apps were associated with positive emotions. However, participants also articulated surprisingly complicated relationship with special apps (23% of participants — not shown in Table 2 as it was not a reason for why an app was special, but something that apps could be special *in spite of*).

First, participants could find apps special even if they did not work reliably or had poor usability. P56, for instance, noted about his special bike rental app that "*it's a mix of that, you know, anxiety that it will not work properly and a positive feeling of what I'm using it for*". And P27 said that his special app *Fitnotes* was *"really, really ugly"* even it if "*serves its purpose*" of tracking his workouts and activities.

Second, some participants felt uneasy about how important their special apps, and their smartphones in general, were in their lives. P53 expressed it as follows: *"A lot of the things that used to be done with just like a notebook or something are now done on our smartphones, and I'm always sort of wondering what would happen if, you know, my account got locked or lost or somehow I would lose access to it, which did happen before"*. Thus, the embedding and integration of special apps in their daily lives for, for example, supporting relationships, seeking information, or wayfinding made some experience a troublesome dependency ("*like you couldn't imagine a day going with you having access to them*", P1; "*I think it's scary how dependent we've become on these apps*", P48).

Third, several participants who said social media or gaming apps were special, also felt that there was a worrying addictive nature to these apps, and that they wasted a lot of time with them, despite the value they provided. P44 expressed it as follows:

> Social media apps like Instagram and Facebook where I, like, I don't know if I…I don't know, it's like a love-hate relationship with them. Like, they help me feel connected sometimes or, like, help me know what's going on or, like, keep me up to date with other people's lives. But also it's essentially such a waste of time. And, like, everything that you're viewing on these apps is pointless, so I don't know. I'd probably be better off without them, actually, but I can't bring myself to delete them because then I feel like I'm missing out.

P14 described a similar relationship with *Instagram*, which she had sometimes completely deleted from her phone because she worried about its effects on her mental health. She felt that her use of *Instagram "was almost like kind of an addiction"*, and was now very actively trying to curate who she followed and what kind of content she posted to make its overall impact on her mental health positive. Another example was provided by P53, who worried about her use of games, which she would often find herself open at any moment of downtime and lose track of time. Despite this, games were very special to her, partly because she had a *"group of other players I play with in like a club"*.

5.3.5 ***Theme 5: The active organization of one's phone shapes the use of special apps.*** Participants made active choices around the organization of apps on their phone, including their special apps, to facilitate intended use. One common concern was simply to make it convenient to get to the apps they needed, for example, by placing frequently used apps on earlier screens. This mirrored rationales around the choice of phone, where performance when opening and using apps was important. However, some participants' organization also reflected careful consideration of how their app arrangement affected their attention and behavior.

First, if participants felt that they overused an app, they sometimes deliberately placed it on infrequently used screens on their smartphone, where it was less convenient to find and open (15% of participants). For example, P60 included her special apps *Spotify* and *Goodreads* on the first screen. Her special app *Instagram*, however, she had a complicated relationship with (and actively tried to limit her use), and so she chose to place it in a folder on her second screen. In this way, app organization served an anti-distraction function similar to muting notifications or putting the phone on 'do not disturb' (which was mentioned by 33% of participants).

Second, many participants (42%) tried to keep their app layout minimalistic and uncluttered. Although this partly helped them find the apps they needed, making their phones more convenient to use, it also served the purpose of not getting overwhelmed. Thus, participants often arranged apps according to the assumption that 'a calm phone is a calm mind'. As P38 explained:

> I organize it in a very nice manner because it gives my mind more peace of mind. If it is all jumbled and all over the place, I believe that it can have a mental impact on my— it might make me feel a bit— messy in my head.

Consequently, some participants said that they would revisit their app arrangement when it felt too cluttered, and reorganize or delete unused apps (*"every few weeks or couple of months when I've downloaded more apps or don't use as many apps anymore, I'll go back and try and figure out how to make my phone a little less overwhelming"*, P20).

Third, the preferred app arrangement was not necessarily as minimalistic as possible. P47 found that *"if I do group them all together, it's going to make me [have] the urge to get more applications on my phone because then my phone starts to feel a little bit empty"*. Similarly, P38 used to have a very dull background in all black and white, in order to avoid becoming 'addicted'. However, this negatively affected his mood, so he changed to an upbeat background image of a mountain road.

Many participants also pointed out that their preferred arrangements reflected their general personality or style (28%; e.g., *"I think I'm just like that with everything [organized and clean]. And so I think it carries over from my normal life onto my phone"*, P06). P49 pointed out that his organization of apps by color mirrored the way he organized books on a bookshelf, and others replicated the layout of their old phone on their new phone, even when switching from an Android to iOS device. Thus, when arranging their phones to facilitate intended use, participants balanced being uncluttered with being aesthetically pleasing or stimulating, according to their personal preferences.

Fourth, a counter force was that participants found it tedious to organize apps (*"it takes too much work, and I don't have the patience"*, P22). Thus, 28% percent of participants said they rarely changed their organization and many only bothered to arrange their most frequently used apps while leaving the rest untouched. Moreover, as participants got used to their apps being arranged in a particular way, they often stuck with this arrangement to avoid having to acquire new habits:

> I would revert back to how it was. Like, sometimes I'll try to put the social media apps on the second page, but then it kind of is a little frustrating for me just because I'm used— when I'm used to something being in a certain spot on my phone, it's like having to retrain myself to remember the new placement (P47)

This friction in organization due to the effort required and habit formation interacted with design decisions by developers around system procedures and default settings. For example, P10 explained that on their Samsung smartphone, every time an app was updated, it was automatically placed in the last available slot on the screen. This meant that whenever P10 organized their apps, they eventually got scattered all over again, significantly increasing the effort involved in organization. Some participants also had apps prominently located that were built-in apps that they never used, but were unable to delete. However, because they had not moved them to other screens early on, they had now gotten used to their location and felt like they were stuck with them where they were (*"if I move things now, it'll be a little harder for me to find things."*, P25).

Finally, the organization of apps in folders was sometimes made more convenient—but also influenced by—automatic naming suggestions by the operating system (*"when I put like apps together, it would automatically write the folder category for me. Most of the time I kept the name that they wrote for me"*, P20).

6 DISCUSSION

In this paper, we have adapted a methodological and analytical approach from the work of Csikszentmihalyi and Rochberg-Halton [16] to study what makes smartphone apps special. Through a large-scale interview study with 60 participants, we identified what types of apps participants find special and why. Some of the 94 special apps were common, with the most frequent special app, *WhatsApp*, being mentioned by 32% of the participants. However, there was a large variation in the specific apps that were found special, as two-thirds of the apps were mentioned by only a single participant, and a bit more than half of the participants mentioned apps that were unique to them. Apps became special by allowing our participants to remember and relive memories, communicate and connect with significant others or groups of people with whom they shared interests, or conveniently carry out tasks of personal interest. Through these routes, special apps helped participants achieve personally important goals and create and maintain their personal identity. Importantly, apps could be considered special even if they were unreliable, poorly designed, or addictive. By actively organizing apps on their smartphones, participants help themselves to make the most of their special apps.

We have argued that Csikszentmihalyi and Rochberg-Halton [16] could form a useful alternative to the frameworks for studying the use of smartphones that were outlined in the related work section. At the concrete level, we find that the use of Csikszentmihalyi and Rochberg-Halton [16] has surprised us in five ways.

- Apps cover all aspects of the lives of the participants, and all aspects of participants' lives are covered by apps. Thus, as suggested in the title of this paper, it is possible to "find a part of my life in every single app". The extent of the intertwining of life and smartphones is surprising.
- Apps that are special to participants are often unique to them; the distribution of special apps has a very long tail. This, as well as the concrete apps that participants talk about, suggests that the uses to which people put apps and the needs they fulfill vary surprisingly much.
- Some concrete uses of the apps surprised us, even though they reflected well-known findings about smartphones. We did not imagine that a participant would keep a useless app, delete an application to bid farewell to an old part of their identity, or use a bus app to ponder past travels.
- Photo apps, and their ability to help people capture and revisit memories are the killer app when we ask people about special apps; it is not social media or messaging apps.
- Active choices shape how participants use the apps. The apps can help people become the person they want to be; this happens not only through the content of the app, but also through how it is used and embedded in the organization of participants' phones.

At a more principled level, the framework has provided three benefits. First, it emphasizes that smartphone users are engaged in the *active* construction of their digital environment. It centers on choices, agency, and developments over time. This contrasts with ideas about smartphone addiction and the study of snapshots of use. This, of course, does not dictate the finding of active construction in the data. It merely centers it and offers a set of concepts (like differentiation or contemplation, see the following sections) that help analyze it. The framework still relies on semi-structured interviews and thematic analysis. Second, the focus on special has

allowed us to identify bottom-up the reason people care about apps. Several of the surprises just listed come from this open approach, because it allows the identification of idiosyncratic apps and the reasons they are special, which has not been the focus of top-down frameworks. The specific questions developed from the framework (see Section 4.3) are central to eliciting what special means to the respondents. Third, as with furniture, the app has been targeted as the unit of analysis. Being able to identify the long-tail of apps and the individual cases of particular uses of apps is a consequence of this unit of analysis. This is in our opinion a step forward compared to smartphone-wide analyses.

Next, we will discuss the results in more depth before turning to limitations and future work.

6.1 Creating and maintaining the self with apps

As we laid out in Section 3.1., one of the central claims by Csikszentmihalyi and Rochberg-Halton [16] is that our self is co-created by the things with which we interact. In particular, the objects with which we surround ourselves reflect not only our relationship with ourselves and others, but also actively structure our attention and cultivate us to a certain way of life.

These relationships with special objects, that Csikszentmihalyi and Rochberg-Halton [16] extensively described in relation to things in the home, were evident in our interview data. First, the most frequent reason that apps were special was that they allowed people to keep memories and reflect on their personal history. Indeed, when asked what their special apps meant to them, many participants described that their apps were like parts of themselves, a digital instantiation of their personal timeline, their daily activities, and the things that mattered to them. Some participants even claimed that all the apps on their smartphones have meaning to them, otherwise they would have deleted them. Csikszentmihalyi and Rochberg-Halton [16] described how people had *contemplative objects* in their homes, which derived their meaning from what one has done in the past and how one is connected to other people. Similarly, the memory-related reasons people gave for why photo apps, or purpose-built reminiscence applications such as *1 Second Every Day*, could similarly be understood as *contemplative apps*. Even apps normally used actively, such as messaging or transportation apps, were sometimes used contemplatively in this manner.

Second, it was clear that special apps were used to actively create oneself. This was achieved through the support of apps for personal projects, hobbies, and lifestyles, from workout apps to finance apps. Apps also supported more social aspects of the self, in relation to how we differentiate ourselves as individuals and realize ourselves among and within others (what Csikszentmihalyi and Rochberg-Halton [16] called 'integration'). Therefore, the second most common reason for apps to be special was that they allowed people to connect with significant others or groups of like-minded people. *Reddit* provided interesting examples of how this aspect allowed apps to be special, with some participants explaining that *Reddit* allowed them to find a community to be part of, no matter how niche their interests are, while simultaneously supporting social integration and individual differentiation.

Third, Csikszentmihalyi and Rochberg-Halton [16] also claimed that not only do people shape objects, but objects also shape their users. In our data, participants often reflected on how apps could have a negative influence on them, for example, by being addictive or because things on social media did not represent reality and therefore could make them feel bad about their lives. Therefore, they developed strategies to regulate the use of such apps so that they do not become who they do not want to be. Participants could hide or even give up some apps to avoid being shaped by them. In Csikszentmihalyi and Rochberg-Halton [16]'s terminology, such behavior reflects cultivation, which includes an active process of self-control, as we discuss further in the next section. Similar perspectives have been raised in the HCI literature. Zimmerman [59], for instance, wrote about product attachment and becoming the person you desire to be through using and interacting with technology. Both Csikszentmihalyi and Rochberg-Halton [16] and Zimmerman [59] mention how people invest attention through repeated use and engagement in activities to achieve product attachment in deliberate ways.

It is worth noting that smartphones come with pre-installed apps and that quite a number of these are considered special (see Table 1, about 22 %). In particular, the photo apps that participants consider special all come pre-installed. On the one hand, this suggests a challenge to the idea that participants actively furnish the smartphone as they furnish their homes. On the other hand, Section 5.3.1 showed that the use of apps to remember and relive is based on the participants' choices about the content they store in them, the purpose of using the apps, and their rituals to remember and relive the stored memories. Thus, even for preinstalled apps, participants develop a purposeful use of them that is not dictated by the fact that they are preinstalled.

6.2 Shaping the influence of special apps by arranging the digital environment

Our fourth and fifth themes unpacked how participants could have a complicated relationship with special apps, and how active arrangement of one's apps could help create intended flows of attention and behavior. Thus, even within an app, participants might attempt to organize their environments (e.g., by following or unfollowing accounts); they might place overused apps in folders where they would be less frequently seen (or simply delete them); and they might use personal background images to remind themselves of loved ones.

Csikszentmihalyi and Rochberg-Halton [16] suggested that people could inadvertently become slaves to their personal objects if they *"attract our attention excessively"* (p.53). This was echoed by some of our participants' concerns that special apps, in particular social games, could waste their time and make them feel unable to control their behavior. In fact, the idea that *"household objects are chosen and could be freely discarded if they produced too much conflict within the self"* [16, p.17] was more clearly demonstrated in our data than in the interviews by Csikszentmihalyi and Rochberg-Halton [16]. For example, Csikszentmihalyi and Rochberg-Halton [16]'s participants would sometimes find their TV set special, yet describe a love-hate or addictive relationship, similar to some of our participants' remarks about *Instagram*. However, Csikszentmihalyi and Rochberg-Halton [16] did not provide any descriptions of participants who, for example, made it less convenient to use their TV

by hiding it in a closet. By contrast, active decision-making around the relative prominence of different apps, and other strategies of regulating use were readily available in our data, perhaps reflecting a lower barrier for changing arrangements of the digital space compared to the physical.

Either way, we believe that the lens of Csikszentmihalyi and Rochberg-Halton [16], and viewing the smartphone as analogous to an actively constructed home, can be valuable to ongoing research on 'problematic use' [21], 'digital wellbeing' [14], and 'digital self-control' [34]. For example, existing work on 'Problematic Facebook Use' has tended to view people as passive subjects that may or may not find themselves using the platform in ways detrimental to their personal wellbeing, simply mediated by differences in personality traits [15, 37, 38]. Insufficient attention has been paid to how users make active choices around placing social media app icons more or less prominently in their digital ecology, or even how they can use tools such as browser extensions to alter their flows of attention within the apps they use [35, 58]. The lens and findings presented in the present paper suggest that this may be a fruitful avenue for future work.

6.3 Qualities of Smartphone Use

Much literature has focused on a priori defined qualities of smartphone use, including addiction [2], comfort [43], meaningfulness [32], and eudaimonic value [40]. One of the objectives of the present study was to understand what quality means when defined from the bottom up. Although done previously for usability [39], we are unaware of efforts to characterize quality with this many participants and this rich interview data. We treat the responses to why an app is special as indicators of the qualities of use. Our data provide three main insights in this regard.

First, our results show that special applications are not necessarily good in the sense of being usable, aesthetic, or pleasant. This is similar to findings that interesting games need not be associated with only positive emotions [6] and that long-term importance and meaningfulness are not correlated with negative affect [40]. It reinforces that the quality of smartphones, and interactive technology in general, is multidimensional, and that important determinants thereof are about quality that only emerges over time.

Second, an app might be special because it fulfills psychological needs. From this premise, a couple of findings stand out in terms of what constitutes smartphone quality. Money–luxury is on the list of needs from Sheldon et al. [54] that have inspired much research on user experience [e.g., 24]. However, it has sometimes been left out in user experience research. We find that it seems to play a role (see Table 2, row "Source of Income"). At the same time, we find that the need of Popularity–Influence is less clearly reflected in the reasons summarized in Table 2 than earlier work had led us to expect.

Third, meaning is mentioned by several participants, is listed in the title of the book on which this study is based, and has been the topic of a great deal of prior work [e.g., 32, 41]. For instance, Lukoff et al. [32] found that users associate productivity and communication with others as meaningful, but they also argued that the unit of analysis is important when trying to understand the meaning of the smartphone, as the same app (e.g., Facebook) could be found to be meaningful for communication, while being found meaningless for passive scrolling through content. Our unit of analysis was apps rather than smartphones, and while communication was present in our findings through messaging apps often being mentioned as special, we observed less focus on special apps and productivity. In fact, several special apps were even considered non-productive but served emotional purposes of the participants.

6.4 Future Work

A central idea in making the data from this paper publicly available is to facilitate the empirical exploration of other questions about smartphones at low cost, and to allow theories different from that of Csikszentmihalyi and Rochberg-Halton [16] to be used to analyze the data. For the other empirical questions to be looked at, we consider three good starting points. First, the data set includes 34 participants with an Android smartphone and 26 participants with an iPhone. The platforms offer different functionality (e.g., for interaction and organization of screens), and some apps are platform-dependent. In addition, some participants stated that they had been sticking to the same platform for many years, while others had switched platforms. We would be curious to see an analysis of how platform matters. Second, we would be interested in analyzing the interviews with natural-language-processing techniques used in earlier work on machine-learning on narratives about interactive products [e.g., 25, 56]. The interviews contain a sufficient number of words to be amenable to such analysis, for instance, of the role of social language around apps or the aspects of usability mentioned. Third, about 22% of the apps were preinstalled. In the present paper, we did not analyze the differences between these apps and the apps that participants pick themselves. Thus, future work should investigate the difference between the roles played by preinstalled and actively chosen apps, as well as differences in how people adapt them to fit the purposes to which they put the apps.

Regarding different theories as the basis for analysis, we believe firmly in the utility of a plurality of theories, sometimes called theoretical ecumenism [52]. As a consequence, we find the application of different theories to the same data set to be inherently valuable, even if such comparisons are rare in HCI (but see Baumer and Tomlinson [3]). In future work, we would be especially interested in seeing applications and comparisons of theories on dual systems [34], attachment [23], and meaning [32, 41]. Each of them touches on key aspects of smartphone use that can be answered by the questions we asked. Such comparisons might be set up as adversarial collaboration [42]. We also would like to see an application of the uses and gratifications framework [29] to these data. Although not a theory in itself, it would provide an alternative way of identifying *why* apps gratify people. Finally, Ross and Bayer [53] argued that "the psychology of smartphone self-extension has received relatively little attention through empirical research". We believe that our data offer a unique possibility for researchers to compare different models of self-extension empirically. For instance, Ross and Bayer [53] found two dimensions of self-extension while Belk [4] offered five ways that digital media might extend the self. Our data could help compare these models.

One important part of the present paper is its methodology. The basis of the method is the semi-structured interview and thematic

analysis. Yet, we have argued that it differs from other approaches (also those using interviews and some form of inductive data analysis) to studying the use of smartphones in two ways. First, it creates a structure for interviews by identifying special apps as the unit of analysis. This unit of analysis is associated with a set of questions that seek to elicit the reasons why an app is special. Second, the methodology we used departs from a conception of the home as a site of active construction of one's psychic energy and, therefore, one's self. We would be happy to see this methodology used in other settings; the available interview questions, as well as the fully available example of a thematic analysis, should facilitate this.

6.5 Limitations

As with all empirical work, this paper is shaped by its methodology and contains inherent limitations. First, the responses to the question on which apps are special might show social desirability bias, in that some apps might not be mentioned (e.g., dating apps) or some justifications for why an app is special not articulated (e.g., that it lets you 'show off' socially). In the home, the objects to be discussed are often visible. On the smartphone, participants have more opportunities to avoid talking about something.

It is difficult to be definitive about the extent of such bias. Consider, for example, dating apps. Table 1 suggests that they are not reported as special. If this is true, one reason could be social desirability bias. Participants would not mention dating apps because such apps conflict with what society considers good behavior. However, participants mentioned that they had used dating apps but stopped using them (P62) and one participant mentioned a dating app they kept on their phone but stopped using because they met their partner on it (P57). Another explanation is simply that dating apps, while widely used, are not specific to participants. An early survey of happiness with apps suggested that dating apps make users unhappy[2]. This survey suggests that dating apps may not be perceived as special. These explanations need to be explored further using another method than interviews, for instance, using surveys.

Second, we did not ask the participants to define what they think the word "special" means, only to select the apps they found special and explain why to us. This is in line with Csikszentmihalyi and Rochberg-Halton [16], but sidesteps the problem of misunderstandings or odd interpretations that participants might have formed about the word special. Follow-up work should explicitly investigate participants' interpretations.

Third, we settled on the app as the unit of analysis, again following Csikszentmihalyi and Rochberg-Halton [16]. Methodologically, this is a step forward from looking at the smartphone as a whole because apps may be used in many ways for different things [28, 49]. However, we wished to have been able to disentangle social and communication uses of social media, as well as have better data on which parts of apps were used.

Fourth, interviews were conducted from July 2021 to June 2022, while the Covid-19 pandemic was still ongoing. Global communication patterns, including smartphone use, appear to have changed dramatically during that period [45]. Eighteen participants mentioned that the pandemic had shaped their use of apps or smartphones in some way, and for some participants, apps became special due to the Covid outbreak (e.g., *FaceTime* for P52 or *FlixBus* for P49). It is not clear how strongly this affects our results.

Fifth, we focused on participants aged 21 to 41 to ensure that participants used smartphones extensively and to limit the heterogeneity of use patterns. Thus, it remains unclear how our findings generalize to older and younger people.

Sixth, participants were recruited through Prolific. As with all crowdsourcing platforms, this raises questions about data quality. Recent work suggests that participants on Prolific are more likely to remember the information presented, pass attention checks, and have a unique IP address compared to platforms like MTurk [20]. In our case, we surveyed participants and were unaware of any studies on this use of platforms like Prolific. However, in our experience (and as evidenced by the transcripts), the participants were interested in the interview and provided what appeared to be honest and informative responses.

7 CONCLUSION

It continues to be a challenge to understand how the smartphone has changed communication and social life. To remedy this, we have adapted an approach originally designed to study objects in the home to the study of smartphones. The approach focuses on empirical data about the apps on people's smartphones that they find special. In particular, these data center the active choices made in furnishing one's phone. In addition, we have outlined a methodological approach to studying the use of smartphones and shared a qualitative data set that can be used to further analyze other questions related to smartphones.

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REFERENCES

[1] Michaela Allaby and Charlene S Shannon. 2020. "I just want to keep in touch": Adolescents' experiences with leisure-related smartphone use. *Journal of Leisure Research* 51, 3 (2020), 245–263.
[2] Julie H Aranda and Safia Baig. 2018. Toward" JOMO" the joy of missing out and the freedom of disconnecting. In *Proceedings of the 20th international conference on human-computer interaction with mobile devices and services*. 1–8.
[3] Eric PS Baumer and Bill Tomlinson. 2011. Comparing activity theory with distributed cognition for video analysis: beyond" kicking the tires". In *Proceedings of the SIGCHI conference on human factors in computing systems*. 133–142.
[4] Russell W Belk. 2013. Extended self in a digital world. *Journal of consumer research* 40, 3 (2013), 477–500.
[5] Matthias Böhmer, Brent Hecht, Johannes Schöning, Antonio Krüger, and Gernot Bauer. 2011. Falling asleep with Angry Birds, Facebook and Kindle: a large scale study on mobile application usage. In *Proceedings of the 13th international conference on Human computer interaction with mobile devices and services*. 47–56.
[6] Julia Ayumi Bopp, Klaus Opwis, and Elisa D Mekler. 2018. "An Odd Kind of Pleasure" Differentiating Emotional Challenge in Digital Games. In *Proceedings of the 2018 CHI conference on human factors in computing systems*. 1–12.
[7] Virginia Braun and Victoria Clarke. 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology* 2, 2 (2006), 77–101.
[8] Virginia Braun and Victoria Clarke. 2012. Thematic analysis. In *APA handbook of research methods in psychology, Vol. 2. Research designs: Quantitative, qualitative, neuropsychological, and biological*. 57–71.

[2]https://web.archive.org/web/20170911223946/http://www.timewellspent.io

[9] Virginia Braun and Victoria Clarke. 2020. One size fits all? What counts as quality practice in (reflexive) thematic analysis? *Qualitative Research in Psychology* 18, 1 (2020), 1–25.

[10] Virginia Braun, Victoria Clarke, Nikki Hayfield, and Gareth Terry. 2018. Thematic Analysis. In *Handbook of Research Methods in Health Social Sciences*, Pranee Liamputtong (Ed.). Springer Singapore, Singapore, 1–18. https://doi.org/10.1007/978-981-10-2779-6_103-1

[11] Barry Brown, Moira McGregor, and Donald McMillan. 2014. 100 Days of iPhone Use: Understanding the Details of Mobile Device Use. *Proceedings of the 2014 CHI conference on human factors in computing systems* (2014), 223–332.

[12] Emeline Brule and Samantha Finnigan. 2020. Thematic analysis in HCI. *Design and Society* 25 (2020).

[13] Antony Bryant and Kathy Charmaz. 2007. The SAGE Handbook of Grounded Theory. (2007).

[14] Marta E. Cecchinato, John Rooksby, Alexis Hiniker, Sean Munson, Kai Lukoff, Luigina Ciolfi, Anja Thieme, and Daniel Harrison. 2019. Designing for Digital Wellbeing. In *Extended Abstracts of the 2019 CHI Conference on Human Factors in Computing Systems*. ACM. https://doi.org/10.1145/3290607.3298998

[15] Justin Cheng, Moira Burke, and Elena Goetz Davis. 2019. Understanding Perceptions of Problematic Facebook Use. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. ACM. https://doi.org/10.1145/3290605.3300429

[16] Mihaly Csikszentmihalyi and Eugene Rochberg-Halton. 1981. *The meaning of things: Domestic symbols and the self*. Cambridge university press.

[17] 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. *Proceedings of the 2019 CHI conference on human factors in computing systems* (2019), 1–14.

[18] Michael Dimock. [n.d.]. Defining Generations: Where Millennials End and Generation Z Begins. https://www.pewresearch.org/fact-tank/2019/01/17/where-millennials-end-and-generation-z-begins/. Accessed: 2022-12-28.

[19] Trinh Minh Tri Do, Jan Blom, and Daniel Gatica-Perez. 2011. Smartphone usage in the wild: a large-scale analysis of applications and context. *Proceedings of the 13th international conference on multimodal interfaces* (2011), 353–360.

[20] Benjamin D Douglas, Patrick J Ewell, and Markus Brauer. 2023. Data quality in online human-subjects research: Comparisons between MTurk, Prolific, CloudResearch, Qualtrics, and SONA. *Plos one* 18, 3 (2023), e0279720.

[21] Jon D. Elhai, Robert D. Dvorak, Jason C. Levine, and Brian J. Hall. 2017. Problematic smartphone use: A conceptual overview and systematic review of relations with anxiety and depression psychopathology. *Journal of Affective Disorders* 207 (Jan. 2017), 251–259. https://doi.org/10.1016/j.jad.2016.08.030

[22] Hossein Falaki, Ratul Mahajan, Srikanth Kandula, Dimitrios Lymberopoulos, Ramesh Govindan, and Deborah Estrin. 2010. Diversity in smartphone usage. In *Proceedings of the 8th international conference on Mobile systems, applications, and services*. 179–194.

[23] Chris Fullwood, Sally Quinn, Linda K. Kaye, and Charlotte Redding. 2017. My virtual friend: A qualitative analysis of the attitudes and experiences of Smartphone users: Implications for Smartphone attachment. *Computers in Human Behavior* 75 (2017), 347–355.

[24] Marc Hassenzahl, Sarah Diefenbach, and Anja Göritz. 2010. Needs, affect, and interactive products–Facets of user experience. *Interacting with computers* 22, 5 (2010), 353–362.

[25] Steffen Hedegaard and Jakob Grue Simonsen. 2013. Extracting usability and user experience information from online user reviews. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 2089–2098.

[26] Maxi Heitmayer and Saadi Lahlou. 2021. Why are smartphones disruptive? An empirical study of smartphone use in real-life contexts. *Computers in Human Behavior* 116 (2021), 106637.

[27] Alexis Hiniker, Shwetak N Patel, Tadayoshi Kohno, and Julie A Kientz. 2016. Why would you do that? predicting the uses and gratifications behind smartphone-usage behaviors. In *Proceedings of the 2016 ACM International Joint Conference on Pervasive and Ubiquitous Computing*. 634–645.

[28] Linda K. Kaye, Amy Orben, David A. Ellis, Simon C. Hunter, and Stephen Houghton. 2020. The conceptual and methodological mayhem of "screen time". *International Journal of Environmental Research and Public Health* 17, 10 (2020), 3661.

[29] Elihu Katz, Jay G Blumler, and Michael Gurevitch. 1973. Uses and gratifications research. *The public opinion quarterly* 37, 4 (1973), 509–523.

[30] Kostadin Kushlev, Jason Proulx, and Elizabeth W Dunn. 2016. " Silence your phones" Smartphone notifications increase inattention and hyperactivity symptoms. In *Proceedings of the 2016 CHI conference on human factors in computing systems*. 1011–1020.

[31] Steinar Kvale. 1994. *Interviews: An introduction to qualitative research interviewing*. Sage Publications, Inc.

[32] Kai Lukoff, Cissy Yu, Julie Kientz, and Alexis Hiniker. 2018. What makes smartphone use meaningful or meaningless? *Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies* 2, 1 (2018), 1–26.

[33] Ulrik Lyngs, Kai Lukoff, Petr Slovak, Reuben Binns, Adam Slack, Michael Inzlicht, Max Van Kleek, and Nigel Shadbolt. 2019. Self-Control in Cyberspace: Applying Dual Systems Theory to a Review of Digital Self-Control Tools. *Proceedings of the 2019 CHI conference on human factors in computing systems* (2019), 1–18.

[34] Ulrik Lyngs, Kai Lukoff, Petr Slovak, Reuben Binns, Adam Slack, Michael Inzlicht, Max Van Kleek, and Nigel Shadbolt. 2019. Self-control in cyberspace: Applying dual systems theory to a review of digital self-control tools. In *proceedings of the 2019 CHI conference on human factors in computing systems*. 1–18.

[35] Ulrik Lyngs, Kai Lukoff, Petr Slovak, William Seymour, Helena Webb, Marina Jirotka, Jun Zhao, Max Van Kleek, and Nigel Shadbolt. 2020. 'I Just Want to Hack Myself to Not Get Distracted'. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. ACM. https://doi.org/10.1145/3313831.3376672

[36] Caroline Marchant and Stephanie O'Donohoe. 2019. Homo prostheticus? Intercorporeality and the emerging adult-smartphone assemblage. *Information Technology & People* 32, 2 (2019), 453–474.

[37] Claudia Marino, Gianluca Gini, Alessio Vieno, and Marcantonio M. Spada. 2018. The associations between problematic Facebook use, psychological distress and well-being among adolescents and young adults: A systematic review and meta-analysis. *Journal of Affective Disorders* 226 (Jan. 2018), 274–281. https://doi.org/10.1016/j.jad.2017.10.007

[38] Claudia Marino, Gianluca Gini, Alessio Vieno, and Marcantonio M. Spada. 2018. A comprehensive meta-analysis on Problematic Facebook Use. *Computers in Human Behavior* 83 (June 2018), 262–277. https://doi.org/10.1016/j.chb.2018.02.009

[39] Mick McGee, Aaron Rich, and Joe Dumas. 2004. Understanding the usability construct: User-perceived usbility. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, Vol. 48. SAGE Publications Sage CA: Los Angeles, CA, 907–911.

[40] Elisa D Mekler and Kasper Hornbæk. 2016. Momentary pleasure or lasting meaning? Distinguishing eudaimonic and hedonic user experiences. In *Proceedings of the 2016 chi conference on human factors in computing systems*. 4509–4520.

[41] Elisa D Mekler and Kasper Hornbæk. 2019. A framework for the experience of meaning in human-computer interaction. In *Proceedings of the 2019 CHI conference on human factors in computing systems*. 1–15.

[42] Barbara Mellers, Ralph Hertwig, and Daniel Kahneman. 2001. Do frequency representations eliminate conjunction effects? An exercise in adversarial collaboration. *Psychological Science* 12, 4 (2001), 269–275.

[43] Shiri Melumad and Michel Tuan Pham. 2020. The Smartphone as a Pacifying Technology. *Journal of Consumer Research* 47, 2 (2020), 237–255.

[44] William Odom, James Pierce, Erik Stolterman, and Eli Blevis. 2009. Understanding why we preserve some things and discard others in the context of interaction design. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. 1053–1062.

[45] Jakob Ohme, Mariek MP Vanden Abeele, Kyle Van Gaeveren, Wouter Durnez, and Lieven De Marez. 2020. Staying informed and bridging "social distance": Smartphone news use and mobile messaging behaviors of flemish adults during the first weeks of the COVID-19 pandemic. *Socius* 6 (2020), 2378023120950190.

[46] Antti Oulasvirta, Tye Rattenbury, Lingyi Ma, and Eeva Raita. 2012. Habits make smartphone use more pervasive. *Personal and Ubiquitous computing* 16, 1 (2012), 105–114.

[47] Martin Pielot, Karen Church, and Rodrigo De Oliveira. 2014. An in-situ study of mobile phone notifications. In *Proceedings of the 16th international conference on Human-computer interaction with mobile devices & services*. 233–242.

[48] John Preston. 2020. Paul Feyerabend. In *The Stanford Encyclopedia of Philosophy* (Fall 2020 ed.), Edward N. Zalta (Ed.). Metaphysics Research Lab, Stanford University.

[49] Maria A Rasmussen, Julie O Frydendahl, Elisa D Mekler, and Kasper Hornbæk. 2021. Is Time on Smartphones Well Spent? *Interacting with Computers* 33, 5 (2021), 522–536.

[50] Byron Reeves, Thomas Robinson, and Nilam Ram. 2020. Time for the Human Screenome Project. *Nature* (2020), 314–317.

[51] Antonio-Manuel Rodríguez-García, Antonio-José Moreno-Guerrero, and Jesus Lopez Belmonte. 2020. Nomophobia: An individual's growing fear of being without a smartphone—a systematic literature review. *International Journal of Environmental Research and Public Health* 17, 2 (2020), 580.

[52] Robert Rosenthal and Ralph L Rosnow. 2008. *Essentials of behavioral research: Methods and data analysis*.

[53] Morgan Quinn Ross and Joseph B Bayer. 2021. Explicating self-phones: Dimensions and correlates of smartphone self-extension. *Mobile Media & Communication* 9, 3 (2021), 488–512.

[54] Kennon M Sheldon, Andrew J Elliot, Youngmee Kim, and Tim Kasser. 2001. What is satisfying about satisfying events? Testing 10 candidate psychological needs. *Journal of personality and social psychology* 80, 2 (2001), 325.

[55] Jonathan A Tran, Katie S Yang, Katie Davis, and Alexis Hiniker. 2019. Modeling the engagement-disengagement cycle of compulsive phone use. In *Proceedings of the 2019 CHI conference on human factors in computing systems*. 1–14.

[56] Alexandre N Tuch, Rune Trusell, and Kasper Hornbæk. 2013. Analyzing users' narratives to understand experience with interactive products. In *Proceedings of the SIGCHI conference on human factors in computing systems*. 2079–2088.

[57] Niels van Berkel, Chu Luo, Chu Anagnostopoulos, Denzil Ferreira, Jorge Goncalves, Simo Hosio, and Vassilis Kostakos. 2016. A Systematic Assessment of Smartphone Usage Gaps. *Proceedings of the 2016 CHI conference on human factors in computing systems* (2016), 4711–4721.

[58] Mingrui Ray Zhang, Kai Lukoff, Raveena Rao, Amanda Baughan, and Alexis Hiniker. 2022. Monitoring Screen Time or Redesigning It?. In *CHI Conference on Human Factors in Computing Systems*. ACM. https://doi.org/10.1145/3491102.3517722

[59] John Zimmerman. 2009. Designing for the self: making products that help people become the person they desire to be. In *proceedings of the SIGCHI Conference on human factors in computing systems*. 395–404.