What Makes Smartphone Use Meaningful or Meaningless?

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Prior research indicates that many people wish to limit aspects of their smartphone use. Why is it that certain smartphone use feels so meaningless? We examined this question by using interviews, the experience sampling method, and mobile logging of 86,402 sessions of app use. One motivation for use (habitual use to pass the time) and two types of use (entertainment and passive social media) were associated with a lower sense of meaningfulness. In interviews, participants reported feeling a loss of autonomy when using their phone in these ways. These reports were corroborated by experience sampling data showing that motivation to achieve a specific purpose declined over the course of app use, particularly for passive social media and entertainment usage. In interviews, participants pointed out that even when smartphone use itself was meaningless, it could sometimes still be meaningful in the context of broader life as a 'micro escape' from negative situations. We discuss implications for how mobile apps can be used and designed to reduce meaningless experiences.

CCS Concepts: • **Human-centered computing~Empirical studies in ubiquitous and mobile computing** • *Human-centered computing~Mobile computing* • Human-centered computing~Smartphones;

Additional Key Words and Phrases: Meaning; eudaimonia; habits; self-regulation; positive computing; persuasive design; uses & gratifications; social media

ACM Reference Format:

Kai Lukoff, Cissy Yu, Julie Kientz, and Alexis Hiniker. 2018. What Makes Smartphone Use Meaningful or Meaningless? *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.* 2, 1, Article 22 (March 2018), 26 pages. https://doi.org/10.1145/3191754

1 INTRODUCTION

Just as with keys and wallets, many people cannot leave home without their smartphones. Yet many also express dissatisfaction with the time they spend attached to their phone [33,77]. Users wish they could give up Twitter [74], hope to spend less time on Facebook in the coming year [62], and say that if they could change one thing about the way they use their phone, it would be to cut back on the use of one or more specific apps [24]. They install tools like Freedom, Forest, and RescueTime to block, limit, and monitor access to selected apps. They read popular science books like *Deep Work* [54], *Irresistible* [1], and *The Distraction Addiction* [57] that advise how to curb digital distractions. A few even join movements like Time Well Spent [85], which seeks to take back control from "the technology hijacking our minds." While users adopt these technologies of their own volition, some report that these experiences lack meaning and that they wish they could change their behavior.

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2474-9567/2018/3-ART22 $15.00

https://doi.org/10.1145/3191754

Anxiety about new technology is at least 2000 years old. According to Plato, Socrates believed that the technology of writing would erode memory and thereby Greek poetry and thinking [13]. In the 1990s, personal computers prompted concerns about addictions to online pornography, gaming, and shopping. In the 2000s, The BlackBerry, which popularized email on mobile devices, was nicknamed the "CrackBerry" for its addictive nature [50]. So it is no surprise that today's smartphones raise concerns too.

Supporting smartphone users who express dissatisfaction requires a nuanced understanding of *when* and *why* users are dissatisfied. Understanding the usage patterns that leave people frustrated with their own choices has the potential to help users shape the strategies they use to manage their usage behaviors. It also has the potential to help designers avoid design patterns that satisfy short-term metrics (e.g., time spent in the app) at the expense of long-term declines in user satisfaction.

To understand user dissatisfaction, one common approach is to examine which types of media use leave people 'feeling bad'. In studies of media use, this negative feeling is often measured in terms of emotional valence [6,37,78]. This approach aligns with a *hedonistic* tradition that views subjective well-being (and sometimes happiness too) in terms of affect balance: the presence of positive affect and absence of negative affect [2]. Yet affect balance alone may not fully capture why people are dissatisfied with aspects of their smartphone use [46].

Another way to study well-being is to follow the *eudaimonic* tradition, which focuses on living life with a sense of fulfillment and meaning [17]. In this study, we focus on the construct of *meaningfulness*, a key component of the eudaimonic conception of well-being. It is true that meaningfulness is positively related to affect balance: most meaningful experiences also make us feel good. However, the two concepts still differ in important ways [4,83]. For example, scrolling through pictures of adorable kittens might cheer one up, but feel meaningless. Conversely, messaging one's ex-girlfriend to apologize might be a sad experience, but meaningful. In contrast to hedonic happiness, people associate meaningfulness with giving rather than taking in relationships, enduring unpleasant experiences in pursuit of future goals, and reflecting one's ideal self [4].

The field of positive psychology made great progress in understanding how to cultivate happiness in the hedonic sense, yet it is only more recently that scholarship has turned to the eudaimonic notion of meaningfulness [4]. Similarly, in positive computing [12], valuable work has investigated happiness, often drawing upon the sensing technologies advanced by affective computing [11], yet there seems to be less emphasis on studying meaningfulness. This paper focuses on the construct of meaningfulness as a key consideration when designing for human flourishing.

Using a Uses and Gratifications (U&G) perspective [65], we explored the meaning, or lack thereof, that people derive from their smartphones through interviews with users and log data capturing their experiences in the moment. We built a mobile app that logged app use and used the experience sampling method (ESM) [16] to capture the behavior of 45 smartphone users for two weeks. We asked smartphone users about their underlying motivation for phone use at the start of, during, and at the end of specific instances of app use. Using qualitative data from these ESM prompts and from exit interviews, we extracted themes about the gratifications users seek as they engage with their phones and the meaning they draw from these experiences. We then corroborated users' subjective descriptions of their experiences through a quantitative analysis of 86,402 sessions of app use and the 9,318 sessions from which we collected experience samples.

Participants reported that habitual use was typically less meaningful than intentional use. Habit-driven experiences made users feel a loss of autonomy over their own behavior. Quantitative analysis of log data was consistent with these themes, showing both that users turn to their phones out of habit and lose track of their intentions and fall into habitual patterns of engagement with their phone. Participants further said that they turn to their phones to escape from negative emotions and held mixed opinions about how well such engagement served them. By examining habit, type of use, and meaning together, we provide insights into why people choose to engage in behaviors they wish they could change.

2 BACKGROUND

2.1 Technology Resistance

Though ICT is pervasive and offers enormous value to users, many people feel conflicted about the way they engage with technology and the amount of time they spend with connected devices. Morrison and colleagues refer to this as "pushback," which they define as a user's resistance to constant connectivity that he or she once embraced [52,53]. A technology probe to explore personal tracking of time spent with digital devices found that participants were interested in viewing their usage data, because they wanted to cut back on overall use and exercise greater self-discipline in resisting the temptation to engage with technology [63]. Baumer and colleagues describe "lagging resistance" among Facebook users, which they define as "a sense of wanting to quit but not doing so just yet (p. 8) [5]."

Prior work has described user enactments of pushback and technology resistance. For example, Schoenebeck documented Twitter users' anxiety about their social media engagement and their practice of taking intentional breaks from the site [74]. Pew Research Center reported in 2015 that 61% of U.S. Facebook users had taken a break from the social networking site (SNS) for "several weeks or more" at least once in the past year [62], and one of the most common motivations for doing so was users' frustration over "spending too much time using the site." Other work describes users committing "Facebook suicide" by deleting their accounts [59], refraining from smartphone ownership in favor of traditional feature phones [39], or asking a friend to take over an account [5].

Despite these makeshift attempts at pushing back, other work has shown that people often struggle to make changes to their usage habits that stick. One study of college students found that participants wanted to reduce their smartphone use but that the strategies they employed to make this change were ineffective [33]. Hiniker and colleagues found that nearly half of the parents they surveyed wanted to cut back on the time they spent using their phone in front of their child but were unable to make this change [26]. In a three-year ethnography, Mazmanian found that depending on workplace practices, some employees were able to set limits on their work-related use of technology, while others felt trapped in a cycle of constant connectivity from which they could not break free [49].

We build on this prior literature by examining users' sense of meaning as they engage with their phones. To contextualize how users derive meaning, we collect in-the-moment data on the motivation underlying particular instances of use.

2.2 Designing for Intentional Technology Use

A growing body of work in HCI investigates the design of tools to support users in curbing their use of technology. Several investigations have demonstrated that such implementations can broadly reduce an individual's overall technology use. For example, one research app leveraged social support techniques to help groups of college students set limits on their collective phone use [33]. FamiLync enabled parents and children to cooperate in setting limits on usage [31] and the AppDetox research project enables users to set rules to block specific apps [43].

Other research projects have sought to support users in cutting back in targeted ways. The PomodoLock research project supported users in resisting self-interruptions while trying to focus on a task by locking them out of distraction experiences for short chunks of time [30]. The MyTime app had users set personal goals and reflect on how they would like to spend their time and then monitored certain types of phone use [24]. Let's FOCUS reduced technology-related distractions in classroom settings [29]. And Lock'n'Lol supported users in self-regulating their use of technology while spending time with others in person [32].

Collectively, this body of work seeks to support users in turning their "lagging resistance" into active resistance, in which their desires to make changes to their behavior are actualized. In this project, we

sought to support the design of such systems by gaining a better understanding of the user needs they address.

2.3 The Uses and Gratifications Perspective

Historically, new technologies have been examined from a media effects perspective, but beginning the 1950s, communications researchers began to examine people's motivations for engaging with technology, rather than simply examining the effects of technology and treating users as passive recipients of media experiences [69]. The resulting Uses and Gratifications (U&G) theory explains that media use is an active choice on the part of a user, driven by the user's desire to seek specific gratifications.

U&G has proven to be a productive frame for understanding users' experiences with a wide variety of new technologies. Prior work has drawn on U&G to explain why users engage with VCRs [15], social media [60], early cellular phones [40], soap operas [68], tablets [47], and many other technologies. While other work has looked at the gratifications users obtain from their smartphone use (e.g., [25,27]), this investigation uses them as a lens for examining technology resistance and users' frustration with their own behavior.

At a high level, the gratifications users seek from media can be grouped under two motivations: *instrumental* motivation, in which the user engages with technology intentionally to achieve a specific purpose, and *habitual* motivation, in which the user engages with technology habitually to pass the time [65,67]. This dichotomy is particularly relevant to this investigation because prior work suggests that habitual motivation is associated with the types of smartphone use that people would like to reduce. For example, SNSs are used habitually [64,73] and are common sources of lagging resistance for users [5,25]. Other work shows that apps with high informational rewards lead to checking habits [56]. Thus, it is possible that the instrumental-habitual divide contributes to the extent to which users draw meaning from their experiences.

We can also consider the gratifications that users seek from a particular technology at a more detailed level that may be more actionable for designers of mobile apps. Research studies that collect large volumes of data about smartphone use tend to rely upon the categories provided by commercial app stores like Apple's App Store and Google's Play Store [21,81], sometimes making manual adjustments [9,61]. However, app store categories are only a crude approximation of the gratifications that smartphone users seek. First, categories can be ambiguous. For instance, the top rankings in the "Lifestyle" category on the Play Store include apps for dating (e.g., Tinder), retail (e.g., Starbucks), tools (e.g., Timely Alarm Clock), and religion (e.g., Salatuk - prayer time). Second, any app-level categorization scheme will not capture how a single app can be used in multiple ways that do not fall under a single category. For instance, as of August 2017, the top-ranked app in the "Communication" category on the U.S. Google Play Store was a mobile browser (Chrome), which can be used for communication (e.g., emailing a friend), but also for information-seeking (e.g., searching on Google) and entertainment (e.g., watching videos on YouTube). A more user-centered typology is needed to understand what people want when launching an app.

Instead of app store categories, typologies based on surveys and experiments with users [8,14,34,35,78] better inform the U&G perspective on smartphone use. Bessiere et al. used surveys and factor analysis to identify four distinct ways of using the internet: communication with close ties, communication to meet people, information-seeking, and entertainment [8]. Chan developed a similar typology for smartphone use, also with 4 types: voice communication, online communication, information-seeking, and passing time [14]. He found that communicative uses were positively related to subjective well-being, whereas non-communicative uses were not. Verduyn et al. compared social media use that was active (direct exchanges) and passive (consuming information), finding that passive Facebook use led to declines in affective well-being [78]. The types used in this prior work informed the development of our own U&G typology of smartphone use. In particular, their findings suggest that active

communication and passive consumption of social media should be seen as distinct types of use that offer different gratifications.

We build on prior work by using a U&G perspective to examine the meaning that people derive from smartphone use. We study what smartphone users want at two levels: at a high level, in terms of *instrumental and habitual motivations*, and, at a more detailed level, in terms of five different *types of use* (see Methods).

2.4 Research Questions

Our research questions were as follows:

RQ 1: Which U&Gs are associated with smartphone use that people find meaningless?

RQ 2: How do U&Gs change as a user engages with an app?

3 METHODS

We used mixed methods to collect both smartphone log data and multiple sources of qualitative data about users' experiences. 45 adults living in the United States installed an Android app that logged their smartphone use and asked them questions about their experience. All participants completed an exit survey, and 11 also participated in an exit interview.

3.1 Study Design

Recruitment

In June 2017, we recruited 45 U.S. adults from Craigslist (n=34) and university email lists (n=11). We did not solicit users who had particular desires to reduce smartphone use, but rather wanted to recruit a general U.S. population. Participants responded to an ad for a study that "tracks the apps you use and asks you about your experience." Median age was 28 (range 18-50). 53% identified as men and 47% as women. Racial identity (non-mutually exclusive) was 77% white, 13% Asian, 4% black, and 9% other, with 16% of all participants indicating Hispanic/Latino ethnicity. In terms of education, 13% held a high school degree or equivalent, 36% had completed some college or an associate degree, 36% held a bachelor's degree, and 16% had a master's degree or doctorate. Prior to this general recruitment, we had also conducted two iterations of pilot testing (n=4, n=5) to ensure that study instructions were clear and to troubleshoot our study app.

Participants were all Android smartphone owners (version 5.0 or later) who reported using their phone for at least 30 minutes per day (median=165 minutes). Our study app was made available on the Google Play Store and required participants to enter an invite code upon installation. Two invited respondents were unable to install the study app due to technical issues and could not continue as participants. Participants were compensated with a $75 Amazon gift card and received an additional $25 if they completed the exit interview. This research was reviewed and approved by The University of Washington's Institutional Review Board.

Experience Sampling Method (ESM)

Using the android.app.usage API [86], we developed a study app that logged the name, category, date, time, and duration of each app that a participant used during the study period. The code for the study app is available on Github [82]. When the study app detected that participants were using their phone, it asked them short self-report questions as per ESM. Our prompt could be dismissed by pressing the back button; study instructions informed participants that skipping a prompt in this manner was okay if their phone use was time-sensitive. Our sampling protocol is shown in Fig. 1 and described in the text that follows.

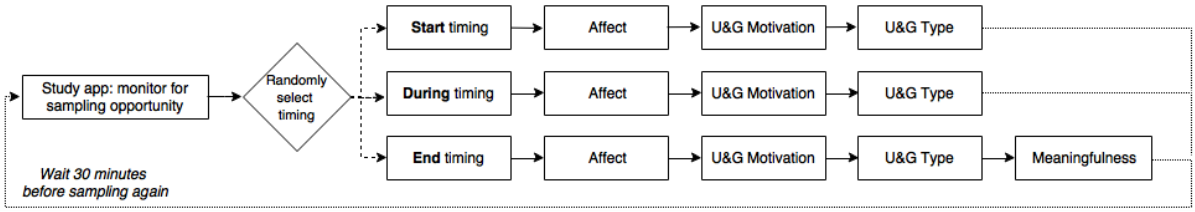

Fig. 1. Sampling protocol for the study app

To capture a diverse set of apps, if an app was sampled, it was not sampled again until after 3 other apps had been sampled. We were concerned that some messaging apps are checked so frequently (e.g., SnapChat) that they would crowd out samples from all other apps [9,72].

The study app prompted participants at one of three random **timings**: *start*, *during*, and *end*. Each instance of app use was sampled at a single timing, not at all three, as we expected that the disruption of our prompt would distort subsequent behavior so that any additional measurement of the same use would be invalid. Although we never collected more than one sample for any particular instance of app use, collecting a large number of samples would allow us to stitch together a picture of how user motivations evolve from the start-to-middle-to-end of app use.

Start samples came at the launch of an app. *During* samples were requested at a random time between 15-120 seconds of use. If a participant closed an app before reaching that number of seconds, the study app went back to the beginning of the sampling protocol. We therefore collected fewer samples during app use than at the other timings. *End* samples were collected immediately after an app's window was closed, provided that the app was used for at least 15 seconds. We selected 15 seconds as the minimum cutoff, as wanted participants to interact with an app before we questioned them about their experience. We took guidance from prior literature that found 15 seconds to be the amount of time associated with at least brief interaction with apps, whereas less time was associated with simply glancing at a device [3]. Again, if an end sample was selected but app use did not reach 15 seconds, the study app reverted to the beginning of the sampling protocol. This also explains why we collected more samples at the start timing than at the end timing. So as not to overburden participants, we waited for at least 30 minutes after sending a prompt (regardless of whether or not it was answered) before sending another one.

We also measured **affect** as has been done in prior studies of social media use [6,37,78]. Although it was not the focus of our study, we thought it might yield interesting comparisons against prior work. Affective state was measured along the two dimensions of the circumplex model of affect [70]: valence (7-point scale; negative to positive) and arousal (7-point scale; low energy to high energy).

U&G motivation asked whether the participant was using the app instrumentally ("To achieve a specific goal") or habitually ("To browse, explore, or pass the time") as done in [25]. "Not sure" was also an option.

Our **U&G types** (see Table 1) were based on prior literature and our own testing. Similar to Bessiere et al. [8] and Chan [14], we included communication, information, and entertainment as types of use. We adopted the distinction between active and passive social media use, reusing language from the study instructions in [78]. In our typology, however, active social media use was subsumed under communication. Our aim was for participants to include all communicative use under communication, even if it occurred in apps that are not always regarded as "social media." For example, chatting with friends in mobile messaging apps (e.g., WhatsApp). Based on usage behavior in prior studies [9,81], we added productivity as an additional type. "Not sure" was also included as an option. Although this paper refers to types of use by their short name (e.g., communication), participants were always shown the full name in the study app (e.g., communicating or interacting *with* other people), as listed in Table 1.

Table 1. U&G types with examples

Type of use		Examples
Short name[a]	**Full name**	
Productivity	Getting things done or self-improvement	• Checking balance in a banking app • Logging a run in a MyFitnessPal
Information	Getting information	• Searching on Google • Checking the forecast in a weather app
Communication	Communicating or interacting *with* other people	• Liking or commenting on Facebook • Messaging with friends on SnapChat
Entertainment	Entertainment	• Watching videos on YouTube • Playing games like Candy Crush
Social media	Browsing social media *without* interacting with other people	• Scrolling through the newsfeed on Facebook • Reading friends' stories on SnapChat
Not sure	Not sure	Anything that doesn't easily fit into one of the other categories

[a]Short names are used in this paper, but participants always saw full names. Participants saw these examples in their training.

To assess our typology, we ran one test of validity and another of reliability. Key methods and results are presented here; for a detailed explanation please see the supporting materials. To test validity, we recruited 64 smartphone owners from Amazon Mechanical Turk. We asked participants to describe 3 recent app uses and categorize them according to our typology. In 5 instances, participants used "Not sure" to classify app uses similar to "recording my gym sessions and bike rides" and "I used the application called Memrise to self-teach some Japanese." We therefore broadened productivity from "Getting things done" to "Getting things done or self-improvement." We chose not to create additional types for a few other uses that participants reported difficulty categorizing, such as online shopping (2 cases), flashlight (2 cases), and taking photos (2 cases), as these were less common. We also created examples that we shared with participants to help them distinguish between types of use (see Table 1).

To test reliability, we recruited 8 new participants from Amazon Mechanical Turk. Thirty cases of app use were randomly selected from those generated by participants in the test of validity. Each participant completed a 5-minute training for our revised typology (with examples) and then categorized the 30 cases. Light's Kappa, a measure of interrater reliability for fully crossed designs with more than two raters [22,42], was 0.74 (where 0.6-0.8 can be interpreted as indicating substantial agreement [79]). The same online training was later administered to participants who enrolled in the main study.

Meaningfulness was asked as, ''How much do you feel like you have spent your time on something meaningful?'' (7-point scale; not at all meaningful – neutral - very meaningful). We did not further define meaningfulness, as we wanted participants to interpret it as relevant to their own lives, as has been done in previous research in positive psychology [4]. The same question was asked about Facebook use in [71], in which answers were found to be highly similar to answers in response to alternate wordings "...wasted your time?" and "...done something useful?" (Cronbach's alpha = .91). This question was asked only at the end timing, as we wanted to allow participants to complete their app use before reflecting upon its meaningfulness.

3.2 Exit Survey

Participants completed a short exit survey that asked how often they wished to use their phone for each of our types of use (5-point scale; far less often - the same amount - far more often). Our aim was to

compare global intention for smartphone use against in-the-moment ESM reports of meaningfulness. We surveyed global intention at the end of the study rather than the beginning because we did not want this question to influence ESM reports. However, it should be noted that there may have been an effect in the opposite direction: after the two-weeks of ESM prompts, participants may have gained greater awareness and formed new intentions for phone use. The survey also inquired whether participants had experienced technical difficulties using the study app.

3.3 Exit Interviews

We chose 12 study participants (6 men, 6 women; age range 18-46) to invite to the exit interview using multistage sampling. In the first stage, we clustered participants into two groups based on gender identity. In the second stage, we further clustered the two groups into sextiles based on age. We then randomly selected one participant from each of these 12 groups. One participant was unable to participate due to schedule conflicts; all other invited participants chose to participate in the interview. We conducted interviews on the phone, and each lasted about 45 minutes.

In the first part of the interview, we asked participants what they had learned about their smartphone use, why they found certain types of use to be more or less meaningful, and whether they wanted to make any changes to their phone-use habits. In the second part of the interview, we made use of a retrospective interviewing technique [51]. For each participant, we prepared a timeline of their previous 24 hours of smartphone use, and we reviewed it together with them to contextualize specific instances of phone use and to better understand how different types of smartphone use fit into their daily life.

3.4 Data Analysis

Interviews

We began our data analysis with the qualitative data from interview recordings that were professionally transcribed. The first and last author first divided interview transcripts and each conducted an open-coding of an independent subset. We then met to collaboratively discuss emergent themes. Using these emergent themes, researchers then repeatedly reviewed transcripts to refine themes and pull out examples. Using example quotes, we conducted collaborative affinity diagramming, clustering examples into a collection of cross-cutting themes. We used these to define our quantitative analysis of ESM and log data by examining whether this log data supported or refuted the themes generated from our qualitative analysis.

ESM Data

We then proceeded with rough confirmatory analysis using ESM data. Rough confirmatory data analysis lies between exploratory data analysis and confirmatory data analysis, using probabilistic approaches such as confidence intervals and significance tests to conduct an initial assessment of plausible models [7]. We present most of our quantitative results using simple graphical representations. When we conducted statistical tests, we were interested in variables that were highly significant ($p < .01$) *and* had large effect sizes, and thus should therefore clearly be included in the model. Our quantitative results should be interpreted as an initial assessment of multiple potential models rather than as confirmation of a single model.

4 RESULTS

We first present descriptive statistics for the ESM data to characterize the smartphone use of participants. Participants used apps a total of 86,402 times over the two weeks of the study. We sampled the experience of participants in 9,318 (10.8%) of app uses. The completed response rate was 86% and the median time taken to answer a sample was 11 seconds. Participants received a mean of 13.3 prompts

per day (sd=6.3). Because we sampled only when a participant was using an app, more frequent smartphone users received more prompts.

Table 2 shows a summary of these ESM samples. The majority of use was instrumental (60.5%) rather than habitual (39.5%). Communication was the most common type of use (31.3%) and we excluded "Not Sure" responses from further analysis.

Table 2: Summary of ESM samples of smartphone use

	Samples	Adjusted Percentage
Total app uses	86402	100%
Non-ESM	77084	89.2%
ESM	9318	10.8%
Timing		
Start	4790	51.4%
During	1578	16.9%
End	2950	31.7%
U&G motivation		
Instrumental	4573	60.5%
Habitual	2984	39.5%
Not sure	493	NA
U&G type		
Productivity	930	12.4%
Information	1702	22.7%
Communication	2346	31.3%
Entertainment	1401	18.7%
Social media	1106	14.8%
Not sure	551	NA

The summary statistics for our affect and meaningfulness measures are shown in Table 3. There was a positive bias in emotional valence ratings, which has also been found in prior studies [23].

Table 3: Summary of affect and meaningfulness

	Number	Mean	SD
Affect			
Valence	8149	3.4	1.2
Arousal	8149	3.0	1.2
Meaningfulness	2230	3.0	1.4

We also examined whether participants reported using the same app in different ways, which was our key motivation for developing a typology of smartphone uses and gratifications. Table 4 shows the results for the 5 apps for which users answered the most ESM prompts. For each app, we list the total number of

samples and the percentage share by type of use, with the largest share in bold. For example, participants used Chrome for information-seeking in **50%** of samples, with the rest of use spread across entertainment (20%), social media (11%), communication (10%), and productivity (9%). Among all 66 apps in our dataset with 20 or more samples, we found that the median of the largest share for a type of use (e.g., information in the Chrome example) was 58%.

These results clearly show that people often use the same app for different types of uses & gratifications. This would not be evident based on app store categories alone: for example, Gmail is listed in Communication on Google Play, but in 39% of samples participants responded that their use was best described as getting information. Snapchat is listed under Social, but in 66% of samples participants reported that they were engaged in active communication rather than passive social media use. For researchers who are interested in the different ways that apps are used or are considering adopting a similar methodology, we anonymized and aggregated this part of the dataset and made it available in the supporting materials.

Table 4: Top 5 most popular apps and the diverse ways in which they are used

App name	Category in Google Play	Total samples	Productivity	Information	Communication	Entertainment	Social media
Chrome	Communication	701	9%	**50%**	10%	20%	11%
Facebook	Social	476	1%	5%	25%	14%	**54%**
Gmail	Communication	459	12%	**39%**	31%	10%	8%
Instagram	Social	360	2%	5%	26%	21%	**46%**
Snapchat	Social	326	1%	2%	**66%**	11%	19%

In the exit survey, study participants shared two notable concerns about our experience sampling protocol. Three participants expressed concern at receiving prompts while they were driving. In the future, researchers who sample app use on smartphones should consider disabling prompts when people are using navigation apps. One participant expressed frustration at prompts that occurred during SnapChat use, when he had limited time to view a friend's photo before it disappeared. In hindsight, we would have more strongly emphasized to participants that they were free to dismiss prompts that came at inopportune times.

4.1 Meaningfulness of Different Types of Use

Participants held similar opinions about which U&G types were more and less meaningful. Productivity and communication with close ties were mostly considered meaningful, while social media and entertainment were frequently viewed as meaningless. In the exit survey, participants expressed the desire to reduce the use of the same U&G types seen as meaningless.

4.1.1 Interview Data

Meaningful Experiences with Smartphones

Participants associated using their smartphone for productivity with a sense of meaning. Productivity use cases were often related to office work: *"The Slack app, that one is meaningful because that one actually gives us support… it's meaningful in that way because it helps me get work done easier"* (P10). For P10, the two weeks of participation helped him realize how he used his phone more productively than he had thought: *"I always knew that my phone is probably more important than my wallet at this point in my life, but I didn't realize how often I used it productively versus just screwing around"* (P10).

Because our definition of productivity was broad ("Getting things done or self-improvement"), participants also reported productivity uses beyond the workplace:

> A fitness app, that would be something productive, or something that had to do with organization, like creating a to-do list, or, you know, keeping up with plans at work and writing down notes and projects. I'd say that feels a lot more meaningful to me than just maybe going into an app and scrolling through cute cat pictures. (P7)

It was common for participants to contrast productivity against other use cases such as social media: *"I have a Fitbit and then a calorie counter thing. Using both together I think is more meaningful and worth my while than just looking at Facebook"* (P6). Asking participants what they found meaningful helped reveal what they found meaningless.

Active communication was also frequently regarded as meaningful regardless of which app store category it fell under:

> Probably the most meaningful task that I used my phone for was communicating or interacting with other people. And that was irrespective of what kind of app I used, so if it was like Messenger or Facebook or Snapchat, it didn't matter what app I was using, or email. If I was using it to interact with someone, I think I associated that usage of the phone more positively. (P3)

Of the apps mentioned in this quote, only Messenger is listed in the "Communication" category on Play Store, whereas email apps are usually in either "Communication" or "Productivity," and Facebook and Snapchat are in "Social." Other participants reported meaningful communication in apps that fall under categories such as "Tools" (e.g., the dialer), "Music and Audio" (e.g., Spotify), and "Lifestyle" (e.g., Tinder). Meaningful communication was not bounded by app store categories.

Participants saw interactions with close ties as especially meaningful:

> I didn't speak to my daughter for at least four or five days. I got my own apartment, I just moved into this apartment where I'm at now, and she's mad because I left. Then yesterday she finally talked to me on Facebook, so that's why I put a 6 [out of 7 for meaningfulness]. (P10)

When we asked participants what type of use they considered meaningful, it sometimes took them a few moments to respond. Communication with family was often the answer these participants gave upon reflection:

> Meaningful... I mean other than maybe just calls with family or texting throughout the day, but yeah I would say just generally... Yeah I'd say calls are probably the only really very meaningful thing that I'd be doing, maybe emails with family news or updates like that. (P11)

We did not distinguish between communication with close and weak ties in our U&G types, but it appears to relate to the meaningfulness of smartphone use.

Meaningless Experiences with Smartphones

Almost all participants singled out passive social media use when asked if they found any smartphone use meaningless:

> Oh yeah. Browsing social media. Going to Facebook just to browse and not doing anything else. Going to Instagram just to browse. I think those are pretty much meaningless. (P3)

As in this quote, qualifier words like *"just"* and *"kind of"* were used almost every time that participants described their social media use, in a way that downplayed the significance of their activity. This contrasted with the more direct language used to describe more meaningful uses that was free of such qualifiers.

Several participants suggested that social media *could* be more meaningful if they engaged more actively:

> Social media has the potential to be meaningful, but the way that I often use it is meaningless, as a way to just pass the time. I am not very active on social media, engaging with it. I am just a consumer which feels less useful to me… not building meaningful connections. (P1)

P6 was similarly critical of the passive nature of his social media use, using words like *"not do anything"* and *"sitting there":*

> I would just scroll through Facebook and not do anything. I was just kind of wasting time, sitting there, looking at pictures and videos. Looking back on it, no, that really wasn't meaningful whatsoever... Maybe if I was actually going to be using Facebook or texting more or Snapchatting more, it would be actually to interact with someone and speak with someone, so I have better relationships with people, instead of just looking at pictures and not doing anything, interaction-wise. (P6)

Similarly, in P7's mind, what she called her "*lurking*" did not build relationships in the same way as "actual interaction" (active communication in our types of use). P3 also regarded his present social media use as mostly meaningless, but believed that it had potential to be more active and meaningful.

Entertainment was also sometimes cited as meaningless. *"I wouldn't say any time spent on that app [the Deep Town game] was meaningful, it's just a way to entertain myself mindlessly"* (P11). Another participant explained why he considered entertainment uses to be meaningless: *"I just tended to gain more out of using it as a tool rather than using it to pass the time or using it to do something that didn't have like an end gain"* (P3). As in this quote, participants often attributed meaningfulness to a lack of 'productive' output.

4.1.2 Experience Sampling Data

Next we investigated whether type of use affects meaningfulness in the experience sampling data. In addition, based on prior literature, we examined how U&G motivation (instrumental versus habitual) relates to meaningfulness.

Fig. 2 reveals a clear relationship between meaningfulness and type of use. Productivity, information, and communication show higher ratings of meaningfulness than entertainment and social media. These results are consistent with the interview data. Fig. 3 shows that meaningfulness is also strongly related to U&G motivation. Habitual use is associated with less meaningful experience.

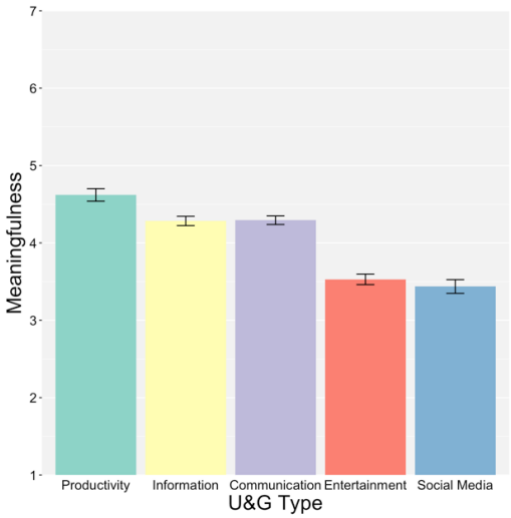

Fig. 2. Meaningfulness vs. U&G type. Shows the mean and its 95% CI.
Entertainment and social media are related to a lower sense of meaningfulness.

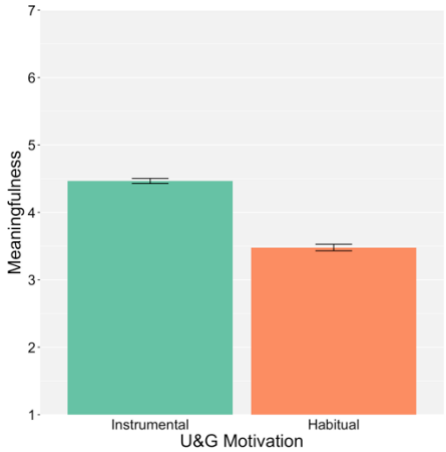

Fig. 3. Meaningfulness vs. U&G motivation. Shows the mean and its 95% CI.
Habitual motivation is related to a lower sense of meaningfulness.

We performed a linear mixed effects analysis of the relationship between meaningfulness and our explanatory variables (Table 5). As fixed effects, we entered U&G type, U&G motivation, and time of day. Time of day was included because prior work suggests that people use their phone less purposefully later in the day [25]. As a random effect, we included participant ID, so that intercept was allowed to vary by participant. We used R and the lmerTest package [38] to run models with the REML estimation and test for significance.

Relative to smartphone use for productivity, social media use decreased ratings of meaningfulness by about 0.67 ± .12 (standard errors), holding other factors constant. Entertainment use led to a roughly similar decline (0.56 ± .11) on the 7-point scale for meaningfulness, whereas information and communication were not significantly different from productivity use. Using one's phone habitually rather

than instrumentally reduced meaningfulness scores by about 0.68 ± .07. Coefficients for time of day were mostly in the expected direction (with evening and night corresponding with less meaningful use), but effect sizes were small and insignificant.

Table 5: Mixed Effects Regression for Meaningfulness (n=1947)

Source	*Estimate*	*SE*	*t*	*P*
Intercept	3.74	0.13	35.28	<.001
U&G Type (baseline = Productivity)				
Information	-.13	.10	-1.32	<.188
Communication	-.09	.09	-.95	<.345
Entertainment	-.56	.11	-5.06	<.001
Social media	-.67	.12	-5.72	<.001
U&G Motivation (baseline = Instrumental)				
Habitual	-.68	.07	-9.47	<.001
Time of day (baseline = Morning (6am-12pm))				
Afternoon (12-6pm)	.08	.07	1.23	.218
Evening (6pm-12am)	-.06	.07	-.91	.365
Night (12-6am)	-.17	.11	-1.55	.121

4.1.3 Exit Survey

In the exit survey, participants rated how often that they wanted to use their phone for different U&G types on a 5-point scale, ranging from far less often to far more often (Fig. 4). An analysis of variance (ANOVA) on these scores yielded significant variation among conditions ($F(4, 225) = 26.41$, $p < 0.001$). The results of a post hoc Tukey test are also shown in Fig. 4.

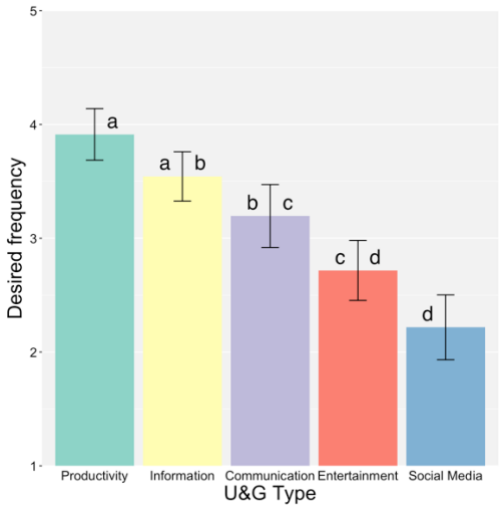

Fig. 4. Desired frequency of use vs. U&G type (1 = far less often, 5 = far more often). Shows the mean and its 95% CI. Letters (a, b, c, d) indicate pairs that are *not* significantly different from each other. For example, Productivity and Information are both marked (a), so do not differ significantly. However, Productivity does differ significantly from all other U&G types ($p < 0.01$).

Ratings were mostly consistent with the ESM data, with productivity receiving the highest average score and social media the lowest. One exception is that communication lay in the middle, with no significant difference relative to entertainment ($p = 0.07$) and informational use ($p = 0.32$). Prior literature and our interview data suggest that communication with close ties would have been rated higher than interaction with weak ties, but our definition of communication as a type of use did not make this distinction. On the whole, participants wanted to reduce usage behavior that was also associated with a lack of meaningfulness in the ESM data.

4.2 Loss of Autonomy

In interviews, participants reported a loss of autonomy during smartphone use. They highlighted the automatic nature of their checking habits, particularly for social media, entertainment, and sometimes communication. This kind of habitual smartphone use was frequently characterized as meaningless.

Experience sampling data reveal social media and entertainment are used habitually far more often than other types of use. These data also show that participants began smartphone use with a higher sense of instrumental motivation than they ended with. In other words, intention is eroded during the course of smartphone use.

4.2.1 Interview Data

A recurrent theme was loss of autonomy, acting without the experience of choice [17]. Many participants felt like they were not in control of their use: "A lot of the times I'd be on my browser and maybe I can get sucked into some mindless BuzzFeed article. I feel like it's kind of more of a black hole than if you go on a fitness app that's strictly for one thing" (P7). Another participant wished that he had more self-control, particularly when his wife was annoyed with him for being on his phone all the time. However, when asked why he thought he lacked this self-control, he clarified that it felt like his use was no longer an active choice:

> I'd say it's more just a condition thing at this point. It's so normalized to have the phone in my pocket or on the table or whatever and just be absentmindedly glancing at it or picking up and scrolling through something. That probably isn't meaningful at all, just kind of a force of habit. (P11)

Lack of control was rarely attributed to active failure to resist in-the-moment, but rather to unconscious habit. We therefore use *loss of autonomy* rather than *loss of self-control* to describe this feeling of acting without the experience of choice.

Participants shared many anecdotes in which they were not even aware of their own use at the moment: *"Without even realizing it, I pulled out my phone and just started mindlessly checking my email. Then when I put it away I realized, 'Oh, I feel bad for ignoring my friends'"* (P1). The presence or intervention of close ties often helped a participant become aware of use that their reflective self also considered problematic. One participant told her fiancé that she was not going to check Facebook on her phone while they were watching television together on the couch:

> I would not look at my phone for about 10 minutes, and then I wouldn't even realize it, but I had it back in my hand and I was looking at it, and then [my fiancé] would bring up, 'You're using your phone again. You said you weren't going to use your phone when we were watching this episode.' I'm like, 'Oh, yeah, right. I forgot,' then put my phone back down. It's gotten better maybe, but it's something that's just a habit. It's really hard to break habits. (P6)

Smartphone use was viewed as a strong habit and sometimes as an 'addiction'. One participant explained why he wanted to use his phone less often after participating in the study:

> Because I kind of realized how glued I was. It's almost second instinct, you know? The minute you are bored or don't have anything to do, you just turn to your phone, and I'd like to be able to get out more and really live life. (P7)

Despite their best intentions, participants reported that because phone use habits had become so ingrained, they were now *"really hard"* to change.

Lack of autonomy went hand-in-hand with a lack of meaning for participants. Again, P6 shared: *"Sometimes, I'll look at the videos, yeah, and they make me sad, so why would I even, why do I keep looking at it? I don't know why I do, but I do."* One participant summed up this relationship, *"Candy Crush is absolutely addictive, and it's just absolutely useless"* (P5). Other participants described cases of unconscious use as *"completely pointless"* and *"a waste of time."*

4.2.2 Experience Sampling Data

To check whether participants were *"sucked into"* meaningless use, we tested the relationship between U&G motivation and the timing of the sample (Fig. 5). A chi-square test of independence revealed that the relation between these variables was significant, $X^2(2, 7557) = 109.74$, $p < .001$. The percentage share of instrumental motivation declined from the start timing (65.6%) to the during timing (51.4%). There was a slight increase in instrumental use from the during timing to the end timing (55.7%), which may be because participants may have looked back upon an app use that started with instrumental motivation and later changed to habitual motivation and concluded that, on the whole, it was still more instrumental. At the start of app use, participants had a specific purpose in mind more often than during or at the end of use.

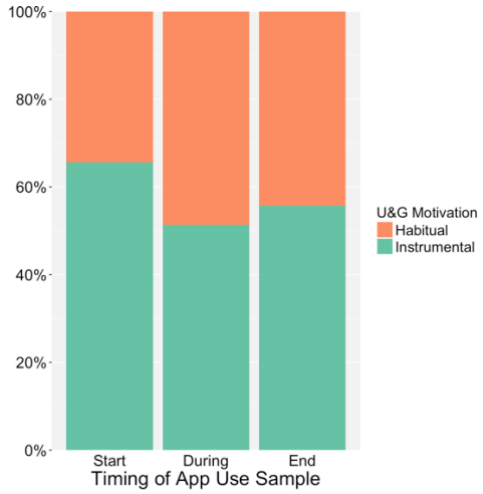

Fig. 5. U&G motivation vs. timing. Instrumental motivation declines over the course of use, relative to habitual use.

We also examined whether the erosion of instrumental motivation differed between types of use. Fig. 6 shows the percent of instrumental use and the sample of the timing, for each type of use. First, we note that different types of use had different baselines. Regardless of timing, productivity, information, and communication use was far more likely to be instrumentally motivated than was entertainment and social media.

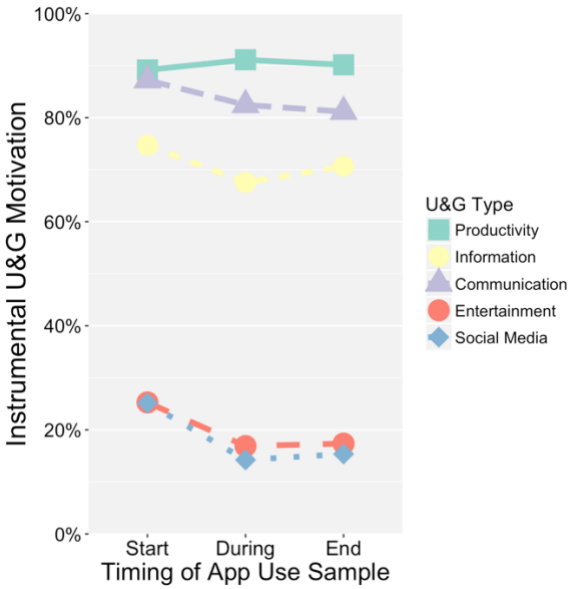

Fig. 6. Instrumental motivation vs. timing, by type of use. Compared to other types of use, entertainment and social media are less likely to be instrumentally motivated to begin with and also show greater decline over the course of use.

In addition, change over time was different for the types of use. The absolute change in instrumental motivation from the start to the end timing was: 0.0% for productivity, -4.0% for information, -6.0% for communication, -7.9% for entertainment, and -9.8% for social media. For each of the five types of use, we ran a logistic regression analysis with U&G motivation of use as the response variable and timing as the explanatory variable. The decrease from the start to end of use was significant ($p<.001$) for communication, entertainment, and social media, but not for productivity and information. This suggests that when phone use was instrumentally motivated, type of use influenced how likely participants were to switch to a habitual intention.

Our results also suggest two pathways between the U&G motivations and types associated with a loss of autonomy. In interviews, participants reported mindlessly checking their phone *"without even realizing it."* This forms a *habitual checking* pathway in which habitual motivation leads to entertainment and social media use. The *erosion of motivation* pathway reinforces the same relationship in the other direction. For the entertainment and social media U&G types, participants were most likely to shift towards habitual motivations later in the course of app use.

4.3 Micro Escapes

Participants reported that their phone served as a temporary relief from negative states, which we call a *micro escape*. In this case, participants were not concerned with the meaningfulness of smartphone use, but rather whether or not it helped them cope with undesirable real-life emotions and situations. Participants held different opinions as to whether micro escapes were helpful.

4.3.1 Interview Data

Escaping from Negative States

Participants described turning to their phone during a wide variety of challenging states, both internal (e.g., boredom) and external (e.g., a dispute at work). For instance, a participant who works in customer service shared, *"I find my phone to be a way for me to get away and distract myself, instead of sitting there*

stressed out because I just argued with a customer" (P10). Instead of enduring such undesirable states, smartphones provided participants with an instant way to escape from almost any situation.

Participants turned to their smartphone for relief when they experienced low emotional valence: *"I mostly scroll through social media just to get through the day, like I'm bored so I scroll social media. Otherwise, I don't think I scroll social media when I'm happy"* (P3). Low valence states that participants said prompted micro escapes included stress, frustration, annoyance, and being upset. One notable exception to this theme was P8, who saw no relationship between his affective state and how he used his phone: *"My emotions have absolutely nothing to do with my phone unless I have to make a call that's of importance."* On the whole, however, participants believed that micro escapes were more common when they were in a negative mood.

The relationship between smartphone escapism and arousal (energy level) was ambiguous. On the one hand, participants reported using their phone to escape when they were upset, annoyed, and overwhelmed, states that are associated with high arousal [70]. On the other hand, participants shared that they often used their phone in this way when they were bored, fatigued, and tired, states linked to low arousal [70]. Four participants observed that micro escapes grew more common as they got tired at night.

Participants characterized smartphone use that was prompted by low valence or low arousal as lacking in meaning and purpose:

> When my mood or when my energy was lower, I tended to reach for my phone to perform tasks that were very nonspecific or did not have any sort of value associated with them. I would either get on Facebook and scroll through my feed or go to YouTube or any activity that had no purpose associated with it other than to pass the time or to distract me from whatever was going on at the moment. (P3)

Passive consumption was the main pattern of use at these times, as indicated by verbs such as *"scrolling," "browsing," "watching,"* and *"checking to pass the time."* Social media and entertainment were the types of use that participants most often described as micro escapes. To escape, participants turned to passive consumption that in-of-itself they reported was not very meaningful.

Do People Find Micro Escapes Helpful?

Participants held mixed opinions about whether smartphone micro escapes were a helpful response to their negative states. Some participants felt that pulling out their phone helped them cope with certain states (particularly negative emotions with high arousal), whereas others wished they did not do so as often (especially when it replaced a work-related task). Our interview data cover only subjective experience of an individual: what participants themselves viewed as useful (or not). However, we note that objective outcomes (e.g., productivity) and the experience of third parties (i.e., other people affected by an individual's smartphone use) are also important to study.

Micro Escapes for Emotional Self-Regulation

P5 described the phone as a *"great distraction tool"* that reduced his anxiety: *"It takes my mind off of it so that I'm not worried about it, or bothered by it."* Four others also found the phone to be an effective tool for emotional self-regulation. P10, who works in customer service, said, *"I tried to help them out and they cursed me out. I'll turn to my phone in order to just pretty much keep me calm and keep me sane pretty much."* In cases where participants found micro escapes to be helpful, the emotions they addressed tended to be low in valence, but high in arousal (e.g., upset, stress, frustration, annoyance, and anxiety [70]). Five of participants reported that smartphone use helped them to cool down these 'hot' emotions.

Other participants felt that smartphone micro escapes were not beneficial, particularly when used to escape low valence and low arousal states (e.g., boredom and fatigue). P6 wished that she did not use her phone when she was bored at night, comparing it against other activities she considered more productive:

> I definitely noticed that, as the night goes on and as it gets later, I'd look at Facebook more and more. I think it's just because I'm getting tired and bored, and it's just a way to pass the time, when, in reality, I could be actually doing stuff at my house and talking to someone in person and getting things done… I feel like it's a waste of time. (P6)

Like P6, P3 also turned to her phone for escape when she was bored or mentally taxed:

> Why do I go on Facebook when I'm bored or I can't write what I want? I don't know… it would have been to just disengage my brain from my task and then I think the ideal is to go back to it with a fresh mind. But I don't think going on Facebook actually accomplishes that. (P3)

P3 was at a loss to explain why she used her phone to escape when she knew it to be ineffective: *"The thing is like I never feel any better, but I still do it. It's such a weird realization. Yeah, the phone usage does not help the situation whatsoever, yet I still do it."* This habitual nature of use contrasted against the aforementioned cases where participants described more consciously choosing to use their phone to relieve negative emotions.

Micro Escapes in Social Situations

Four participants valued how smartphones helped them escape from social situations. For P2, who described herself as a *"sociable introvert"* who sometimes needs *"a little escape from the humans,"* her smartphone provided her with the means to do so*: "It's not okay in our society to be like, 'You guys are exhausting. I'm just gonna stand over here for five minutes and take a deep breath, and then I'm gonna come back to the party or the picnic or whatever.'"* P3 similarly liked using his phone to escape from socializing with relatives. Both participants appreciated that they could use their smartphone to escape while in social settings, a form of use they viewed as socially acceptable.

P9 described how his phone helped him to cope with the stress of family life without having to leave the kitchen: "You can't step outside for a minute each time it gets hectic, because it's always hectic with three children. Again, I end up using [apps and games] to uplift myself and relax." For P9, a micro escape was a helpful emotional self-regulation strategy relative to physically removing himself from the setting. We cannot say whether other family members share this opinion.

5 DISCUSSION

Our results reveal systematic ways in which habitual use, type of use, and feelings of meaning all move together. We sought to better understand, first, which uses and gratifications are associated with meaningless experiences, and, second, how these uses and gratifications change as the user engages with an app. Our results show that both the motivation of use (i.e., whether a user picks up the device with intention or out of habit), and the type of use they engage in (as defined by our U&G taxonomy) each independently predict the meaning the user will derive from the experience. Our results also show that habitual use leaves users feeling a lack of control over their own behavior and that these are patterns of engagement that users would like to change.

5.1 Characterizing Meaningless Experiences

Reflecting on their phone use generally, participants repeatedly told us they derive relatively little meaning from passively consuming social media and entertainment content. However, they also explained that this was a function of the type of use they engaged in rather than the content itself. Though participants consistently cited Facebook as a source of feelings of meaninglessness, these reports reflected their attitude toward passively scrolling through content, not their attitude toward engaging with their friends through the platform. This suggests that with respect to the meaning users derive from their phone use, the type of use an individual engages in may be a more useful unit of analysis than app name or app category. Though it can also be valuable to ask questions of particular apps, our results show

the value of U&G in this space and that an app-level analysis might miss distinctions specific to the type of use. For example, while some prior work reports that Facebook use predicts declines in subjective well-being [37], other work finds that Facebook use increases social capital and feelings of connectedness [19]. Our results suggest that these seemingly contradictory perspectives may both capture users' experiences accurately and that their differing conclusions may arise from distinctions in the type of use and the gratifications users are seeking.

In addition to the type of use participants engaged in, the motivation behind app use also predicted meaningfulness. Passively browsing social media or consuming entertainment was more meaningful when it was a conscious choice on the part of the user and less meaningful when it was an instinctive reflex. Prior work has shown that "**S**hort-duration, **I**solated, **R**eward-**B**ased" (SIRB) phone use (such as passive social media consumption) is associated with habit-driven phone use, and that these experiences erode the user's intentions [56]. Here, we show that using the phone to engage with SIRB activities and habitually motivated use are each independently associated with less meaningful experiences. Each of these factors independently contributes to a loss of meaning, over and above the contributions of the other.

This is important from a design perspective, because participants reported that they are dissatisfied with their engagement in meaningless activities. In theory, there might be no need for designers to promote experiences that users find meaningful: if users felt good about engaging in habitual phone use and the SIRB activities they characterize as meaningless, one might argue that these are scenarios to support. But consistent with the construct of lagging resistance [5] and other prior work on SIRB experiences [24,74], many of the participants in our study reported they would like to change this usage. Prior work on SIRB activities shows that these experiences lead to checking habits and increased phone use [56]. Here, we further show that these patterns of use predict meaningless experiences that participants wish to reduce.

5.2 Lack of Autonomy and Meaning

The relationship between habitual use and a lack of meaning persisted across all types of use, even types of use that participants usually found meaningful, like getting things done or connecting with others. Participants shared that they would frequently use their phones without realizing what they were doing and that these experiences lacked meaning. This is consistent with the underlying principles of U&G, which conceives of users as active agents seeking specific gratifications through specific uses [69]. Our results suggest that experiences that erode intention and promote habitual use disrupt this core pathway to a user valuing a medium.

These findings imply that even persuasive interfaces designed to draw users into meaningful activities may promote dissatisfaction by pushing users to engage mindlessly. Designers of persuasive interfaces that intend to promote meaningful activities should also consider when and why users might want to engage in this activity of their own volition. A game that encourages a user to solve math problems, care about environmental sustainability, or remember to vote might promote an activity that she finds meaningful, yet could still leave her feeling a lack of autonomy if the interface promotes habitual phone use, checking habits, and erosion of intentions. A value-sensitive design approach [20] could help designers identify not only what habits users want to form, but also the context-specific ways in which they wish to enact them and the social norms that may help or hinder [44].

5.3 Micro Escapes

Some participants explained that they were not always seeking meaning from their phone use; they described sometimes seeking the gratification of escaping from their surroundings and the present moment, not a gratification that comes from phone content directly. This is consistent with prior work in U&G showing escapism as a common motivation for media use [28,66]. Notably, participants pointed out

that these escapes offered them lasting value in times of stress or anger. In these cases, users said that the distraction of the phone allowed them escape from high-arousal feelings, which dissipated as they engaged in phone activities. It was less clear that micro escapes to avoid boredom or tiredness offered the same lasting value. This provides some suggestion that users may benefit from micro escapes to avoid high-arousal situations but not low-arousal ones. But given that we only encountered this theme through retrospective interviews, the extent to which we can make this claim is limited.

We believe that it would be valuable for future work to examine the lasting impact of micro escapes in both high-arousal and low-arousal contexts. Does turning to Candy Crush in a moment of outrage make it less likely that an individual will fire off an angry email? And does turning to Candy Crush at the end of an exhausting day offer rejuvenation? Participants' reflections suggest that micro escapes can help with the first scenario but offer less assistance in the second. Future work to understand the consequences of escaping in these various scenarios has the potential to offer concrete guidance to users about how they might expect their phone activity to influence their well-being. For developers, it suggests that a general population could benefit from smartphone experiences that detect high-arousal states and assist with emotional self-regulation, as has previously been done with clinical populations [58].

5.4 Why Design for Meaningfulness?

From a pessimistic economic perspective, monetization in the form of advertising provides developers with strong motivation to optimize for engagement rather than a user's sense of meaningfulness. Indeed, the thriving casino industry exploits behavioral science to design gambling machines that draw people into trancelike states and relieve them from everyday concerns [75]. Tristan Harris, co-founder of the advocacy group Time Well Spent, argues that in the attention economy, "there's a thousand people on the other side of the screen whose job is to break down whatever responsibility I can maintain" [10]. When incentives lead developers to design apps for meaningless engagement, it is up to either individual users or society to push back.

A more hopeful economic perspective is that designing for meaningfulness will increase user loyalty in the long term, even if it decreases engagement in the short term. For example, in January 2018, CEO Mark Zuckerberg announced that the social network's news feed would prioritize "meaningful interactions" over passive experiences [84]. He shared that he believes this will hurt his firm's engagement measures in the short run, but make the service more valuable to users in the long run. In modest support of this view, our study finds that types of use that people find meaningless are also those they wish to use less frequently, although we cannot say how often they actually follow through on that desire. It is worth noting that actors with longer investment time horizons, such as platform owners and apps with low customer churn, are in better position to benefit from long-term user engagement.

5.5 Design Implications

In the technology industry, it's often said that "you build what you measure" [2]. Measuring a user's sense of meaningfulness is undoubtedly harder than tracking their views, taps, or time spent in an app, but can still be done. The overall agreement of the quantitative and qualitative findings in this study suggest that asking for numerical ratings during app use is a valid approach to measuring meaningfulness. However, the interview finding that apps are used as micro escapes from stressful situations shows that qualitative investigation is still critical to understanding the meaningfulness of app use in a broader context. In Facebook's case, the firm setup an offline panel to solicit qualitative input from users and discovered, for instance, that tragic posts were low in engagement metrics but "really mattered" to people [55]. Developers should consider both quantitative and qualitative data when designing for meaningfulness.

Mobile app designers who want to build meaningful experiences should consider how to respect a user's autonomy. To do so, designers should examine how an app supports or distracts a user from their

purpose for visiting. Prior work in ubiquitous computing has shown that it is possible to detect or predict when a user is likely to be using the phone mindlessly or problematically [25,77], suggesting that it may be possible for an app to detect when it is and *is not* being used with intention. If intention is clear, an app could dynamically change its interface to foreground that use case and background others. If a single pattern of use is especially common, a developer may even consider "unbundling" it. For instance, Facebook split off its instant messaging features into a separate Messenger app. If intention is unclear, an app could provide the user with a pause to reflect, rather than defaulting to its most engaging content. For example, when a user opens a new browser window, one could present top news stories or most frequently visited sites, but The Momentum browser extension [87] asks, "What is your main focus for today?"

Apps can also encourage users to move on when their original purpose is achieved. For example, when a user reaches a clean email inbox in Gmail, it shows a blank screen with the message "You're all done! Please enjoy your day." By contrast, when a user finishes watching a video on YouTube or Netflix, they start auto-playing the next video by default. Designing for a positive disengagement experience could heighten a user's autonomy and sense of meaning.

Lastly, smartphone users themselves can also take steps to retain control over their experience. Before picking up their phone, they could form a clear intention for use. Mindfulness-based approaches may aid users to observe and establish psychological distance from the internal triggers that prompt habitual use [41]. Users can also architect the environment on their device to encourage single purpose use, for instance by removing app icons from their home screen and instead accessing them via search [10,45]. Hiding cues that trigger habitual use could help people keep control and use their smartphone in more meaningful ways [45].

5.6 Limitations and Future Work

Though we collected ESM and log data from participants, our investigation was exploratory. We used themes from interviews and open-ended ESM responses rather than preconceived hypotheses to guide our analysis. Our claims should be interpreted as qualitative findings rather than hypothesis-confirmation; it would be valuable for future work to evaluate these relationships experimentally. We sampled participants from one cultural context and our sample was over-representative of younger adults, so our results may not generalize to other populations. In future work, analyzing individual app use as part of a larger sequence of use (e.g., use that follows an incoming message/notification) could also yield further insights.

Our findings suggest specific links between motivation of use, type of use, and meaning, and they suggest two pathways—specifically, checking habits and an erosion of purpose—that lead to a loss of autonomy. A future, large-scale quantitative investigation would help confirm or refute the existence of these links and help to develop these themes into formal theory if applicable. Future work also remains to examine these relationships in the larger social context in which phone use occurs; here we examined only how specific motivations and types of use affect the individual.

U&G is one of many lenses that can be used to understand people's experiences with their smartphones. It has been critiqued for its reliance on self-report [76], its emphasis on the individual without consideration of the collective [80], and its assumption—in contrast to a media effects perspective—that users have full agency when they choose to engage with technology [18]. Despite its shortcomings, U&G has proven over many decades to be one productive way of understanding how individuals' engage with media and technology [69]. Similarly, although we chose to focus on meaningfulness, concepts such as self-actualization [48] and meaning-making [36] also shed light on eudaimonic well-being. Using other frameworks to examine how people derive meaning from their smartphone use would provide a valuable complement to the data we present here.

6 CONCLUSION

In this study, we used a U&G perspective to examine how motivation (i.e., a specific intention or a general habit) and type of use (e.g., information-seeking or communication) affect the meaning that a user derives from phone use. We developed a typology of 5 different smartphone uses and gratifications and found that users routinely used the same app for different purposes. Passively browsing social media and consuming entertainment felt less meaningful to participants than other types of use. Using one's phone out of habit—for any type of use—also reduced meaning. Participants explained that they wanted to cut back on this habitual use, which they associated with a lack of autonomy. Separately, some participants said that they do not always seek meaning from their phone; sometimes they seek escape, which can offer lasting value by distracting or calming them during high-arousal emotions (e.g., anger). Designers who seek to promote experiences that users find meaningful can consider the types of use they promote, the extent to which they erode users' intentions, and how their designs are likely to promote or inhibit autonomy.

ACKNOWLEDGMENTS

Funding for this study was provided by the Intel Science & Technology Center on Pervasive Computing and NSF grant #IIS-1553167. We thank Gary Hsieh, Tadayoshi Kohno, and Sean Munson for their assistance with the study design; Philippe Verduyn for sharing his study protocol; David Ribes, Daniela Rosner, Sean Munson, and Ulrik Lyngs for their feedback on draft versions; Xiaoyi Zhang for support in the development of our Android app; IMWUT reviewers for their thoughtful feedback; and all of the study participants for their responses.

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Received November 2017; revised January 2018; accepted January 2018.