

The Smartphone as a Pacifier and its Consequences

Young adults' smartphone usage in moments of solitude and correlations to self-reflection

Sarah Diefenbach

Department of Psychology
Ludwig-Maximilians University of Munich
Munich, Germany
sarah.diefenbach@lmu.de

Kim Borrmann

Department of Psychology
Ludwig-Maximilians University of Munich
Munich, Germany
kim.borrmann@gmx.de

ABSTRACT

The smartphone plays a dominant role in everyday life. Among young adults, the average daily usage time is almost four hours. The present study [N=399] examines the specific psychological role of smartphone usage during alone time (e.g. in the subway, waiting, in bed). Particularly, we explore its role in coping with negative emotions in the sense of an “attachment object”, providing comfort like a pacifier for infants. Results underlined the pacifying role of smartphone usage to cope with negative emotions in moments of alone time. Moreover, particular personality dispositions (e.g., high need to belong, high proneness to boredom) were associated with more extensive self-reported smartphone usage and mediated by the perception of the smartphone as an attachment object. Finally, smartphone usage was negatively correlated to self-insight, possibly substituting intense inner debates or self-realizations during alone time. Implications for HCI research and practice are discussed.

KEYWORDS

Smartphone usage, alone time, attachment object, capacity for solitude, need to belong, proneness to boredom, self-reflection, self-insight, positive technology design

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1 INTRODUCTION

Since the invention of the first iPhone more than a decade ago, the smartphone's influence on peoples' lives has been continuously increasing. Its rising pervasiveness becomes evident through statistics on adoption rate and usage time. For example, the average daily time millennials (i.e., people born between 1980 and 2000) worldwide spent on mobile internet applications increased from 107 to 223 minutes from 2012 to 2017 [93]. With its handiness and multifunctionality the smartphone has become the “consumers' constant companion” [103:149] and is present across all domains of life: work, relationships, and solitude [16, 103]. Simultaneously to the rise of the smartphone, research in the fields of human-computer interaction (HCI) and psychology showed increasing interest in users' experiences and motivations related to smartphone usage, including personality factors, individual perceptions, and connotations of the smartphone, as well as consequences of usage for cognitive and emotional variables. For example, HCI research found positive correlations between intensity of smartphone use and personality traits such as capacity for solitude [11], need to belong [50], and proneness to boredom [62, 67]. Such findings suggest that smartphone usage may seem more or less attractive depending on one's personality structure. More specifically, the smartphone may fulfill psychological needs related to particular personality traits, whereby the utilization of the smartphone for need fulfillment could also be an unconscious process. This also fits users' reflections about their own usage behavior, typically describing smartphone usage as “unplanned” activity and running “under the radar” for most of the time [60]. In extreme cases, smartphone usage may even result in compulsive behavior (e.g., continuous habitual checking on missed calls or messages) that is no more enjoyable but primarily stressful [58]. In an ethnographic HCI study by Aranda and Braig [4], one participant labelled this kind of habitual, excessive smartphone use as a “prison”, since “you can get lost in your phone and not get out.” [4:19:4]. However, despite

feeling stressed by the phone from time to time, for many of the participants, the imagination of being without one's phone appeared even more stressful and extremely inconvenient. Referring to the irresistibility of constant checking, one participant described the smartphone as a "pocket slot machine" where a reward could arrive at any moment, logically implying continuous use: "If you could win the lottery at any moment, wouldn't you keep checking?" [4:19:3]. All these findings underline the pervasive effects of the smartphone in daily life and the immense relevance of related psychological functions.

In the realms of work or academic performance, a correlational study found a negative association between cell phone use and academic performance [63]. An experimental study showed that the mere presence of the smartphone reduced cognitive capacity, especially for those users with a higher dependence on the phone [103]. A review of the literature on habitual smartphone usage and cognition concluded that smartphones have the potential to affect cognitive capabilities such as attention and memory, however results are still inconclusive and further research is necessary [105]. Regarding interpersonal relationships, Przybylski and Weinstein [78] showed that the mere presence of a smartphone in social situations reduced the perceived interpersonal closeness, connection, and quality of a face-to-face conversation. Further, digital interaction and especially the usage of social media and Facebook was linked to less social capital [14] and increased loneliness [49]. For single measures, academic studies found also positive effects of social media, such as texting to express affection being linked to higher partner attachment [86]. Another set of studies hints at contradictions between attitude and smartphone behavior. For example, a survey by Drago [27] found that 85% agreed to the statement that present technology impairs interpersonal communication. Nevertheless, 62% were observed using either smartphones, tablets or laptops during conversations. Besides academic research, also popular press articles on negative side effects of smartphone usage on relationships and work increased and initiatives like the "Stop Phubbing" Campaign occurred [28]. Despite all these warnings about the smartphone's negative impact on social situations, the overall smartphone usage time continued to rise (e.g. [18]). However, the still increasing smartphone usage time might not only reflect usage habits in social situations. It may also be an indication that we use more and more of our solitary time to engage with our phones – time, that in earlier days may have been spent with contemplation and self-reflection. Despite the central link of self-reflection and self-insight to psychological well-being (e.g. [41, 36]), little attention has

been given to smartphone usage in the context of solitude and self-reflection. Rare exceptions are concepts such as "GoSlow" [20], i.e., a mobile app to help users slow down, contemplate, and be alone. As a counterpart to the community-driven features of almost every new application, "GoSlow" puts solitude instead of connection into the focus of design. Most studies, however, rather considered the consequences of smartphone usage for cognitive performance and interpersonal relationships and did not necessarily differentiate between usage during alone time and in presence of relevant others.

2 RESEARCH GOALS AND CONTRIBUTIONS TO HCI

In order to fill this gap, the present research focuses on the specific situation of smartphone usage in moments of solitude, its determinants, and consequences. Referring to the psychological hypothesis of the smartphone as an "adult pacifier" [71], we explore to what degree the smartphone is perceived as an attachment object with the power to reduce negative emotions in solitude and how this perception may mediate usage frequency. Thereby, our research follows an interdisciplinary approach grounded in HCI and utilizing psychological theory. Our study starts from a well-documented empirical phenomenon of HCI (increasing smartphone usage), links this phenomenon to assumptions about potential consequence for user well-being based on psychological theory (intense smartphone usage in moments of solitude, change of self-reflective routines), and thus addresses a current gap in HCI research (lacking studies on smartphone usage during alone time). Hence, our study provides a first account to specifically investigate potential reasons for and consequences of smartphone usage during alone time with various contributions to the field of HCI and psychology. First, as the smartphone is continuously granted more of our time, it is important to understand its effect on psychological well-being. This study adds to the HCI literature by exploring the consequences of smartphone usage on self-reflection and self-insight. In addition, our research underlines the importance of a context-specific approach that accounts for drivers of smartphone usage in different situations. While previous studies already linked personality traits and dispositions such as extraversion, neuroticism or impulsiveness (e.g. [73, 82]) to increased smartphone usage and addiction (for an overview see [25]), the present study identifies personality dispositions which might especially contribute to the smartphone use during solitude. As argued by Srivastava [92], one of the key psychological functions of the smartphone is its social function in the

sense of fulfilling needs for belongingness and building up a social network. The smartphone “has moved from being a mere ‘technological object’ to a key ‘social object.’” [92:111]. This social function may become especially relevant during alone time, why we also relate our research to social network studies. Additionally, the consideration of the smartphone as a coping tool for negative emotions outlines a new perspective that goes beyond the personality approach and might help to further understand the rising usage hours.

Besides these benefits to a better theoretical understanding of HCI, this study also aims to derive practical implications for different fields, reaching from psychoeducation, which supports people to understand their own behaviors and act more consciously, to digital marketing and well-being-oriented technology design.

In the following, we first summarize related work from HCI and psychology and derive related hypotheses. This includes smartphone usage during alone time in general, personality factors related to a more negative experience of alone time and their relation to increased smartphone usage in such moments, the potential mediating role of perceiving the smartphone as an attachment object, and finally consequences for self-reflection and self-insight. After this, we present findings from an empirical study of smartphone usage during alone time and discuss its implications for HCI research and practice.

3 RELATED WORK AND HYPOTHESES

3.1 Smartphone usage during alone time

Most statistics on smartphone usage do not differentiate between diverse situations of usage. For instance, it is not clear how much of the time is spent on the phone during lectures, at work, while being with friends or alone. However, single studies on specific situations of alone time already indicate that smartphone usage has become an inherent part of many of such situations. For example, situations of transit or waiting times are often perceived as a waste of time or as boring so that the smartphone provides a welcome opportunity for stimulation and distraction. An observational study found that 62% of the individuals who were waiting alone in public spaces used their phones, while less people who were engaged in conversations did so [53]. Another survey revealed that around 87% of participants reported to use their smartphones while waiting for something or someone [96]. In addition, people generally agreed that it is more acceptable to use the phone on the way or when waiting somewhere, compared to when being with family and friends, in a meeting, at the movies or in church [80]. These

results indicate that people show a high tendency to be occupied with their smartphones when they are commuting or waiting alone.

Not only in waiting situations, smartphone usage seems to be a popular strategy against boredom for many. A survey by Smith [90] showed that 93% of the 18-29-year-olds used their smartphones to avoid boredom at least once during a one-week study period. Since people may often feel bored when being alone, boredom could be one initiation of smartphone usage during alone time. Moreover, solitude is often perceived as loneliness, especially by those with higher needs to belong [70]. The smartphone may offer a relief to this negative mood through distraction or the possibility to communicate to other people. McNally and Harrington [69] found that in situations such as right before going to sleep, waiting or during downtime, young adults watch videos (primarily on their smartphones) to relax, relieve stress or boredom or to wind down. In this sense, smartphone usage in situations of solitude might serve as a mood repair strategy and help to escape negative emotions such as boredom or loneliness. On the other hand, *not* engaging in boredom or solitude might negatively affect creativity and self-reflection on the long-term. As the psychologist and technology critic Sherry Turkle argues, “the disrespect for solitude” might have detrimental effects on people’s capacity to self-reflect (Sherry Turkle in an interview with Gross [38]). Spending most of the alone time on the phone might have negative long-term effects, because people actually need time alone to recover from social stressors and to gain self-insights and personal development (e.g. [13, 51]). In line with this, studies on smartphone overuse [59] identified frequent interferences between smartphone use and personal needs in times typically suited for self-reflection, e.g., before going to bed or when waking up. Also, besides the home environment, many spaces once associated with solitude and reflection become more and more absorbed by technology usage, such as the nature context. As argued by Häkkinen et al. [39], mobile technology provides many possibilities to enhance user experiences in nature, and applications for navigation, wellness tracking, and photo sharing are certainly useful for many users. However, this technology is also a factor of distraction. Hence, they consider it as an important goal to develop mobile technologies that enable going into nature but do not interrupt the user’s experience of nature. Formulated more drastically, Montag and Walla [74:2] claim that “[d]ue to smartphones and Internet, we stop communicating with our directly available environment and we stop experiencing the current moment. In general, we forget what life really is all about.”

3.2 Personality factors contributing to negative emotions during alone time

People experience solitude differently [64]. While some people mainly see solitude as an aversive state they try to avoid, others even seek solitude and profit from it. This also explains the rather low correlation between social isolation and experienced loneliness, i.e., a felt pain of being alone [24]. Regarding the present research, individual differences in the experience of solitude could be relevant to whether people feel an urge to counteract solitude through digital communication and social media.

One central personality factor for a person's experience of solitude seems the so-called **capacity for solitude** [107]. It describes the ability to be (mentally) separate from others without acting on impulsiveness or feeling negative emotions like loneliness or fear [54]. The degree to which a person builds up a capacity to be alone is crucial for how time alone is being spent and experienced. According to Long, Seburn, Averill, and More [64], time alone can be categorized into three experiential facets: inner-directed solitude (characterized by self-discovery and peace), outer-directed solitude (characterized by intimacy and spirituality), and loneliness. While engaging in inner- and outer-directed solitude is positively connoted, loneliness is negatively connoted and associated with emotional pain [64, 97]. Most empirical psychological research has been focused on the latter facet, i.e., the negative perception of time spent alone [64]. Loneliness has been associated to a broad range of negative psychological outcomes, such as depression, anxiety, increased likelihood of substance misuse, lower social skills, a more critical view of self, and perfectionism [111]. Moreover, loneliness has been found to be correlated to different personality traits, especially neuroticism (i.e., emotional lability) and introversion [64]. As argued by Long et al. [64: 581], the correlation to introversion may seem surprising, given that stereotypically, the introvert is less in need of the company of others than an extravert is. On the other hand, they argue, introversion is also more associated with negative affect, of which loneliness may be a part of.

In contrast to those who suffer from solitude and experience it negatively, individuals capable to exploit solitude for appraisal and regeneration have been found to be more stress resilient [55]. Chua and Koestner [21] found that individuals who spent time alone in a volitional and autonomous manner, reported lower levels of loneliness and higher levels of well-being. In addition, Burger [12] emphasized the potential bidirectional relation between pursued solitude and well-being, meaning solitude

contributes to happiness and well-adjusted people learned to appreciate time alone.

However, nowadays, in our digitally connected world, the capacity for solitude and the ability to bear the absence of immediate social reinforcement [54] may become less practiced. Technology enables everyone to constantly connect with others via messengers like WhatsApp. Social networks like Facebook offer instant access to social reinforcement at almost any time. In this vein, Turkle [99] argues that children who grow up surrounded with smart communication devices do not learn to cope with being alone. This is in line with empirical findings of correlations between experienced social isolation and social media usage [77, 102], loneliness, and smartphone addiction [48], as well as preference for solitude being linked to less smartphone usage in moments of alone time [11]. In sum, the way we experience solitude is likely to influence whether we turn to our smartphones in alone times.

Another relevant personality factor for smartphone use in alone time could be the individual **need to belong**, i.e., one's desire to build lasting interpersonal relationships [5, 75]. Many psychological need theories acknowledged belongingness as a fundamental human need (for an overview see [88]). Although all human beings desire to belong, people chronically differ in the extent to which they do so [5, 57], implying different reactions in moments of alone time. Generally, people with a higher need to belong experience more loneliness in situations of solitude [70]. Furthermore, Hartung and Renner [42] showed that the physical health of people with a higher need to belong was negatively affected by the perceived loneliness. Conversely, among people with a lower need to belong, social isolation did not negatively impact their physical health. Moreover, research demonstrated behavioral differences in situations of solitude, depending on the individual need to belong. For example, people with a higher need to belong talk more to themselves while being alone [81] and engage more in parasocial interactions (one-sided relationships) with TV personalities to reduce feelings of loneliness [37]. Nowadays, also the smartphone offers various possibilities to distract oneself to feel less lonely. For example, research showed that a higher need to belong is associated with higher mobile phone usage and social media usage [50]. In another study, social needs had the largest effect on the motivation to use social and other media, compared to emotional, cognitive, and habitual needs [102]. Interestingly, the need to belong was not immediately gratified by social media. Thus, although smartphones or rather social media do not seem to reliably fulfill the need to belong, people seem to believe so and repeatedly search

for social reinforcement in the digital space. This is in line with the claims of Maulana [68:31] about “pseudo-social networks, where we post too many messages and just read very few”. As he suggests, social media make it very easy to express ourselves, but it becomes increasingly difficult to attract other users’ attention. Not getting the attention one hopes for in social media is a painful experience, given that “unfortunately, we cannot ignore being ignored” [68:32].

Finally, considering that the largest part of smartphone usage is not instrumental usage related to a specific goal, but ritualistic usage to browse, explore, or pass the time [44], also the individual **proneness to boredom** could be relevant for smartphone usage in alone time: Boredom is a well-known human experience that describes a state of dissatisfaction caused by insufficient stimulation [72], which can be further differentiated into state boredom, i.e., the actual experience of boredom, and trait boredom, i.e., the predisposition to become bored [67]. In the present study we focus on the trait facet, namely, proneness to boredom as a tendency to experience boredom more easily [29]. In contrast to state boredom, which has also been linked to positive outcomes such as creativity [66], trait boredom has rather been linked to negative emotions and behaviors such as gambling [7], depression, anxiety, and substance abuse [61, 35] as well as less mindfulness [61] and lower academic achievements [15]. Moreover, and of primary relevance for the present research focus, proneness to boredom has also been linked to more perceived loneliness [29] and sensation seeking [46]. Concerning smartphone usage, this may indicate that people prone to boredom might turn to their phones more often, especially when they are alone. Smartphones offer stimulation [76] and the possibility to reach out to other people, which could counteract boredom. In line with this, Matic, Pielot, and Oliver [67] found a linkage between high proneness to boredom and particular mobile phone usage behaviors such as opening the phone more often during the day, changing the screen orientation more often, receiving more social network notifications, launching more apps, having higher charging times, and transmitting higher amounts of data. Based on these findings of previous research, we may assume that a dispositional proneness to boredom goes along with more perceived boredom in moments of alone time, and finally higher smartphone usage.

In sum, we thus assume (H1) that personality dispositions leading to negative emotions in moments of alone time are positively associated with smartphone usage during alone time. More specifically, we hypothesize (H1a) a negative association between smartphone usage during alone time and capacity for solitude and a positive association between

smartphone usage during alone time and (H1b) need to belong as well as (H1c) proneness to boredom.

3.3 The smartphone as an attachment object to cope with negative emotions

Previous research on the psychological effects of smartphone usage and users’ bonding to their phone often focused on excessive usage and the negative outcomes of smartphone addiction (e.g. [6, 82, 85]). In contrast, less research has considered positive effects of the smartphone and its potential value for the user as an “attachment object”. The concept of attachment objects can be traced back to Bowlby’s [9, 10] influential theory of attachment in the context of developmental psychology, originally referring to the relationship between children and their primary caregiver. If the primary caregiver responds to the child’s needs adequately, it acquires the role of an “attachment object” with the ability to provide a sense of security to the child, whereas separation from it leads to stress [9, 43]. If the primary caregiver is not available, children search for compensatory attachment objects, which can be other people or also objects (e.g., a pacifier) [43, 108]. This theory has proven to be also helpful to explain relationships between adults as well as between adults and objects. The possession of attachment objects showed to have positive outcomes such as better mood and higher life satisfaction [89], better psychological health [109], and spending comfort in times of stress [95].

Several characteristics suggest the smartphone might qualify as an attachment object. First, like a responsive caregiver, it serves various psychological needs. For example, it provides connectedness through calls, texting, and social media functions [3, 92], whereas features such as Google maps may provide a sense of autonomy and personal safety [3], also in unknown surroundings. Second, personalization features like display backgrounds support uniqueness [96, 100], which might contribute to its perceived personal relevance. Third, the high usability and the option to perform various tasks quickly and easily might serve promote high usage frequencies and thus familiarity [96]. Finally, it is reliable and controllable [52].

If assuming that for some people the smartphone functions as an attachment object, its separation should cause symptoms of stress and anxiety while its proximity should provide comfort and stress relief [71]. Indeed, several studies show first incidence for this assumption. For example, in a qualitative study by Fullwood and colleagues [31] participants stated that their smartphones were “like friends” and that the thought of losing their phone made them anxious. Moreover, several empirical studies showed

that separation from the phone resulted in increased anxiety (e.g. [22, 52, 45, 98, 31]), especially for heavy users [19] or individuals feeling uncertain about their relationships [47]. On the other hand, proximity of the phone was associated with positive affect (e.g., feeling safe [98]), and reduced negative affect (e.g., feeling less bored and less stressed [31]). Similarly, Melumad and Pham [71] conducted two experimental studies showing that after a stressful situation, participants felt more comfort and more stress relief after interacting with their smartphone than with a laptop. Based on these findings, we may assume (H2) that people who perceived the smartphone as an attachment object tend to use their smartphone more often in moments of alone time and that this perception is also deciding for whether smartphone usage appears as an evident way to cope with negative emotions. We thus hypothesize that (H2a) the perception of the smartphone as an attachment object, which helps to cope with negative emotions, is positively associated with smartphone usage during alone time. Furthermore, we assume that the perception of the smartphone as an attachment object mediates the relationship between smartphone usage during alone time and the need to belong as well as proneness to boredom. In other words, only if the smartphone is perceived as an object with the power to provide relief and reduce negative emotions, personality traits related to a negative experience of alone time (i.e., a high need to belong and proneness to boredom) should trigger smartphone usage in such situations. We thus hypothesize that the perception of the smartphone as an attachment object, which helps to cope with negative emotions, mediates the relationship between smartphone usage in moments of alone time and (H2b) need to belong as well as (H2c) proneness to boredom.

3.4 Effects of smartphone usage on self-reflection and self-insight

While smartphone use in moments of alone time may provide momentary relief and reduce the negative experience of solitude (i.e., loneliness), it may on the other hand hinder some of the possible positive effects of solitude, such as the engagement in self-reflection (e.g. [54]). Several researchers already raised concerns about the diminishing time for self-reflection as we spend less time alone and more with our phones (e.g., [99]). Similarly, it has been argued that the digitalization in general drives our desire for continuous stimulation and stops us from exploring complex thoughts and questions that might not lead to instant rewards [104]. Besides self-reflection per se, also positive outcomes of self-reflection such as self-insight

could be negatively associated to smartphone usage in alone time. Though self-reflection and self-insight are related (it is hardly imaginable that one will reach insight about oneself without any self-reflection), self-reflection must not necessarily lead to effective self-insight, i.e., reaching a “clarity of understanding of one’s thoughts, feelings, and behavior” [36:821]. Instead, considerable time spent with self-reflection can still result in no insight. This perspective highlights that the process of self-reflection can be frustrating, which could make the instant gratifications of a mobile device appear even more tempting. However, from a long-term perspective, the avoidance of self-reflection seems dysfunctional, given its importance for self-regulation [17, 87] and psychological well-being [94]. Additionally, self-insight has been associated with a number of positive variables such as satisfaction with life, perceived purpose in life, positive relationships with others, environmental mastery, autonomy, and personal growth [41], and negatively associated with depression, anxiety, stress, and alexithymia [36]. In sum, we deem it possible that the engagement in self-reflective processes is diminishing when alone time becomes more and more absorbed by smartphone usage. We thus hypothesize that a higher engagement in smartphone activities during alone time is linked to (H3a) fewer self-reflection and (H3b) fewer self-insight.

4 STUDY

4.1 Qualitative pre-study

Prior to the main study, we performed a qualitative pre-study (N=14) consisting of three focus group sessions (n=6, n=4, n=4), each accompanied by a preparation exercise. Two days prior to the focus group, participants were asked to observe themselves the next day and to note down at least five incidents of personal smartphone usage, including motivations for smartphone use and context factors. The aim of this pre-study was to get a first glimpse of the general relevance of smartphone usage during alone time and to collect input for scale development for the main study, especially to capture smartphone usage during alone time. In the focus group sessions participants discussed reasons for smartphone usage and situation-specific unwanted side effects. More specifically, the discussion was led by two guiding questions, namely, “Why do you use your smartphones?” and “In which situations are you using your smartphones and how does this impact the respective situation?”. This open question format was chosen to test whether participants would freely express the importance and reasons of smartphone usage during alone time and possible impacts on self-reflection. A detailed presentation

of findings is beyond the scope of the present paper. However, regarding our central research interest, a central finding was that alone time appeared as one typical situation of smartphone usage. Regarding the impacts of smartphone usage, some participants actually uttered a concern in the direction of diminishing time for self-reflection (e.g., “I fear I am taking less time for myself”, “thinking seems to be harder, when it is so easy to numb oneself [with the phone]”), whereas others argued that alone time was actually the best time to use the phone (“I’d say these are the most appropriate situations. If you are not doing anything; neither tying social contacts nor working, these are the best moments to answer WhatsApp messages or to practice Duolingo.”). This latter perspective underlines that some people might deliberately choose to use their phones while being alone rather than while being with others and thus confirms alone time as a relevant context of study. While for most measures of interest in the main study, we could refer to established validated scales, there was no existing scale to measure smartphone usage during alone time. Thus, based on the most frequently mentioned situations of smartphone usage during alone time, we developed four items to capture smartphone usage during alone time (e.g. commuting, awake in bed, waiting situations, see Table 1 for full instruction and a sample item).

4.2 Method

Data was collected through an online survey with the software Unipark. The convenience sample was recruited via different social networks, online blogs, and university websites. Participation was anonymous and voluntary. 339 individuals (271 female) took part in the study and completed the whole survey, most of them (294) being students of diverse study subjects. The mean age was 21.2 years ($SD = 3.09$, $min = 17$, $max = 30$). After a short introduction to the study, we surveyed different measures related to smartphone usage and personality dispositions with regards to the above specified hypotheses as listed in Table 1. Most items were assessed on 5-point-Likert scales, ranging from 1 = completely disagree to 5 = totally agree. For proneness to boredom, self-reflection and self-insight, we used a 7-point-Likert scale. For smartphone usage during alone time the scale endpoints were labelled 1 = no time at all and 7 = the whole time. The internal scale consistency was satisfying for all scales (see Table 1, last column for Cronbach’s alpha values). In addition, we surveyed gender, age, occupation, and usage of different smartphone applications (e.g., messaging apps, gaming).

Table 1. Surveyed measures of smartphone (SP) usage and personality dispositions.

Measure	Origin	Sample item	α
Capacity for solitude, 7 items	Burger, 1995	I enjoy being by myself.	.80
Need to belong, 6 items	Leary, 2013	I have a strong need to belong.	.71
Proneness to boredom, 7 items	Farmer & Sundberg, 1986	In any situation, I can usually find something to do or see to keep me interested.	.75
Perception of SP as attachment object, 4 items	Melumad & Pham, 2017	If I feel lonely, using my smartphone calms me down.	.75
SP usage during alone time 4 items	Self-developed	Please think about day-to-day situations during the last week in which you were alone on the way, e.g. commuting to work or school taking the bus or subway. How much of the time on the way did you use your smartphone?	.70
Self-reflection 8 items	Grant et al., 2002	I frequently take time to reflect on my thoughts	.86
Self-insight, 8 items	Grant et al., 2002	I usually have a very clear idea about why I have behaved in a certain way.	.83

4.3 Results

Table 2 shows the descriptive data of the surveyed measures. It shows that the average total time of smartphone usage was more than three hours a day, with messaging apps and social media being the most used applications. The mean value of smartphone usage during alone time on the applied 7-point-scale was 4.48 and significantly exceeding the neutral scale midpoint ($T = 8.98$, $p < .001$), indicating a general tendency to smartphone usage in moments of solitude.

Table 3 shows the correlational analysis of the relevant measures regarding our hypotheses. In line with H1a, the capacity for solitude was negatively linked to smartphone usage during alone time ($r = -.21$, $p < .001$). Need to belong was positively related to smartphone usage during alone

time ($r = .20, p < .001$) and so was proneness to boredom ($r = .24, p < .001$), supporting hypothesis H1b and H1c. Overall, the empirical data thus supported the assumption that personality traits leading to negative emotions in moments of alone time are positively associated with smartphone usage in moments of alone time and vice versa.

Table 2. Descriptive data of surveyed measures.

Measure	M	SD	min	max
Capacity for solitude	3.53	.75	1.43	5.00
Need to belong	3.28	.75	1.00	5.00
Proneness to boredom	3.15	.93	1.14	5.86
SP as attachment object	3.18	.88	1.00	5.00
SP usage during alone time	4.48	.99	1.50	7.00
Self-reflection	5.13	1.06	1.50	7.00
Self-insight	4.80	.98	1.63	7.00
Daily SP usage [min]	197	138	6	730
Messaging Apps [min]	74	73	0	540
Social Media [min]	60	56	0	360
Information Sources [min]	16	21	0	150
Functional Services (Camera, Alarm, Notes etc.) [min]	12	14	0	120
Gaming [min]	10	23	0	200
E-Mails [min]	10	11	0	90

Table 3. Correlational analysis. Note: * $p < .05$; ** $p < .01$.

Measure	1	2	3	4	5	6	7
1 Capacity for solitude	1						
2 Need to belong	-.48**	1					
3 Proneness to boredom	-.14**	.24**	1				
4 SP as attachment object	-.10	.29**	.34**	1			
5 SP usage alone time	-.21**	.20**	.24**	.58**	1		
6 Self-reflection	.23**	.03	-.14*	-.03	-.07	1	
7 Self-insight	.16**	-.32**	-.35**	-.18**	-.21**	.23**	1

The perception of the smartphone as an attachment object was strongly positively related to smartphone usage during alone time ($r = .58, p < .001$), supporting Hypothesis H2a. Need to belong and proneness to boredom were both moderately positively related to the perception of the smartphone as an attachment object ($r = .29, p < .001$; $r = .34, p < .001$), meeting the requirement for an analysis of the assumed mediation effects (H2b, H2c).

Figure 1 illustrates the standardized regression coefficients for the relationship between need to belong and smartphone usage during alone time (top) as well as between proneness to boredom and smartphone usage during alone time (bottom) with perception of the

smartphone as an attachment object as a mediator. In both cases, the perception of the smartphone as an attachment object, which helps to cope with negative emotions, fully mediated the relationship between the two analyzed measures. For the relationship between need to belong and smartphone usage during alone time the indirect effect was .17 ($p < .001$) and statistically significant. The model explained 33.8% ($R^2 = .338$) of the variance of smartphone usage during alone time. Thus, hypothesis H2b was supported. For the relationship between proneness to boredom and smartphone usage during alone time the indirect effect was .2 ($p < .001$) and also statistically significant. The model explained 33.9% ($R^2 = .339$) of the variance of smartphone usage during alone time. Thus, hypothesis H2c was supported as well. Contrary to H3a, self-reflection was not significantly related to smartphone usage during alone time ($p \geq .05$). However, in line with H3b, self-insight was negatively related to smartphone usage during alone time ($r = -.21, p < .001$).

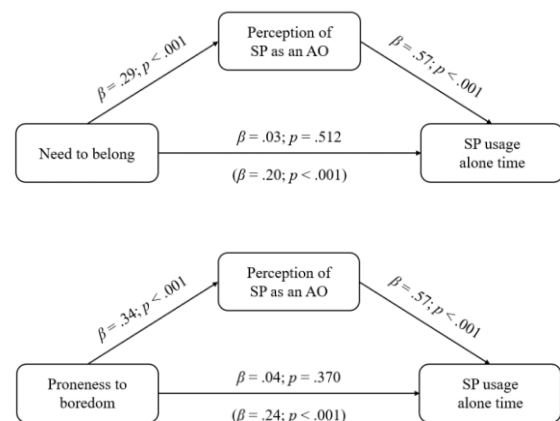


Figure 1: Mediation analysis.

5 DISCUSSION

The present study found that people with less capacity for solitude, higher need to belong, and higher proneness to boredom also report more frequent smartphone usage during alone time (e.g. while commuting, in waiting situations, alone in bed). These results are in line with other research positively linking need to belong [50], proneness to boredom [62, 67], and capacity for solitude [11] to smartphone use in general. A possible interpretation is that people who are more prone to negative emotions during solitude are more likely to use their phones. Note, however, that the present statistical results do not allow for causal attribution. In general, the present study must be seen as a

first exploration into a new research topic in HCI, providing preliminary findings which do not allow for clear conclusions yet. In particular, the interpretability of findings is limited by the lack of longitudinal and experimental data, the mere use of self-reports but no external assessments or objective usage data, a potentially related single source bias, as well as the focus on the user group of young adults. This needs to be kept in mind when discussing and interpreting the present findings (a detailed discussion of limitations and implications for future studies follows in the next section).

Regarding correlations to personality factors, it is more likely to assume that personality traits influence smartphone usage than not vice versa, since personality factors are considered as rather stable [29, 57]. Yet, also reciprocal relationships are possible. For example, it is imaginable that the more time people spend with their phones, the less capacity for solitude they develop. In general, the size of the detected correlations between personality factors and smartphone usage are rather small [23], ranging from .20-.30. However, this range is in line with other research trying to link personality traits like extraversion, neuroticism or impulsiveness to smartphone usage and addiction, which found similar or even smaller effect sizes (e.g. [25, 82]). Thus, in order to gain a full picture of the motivations behind smartphone use and its consequences, other factors beyond personality traits need to be considered.

In this regard, our study revealed that besides personality factors, another factor associated to smartphone usage during alone time is the perception of the smartphone as an attachment object with the power to reduce negative emotions like stress, sadness or boredom. Moreover, this factor mediated the relationships between need to belong and proneness to boredom with smartphone usage during alone time. In other words: People who feel lonely or bored during alone time only turn to their smartphones if they generally believe that it will provide comfort – similar to a pacifier. In contrast, people who do not perceive the smartphone as an attachment object might rather turn to other things or activities in moments of solitude. Note, however, that the present study did only survey people's subjective perceptions of the smartphone as an attachment object but did not investigate how much relief people actually experience from smartphone usage. In light of previous research, it can be assumed those peoples' hopes about smartphone use as a mood repair strategy might not be fulfilled to full degree. For example, Sagioglou and Greitemeyer [84] found that Facebook users kept checking Facebook, because they believed it would improve their

mood, when in fact they felt worse after using it. As typical for many areas of life, people might be subject to an affective forecasting error (for a review, see [106]). In addition, the study by Sagioglou and Greitemeyer [84] found that people regularly spend more time on Facebook than planned. Similarly, as already cited in the introduction section, smartphone usage often happens “unplanned”, using the smartphones in all kinds of unexpected situations but running “under the radar” for most of the time, so that people are unaware of the full extent to which unplanned uses fill up their time [60]. Especially routines such as compulsive checking habits promote a ground for continuous smartphone usage in all kinds of situations [58], including situations of alone time. However, further research is necessary to fully understand if and how the smartphone releases negative emotions and to what degree people engage in smartphone usage as a deliberate decision or simply out of habit.

Finally, referring to H3, our study revealed first insight into the association between smartphone usage in alone time and self-reflective processes. Other than assumed, there was no correlation between smartphone usage and self-reflection. This suggests that the engagement in self-reflection is independent from the smartphone usage during alone time: some of the young adults might use their smartphones while being engaged in self-reflective processes and some might not. In this regard, future research could explore whether there are specific smartphone activities that might be related to more or less engagement in self-reflection. It is presumable that some applications could even be supportive for self-reflective processes. For example, social media related activities like creating postings for a (positive) self-presentation, reading other people's posts and looking at the own profile history could initiate self-reflective processes. When social media consumption leads to envy [84], lower self-esteem [101] or depressive symptoms [65] through social comparison, one must reflect on oneself to compare oneself to others. In line with this, Yang and Bradford Brown [110] found small positive associations between intentionality and depth of Facebook postings to engagement in self-reflection.

While our research did not reveal an association between self-reflection and smartphone usage in alone time, the expected negative association between smartphone usage in alone time and self-insight was significant (H3b). One possible interpretation is that those who engage in self-reflective processes while being on the phone get less out of it. For example, the outcomes of self-reflection while being on the phone are potentially more superficial, because of interruptions like new messages that disturb thought

streams or biased self-perceptions through social media. In addition, while social media activities could potentially initiate self-reflection (e.g., thinking about how to present oneself on one's Facebook page), this external oriented type of reflection might not correspond to "honest" self-reflection and thus no self-insight. One problem might be that social media content is not representative as users tend to post mostly positive content and exaggerate positive events [33]. Naturally, looking at one self's highlights of the past year will improve the mood [34]. In contrast, comparing oneself to the never-ending highlights of other people's lives will deteriorate the mood (e.g. [65]). However, the self-reflection based on this content might lead to a biased perception of what really makes oneself happy or what is important to someone. For example, if someone presents herself as an outgoing and sociable person, because it is fashionable, although she is rather introverted, she might come to wrong conclusions about her own personality and subsequently will not understand why e.g. going to a big party makes her unhappy. In general, studies revealed that people tend to slip into negative behavioral cycles of smartphone and social media usage against their true desires (e.g., [4]): even though they are aware of the freedom to disconnect, they have difficulties to realize this in their daily routines, and often find themselves feeling trapped in a negative habit of excessive use. To break the cycle, it often needs external triggers. For example, Aranda and Braig [4:19:1] report anecdotes about users who first felt stressed when their phone ran out of battery, "but soon after, they felt a sense of calm wash over them, as if they were 'free'". Obviously, self-regulation related to healthy technology usage poses a challenge to people and an interesting question is how technology could lend support here.

Though our study found a small correlation between self-reflection and self-insight, the distinct correlation to smartphone usage of only self-insight underlines the distinction of the two different facets within theories of self-reflection [36]. Similar findings occurred for persuasive systems in the context of health behavior. In a survey among users of mobile health and fitness applications Halttu and Oina-Kukkonen [40] found that most of these tools aim to increase self-knowledge by providing information upon which to reflect, however, merely spending time reflecting did not always lead to insightful outcomes. Hence, another interesting question concerns more or less effective types of self-reflection. Previous research [83] already found correlations between social vs. non-social purposes of smartphone usage and different general self-regulation strategies (here: cognitive

reappraisal, emotional suppression). In this vein, future research could also explore particular types of smartphone usage in alone time (e.g., social vs. non-social purposes) and how these relate to self-reflection and self-insight.

6 LIMITATIONS

The present research is subject to several limitations to be addressed in future research. First, the data of the online survey was cross-sectional and correlational. Although the tested hypotheses were based on previous research and theories, given the lack of longitudinal and experimental data, causal attributions cannot be assumed (e.g. [8]). As mentioned above, it is, for example, possible that the more time people spend with their phones, the less capacity for solitude they develop or that the less self-insight someone has, the more he or she uses the smartphone during alone time. The relationships might also be reciprocal. Similarly, alternative models could be considered for the mediation models. Further studies are necessary to clarify the effective directions.

Second, the study focused on the generation of young adults. This generation might be especially susceptible for the effects of interest because they use smartphones more and differently than other generations [2]. Future studies should try to replicate the findings with more representative samples and compare different generations.

Third, the quantitative survey may underlie a single source bias. Participants might have tried to provide consistent and socially accepted answers which can lead to artificial correlations [91]. The risk of shared method variance was partially limited by assuring participants of the anonymity of their data and asking them to answer truthfully. Nevertheless, in line with the principle of data triangulation, future research must be complemented by other data sources like qualitative data, behavioral data, or reports from other people. A related limitation is that the study mainly relied on self-reports. Especially the indicated time people used their smartphones might be biased, given that people tend to underestimate the time they spend with their phones [1]. Yet, describing specific situations of alone time to help them remember and surveying the overall time spent with the phone instead of indicating minutes should have increased the validity.

Finally, smartphone, social media, internet, laptop, and tablet consumption are not completely distinctive. As seen in this study, most participants spent a lot of their time on their phone with social media. However, social media is also accessible on tablets or laptops. The smartphone is presumably the device of choice on the way or while waiting. However, the laptop might be the first choice

when being alone at home. This might have had confounding effects. Future research should explore if other digital devices are also used to escape negative emotions (during solitude), as the medium at hand might also result in different outcomes.

7 IMPLICATIONS FOR HCI RESEARCH AND PRACTICE

Regarding implications for HCI research and theory, we want to highlight three central aspects: One aspect to be examined further is the situation-specific approach to the study of motivations behind smartphone use. Though the influence of situational variables on behavior in general has been widely discussed in psychology (e.g. [30]), previous HCI research mainly investigated determinants of cross-situational smartphone usage finding only small effects (e.g. [82]). Thus, a dedicated focus on relationships between smartphone usage and well-being related to different contextual conditions, as realized in the present research, seems promising and may provide more profound insights into the determinants of smartphone usage. Within this, moments of solitude represent a so far understudied context with particularly interesting links to well-being, especially potential links to self-reflective processes. Nevertheless, the present study must be seen as only a first exploration of such relationships and cannot provide definite conclusions on the relationship between smartphone usage and self-reflection yet. Given the complexity of both elements, i.e., the many sub facets of self-reflection and their unclear relation to self-insight, as well as the various ways of how one could use the smartphone in alone time, our study based on general measures of self-reflection and smartphone usage only provides limited interpretability. Yet, in combination with previous studies in HCI and psychology, it points at the double-edged nature of the smartphone: while its consideration as a pacifier and distraction from negative feelings could prevent self-reflective processes, also productive uses that actually trigger and support self-reflection are thinkable. Individual tendencies to utilize the smartphone in one way or the other may be linked to personality factors and mediating smartphone connotations. In the present study, we only considered a limited set of personality factors and focused on one particular connotation of the smartphone in alone times, i.e., its perception as an attachment object. The found correlations of this perception to personality factors and self-reported smartphone usage during alone time suggest this field is worthy of further exploration, and must be advanced by studies around additional smartphone

connotations, as well as more substantial measures of smartphone usage such as real time usage data.

Thus, a second important implication of our research is to consider, and further study, individual connotations of the smartphone (or even other computing devices) that may help to understand the actual motivations behind usage and relations to personality factors. Regarding the present focus on the conceptualization of the smartphone as an attachment object, previous studies already proved that the separation from the smartphone causes anxiety and stress for some people (e.g. [22, 52, 98 31]). Future research in the field HCI could explore this aspect further, gaining a differentiated understanding of which particular technological factors contribute to the perception of an attachment object. Possible starting points might be personalization features (background pictures etc.), apps used (social media etc.) or its constant presence; previous studies on determinants of experienced product attachment already revealed similar factors (e.g. [26]). Furthermore, the potential positive effects of the attachment object could be investigated by experimental studies. For example, an experimental manipulation could induce negative emotions (e.g. loneliness, boredom) and offer different participant groups or different objects for coping (e.g. smartphone, tablet, newspaper, lucky charm) to gain deeper insight into the specific consequences of these objects. In a larger frame of HCI research, this will provide a basis for more elaborated models of relationships between smartphone usage and well-being, especially self-reflective processes.

Finally, even if the smartphone should prove to have short-term beneficial effects on the mood, its long-term effects on psychological well-being should be further investigated. Considering the present findings that the smartphone is used a lot during alone time and that this type of usage shows a negative association to self-insight, future research should investigate these mechanisms further – especially since self-insight represents an important protective factor against psychological disorders (e.g. [36]). One possible mechanism could be a reciprocal process between smartphone use and self-insight, leading into a vicious cycle. As argued by Carver and Scheier [17, 87], self-insight is necessary for self-regulation, whereby a decrease in self-regulation has been associated with an increase in smartphone usage (e.g. [82]). These associations might intensify each other adversely.

Besides these implications for HCI research and new theoretical perspectives on phenomena of human-computer interaction, the present study also offers starting points for different fields of practical applications of HCI research, such as marketing, health and psychoeducation. For

example, consumers' perception of marketing messages could depend on the individual attachment to the transmitting object: Perceiving the smartphone as an attachment object, which releases stress and provides comfort, could promote a generally higher effectiveness of marketing campaigns. On the other hand, it is also thinkable that this target group focuses more on the smartphone as an object and less on the content. From a health perspective, health promotion could utilize the potential calming effect of the smartphone, for example, in form of a self-reflection application. If the smartphone provides comfort and can to some degree buffer the accompanying negative emotions of self-reflection [17], it might form an adequate tool to enhance engagement in self-reflection. Such approaches, however, need profound exploration and evaluation. As already shown in HCI research, technology to support reflective thinking can generally be helpful [32, 79], but it still remains challenging to provide functions to actually integrate and maintain behavior change in daily life [20]. Finally, the present field of research could be relevant for psychoeducation and the promotion of a healthy consumption of digital technology. To name just one example: a workshop on responsible digital consumption could encourage participants to reflect on their current smartphone behavior and potential for change, using guiding questions such as, "Do I use my phone to escape negative emotions during alone time? How effective is that behavior and are there (better) alternatives?"

8 CONCLUSION

The present research provides a first empirical investigation of potential determinants and effects of smartphone usage during solitude. Our findings reveal that there are young adults who perceive the smartphone as an object which calms them down and helps them to regulate negative emotions, which may be interpreted in the sense of a pacifier, providing similar psychological functions. The consideration of the smartphone as an emotion-regulating attachment object during alone time offers an important extension of HCI research on the effects of smartphone use in everyday life. Hopefully, the present study inspires further research in this direction with the final aim to design actually smart technologies and human-computer-interactions that promote well-being.

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REFERENCES

- [1] S. Andrews, D. A. Ellis, H. Shaw, and L. Piwek. 2015. Beyond Self-Report: Tools to Compare Estimated and Real-World Smartphone Use. *PLOS ONE*, 10(10), e0139004. <https://doi.org/10.1371/journal.pone.0139004>
- [2] M. Anshari, Y. Alas, G. Hardaker, J. H. Jaidin, M. Smith, and A. D. Ahad. 2016. Smartphone habit and behavior in Brunei: Personalization, gender, and generation gap. *Computers in Human Behavior*, 64, 719–727. <https://doi.org/10.1016/j.chb.2016.07.063>
- [3] K. Aoki and E.J. Downes. 2003. An analysis of young people's use of and attitudes toward cell phones. *Telematics and Informatics*, 20(4), 349–364. [https://doi.org/10.1016/S0736-5853\(03\)00018-2](https://doi.org/10.1016/S0736-5853(03)00018-2)
- [4] J. H. Aranda and S. 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 (*MobileHCI '18*). ACM, New York, NY, USA, Article 19, 8 pages.
- [5] R. F. Baumeister and M. R. Leary. 1995. The need to belong: desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, 117(3), 497–529.
- [6] M. Bian and L. Leung. 2015. Linking Loneliness, Shyness, Smartphone Addiction Symptoms, and Patterns of Smartphone Use to Social Capital. *Social Science Computer Review*, 33(1), 61–79. <https://doi.org/10.1177/0894439314528779>
- [7] A. Blaszczyński, N. McConaghy, and A. Frankova. 1990. Boredom proneness in pathological gambling. *Psychological Reports*, 67(1), 35–42. <https://doi.org/10.2466/PRO.67.5.35-42>
- [8] J. Bortz and N. Döring. 2006. *Forschungsmethoden und Evaluation*. Berlin, Heidelberg: Springer. <https://doi.org/10.1007/978-3-540-33306-7>
- [9] J. Bowlby. 1969. *Attachment and Loss (Vol. 1)*. New York, NY: Attachment Basic Books. <https://doi.org/10.1177/000306518403200125>
- [10] J. Bowlby. 1982. Attachment and loss: retrospect and prospect. *American Journal of Orthopsychiatry*, 52(4), 664–678. <https://doi.org/10.1111/j.1939-0025.1982.tb01456.x>
- [11] L. Braun. 2016. Solitude Experiences in the Smart Phone Era. Master's Thesis. Universität Mannheim.
- [12] J. M. Burger. 1995. Individual Differences in Preference for Solitude. *Journal of Research in Personality*. <https://doi.org/10.1006/jrpe.1995.1005>
- [13] J. M. Burger. 1998. Solitude. In Encyclopedia of mental health (Vol. 3, p. 563–569). San Diego, CA: Academic Press.
- [14] M. Burke, C. Marlow, and T. Lento. 2010. Social network activity and social well-being. *Proceedings of the 28th International Conference on Human Factors in Computing Systems, 1909–1912*. <https://doi.org/10.1145/1753326.1753613>
- [15] L. L. Caldwell and E. a. Smith. 2006. Leisure as a Context for Youth Development and Delinquency Prevention. *Australian and New Zealand Journal of Criminology*, 39(3), 398–418.
- [16] S. W. Campbell. 2007. A cross-cultural comparison of perceptions and uses of mobile telephony. *New Media & Society*, 9(2), 343–363. <https://doi.org/10.1177/1461444807075016>
- [17] C. S. Carver and M. F. Scheier. 1988. *On the Self-Regulation of Behavior*. Cambridge, UK: Cambridge University Press.
- [18] D. Chaffey. 2017. Mobile marketing statistics 2017. Retrieved December 18, 2017, from <https://www.smartinsights.com/mobile-marketing/mobile-marketing-analytics/mobile-marketing-statistics/>
- [19] N. A. Cheever, L. D. Rosen, L. M. Carrier, and A. Chavez. 2014. Out of sight is not out of mind: The impact of restricting wireless mobile device use on anxiety levels among low, moderate and high users. *Computers in Human Behavior*, 37, 290–297. <https://doi.org/10.1016/j.chb.2014.05.002>
- [20] J. Cheng, A. Bapat, G. Thomas, K. Tse, N. Nawathe, J. Crockett, and G. Leshed. 2011. GoSlow: designing for slowness, reflection and solitude. In *CHI '11 Extended Abstracts on Human Factors in Computing Systems (CHI EA '11)*. ACM, New York, NY, USA, 429–438. <https://doi-org.emedien.uni-muenchen.de/10.1145/1979742.1979622>
- [21] S. N. Chua and R. Koestner. 2008. A Self-Determination Theory Perspective on the Role of Autonomy in Solitary Behavior. *The Journal of Social Psychology*, 148(5), 645–648. <https://doi.org/10.3200/SOCP.148.5.645-648>
- [22] R. B. Clayton, G. Leshner, and A. Almond. 2015. The Extended iSelf: The Impact of iPhone Separation on Cognition, Emotion, and Physiology. *Journal of Computer-Mediated Communication*, 20(2), 119–135. <https://doi.org/10.1111/jcc4.12109>
- [23] J. Cohen. 1988. *Statistical Power Analysis for the Behavioral Sciences (Vol. 2nd)*. Hillsdale, NJ: Erlbaum.
- [24] C. E. Coyle and E. Dugan. 2012. Social isolation, loneliness and health among older adults. *Journal of aging and health*, 24(8), 1346–1363.

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- [25] J. De-Sola Gutiérrez, F. Rodríguez de Fonseca, and G. Rubio. 2016. Cell-Phone Addiction: A Review. *Frontiers in Psychiatry*, 7, 175. <https://doi.org/10.3389/fpsy.2016.00175>
- [26] S. Diefenbach and M. Hassenzähl. 2017. Combining model-based analysis with phenomenological insight: a case study on hedonic product quality. *Qualitative Psychology*.
- [27] E. Drago. 2015. The effect of technology on face-to-face communication. *The Elon Journal of Undergraduate Research in Communications*, 6(2), 13–19.
- [28] C. Ellicott. 2013. Are you a phubber? Campaign launched to stop smartphone addicts snubbing others by checking their mobiles. Retrieved December 18, 2017, from <http://www.dailymail.co.uk/news/article-2384397/Are-phubber-Campaign-launched-stop-smartphone-addicts-snubbing-checking-mobiles.html>
- [29] R. Farmer and N. D. Sundberg. 1986. Boredom proneness: The development and correlates of a new scale. *Journal of Personality Assessment*, 50(1), 4–17. https://doi.org/10.1207/s15327752jpa5001_2
- [30] W. Fleeson and E. Nofhle. 2008. The End of the Person–Situation Debate: An Emerging Synthesis in the Answer to the Consistency Question. *Social and Personality Psychology Compass*, 2(4), 1667–1684. <https://doi.org/10.1111/j.1751-9004.2008.00122.x>
- [31] C. Fullwood, S. Quinn, L. K. Kaye, and C. 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, 347–355. <https://doi.org/10.1016/j.chb.2017.05.029>
- [32] M. Ghajargar, M. Wiberg, and E. Stolterman. 2018. Designing IoT Systems that Support Reflective Thinking: A Relational Approach. *International Journal of Design [Online]* 12:1. <http://www.ijdesign.org/index.php/IJDesign/article/view/2972>
- [33] O. Gil-Or, Y. Levi-Belz, and O. Turel. 2015. The “Facebook-self”: characteristics and psychological predictors of false self-presentation on Facebook. *Frontiers in Psychology*, 6, 99. <https://doi.org/10.3389/fpsyg.2015.00099>
- [34] A. L. Gonzales and J. T. Hancock. 2011. Mirror, Mirror on my Facebook Wall: Effects of Exposure to Facebook on Self-Esteem. *Cyberpsychology, Behavior, and Social Networking*, 14(1–2), 79–83. <https://doi.org/10.1089/cyber.2009.0411>
- [35] A. Gordon, R. Wilkinson, A. McGown, and S. Jovanoska. 1997. The psychometric properties of the Boredom Proneness Scale: An examination of its validity. *Psychological Studies*, 42(2–3), 85–97. <http://www.springer.com/psychology/journal/12646>
- [36] A. M. Grant, J. Franklin, and P. Langford. 2002. The Self-Reflection and Insight Scale: a New Measure of Private Self-Consciousness. *Social Behavior and Personality*, 8, 821–836. <https://doi.org/10.2224/sbp.2002.30.8.821>
- [37] D. N. Greenwood and C. R. Long. 2009. Psychological Predictors of Media Involvement. *Communication Research*, 36(5), 637–654. <https://doi.org/10.1177/0093650209338906>
- [38] J. Gross. 2015. Relearning How to Talk in the Age of Smartphone Addiction. Retrieved December 17, 2017, from <https://longreads.com/2015/10/06/relearning-how-to-talk-in-the-age-of-smartphone-addiction/>
- [39] J. Häkkinä, A. Colley, K. Cheverst, S. Robinson, J. Schöning, N. J. Bidwell, and F. Kosmalla. 2017. NatureCHI 2017: the 2nd workshop on unobtrusive user experiences with technology in nature. In *Proceedings of the 19th International Conference on Human-Computer Interaction with Mobile Devices and Services (MobileHCI '17)*. ACM, New York, NY, USA, Article 77, 4 pages. <https://doi.org/10.1145/3098279.3119836>
- [40] K. Halttu and H. Oinas-Kukkonen. 2017. Persuading to reflect: role of reflection and insight in persuasive systems design for physical health. *Human-Computer Interaction*, 32(5–6), 381–412.
- [41] R. Harrington and D. A. Loffredo. 2010. Insight, Rumination, and Self-Reflection as Predictors of Well-Being. *The Journal of Psychology*, 145(1), 39–57. <https://doi.org/10.1080/00223980.2010.528072>
- [42] F.-H. Hartung and B. Renner. 2014. The Need to Belong and the Relationship Between Loneliness and Health. *Zeitschrift Für Gesundheitspsychologie*, 22(4), 194–201. <https://doi.org/10.1026/0943-8149/a000129>
- [43] C. Hazan and P. R. Shaver. 1994. Deeper Into Attachment Theory. *Psychological Inquiry*, 5(1), 68–79. https://doi.org/10.1207/s15327965pli0501_15
- [44] A. Hiniker, S. N. Patel, T. Kohno, and J. 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 (UbiComp '16)*. ACM, New York, NY, USA, 634–645. <https://doi.org/10.1145/2971648.2971762>
- [45] C. A. Hoffner, S. Lee, and S. J. Park. 2016. “I miss my mobile phone!”: Self-expansion via mobile phone and responses to phone loss. *New Media & Society*, 18(11), 2452–2468. <https://doi.org/10.1177/1461444815592665>
- [46] S. J. Kass and S. J. Vodanovich. 1990. Boredom proneness: Its relationship to Type A behavior pattern and sensation seeking. *Psychology: A Journal of Human Behavior*, 27(3), 7–16.
- [47] L. A. Keefer, M. J. Landau, Z. Rothschild, and K. D. Sullivan. 2012. Attachment to objects as compensation for close others’ perceived unreliability. *Journal of Experimental Social Psychology*, 48(4), 912–917. <https://doi.org/10.1016/j.jesp.2012.02.007>
- [48] E. Kim, I. Cho, and E. J. Kim. 2017. Structural Equation Model of Smartphone Addiction Based on Adult Attachment Theory: Mediating Effects of Loneliness and Depression. *Asian Nursing Research*, 11(2), 92–97. <https://doi.org/10.1016/j.anr.2017.05.002>
- [49] J. Kim, R. LaRose, and W. Peng. 2009. Loneliness as the cause and the effect of problematic Internet use: The relationship between Internet use and psychological well-being. *Cyberpsychology & Behavior*, 12(4), 451–455. <https://doi.org/10.1089/cpb.2008.0327>
- [50] Y. Kim, Y. Wang, and J. Oh. 2016. Digital Media Use and Social Engagement: How Social Media and Smartphone Use Influence Social Activities of College Students. *Cyberpsychology, Behavior, and Social Networking*, 19(4), 264–269. <https://doi.org/10.1089/cyber.2015.0408>
- [51] P. Koch (1994). *Solitude: A philosophical encounter*. Chicago: Open Court.
- [52] V. Konok, D. Gíglér, B. M. Ereczky, and A. Miklósi. 2016. Humans’ attachment to their mobile phones and its relationship with interpersonal attachment style. *Computers in Human Behavior*, 61, 537–547. <https://doi.org/10.1016/j.chb.2016.03.062>
- [53] D. J. Kruger, A. Duan D. Juhász, C. V. Phaneuf, V. Sreenivasa, C. M. Saunders, A. M. Heyblom, P. A. Sonnega, M. L. Day, S. L. Misevich. 2017. Cell Phone Use Latency in a Midwestern USA University Population. *Journal of Technology in Behavioral Science*. <https://doi.org/10.1007/s41347-017-0012-8>
- [54] R. W. Larson. 1990. The solitary side of life: An examination of the time people spend alone from childhood to old age. *Developmental Review*, 10(2), 155–183. [https://doi.org/10.1016/0273-2297\(90\)90008-R](https://doi.org/10.1016/0273-2297(90)90008-R)
- [55] R. Larson and M. Lee. 1996. The capacity to be alone as a stress buffer. *The Journal of Social Psychology*, 136(1), 5–16.
- [56] M. R. Leary. 2013. Need to Belong Scale. Retrieved December 4, 2017, from <http://www.midss.org/content/need-belong-scale>
- [57] M. R. Leary, K. M. Kelly, C. Cottrell, and L. S. Schreindorfer. 2013. Construct validity of the need to belong scale: mapping the nomological network. *Journal of Personality Assessment*, 95(6), 610–24. <https://doi.org/10.1080/00223891.2013.819511>
- [58] Y. Lee, C. Chang, Y. Lin, and Z. Cheng. 2014. The dark side of smartphone usage: Psychological traits, compulsive behavior and technostress. *Computers in Human Behavior* 31: 373–383. <http://doi.org/10.1016/j.chb.2013.10.047>
- [59] U. Lee, J. Lee, M. Ko, C. Lee, Y. Kim, S. Yang, K. Yatani, G. Gweon, K. Chung, and J. Song. 2014. Hooked on smartphones: an exploratory study on smartphone overuse among college students. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '14)*. ACM, New York, NY, USA, 2327–2336. <http://dx.doi.org/10.1145/2556288.2557366>
- [60] Y. Lee, Y. Lim, and K. Lee. 2016. Timelessness: User Experience of unplanned Smartphone Use. In *Proceedings of the 2016 ACM Conference on Designing Interactive Systems (DIS '16)*. ACM, New York, NY, USA, 73–83. <https://doi.org/10.1145/2901790.2901839>
- [61] N. LePera. 2011. Relationships between boredom proneness, mindfulness, anxiety, depression, and substance use. *The New School Psychology Bulletin*, 8(2), 15–25.
- [62] A. Lepp and J. Barkley. 2014. Cell phone use as leisure: Activities, motivations and affective experiences. In *Book of Abstracts for the Leisure Research Symposium of the National Recreation and Parks Association’s Annual Congress* (pp. 154–156).
- [63] A. Lepp, J. E. Barkley, and A. C. Karpinski. 2014. The relationship between cell phone use, academic performance, anxiety, and Satisfaction with Life in college students. *Computers in Human Behavior*, 31(1), 343–350. <https://doi.org/10.1016/j.chb.2013.10.049>
- [64] C. R. Long, M. Seburn, J. R. Averill, and T. A. More. 2003. Solitude Experiences: Varieties, Settings, and Individual Differences. *Personality and Social Psychology Bulletin*, 29(5), 578–583.
- [65] K. Lup, L. Trub, and L. Rosenthal. 2015. Instagram #Instasad?: Exploring Associations Among Instagram Use, Depressive Symptoms, Negative Social Comparison, and Strangers Followed. *Cyberpsychology, Behavior and Social Networking*, 18(5), 8–10. <https://doi.org/10.1089/cyber.2014.0560>
- [66] S. Mann and R. Cadman. 2014. Does being bored make us more creative? *Creativity Research Journal*, 26(2), 165–173.
- [67] A. Matic, M. Pielot, and N. Oliver. 2015. Boredom-Computer Interaction: Boredom Proneness and The Use of Smartphone. *Proceedings of the ACM International Joint Conference on Pervasive and Ubiquitous Computing, UbiComp 2015*, 837–841. <https://doi.org/10.1145/2750858.2807530>
- [68] I. Maulana. 2018. Spontaneous Taking and Posting Selfie: Reclaiming the Lost Trust. In S. Hai-Jew (Ed.) *Selves as a Mode of Social Media and Work Space Research* (pp. 28–50). IGI Global.
- [69] J. McNally and B. Harrington. 2017. How Millennials and Teens Consume Mobile Video. In *Proceedings of the 2017 ACM International Conference on Interactive Experiences for TV and Online Video (TVX '17)*. ACM, New York, NY, USA, 31–39.

- [70] D. Mellor, M. Stokes, L. Firth, Y. Hayashi, and R. Cummins. 2008. Need for belonging, relationship satisfaction, loneliness, and life satisfaction. *Personality and Individual Differences*, 45(3), 213–218. <https://doi.org/10.1016/j.paid.2008.03.020>
- [71] S. Melumad and M. T. Pham. 2017. “Understanding the Psychology of Smartphone Usage: the Adult Pacifier Hypothesis”. In *NA - Advances in Consumer Research Volume 45*, eds. Ayelet Gneezy, Vladas Griskevicius, and Patti Williams, Duluth, MN: Association for Consumer Research, Pages: 25-30.
- [72] W. L. Mikulas and S. J. Vodanovich. 1993. The essence of boredom. *Psychological Record*, 43(1), 3–13.
- [73] C. Montag, K. Blaszkievicz, B. Lachmann, I. Andone, R. Sariyska, B. Trendafilov, M. Reuter, A. Markowitz. 2014. Correlating Personality and Actual Phone Usage. *Journal of Individual Differences*, 35(3). <https://doi.org/10.1027/1614-0001/a000139>
- [74] C. Montag and P. Walla. 2016. Carpe diem instead of losing your social mind: Beyond digital addiction and why we all suffer from digital overuse. *Cogent Psychology*, 3(1), 1157281.
- [75] A. L. Nichols and G. D. Webster. 2013. The single-item need to belong scale. *Personality and Individual Differences*, 55(2), 189–192. <https://doi.org/10.1016/j.paid.2013.02.018>
- [76] A. Oulasvirta, T. Rattenbury, L. Ma, and E. Raita. 2012. Habits make smartphone use more pervasive. *Personal and Ubiquitous Computing*, 16(1), 105–114. <https://doi.org/10.1007/s00779-011-0412-2>
- [77] B. A. Primack, A. Shensa, J. E. Sidani, E. O. Whaitte, L. yi Lin, D. Rosen, J. B. Colditz, A. Radovic, and E. Miller. 2017. Social media use and perceived social isolation among young adults in the US. *American journal of preventive medicine*, 53(1), 1-8.
- [78] A. K. Przybylski and N. Weinstein. 2013. Can you connect with me now? How the presence of mobile communication technology influences face-to-face conversation quality. *Journal of Social and Personal Relationships*, 30(3), 237–246. <https://doi.org/10.1177/0265407512453827>
- [79] N. Ptakauskaite, A. L. Cox, and N. Berthouze. 2018. Knowing What You’re Doing or Knowing what to do: How Stress Management Apps Support Reflection and Behaviour Change. In *Extended Abstracts of the 2018 CHI Conference on Human Factors in Computing Systems (CHI EA ’18)*. ACM, New York, NY, USA, Paper LBW599, 6 pages.
- [80] L. Rainie and A. Perrin. 2017. 10 facts about smartphones. Retrieved December 18, 2017, from <http://www.pewresearch.org/fact-tank/2017/06/28/10-facts-about-smartphones/>
- [81] C. Reichl, J. F. Schneider, and F. M. Spinath. 2013. Relation of self-talk frequency to loneliness, need to belong, and health in German adults. *Personality and Individual Differences*, 54(2), 241–245. <https://doi.org/10.1016/j.paid.2012.09.003>
- [82] J. A. Roberts, C. Pullig, and C. Manolis. 2015. I need my smartphone: A hierarchical model of personality and cell-phone addiction. *Personality and Individual Differences*, 79, 13–19. <https://doi.org/10.1016/j.paid.2015.01.049>
- [83] D. Rozgonjuk and J. Elhai. 2018. Problematic smartphone usage, emotion regulation, and social and non-social smartphone use. In *Proceedings of the Technology, Mind, and Society (TechMindSociety ’18)*. ACM, New York, NY, USA, Article 35
- [84] C. Sagioglou and T. Greitemeyer. 2014. Facebook’s emotional consequences: Why Facebook causes a decrease in mood and why people still use it. *Computers in Human Behavior*, 35, 359–363. <https://doi.org/10.1016/j.chb.2014.03.003>
- [85] M. Samaha and N. S. Hawi. 2016. Relationships among smartphone addiction, stress, academic performance, and satisfaction with life. *Computers in Human Behavior*, 57, 321–325. <https://doi.org/10.1016/j.chb.2015.12.045>
- [86] L. C. Schade, J. Sandberg, R. Bean, D. Busby, and S. Coyne. 2013. Using Technology to Connect in Romantic Relationships: Effects on Attachment, Relationship Satisfaction, and Stability in Emerging Adults. *Journal of Couple and Relationship Therapy*, 12(4), 314–338. <https://doi.org/10.1080/15332691.2013.836051>
- [87] M. F. Scheier and C. S. Carver. 1985. The Self-Consciousness Scale: A Revised Version for Use with General Populations. *Journal of Applied Social Psychology*, 15(8), 687–699. <https://doi.org/10.1111/j.1559-1816.1985.tb02268.x>
- [88] K. M. Sheldon, A. J. Elliot, Y. Kim, and T. Kasser. 2001. What is satisfying about satisfying events? Testing 10 candidate psychological needs. *Journal of personality and social psychology*, 80(2), 325.
- [89] E. Sherman. 1991. Reminiscencia: Cherished objects as memorabilia in late-life reminiscence. *Journal of Aging and Human Development*, 33(2), 89–100. <https://doi.org/10.2190/FJW1-60UF-WW1R-FP2K>
- [90] A. Smith. 2015. U.S. Smartphone Use in 2015. Retrieved October 4, 2017, from <http://www.pewinternet.org/2015/04/01/us-smartphone-use-in-2015/>
- [91] F. Söhnchen. 2007. Common Method Variance und Single Source Bias. *Methodik Der Empirischen Forschung, (Churchill 1979)*, 135–150. https://doi.org/10.1007/978-3-8349-9121-8_10
- [92] L. Srivastava. 2005. Mobile phones and the evolution of social behaviour. *Behaviour & Information Technology*, 24(2), 111–129. <https://doi.org/10.1080/01449290512331321910>
- [93] Statista. 2018. Daily time spent on mobile by Millennial internet users worldwide from 2012 to 2017 (in minutes). Retrieved January 7, 2018, from <https://www.statista.com/statistics/283138/millennials-daily-mobile-usage/>
- [94] D. Stein and A. M. Grant. 2014. Disentangling the relationships among self-reflection, insight, and subjective well-being: The role of dysfunctional attitudes and core self-evaluations. *The Journal of Psychology: Interdisciplinary and Applied*, 148(5), 505–522. <https://doi.org/10.1080/00223980.2013.810128>
- [95] J. S. St. George. 2013. The things they carry: A study of transitional object use among US military personnel during and after deployment. *Theses, Dissertations, and Projects*. 973, from <https://scholarworks.smith.edu/theses/973>
- [96] G. Thorsteinsson and T. Page. 2014. User attachment to smartphones and design guidelines. *International Journal of Mobile Learning and Organisation*, 8(3), 201–215. <https://doi.org/10.1504/IJMLO.2014.067020>
- [97] P. Tillich. (1959). The eternal now. In H. Feifel (Ed.), *The meaning of death* (pp. 30–38). New York: McGraw-Hill.
- [98] L. Truband B. Barbot. 2016. The paradox of phone attachment: Development and validation of the Young Adult Attachment to Phone Scale (YAPS). *Computers in Human Behavior*, 64, 663–672. <https://doi.org/10.1016/j.chb.2016.07.050>
- [99] S. Turkle. 2015. *Reclaiming Conversation: The power of talk in a digital age*. New York: Penguin Books.
- [100] J. Vincent. 2006. Emotional attachment and mobile phones. *Knowledge, Technology & Policy*, 19(1), 39–44. <https://doi.org/10.1007/s12130-006-1013-7>
- [101] E. A. Vogel, J. P. Rose, B. M. Okdie, K. Eckles, and B. Franz. 2015. Who compares and despairs? The effect of social comparison orientation on social media use and its outcomes. *Personality and Individual Differences*, 86, 249–256. <https://doi.org/10.1016/j.paid.2015.06.026>
- [102] Z. Wang, J. M. Tchernev, and T. Sooloway. 2012. A dynamic longitudinal examination of social media use, needs, and gratifications among college students. *Computers in Human Behavior*, 28(5), 1829–1839. <https://doi.org/10.1016/j.chb.2012.05.001>
- [103] A. F. Ward, K. Duke, A. Gneezy, and M. W. Bos. 2017. Brain Drain: The Mere Presence of One’s Own Smartphone Reduces Available Cognitive Capacity. *Journal of the Association for Consumer Research*, 2(2), 140–154. <https://doi.org/10.1086/691462>
- [104] T. Wayne. (2016). *The end of Reflection*. *The New York Times*. Retrieved October 4, 2017 from <https://www.nytimes.com/2016/06/12/fashion/internet-technology-phones-introspection.html>
- [105] H. H. Wilmer, L. E. Sherman, and J. M. Chein. 2017. Smartphones and Cognition: A Review of Research Exploring the Links between Mobile Technology Habits and Cognitive Functioning. *Frontiers in Psychology*, 8, 1–16. <https://doi.org/10.3389/fpsyg.2017.00605>
- [106] T. D. Wilson and D. T. Gilbert. 2005. Affective Forecasting. *Current Directions in Psychological Science*, 14(3), 131–134. <https://doi.org/10.1111/j.0963-7214.2005.00355.x>
- [107] D. Winnicott. 1958. The capacity to be alone. *International Journal of Psychoanalysis*, 39, 416–420.
- [108] D. W. Winnicott .1971. *Playing and reality*. New York, NY: Routledge. <https://doi.org/10.4324/9780203441022>
- [109] R. Wiseman and C. Watt. 2004. Measuring superstitious belief: Why lucky charms matter. *Personality and Individual Differences*. <https://doi.org/10.1016/j.paid.2004.02.009>
- [110] C. Yang and B. Bradford Brown. 2016. Online Self-Presentation on Facebook and Self Development During the College Transition. *Journal of Youth and Adolescence*, 45(2), 402–416. <https://doi.org/10.1007/s10964-015-0385-y>
- [111] L. Zysberg. 2012. Loneliness and Emotional Intelligence. *The Journal of Psychology*, 146(1–2), 37–46. <https://doi.org/10.1080/00223980.2011.574746>
- [111] L. Zysberg. 2012. Loneliness and Emotional Intelligence. *The Journal of Psychology*, 146(1–2), 37–46. <https://doi.org/10.1080/00223980.2011.574746>