

Antecedents and Consequences of Smartphone Self-Extension

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Abstract

The psychological connection between mobile media (e.g., smartphones) and the self is a central consideration of mobile communication scholarship. However, extant work on a key construct that indexes this connection – smartphone self-extension — has relied primarily on cross-sectional designs. Using a two-wave panel design ($N = 227$), we tested potential antecedents and consequences of smartphone self-extension. Both functionality and identity self-extension predicted perceiving smartphone use as more enjoyable. Moreover, functionality self-extension was predicted by frequent and habitual smartphone use, whereas identity self-extension was predicted by smartphone use to pass time while bored, problematic smartphone use, and viewing the smartphone as a reflection of self (and predicted less autonomy). These findings pave the way for future research and theory on smartphone self-extension.

Keywords: antecedents, consequences, longitudinal, mobile communication, mobile media, panel, self-extension, smartphone, smartphone self-extension

Antecedents and Consequences of Smartphone Self-Extension

The psychological connection between mobile media (i.e., communication technologies that can be used on-the-go; Campbell, 2013) and the self is a central consideration of mobile communication scholarship (Bayer et al., 2023). Scholars have proposed a variety of concepts to capture this connection, including addiction, attachment, nomophobia, self-expansion, and self-extension. Despite stemming from different theoretical traditions, these concepts are highly correlated, suggesting that they tap into the same underlying construct (Davidson et al., 2022): the psychological connection between mobile media and the self.

Among this array of concepts, the current paper focuses on self-extension, or the extent to which “we regard our possessions as parts of ourselves” (Belk, 1988, p. 139). As possessions, mobile media lie firmly within the scope of self-extension, and scholars have increasingly applied self-extension to mobile devices (Clayton et al., 2015; Park & Kaye, 2019; Ross & Bayer, 2021; Sawalha & Karnowski, 2022). In contrast, mobile media do not seamlessly fit into the scope of other concepts in this area: addiction involves substances or behaviors (Panova & Carbonell, 2018), attachment refers to caregivers or transitional objects (Keefer et al., 2012), and self-expansion focuses on other people (Hoffner et al., 2016). Additionally, addiction and nomophobia (i.e., fear of not having one’s smartphone) lend a negative connotation to the psychological connection between mobile media and the self, whereas self-extension acknowledges that this connection can be ambivalent (Park & Kaye, 2019).

Thus far, scholarship on smartphone self-extension has relied extensively on cross-sectional designs. This work has painted a rich picture of how self-extension aligns with people’s identities, media use, and social relationships. However, there has been scant longitudinal work on smartphone self-extension; it is unclear how smartphone self-extension develops over time

and what it is able to predict. An exploration of the antecedents and consequences of smartphone self-extension is necessary to turn this construct from an interesting concept to a useful theory.

The current paper begins by reviewing the concept of smartphone self-extension, with emphasis on its multi-dimensionality. We then propose several antecedents and consequences of smartphone self-extension, which we test using a two-wave panel design. After interpreting the results, we consider implications for future research and theory on smartphone self-extension.

Smartphone Self-Extension

The concept of smartphone self-extension has its roots in Belk (1988). According to Belk, “we regard our possessions as parts of ourselves” (p. 139) and our possessions contribute to and reflect our identities. Early work applying self-extension to mobile media relied on Belk’s conceptualization of self-extension (e.g., Vishwanath & Chen, 2008), and Sivadas and Machleit’s (1994) scale based on his conceptualization has been applied to mobile media (e.g., Clayton et al., 2015). Notably, Belk’s conceptualization and Sivadas and Machleit’s operationalization of self-extension are unidimensional, with a single factor representing the extent to which a possession extends the self.

However, recent work applying self-extension to smartphones has departed from this unidimensional view of self-extension. In a summary of why the smartphone may offer multiple forms of self-extension, Ross and Bayer (2021) note that the smartphone is multi-functional, stores digital traces, is customizable, and can be anthropomorphized. In that vein, Park and Kaye (2019) proposed functional, anthropomorphic, and ontological dimensions of smartphone self-extension. Functional self-extension involves the expansion of one’s mental capabilities (e.g., via offloading information) and physical capabilities (e.g., via the flashlight function). Anthropomorphic self-extension involves anthropomorphism (e.g., via perceiving the

smartphone as Siri's body) and / or customization in line with one's identity (e.g., via a personal screen saver). Ontological self-extension involves a blurred boundary between the smartphone and the self, ranging from the smartphone being perceived as not part of the self (i.e., ontological security), to maybe part of the self (i.e., ontological insecurity), and finally part of the self (i.e., ontological self-extension) (Park & Kaye, 2019).

Ross and Bayer (2021) developed a scale to capture each of the dimensions of smartphone self-extension conceptualized by Park and Kaye (2019). The scale, however, produced only two factors: functionality and identity self-extension, with items from anthropomorphic and ontological self-extension loading onto the latter.¹ Similar to functional self-extension, functionality self-extension involves perceiving the smartphone as a "tool" that is integral to one's personal goals, and identity self-extension involves perceiving the smartphone as an "amulet" that is integral to one's sense of self (Ross & Bayer, 2021; p. 497). Sawalha and Karnowski (2022) demonstrated the utility of these dimensions of self-extension in the context of breastfeeding mothers using smartphones for self-tracking. They identified three classes of self-trackers, which were distinguished by identity but not functionality self-extension; advisory-oriented self-trackers were more likely to experience identity self-extension than straightforward basic trackers and meticulous data collectors. The current study leveraged this two-dimensional framework of smartphone self-extension.

¹ The double-barreled nature of anthropomorphic self-extension may have hampered the attempt to distinguish it from ontological self-extension. One component of anthropomorphic self-extension – customization in line with identity – likely results in the device reflecting the self (Lee & Sundar, 2015). This component seems to relate to ontological self-extension, where the device is perceived as part of the self. With this component of anthropomorphic self-extension loading onto identity self-extension, the other component of anthropomorphic self-extension – anthropomorphism – may not have emerged as its own factor.

Antecedents of Smartphone Self-Extension

For possible antecedents of smartphone self-extension, we start with Belk. Belk (1988) proposed three processes by which possessions become part of the self. First, self-extension emerges through “appropriating or controlling an object for [one’s] own personal use” (p. 150). Based on the examples that Belk provides (e.g., “learning to ride a first bicycle”), we view usage as paramount to this process, such that people develop control over their devices by using them. Thus, we propose that *frequent smartphone use* may lead to smartphone self-extension. Extant work offers cautious support for this proposition. Park and Kaye (2019) linked functional self-extension to frequent smartphone use, and Ross and Bayer (2021; Study 2) linked functionality self-extension to frequent smartphone use. Moreover, Harkin and Kuss (2021) identified constant connectivity to friends, family, and work as a subtheme of overall self-extension, suggesting that self-extension may relate to specific functions of smartphone use. However, Ross and Bayer (2021; Study 1) found no association between either dimension of self-extension and frequent smartphone use, either overall or for specific functions. Across the two studies in Ross and Bayer (2021), the time spent using smartphones (overall and for specific functions) was not related to either dimension of self-extension (Study 1), but how often smartphones were used (e.g., “about every five minutes”) was related to functionality self-extension (Study 2); we therefore use the latter measure in this study (Boase & Ling, 2013).

We additionally propose key and unique ways that people use their smartphones as antecedents of smartphone self-extension. We first propose that *habitual* and *problematic smartphone use* may lead to smartphone self-extension. Habitual and problematic smartphone use are two key frameworks that explain how people use their devices, and Ross and Bayer (2021) posited that they were specifically relevant to smartphone self-extension. People develop

habits (i.e., frequent and automatic behaviors) to achieve their goals and follow their values (Verplanken & Sui, 2019), and they are particularly likely to do so using possessions (e.g., smartphones) that are integral to the self. Moreover, problematic smartphone users perceive their devices as salient and experience withdrawal symptoms without them (Kwon et al., 2013), paralleling how people experiencing self-extension keep their smartphones top-of-mind and are loathe to be without them. In support of these propositions, Ross and Bayer (2021) found that habitual smartphone use predicted functionality (but not identity) self-extension and problematic smartphone use predicted identity (but not functionality) self-extension.

Further, we propose that *mobility of smartphone use* may also lead to smartphone self-extension. Since smartphones can be used across time and space, using smartphones on-the-go is a unique facet of their usage (Campbell, 2013). Extant work offers scattered support for this proposition. Lemish and Cohen (2005) found that only men experienced self-extension toward their mobile phones. Men used their phones more frequently than women, but these differences were primarily due to men being more likely to use their phones at work or school and while driving a private vehicle; their experience of self-extension may be pinned to using their phones while out and about. Furthermore, Clayton et al. (2015) demonstrated that smartphone self-extension was greater in the presence of one's smartphone and Harkin and Kuss (2021) noted that perceiving the smartphone as an extension of the self relates to the perception of safety that comes with moving around with it. Although these findings pertain to the presence of the smartphone, its presence is a prerequisite for its use.

Returning to Belk (1988), self-extension was also considered to emerge through creation and knowledge. In line with scholarship on extended cognition (e.g., Clark & Chalmers, 1998),²

² We find it important to allude to parallels between self-extension and extended cognition (see Miller, 2014), but do not elaborate them here.

people experience self-extension for possessions that they create and / or intimately know. In the context of smartphones, people create digital traces (e.g., message transcripts) and possess intimate knowledge of these traces, such that the smartphone comes to reflect the self. This process is eloquently described by Vincent (2005):

“The mobile phone is an icon for the user – an articulation of who they are. Each mobile phone is uniquely reflecting the user’s life at that point in time; so the device ‘holds’ the memories, the sentiments that are associated with the text messages and numbers stored on the phone, the appointments, the ringtones chosen and the pictures held on the phone and not in the wallet and so on. The mobile phone as an icon is about ‘me, my mobile and my identity.’” (pp. 41-2)

This proposition further syncs with Park and Kaye’s (2019) conceptualization of anthropomorphic self-extension, where the user’s identity is reflected in the device, and Harkin and Kuss (2021) identify externalized identity as a subtheme of viewing the smartphone as an extension of the self. We term this concept *smartphone as a reflection of the self*.

Overall, we consider frequent smartphone use (both overall and for specific functions), habitual smartphone use, problematic smartphone use, mobility of smartphone use, and smartphone as a reflection of the self as potential antecedents of functionality and identity self-extension. Although we allude to the directionality of these predictions above, we consider this work exploratory and thus pose the following research question:

RQ1: What are the antecedents of smartphone self-extension?

Consequences of Smartphone Self-Extension

Belk (1988) is less explicit regarding the consequences of self-extension, but generally suggests two propositions: (1) self-extension changes how we think about possessions, and (2) self-extension promotes our overall well-being. We consider these propositions in turn.

First, smartphone self-extension may lead to different *smartphone mindsets*, or ways that people think about their smartphones. In the context of social media, Lee and Hancock (2023) found two types of mindsets: valence, where people think that social media use is good for them, and control, where people think that they are in control of their social media use. We adapt this work to consider the valence and control of smartphone mindsets. Regarding valence, people may feel better about their smartphone use when they see themselves reflected in these devices (Lee et al., 2022). Regarding control, people may feel in control of devices that they consider part of themselves (Harkin & Kuss, 2021; cf. Park & Kaye, 2021).

Second, smartphone self-extension may lead to higher *well-being*. In line with the above argumentation, when people experience smartphone self-extension, they may feel better and more in control in general, not just with regard to their devices. Due to the limited specificity of this prediction, however, we leverage a variety of common well-being measures to comprehensively assess the potential impact of smartphone self-extension on well-being.

Overall, we consider smartphone mindsets (valence and control) and well-being (life satisfaction, autonomy, meaning, positive mood, and negative mood) as potential consequences of functionality and identity self-extension. Although we allude to the directionality of these predictions, we again pose a nondirectional research question:

RQ2: What are the consequences of smartphone self-extension?

Method

Please see our Open Science Framework (OSF) page for the postregistration,³ de-identified data, and analysis script:

https://osf.io/7hmvq/?view_only=a7b1c01d30df4397a0398978b0d7bfe2.

Participants

We used Cloud Research to recruit participants through Amazon Mechanical Turk (MTurk) from the United States. We aimed to recruit at least 200 participants who completed both surveys. Expecting up to 50% dropout, we aimed to recruit 400 participants. Our initial sample was 409 participants who completed the first survey and our final sample was 227 participants who also completed the second survey. Sensitivity analyses using linear multiple regression (fixed model, single regression coefficient) with two or three predictors (see Analysis Plan) on GPower 3.1 (Faul et al., 2009) indicated that this sample size allows us to detect small-to-medium effects, $f^2 = .035$, with 80% power ($\alpha = .05$, two-tailed).

Participants were 41.25 years old on average ($SD = 12.62$). They consisted of 109 cisgender men, 113 cisgender women, one transgender man, one transgender woman, one person who inputted their own gender, and two people who preferred not to answer. Participants were able to select multiple races and ethnicities; they selected White ($n = 184$), Black / African American ($n = 17$), Asian ($n = 16$), Hispanic / Latino/a/x ($n = 13$), Native Hawaiian / Pacific Islander ($n = 4$), Native American / Alaska Native ($n = 3$), and Middle Eastern / North African ($n = 1$). On average, participants reported that they were somewhat impacted by the Covid-19 pandemic ($M = 2.6$; $SD = 1.1$), using response options from *Not impacted* (1) to *Extremely impacted* (5). They were paid \$0.80 for completing the first survey and \$1.20 for completing the

³ We intended to preregister this project, but we accidentally did not save the preregistration in OSF. We therefore share our preregistration as a postregistration and treat all analyses as exploratory.

second survey. On average, the first survey took 6.38 minutes to complete ($SD = 7.92$) and the second survey took 6.40 minutes to complete ($SD = 5.83$). Participants who dropped out after the first survey were younger than participants in the final sample, $t(383.48) = 2.78, p = .006$, but similar in terms of gender, $\chi^2(6) = 6.12, p = .41$, race/ethnicity, $\chi^2(6) = 9.81, p = .13$, pandemic impact, $t(357.13) = 0.42, p = .68$, and time spent on the first survey, $t(376.06) = -0.37, p = .71$.

Procedure

The study was reviewed and approved by the IRB at the second author's institution. Data were collected in January and February of 2022 through the survey platform Qualtrics. In the first survey, after indicating consent, participants responded to measures on well-being, their smartphones, and demographics in the order presented in Appendix A. Participants who completed this survey were invited to take the same survey one month later.

Measures

Full measures can be found in Appendix A. Participants responded to all measures with a seven-point Likert scale from *Strongly disagree* to *Strongly agree* unless noted otherwise. Descriptive statistics and reliability measures in the final sample for all measures can be found in Table 1. Since we measured a wide array of constructs, some measures were shortened to reduce participant burden, maximize retention, and improve the quality of the data (Galesic & Bosnjak, 2009; Revilla et al., 2017; Rolstad et al., 2011). All measures with more than one item were reliable (α 's > .83).

Smartphone Self-Extension

We measured self-extension with half of the items from the Smartphone Self-Extension scale (Ross & Bayer, 2021), which includes dimensions of functionality and identity. For functionality, we selected the items that referred to broad uses rather than specific functions and

adapted the item “My smartphone helps me at work” to “My smartphone helps me at work/school.” For identity, we selected items with the highest factor loadings in Ross and Bayer (2021) (e.g., “My smartphone is central to my identity”).

Antecedents of Smartphone Self-Extension

Frequent Smartphone Use. We measured frequent smartphone use based on one item for “how often” participants used their smartphones (Boase & Ling, 2013) (“How often do you use a smartphone overall?”). We additionally measured the frequency of nine key functions of mobile media use (e.g., “to maintain personal relationships”) with single items. The use of single items aligns with most work that studies distinct functions of mobile media use (e.g., Wolfers et al., 2020). All items used response options from *Once a week or less* (1) to *About every five minutes* (9).

Habitual Smartphone Use. We measured habitual smartphone use with the ten-item measure from Ross and Bayer (2021). They used an adapted measure of texting habits (Bayer & Campbell, 2012), which was adapted in turn from the Self-Reported Habit Index (Verplanken & Orbell, 2003) to measure habits in a frequency-independent manner. The lead-in to each statement was modified from “Texting is. . .” to “Using my smartphone is. . .” (e.g., “Using my smartphone is something I do automatically”).

Problematic Smartphone Use. Following previous studies (e.g., Wolniewicz et al., 2018), we used the short 10-item version of the Smartphone Addiction Scale (Kwon et al., 2013) to measure problematic smartphone usage (e.g., “I miss planned work due to smartphone use”). This scale is highly related to other measures of problematic use (Davidson et al., 2022). Participants completed this measure last in light of work finding that scales of problematic

smartphone use can prime responses to other measures (e.g., well-being; Mieczkowski et al., 2020).

Mobility of Smartphone Use. We measured mobility of smartphone use using a measure from AUTHOR (e.g., “I use my smartphone while going about from place to place”).

Participants used response options from *Never* (1) to *All the time* (5).

Smartphone as a Reflection of the Self. We measured smartphone as a reflection of the self with three items from the six-item memory scale in Han et al. (2017) (e.g., “Over time, more and more meaning gets layered onto my smartphone”), who adapted half of the items from the memory component of Schifferstein & Zwartkuis-Pelgrim’s (2008) scale for product attachment. We omitted items that were unclear or appeared to overlap highly with the remaining items.

Consequences of Smartphone Self-Extension

Smartphone Mindsets. We adapted a measure of social media mindsets (Lee & Hancock, 2023) to measure smartphone mindsets. We selected one item each for valence (“Using my phone is enjoyable for me”) and control mindsets (“I’m in control of how I use my phone”) based on face validity.

Well-Being. We included three three-item subscales from the Comprehensive Inventory of Thriving (CIT) (Su et al., 2014): life satisfaction (e.g., “In most ways my life is close to my ideal”), autonomy (e.g., “Other people decide most of my life decisions”), and meaning (e.g., “My life has a clear sense of purpose”). We additionally measured positive and negative mood using a short form of the Positive Affect and Negative Affect Schedule (PANAS) (Thompson, 2007; Watson et al., 1988). Participants evaluated the degree to which they felt five positive

adjectives (e.g., “determined”) and five negative adjectives (e.g., “afraid”) “in [their] life in general.”

Analysis Plan

We conducted ordinary least square (OLS) regression analyses. For the antecedents of smartphone self-extension (RQ1), we specified each of the antecedents at Time 1 (T1) as predictors of each of the dimensions of smartphone self-extension at Time 2 (T2), controlling for the given dimension of smartphone self-extension at T1. For the consequences of smartphone self-extension (RQ2), we specified each of the dimensions of self-extension at T1 as predictors of each of the consequences at T2, controlling for the given consequence at T1. In line with best practices (Rohrer, 2018) – but not postregistered – we controlled for variables that clearly predict both the independent and dependent variables in a given model. Thus, with the exception of controlling for overall frequency of smartphone use at T1 when predicting smartphone self-extension based on specific functions of smartphone use, mobility of smartphone use, and problematic smartphone use, we examined each antecedent and consequence in separate models. We applied the Benjamini-Hochberg procedure to correct for multiple comparisons. We ran models for 14 antecedents and seven consequences for the two dimensions of smartphone self-extension, for a total of 42 models. We first ordered the p -values of the antecedents and consequences from these models. We then compared these p -values with their unique critical alphas: the overall alpha (.05) divided by the number of models (42) and multiplied by the rank of the p -value (1, 2, 3, etc.). We next identified the highest p -value that was less than its critical alpha. This critical alpha was .0095. All relationships with p -values less than or equal to this p -value were thus considered significant.

Results

Antecedents of Smartphone Self-Extension (RQ1)

Frequent smartphone use predicted functionality self-extension, $\beta = .17, p < .001, \Delta R^2 = .02$, but not identity self-extension. Among functions of smartphone use, the only significant antecedent was frequent smartphone use to pass time while bored, which predicted identity self-extension, $\beta = .14, p = .006, \Delta R^2 = .01$. Habitual smartphone use predicted functionality self-extension, $\beta = .12, p = .007, \Delta R^2 = .01$, but not identity self-extension. Conversely, problematic smartphone use predicted identity self-extension, $\beta = .25, p < .001, \Delta R^2 = .03$, but not functionality self-extension. Mobility of smartphone use predicted neither dimension of self-extension. Finally, smartphone as a reflection of the self predicted identity self-extension, $\beta = .13, p = .007, \Delta R^2 = .01$, but not functionality self-extension. These results provide an answer to RQ1, are summarized in Table 2, and are fully reported in the supplemental materials.

Consequences of Smartphone Self-Extension (RQ2)

Both functionality and identity self-extension predicted smartphone mindsets for valence (functionality: $\beta = .18, p = .003, \Delta R^2 = .02$; identity: $\beta = .15, p = .001, \Delta R^2 = .02$), but not control. Neither functionality nor identity self-extension predicted life satisfaction; identity self-extension negatively predicted autonomy, $\beta = -.12, p = .007, \Delta R^2 = .01$, but functionality self-extension did not; and neither functionality nor identity self-extension predicted meaning, positive mood, or negative mood. These results provide an answer to RQ2, are summarized in Table 3, and are fully reported in the supplemental materials.

Discussion

Smartphone self-extension is a key construct that indexes the psychological connection between mobile media and the self. However, it has typically been studied with cross-sectional

designs. The current study therefore applied a longitudinal approach to smartphone self-extension. We tested potential antecedents (RQ1) and consequences (RQ2) of smartphone self-extension and interpret these findings in turn.

Starting with the antecedents (RQ1), the overall frequency of smartphone use, but not the frequency of any individual function of smartphone use, predicted functionality self-extension. The functionality dimension of self-extension was supported by myriad functions in aggregate, which contribute to the overall functionality of the device. In contrast, identity self-extension was predicted by one function of frequent smartphone use – passing time while bored – but not overall frequency of smartphone use. Together, these findings suggest that the centrality of the smartphone to identity may be supported by smartphone use in certain situations but not overall. Frequent smartphone use to pass time while bored may index the extent to which the smartphone represents the most readily available way to express one's identities in boring situations, anticipating an increase in identity self-extension. Future work should therefore consider a situational approach to self-extension, probing whether identity self-extension is heightened in boring or other situations (see Clayton et al., 2015).

Next, habitual smartphone use predicted functionality (but not identity) self-extension and problematic smartphone use predicted identity (but not functionality) self-extension. These findings provide longitudinal support for the cross-sectional associations identified by Ross and Bayer (2021). People who develop habits around their smartphones come to see their devices as key to their functionality, whereas people who use their devices problematically come to see their devices as key to their identity. One interpretation of these findings is that self-extension is conceptually linked to these frameworks (as suggested in the Introduction). However, another possibility is that perceptions of self-extension represent mechanisms for dealing with (or at least

lay theories to understand) smartphone use (see also Ross & Bayer, 2021). A smartphone user may be concerned with their habitual smartphone use, but assure themselves that these habits are key to accomplishing their goals, thus experiencing functionality self-extension. Another smartphone user may dislike their problematic smartphone use, but consider it a natural outgrowth of the incorporation the smartphone into the self that is increasingly necessary in contemporary life, thus experiencing identity self-extension. Future work could attempt to disentangle these perspectives by using metacognitive measures that capture how users think about their habitual or problematic smartphone use. Qualitative approaches would also be well positioned to shed light on the complex relationships between user perceptions of their device use and the device per se (see Lanette et al., 2018).

Mobility of smartphone use was related to neither functionality nor identity self-extension. This result perhaps reflects the only scattered support for this proposition in extant literature. However, it may stem from the conceptualization of the construct as using the smartphone while out and about. On-the-go smartphone use makes up a relatively small proportion of overall smartphone use (Hintze et al., 2017). Smartphone self-extension may instead emerge from using the smartphone in different places, where people not only spend more time but also enact different identities (e.g., parent at home, employee at work; see Lemish & Cohen, 2005). Future work should expand the situational perspective discussed above to include the places that people visit and the distribution of time across these places.

Last, smartphone as a reflection of the self predicted identity (but not functionality) self-extension. Functionality self-extension is likely less contingent on whether the device reflects the self than what the device allows the user to do. However, the opposite may hold true for identity self-extension. Although identity self-extension is an abstract perception (Ross & Bayer, 2021),

viewing the smartphone as a reflection of the self makes it more concrete: if the brain stores memories and is considered part of the self, why not the smartphone (see Chalmers, 2008)? An interesting direction for future work would be to connect this concept to the affordances that support it. The persistence of digital traces seems paramount; using an ephemeral social media platform like Snapchat may be less likely to contribute to the smartphone as a reflection of the self than a more permanent platform like Facebook (Bayer et al., 2016). Further, the interactivity of the smartphone may also be crucial for individuals to be able to customize the device in line with their identities (Lee & Sundar, 2015).

Moving to consequences (RQ2), we first consider the findings for valence smartphone mindsets and measures of well-being (except autonomy) and then the findings for control smartphone mindsets and autonomy, highlighting the conceptual parallels between these constructs. Both functionality and identity self-extension led to valence smartphone mindsets. Interestingly, this consequence was the only bridge between functionality and identity self-extension identified in the current study; whether one views the smartphone as a tool for one's personal goals or an amulet for one's personal identity, the result is thinking that smartphone use is enjoyable. People enjoy seeing themselves reflected in their devices (Lee et al., 2022), whether their functionality or identity is the focus of reflection. Yet, although both dimensions of self-extension translated to feeling better about smartphone use, neither dimension resulted in more life satisfaction, meaning, or positive mood, or less negative mood. Feeling better about smartphone use does not appear to translate feeling better about oneself or one's life overall.

However, the opposite pattern emerged with regard to control smartphone mindsets and autonomy. Identity (but not functionality) self-extension was associated with reduced autonomy, but neither identity nor functionality self-extension affected control smartphone mindsets. In

other words, people who viewed their smartphones as central to their identity felt less control over their lives, but they did not think that they had less control over their smartphones. The latter finding may simply be an artifact of the high floor of the single item used to measure control smartphone mindsets ($M = 6.01$ on a 7-point Likert scale). However, we also offer another interpretation. A person may offload their identity to their smartphone. Such offloading entails a degree of control over the device, but may in turn undermine one's control over the device (see Park & Kaye, 2019), coalescing into a null effect on control smartphone mindset. Moreover, offloading identity to the smartphone may maintain or even increase the autonomy of the person-smartphone assemblage (Marchant & O'Donohoe, 2019), but it may curtail the autonomy of the person per se, resulting in a negative effect on autonomy due to the locus of our measure. Taken together, future work is required to sort out the paradox that people who experience smartphone self-extension think that they enjoy and maintain control over their smartphone use – even as they do not feel better about and lose control over their lives.

Several implications emerge from these findings. We support previous work that identified functionality and identity self-extension as distinct constructs (Ross & Bayer, 2021; Sawalha & Karnowski, 2022). Functionality self-extension was predicted by frequent and habitual smartphone use, whereas identity self-extension was predicted by smartphone use to pass time while bored, problematic smartphone use, and smartphone as a reflection of the self (and predicted less autonomy). Yet, their shared prediction of valence smartphone mindsets and the small-to-moderate correlation between them (T1: $r = .24$; T2: $r = .25$) affirms their inclusion under the umbrella of smartphone self-extension.

The current study represents an initial step towards a theoretical model of smartphone self-extension. Based on Belk's (1988) initial theorizing and extant work on smartphone self-

extension, we identified several strong antecedents and consequences of smartphone self-extension. These antecedents and consequences shed light on when smartphone self-extension develops and what results it can explain. Future work can continue to test and refine this model.

This initial model of smartphone self-extension could inform work on self-extension itself. Although we argue that smartphones have unique potential for self-extension (Ross & Bayer, 2021), Belk's (1988) initial application of the concept spanned a variety of targets. For example, some people view their cars as extensions of themselves (Sivadas & Machleit, 1994). Many of the concepts linked to self-extension in the current study could be readily adapted to that end: whether one drives frequently, habitually (Verplanken et al., 1997), to pass time (e.g., joyriding), or problematically (e.g., speeding); whether the car represents one's memories (e.g., through clutter); and whether one thinks that driving is enjoyable. Future work should therefore explore the generalizability of our model.

Moreover, our findings on smartphone self-extension may also generalize to other constructs that capture the psychological connection between mobile media and the self (Bayer et al., 2023). Indeed, the finding that problematic smartphone use predicted identity self-extension suggests the potential that our findings may generalize to smartphone addiction (see Davidson et al., 2022). However, we also emphasize that the generalizability of our findings to other constructs should be grounded in the theoretical backgrounds of these constructs. For example, scholars should derive antecedents and consequences of smartphone addiction from theoretical traditions of behavioral addiction, using the current findings as ancillary support.

We conclude with several limitations. Longitudinal panel studies are limited to examining change on the time scale between waves. Shorter time scales may not allow constructs of interest to sufficiently change, whereas longer time scales complicate arguments

that constructs at T1 affect constructs at T2. Although our time scale was long enough that we found several significant antecedents and consequences, the high correlations between waves for functionality self-extension, $r = .83$, and identity self-extension, $r = .81$, indicate that these constructs are fairly stable from month to month. Yet, longer time scales also run the risk of higher participant attrition. In the current study, 182 participants (44% of the initial sample) dropped out after the first wave. Critically, younger participants and participants who used their smartphones to coordinate plans more often were more likely to drop out between waves (see supplemental materials). These differences limit the generalizability of our findings. Future work must therefore continue to weigh the tradeoffs of shorter and longer time scales.

Next, space constraints resulted in fewer items than ideal for several measures. We only used a single item for smartphone mindsets and frequent smartphone use for key functions (although the latter is typically measured in this manner), preventing calculations of reliability. Among other measures, some were short (mobility of smartphone use) or omitted items from the original scale (self-extension and smartphone as a reflection of the self), although we attempted to justify these omissions in the method section. Yet, all measures with more than one item were reliable (α 's $> .83$). Moreover, since we measured a wide variety of constructs, shortening measures allowed us to reduce participant burden, maximize retention, and improve data quality (Galesic & Bosnjak, 2009; Revilla et al., 2017; Rolstad et al., 2011).

Finally, our survey method relied on self-reports. Many of our measures were perceptual, warranting this choice of measurement, and for other measures (e.g., frequent smartphone use), we followed best practices for self-report measurement (Boase & Ling, 2013). However, the frequency of smartphone use is notoriously difficult to self-report (Parry et al., 2022), and the mobility of smartphone use could be captured with more validity by using behavioral data. This

concern is amplified in light of Ellis et al.'s (2019) findings that self-extension is related to time spent using smartphones but not two other objective indicators of smartphone use (pickups and notifications), shedding doubt on the objective underpinnings of smartphone self-extension.

Ultimately, our methodology is best suited to capture the subjective antecedents and consequences of the perception of smartphone self-extension. Our findings lay the foundation for future work that leverages more intensive methods involving behavioral data, which are best suited to ground smartphone self-extension in behavior.

Conclusion

The current paper contributes to work on the psychological connection between mobile media and the self, which is a central consideration of mobile communication scholarship. We apply an oft-neglected longitudinal approach, which sheds light on how smartphone self-extension develops over time and clarifies its explanatory power. Our findings reveal that both functionality and identity self-extension predict perceiving smartphone use as more enjoyable; functionality self-extension is predicted by frequent and habitual smartphone use; and identity self-extension is predicted by smartphone use to pass time while bored, problematic smartphone use, and viewing the smartphone as a reflection of the self (and predicts less autonomy). These results encourage future work that continues to advance smartphone self-extension from being an interesting concept to a useful theory.

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Appendix A**Well-Being***Life Satisfaction*

In most ways my life is close to my ideal.

I am satisfied with my life.

My life is going well.

Autonomy

Other people decide most of my life decisions.

The life choices I make are not really mine.

Other people decide what I can and cannot do.

Meaning and Purpose

My life has a clear sense of purpose.

I have found a satisfactory meaning in life.

I know what gives meaning to my life.

Positive Mood

Please rate the extent to which you feel the following in your life in general:

Determined

Attentive

Alert

Inspired

Active

Negative Mood

Please rate the extent to which you feel the following in your life in general:

Afraid

Nervous

Upset

Ashamed

Hostile

Smartphone Self-Extension

Functionality

My smartphone helps me in everyday life.

My smartphone helps me at work/school.

I use my smartphone to accomplish many functions.

Identity

My smartphone has a mind of its own.

My smartphone lets me assume multiple identities.

My smartphone is central to my identity.

Mobility of Smartphone Use

I use my smartphone while going about from place to place.

I use my smartphone between the different places I visit.

(Never to All the time)

Habitual Smartphone Usage

Using my smartphone is something...

I do automatically.

I do without having to consciously remember.

I do without thinking.

I start doing before I realize I am doing it.

I have no need to think about doing.

I do without meaning to do it.

That would require effort not to do.

That I would find hard not to do.

That is typically “me.”

That belongs to my daily routine.

Smartphone as a Reflection of the Self

My smartphone reminds me of people who are important to me.

If I lose my smartphone, I would lose an important part of my history.

Over time, more and more meaning gets layered onto my smartphone.

Smartphone Mindsets

Valence

Using my phone is enjoyable for me.

Control

I'm in control of how I use my phone.

Frequent Smartphone Use

How often do you use a smartphone overall?

How often do you use a smartphone for the following functions?

To maintain personal relationships

To coordinate plans

Entertainment (e.g., games, music, fun videos)

News

Work or school

To pass time when bored

To take photos or videos

Social media

To find information

(Once a week or less to About every five minutes)

Problematic Smartphone Use

I miss planned work due to smartphone use.

I have a hard time while working due to smartphone use.

I feel pain in my wrists or the back of my neck while using a smartphone.

I would not be able to stand not having a smartphone.

I feel impatient and fretful when I am not holding my smartphone.

I have my smartphone in my mind even when I am not using it.

I will never give up using my smartphone even when my daily life is already greatly affected by it.

I constantly check my smartphone so as not to miss conversations between other people on social media.

I use my smartphone longer than I intend.

The people around me tell me that I use my smartphone too much.

Table 1*Descriptive Statistics and Reliability for Key Measures*

	T1			T2		
	<i>M</i>	<i>SD</i>	α	<i>M</i>	<i>SD</i>	α
Smartphone Self-Extension						
Functionality	5.57	1.17	.90	5.66	1.09	.88
Identity	2.66	1.28	.87	2.69	1.33	.89
Antecedents of Smartphone Self-Extension						
<i>Frequent Smartphone Use</i>						
Overall	4.98	1.23		4.98	1.24	
Relationship Maintenance	3.51	1.35		3.41	1.42	
Coordinating Plans	2.68	1.34		2.74	1.34	
Entertainment	3.73	1.42		3.55	1.38	
News	3.39	1.34		3.41	1.28	
Work or School	3.41	1.58		3.43	1.56	
Passing Time While Bored	3.85	1.50		3.73	1.45	
Photos or Videos	2.73	1.35		2.73	1.29	
Social Media	3.64	1.45		3.52	1.45	
Information	3.92	1.34		3.92	1.24	
Mobility of Smartphone Use	3.87	0.86	.94	3.70	0.93	.93
Habitual Smartphone Use	4.70	1.50	.95	4.51	1.47	.95
Problematic Smartphone Use	2.78	1.24	.91	2.72	1.21	.91
Smartphone as a Reflection of the Self	4.06	1.65	.87	4.07	1.61	.86

Consequences of Smartphone Self-Extension
Smartphone Mindsets

Valence	5.67	1.13	5.69	1.13
Control	6.03	1.03	6.01	1.03

Well-Being

Life Satisfaction	4.36	1.61	.94	4.45	1.61	.94
Autonomy	5.50	1.28	.90	5.44	1.32	.89
Meaning	4.73	1.65	.95	4.76	1.64	.96
Positive Mood	5.14	1.12	.86	5.13	1.10	.83
Negative Mood	2.41	1.41	.91	2.37	1.34	.90

Table 2*Antecedents of Smartphone Self-Extension*

Antecedent	Dimension of Smartphone Self-Extension	β	p	ΔR^2
<i>Frequent Smartphone Use</i>				
Overall	Functionality	.17	<.001	.02
	Identity	.05	.26	.002
Relationship Maintenance	Functionality	.08	.04	.005
	Identity	.09	.03	.007
Coordinating Plans	Functionality	.03	.39	.001
	Identity	.08	.06	.005
Entertainment	Functionality	.07	.10	.003
	Identity	.08	.09	.004
News	Functionality	.04	.34	.001
	Identity	.07	.14	.003
Work or School	Functionality	.007	.87	<.001
	Identity	.07	.10	.004

Passing Time While Bored	Functionality	.03	.51	.001
	Identity	.14	.006	.01
Photos or Videos	Functionality	.04	.27	.002
	Identity	.01	.81	<.001
Social Media	Functionality	.09	.03	.006
	Identity	.10	.03	.007
Information	Functionality	.06	.20	.002
	Identity	.03	.54	.001
<i>Mobility of Smartphone Use</i>	Functionality	-.01	.76	<.001
	Identity	-.05	.29	.002
<i>Habitual Smartphone Use</i>	Functionality	.12	.007	.01
	Identity	.06	.14	.003
<i>Problematic Smartphone Use</i>	Functionality	.005	.90	<.001
	Identity	.25	<.001	.03
<i>Smartphone as a Reflection of the Self</i>	Functionality	.04	.29	.002
	Identity	.13	.007	.01

Note: Significant statistics are bolded. Models for frequent smartphone use, mobility of smartphone use, and problematic smartphone use included overall frequency of smartphone use as a control variable.

Table 3*Consequences of Smartphone Self-Extension*

Dimension of Smartphone Self-Extension	Consequence	β	p	ΔR^2
<i>Smartphone Mindsets</i>				
Functionality	Valence	.18	.003	.02
Identity		.15	.001	.02
Functionality	Control	.03	.54	.001
Identity		-.07	.20	.005
<i>Well-Being</i>				
Functionality	Life Satisfaction	-.02	.52	<.001
Identity		.01	.70	<.001
Functionality	Autonomy	.03	.45	.001
Identity		-.12	.007	.01
Functionality	Meaning	-.05	.08	.002
Identity		.00	.97	<.001
Functionality	Positive Mood	.03	.53	.001
Identity		-.09	.02	.008
Functionality	Negative Mood	.04	.25	.002
Identity		.05	.16	.003

Note: Significant statistics are bolded.