Understanding the Psychology of Smartphone Usage: The Adult Pacifier Hypothesis

Essay 1 of a Dissertation on

The Distinct Psychology of Smartphone Usage

Draft in Progress

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Columbia University Graduate School of Business Consumers are officially spending more time on their smartphones than on any of their other electronic devices (Millward Brown 2014), and in 2015 the amount of time spent on the device increased by 35% from 2014 alone (Yahoo! Insights 2015). In nearly every environment, at almost any time of day, a cursory observation of consumer behavior – whether on the subway, at dinner, in bed, or even while crossing the street – will inevitably find consumers engrossed in their smartphone. While not clinically recognized as a behavioral dependence (American Psychiatric Association 2013), the term "smartphone addiction" has been commonly used to describe consumers' seemingly nonstop use of their device (e.g., The New York Times 2015; The Guardian 2016; TechCrunch 2015).

What might account for consumers' persistent increase in smartphone use relative to comparable electronic devices? While the marketing implications of mobile platforms are receiving emerging attention in the marketing modeling literature (e.g., Danaher et al. 2015; Ghose et al. 2013; Sultan et al. 2009), still very little is known about the consumer psychology of smartphone usage. The purpose of my research is to provide a rigorous investigation into why consumers have such as strong drive to engage with their smartphones. I advance the hypothesis that this phenomenon is driven by a general and developmentally primitive psychological mechanism: namely, that smartphones fulfill the role of an "attachment object" or "adult pacifier" for consumers over and above their other technology. Consistent with this "Adult Pacifier Hypothesis," I report results from three studies, including two controlled lab experiments and one large correlational study, showing that relative to a comparable device such as one's personal computer, smartphones exhibit at least two of the defining characteristics of attachment objects.

THE ADULT PACIFIER HYPOTHESIS

"Smartphone Addiction"

Outside of marketing, a mostly correlational body of work has emerged on the topic of "smartphone addiction." It is important to note upfront that smartphone addiction is not formally recognized as a behavioral dependence along clinical diagnostic criteria (American Psychiatric Association 2013). Instead the term "addiction" is used loosely throughout this literature to refer to use of the device that is excessive or somehow disruptive or detrimental to one's life. Such "addictive" behaviors can include use of the device that hinders productivity (e.g., using one's phone at work), degrades interpersonal interactions (e.g., using one's phone at dinner with a friend) or is generally unsafe (e.g., texting while driving) (e.g., Bianchi and Phillips 2005; Yen et al. 2009).

Unsurprisingly, much of the extant research focuses on the negative consequences of smartphone addiction. For example, users who demonstrate addictive tendencies with their smartphone also report higher rates of sleep disturbances, depressive symptoms (Thomee, Harenstam and Hagberg 2011) and psychological distress (Beranuy et al. 2009). When separated from their devices, addicted users have also described fear of social exclusion (e.g., James and Drennan 2005). Relatedly, in one of the few experimental studies on the topic, Cheever et al. (2014) found that participants separated from their smartphones reported increased feelings of anxiety over time. Similarly, in another experiment Clayton et al. (2015) found that restricting participants from answering their ringing iPhone while performing a cognitive task resulted in diminished performance on the task, higher reported levels of anxiety and even physiological effects such as increased heart rate and blood pressure. Many of the papers in this stream of research also describe the user characteristics that are correlated with smartphone addiction. For example, one consistent finding is that younger female users are more likely to exhibit addictive behavior towards their smartphone (e.g., Mok et al. 2014; Walsh et al. 2011). In addition to demographic factors, personality traits have also been shown to predict smartphone addiction. For example, people with lower trait self-esteem (e.g., Bianchi and Phillips 2005) and higher need to belong (Lapointe et al. 2013) tended to report higher levels of smartphone addiction. In sum, this nascent body of work offers a variety of findings on the potential antecedents and consequences of smartphone addiction.

Attachment Theory: Smartphone as an Attachment Object

In this research I offer a parsimonious hypothesis to conceptualize the disparate findings on smartphone addiction. I offer the novel hypothesis that consumers' apparent addiction to the device can be explained by the idea that smartphones have come to serve as an attachment object—a proposition that I refer to as the Adult Pacifier Hypothesis. Specifically, I propose that insight into the psychology of smartphone addiction can be found in the developmental literature on attachment theory. This literature describes how children form strong emotional attachments to certain objects that over time come to represent a source of security and help develop effective emotional regulation and coping strategies (e.g., Bowlby 1969, 1982). These attachments can be formed towards social objects, such as the child's primary caretaker, as well as nonsocial objects, such as a security blanket or pacifier (e.g., Passman 1977; Winnicott 1953). Specifically, the attachment theory literature has conceptualized relations to attachment objects as exhibiting four major characteristics. I advance the argument that smartphones exhibit each of these four defining traits. Specifically, in the section below I will (1) describe

each of the four major characteristics of attachment objects, (2) cite findings from the smartphone addiction literature that relate to each characteristic, and (3) argue that these findings can be explained by the role that smartphones play as attachment objects. I then propose the three hypotheses tested in this paper.

1. Learned associations of positive outcomes

In his seminal work, Bowlby (1969, 1982) explained that infants form strong attachments to their primary caregiver to achieve the evolutionary goal of protection from danger. This attachment develops through associative learning, wherein the child becomes accustomed to the figure providing positive outcomes such as safety and comfort (e.g., Cairns 1966). As an example, an infant son will form a strong attachment to his mother because he learns over time that she most reliably responds to and soothes his crying. Once the infant becomes attached to his mother, his mother comes to represent an "attachment figure" that is sought out in order to increase feelings of comfort or security. Children can also become emotionally attached to inanimate objects, such as a pacifier or blanket, because they similarly expect the objects to provide positive outcomes. For example, as children learn to associate their blanket with physical warmth, softness and the pleasure of being tucked into bed at night, over time they may develop an emotional attachment to the object (Jolango 1987). Therefore, in moments when an attachment figure is unavailable or unresponsive, children can begin to use their blanket or pacifier in order to substitute the sense of comfort typically afforded by the attachment figure. As children increasingly rely on the object to derive security and comfort in lieu of their primary caretaker, the possession comes to represent a "transitional" or "attachment object" (Winnicott 1953).

Similar to the attachment children form towards their pacifiers, I argue that consumers form a particularly strong emotional attachment towards their smartphones because they come to associate the device with positive outcomes and therefore expect such outcomes. A number of factors contribute to such positive associations. For one, smartphones are multifunctional – they serve as a primary means of communication; provide users with access to virtually any information they want, such as news or social media updates; and offer various sources for entertainment, such as gaming apps (e.g. Oulasvierta et al. 2012; Wei and Lo 2006). In addition, as a result of its small, mobile nature users can take their smartphone with them virtually everywhere they go, making all of these functionalities immediately accessible to the user at a given moment. The portability of the device also allows many users to rely on their smartphone to provide a sense of personal safety in case of emergency (e.g., Aoki and Downes 2003; Leung and Wei 2000). In sum, as a result of its portability and the functions available on the device, consumers come to expect their smartphone to provide a unique set of immediately accessible benefits.

2. Object increases owner's sense of comfort

Once a child learns that the object is associated with positive outcomes, engaging with this attachment object will provide a feeling of comfort in general – even in the absence of a stressor (e.g., Bowlby 1969; Weisberg and Russell 1971). In this sense, a feeling of comfort is conceptualized not as a source of relief from distress but rather as an enduring state of ease or contentment (e.g., Kolcaba and Kolcaba 1991). One tangentially related finding in the smartphone addiction literature is that, in addition to fulfilling social gratifications such as feeling closer to others, people report often using their smartphones

as a means of increasing relaxation (Harvard Business Review 2013; Leung and Wei 2000). If smartphones serve as attachment objects then the feelings of comfort derived from engaging with the device could also logically result in heightened feelings of relaxation. As will be elaborated on subsequently, in the present research I formulate and directly test the hypothesis that smartphones exhibit this primary characteristic of attachment objects.

3. Stress relief

Another distinctive trait of an attachment object is that, since it represents a source of comfort, engaging with the object provides relief from negative feelings when the owner feels distressed (e.g., Bretherton 1985; Mikulincer and Shaver 2007). This characteristic arises through learned associations about the attachment object, wherein the owner comes to expect the object to be available and comforting when a threat or stressor is present (e.g., Crowell and Treboux 1995; Waters et al. 1991). Consistent with this characteristic, smartphone users have reported that they often use the device as a means of escaping daily pressures (Bianchi and Phillips 2005) and reducing negative affect in the short term (Billieux et al. 2007). Thus, to the extent that smartphones serve as attachment objects, this could explain why it is that owners use the device to regulate negative emotions. As elaborated on subsequently, I advance the hypothesis that smartphones exhibit this defining trait of attachment objects and directly test this proposition in the present research.

4. Owners can become distressed when restricted from engaging with the object

Another defining characteristic of attachment objects is that the owner becomes distressed when separated from the object. For example, when separated from an

attachment figure such as their mother, children can become anxious and react by searching for her, crying or throwing a temper tantrum (e.g., Bretherton 1992; Bowlby 1982). Notably, recent findings show that when they are restricted from using their smartphones, owners report increased levels of anxiety (Cheever et al. 2014; Clayton et al. 2015) and even showed elevated blood pressure and heart rate (Clayton et al. 2015). Thus, the distress that owners experience when restricted from their devices could be explained by the role that smartphones play as attachment objects.

In sum, a set of findings in the smartphone addiction literature suggests that smartphones exhibit at least two distinctive characteristics of attachment objects. For one, ample evidence shows that users rely on their smartphones to provide a variety of positive outcomes, such as safety and instant access to information (e.g., Aoki and Downes 2003). In addition, the aforementioned experimental findings suggest that users feel markedly distressed as a result of being restricted from their smartphones (e.g., Cheever et al. 2014).

One primary objective of the present research is to demonstrate that smartphones exhibit two additional defining characteristics of attachment objects over and above comparable electronic devices. First, if one's smartphone indeed represents an attachment object then engaging with the device should provide a distinct feeling of comfort to the owner. That is, smartphone use should not change one's affective state in general, but rather one's sense of comfort in particular. This leads to my first hypothesis:

Hypothesis 1: Using one's smartphone provides a distinct feeling of comfort relative to the use of comparable devices, holding all else equal.

Second, if smartphones act as attachment objects, then using one's smartphone should alleviate feelings of stress or discomfort. In the second hypothesis I predict that:

Hypothesis 2: Using one's smartphone provides a faster recovery from a stressful situation relative to the use of comparable devices, holding all else equal.

The first two hypotheses are tested in Studies 1-3.

Overview of Studies

The Adult Pacifier Hypothesis is tested across three studies so far, including two controlled experiments and one large correlational study. (Additional studies are in the planning stage.) In the controlled experiments (Studies 1-2), I tested the proposition that smartphones uniquely exhibit defining characteristics of attachment objects over and above comparable electronic devices. In particular, it was important to examine a comparative device that (1) offers similar functions; (2) is as widely used across the U.S. market; and (3) exhibits a similar rate of daily usage among U.S. consumers. Personal computers (PCs) were a natural point of contrast, since smartphones and PCs offer similar communication and browsing capabilities (e.g., email, web-based Internet, applications), exhibit comparable ownership rates in the U.S., with 68% of consumers owning a smartphone and 71% owning a PC (Pew Research 2015), as well as comparable average daily usage rates, with users consuming digital media for about 2.8 hours a day on their smartphones and 2.4 hours a day on their PC (KPCB 2015). Studies 1-2 therefore tested how participants felt after engaging with their smartphones relative engaging with their laptops, holding constant the content consumed across devices.

The results show that smartphones (vs. laptops) contain at least two of the primary characteristics of attachment objects. Specifically, one defining benefit of attachment objects is that owners feel a heightened sense of comfort after engaging with the possession (e.g., Bowlby 1982). Consistent with this, Study 1 shows that, holding the content consumed across devices constant, engaging with one's smartphone confers a

greater sense of comfort than engaging with one's PC (H1). Another major characteristic of attachment objects is that they are often used as a means of reducing negative feelings such as stress or anxiety (e.g., Thomson et al. 2005). Study 2 demonstrates that again, when holding the content constant, engaging with one's smartphone provides a greater sense of comfort and faster recovery from a stressful situation than using one's PC (H2).

Study 3 builds on the findings of Study 2 to test a corollary real world prediction that using one's smartphone will be particularly appealing to consumers who are particularly vulnerable to anxiety or stress – for example, people who have recently quit smoking cigarettes. Research has shown that cigarettes can serve as a source of stress and tension relief for smokers and that, soon after they quit smoking, people crave a substitutive means through which to relieve feelings of anxiety (e.g., Burr 1984; Sussman and Black 2008). If the recent cessation of smoking is a source of stress and anxiety, people who have recently quit smoking may more intensely engage with their smartphone as a substitutive source of comfort. Study 3 therefore compared smartphone usage patterns among participants who either recently quit smoking cigarettes or who were still smoking at the time. The results show that the drive to use one's smartphone becomes especially pronounced among consumers who have recently quit smoking relative to consumers who are still currently smoking, which provides further evidence suggesting that smartphones contain tension-relieving properties (H2).

STUDY 1

Given that one of the defining benefits characteristics of attachment objects is that owners feel a sense of comfort after engaging with this possession, the purpose of Study 1 was to examine whether smartphone usage does increase owners' sense of comfort relative to a comparable electronic device such as a PC, holding the content constant across devices. To test this, participants in Study 1 were randomly assigned to browse content on either their smartphone or their laptop, and were asked to rate their feeling states at two points in the study: Prior to using their assigned device, and after using their device. If consumers indeed perceive their smartphone as an attachment object over and above their comparable devices, then participants assigned to use their smartphone should show a greater increase in their sense of comfort as a result of using their device relative to participants assigned to use their laptop.

Method

Eighty-seven participants from the participant pool of the behavioral lab of an east coast university (66.7% women) participated in a 2 (device: smartphone vs. laptop) x 2 (time: pre-device usage [time 1] vs. post-device usage [time 2]) mixed design, with the first factor being between-subjects and the second factor being within-subject. The dependent measure of interest was the change in participants' sense of comfort over time (i.e., from time 1 to time 2). I predicted that participants in the smartphone condition would show a greater increase in their sense of comfort from time 1 to time 2 than participants in the laptop condition (H1).

Sense of comfort measure (time 1). Participants were told that they would be participating in three (allegedly) unrelated studies that were combined for greater efficiency. The alleged purpose of the "first study" was to understand their current state of mind. In "Study 1: Psychographic Survey I", which was completed on paper, participants were asked to answer a series of questions about themselves. After answering a set of filler questions, participants were asked to report their momentary feelings by indicating the extent to which they agreed with a total of thirteen statements about "how [they] are currently feeling at this moment". Among the feelings listed (e.g., "I feel excited", "I feel frustrated") were the four items of interest: "I feel relaxed", "I feel calm", "I feel at ease", and "I feel a sense of comfort" (1: "Not at all"; 7: "Very much so" scale). Responses to these items ($\alpha = .91$) were averaged to create an index of felt sense of comfort at time 1.

Device usage manipulation. After completing "Study 1" participants received instructions for "Study 2: Social Media Survey" whose actual purpose was to administer the device manipulation. Participants were instructed to browse a specific social media site either on their smartphone in the experimental condition or on their laptop in the control condition. To avoid sensitizing participants to the nature of the manipulation, the random assignment to conditions was done across sessions. To ensure that the two conditions were as comparable as possible, all participants were asked to browse the same content across the two conditions. Specifically, all participants were directed to the social blogging website Tumblr and were asked to browse the blog "Things Fitting Perfectly Into Other Things." This content was chosen for a few key reasons. First, Tumblr is one of the most popular social networking sites in the U.S. (Comscore 2015), which made it a particularly relevant consumption context within which to test for the predicted effects and minimized the likelihood of differences in familiarity across participants. Second, the Tumblr site has similar interfaces across its mobile and webbased formats, which ensured that the browsing experiences did not differ substantially across devices. Third, "Things Fitting Perfectly Into Other Things" displays simple images of objects fitting in to other objects, and includes minimal or no text, such that the content was similarly amenable to browsing on both laptop and mobile devices. Participants across conditions received the following instructions for "Study 2":

> "In the second survey, we are interested in people's assessments of user-generated content such as posts on YouTube, Instagram, Tumblr, etc. You will be asked to browse the Tumblr account 'Things Fitting Perfectly Into Other Things' and evaluate the images posted there. Specifically, you will be given 5 minutes to browse this account and look for images that you particularly like."

In the smartphone (laptop) condition, participants then read the following instructions: "At this time, please take out your <u>smartphone</u> (<u>laptop</u>) to open the Tumblr mobile application and locate the account 'Things Fitting Perfectly Into Other Things' (http://thingsfittingperfectlyintothings.tumblr.com)."

Sense of comfort measure (time 2). After five minutes had passed, the experimenter instructed participants to stop browsing and handed out the final set of questions. While the alleged purpose of these questions was to gauge participants' opinions about the Tumblr page, the actual purpose was to measure participants' sense of comfort after using their assigned devices (time 2). Participants were therefore told that before providing their opinions about Tumblr page, "we would like to again ask you how you are feeling at this moment". Participants then indicated their responses to the same questions presented in "Study 1" (time 1). Responses to the same four measures used for time 1 were averaged into an index of felt sense of comfort for time 2 ($\alpha = .88$).

Next, participants were asked to answer a series of questions about the Tumblr blog to reinforce the cover story. In addition, to control for potential differences in preexisting familiarity with Tumblr, participants were asked to indicate whether they had a Tumblr account prior to signing up for the study. Another possible concern is that any difference in sense of comfort observed might be driven not by participants' levels of attachment to their respective devices, but rather by differences in the user-friendliness of Tumblr across devices. To address this, participants were next asked to indicate how user-friendly they found the Tumblr mobile application (web-based site). Finally, participants completed a set of demographic questions.

Results

Preliminary analyses. A one-way ANOVA of participants' situational feelings at time 1 confirms no differences across conditions (largest F(1, 85) = 2.70, *NS*), which minimizes the concern that any difference in sense of comfort reported below was driven by differences in participants' feelings upon arrival to the study. Participants also did not differ across conditions in terms of their familiarity with Tumblr prior to the study, or along any of the demographic variables (largest $\chi^2(1, N = 87) = 1.37$, *NS*). Additionally, the results reveal no difference in the perceived user-friendliness of the Tumblr site across conditions (F(1, 85) < 1, *NS*). These preliminary findings confirm that the results reported below cannot be explained by differences in participants' feelings prior to device usage, differences in the perceived user-friendliness of the website, or differences in demographic factors across conditions.

Main results. Participants' ratings of sense of comfort at times 1 and 2 were submitted to a mixed ANOVA, with time as a within-subject factor and device as a between-subjects factor. First, the results reveal a main effect of time, such that participants' reported sense of comfort was greater at time 2 (M = 5.43) than time 1 on average (M = 4.99; F(1, 85) = 17.71, p < .001). More importantly, this main effect was qualified by a significant device × time interaction (F(1, 85) = 7.37, p < .015; see Figure 1). Simple effects analyses reveal that, as predicted, participants who used their

smartphone showed a significant increase in their sense of comfort from time 1 (M = 4.93) to time 2 (M = 5.66; F(1, 43) = 29.78, p < .001), while participants who had used their laptop did not show a significant increase in their sense of comfort over time (M_{Time 1} = 5.05 vs. M_{Time 2} = 5.21; F(1, 42) < 1, *NS*). Simple effects analyses in the other direction confirm that while participants did not differ across conditions in their reported sense of comfort at time 1, at time 2 participants who had used their smartphone reported a greater sense of comfort (M = 5.66) than participants who had used their laptop (M = 5.21; F(1,85) = 5.43, p < .025). Finally, additional analyses confirm no time × device interaction on any of the other situational feelings that were unrelated to sense of comfort (largest F(1,85) = 1.86, *NS*; see Table 1), which suggests that it is one's sense of comfort the hypothesis that users feel a distinct sense of comfort after engaging with their smartphone relative to their PC (H1).

[Insert Figure 1]

[Insert Table 1]

Discussion

The results of Study 1 suggest that smartphones contain one of the four defining characteristics of attachment objects: namely, that they provide a sense of comfort to owners. Further, the finding that participants did not show a change in any of the other situational feelings implies that smartphone use does not impact owners' affect in general but rather their sense of comfort in particular, which is central to the argument that smartphones serve as attachment objects. Additional analyses confirm that the main findings cannot be explained by preexisting individual differences across conditions or

differences in situational feelings prior to the device manipulation. Since the webpage browsed was held constant across devices, Study 1 also addresses the possibility that differences in sense of comfort were simply driven by differences in the content consumed across devices. Finally, the observed differences in sense of comfort also cannot be explained by differences in the perceived user-friendliness of the mobile vs. web-based versions of the content.

In sum, Study 1 provides preliminary evidence that smartphones serve as a type of attachment object for consumers over and above their comparable devices. In the next chapter, I test the prediction smartphones contain a second defining characteristic of attachment objects: namely, that they provide relief from feelings of stress (H2).

STUDY 2

In addition to imparting a sense of comfort in general, another primary characteristic of attachment objects is that they are often used as a means of alleviating stress. Specifically, by increasing one's sense of comfort, an attachment object can consequently provide relief from negative feelings when the owner feels distressed (e.g., Mikulincer and Shaver 2007). In Study 2 I test the hypothesis that, holding all else constant, using one's smartphone relieves stress to a greater extent than using one's laptop (H2). To examine this, participants first underwent a stress induction, and were then randomly assigned to engage either with their smartphone in one condition or with their laptop in another condition. Participants' sense of comfort was measured at three points in time throughout the study: (1) prior to the stress induction, (2) after the stress induction/before device usage, and (3) after using their assigned devices for 5 minutes. I predicted that after becoming stressed, participants who used their smartphone would

report a greater return to a sense of comfort – that is, faster recovery from stress – than those who used their laptops.

Method

Stress induction. To increase participants' level of stress in the main study – and thereby decrease their sense of comfort — I created a stress induction consisting of cognitive tasks administered under time constraints, which is a common method of inducing stress (e.g., Boyes and French 2010; Caciopo et al. 1995). Two separate pretests were conducted across two different participant pools to determine the appropriate stimuli and time constraints for the stress induction. Based on the results of the pretests, the stress induction was comprised of three tasks: 15 GMAT math problems, 18 Remote Associates Test (RAT) items (Mednick and Mednick 1967), and 18 anagrams. The three sets of problems were presented in increasing order of difficulty (math, anagrams and RAT) and the problems within each task were organized in ascending order of difficulty. In the main study participants received three minutes to complete each task, which was selected in order to sufficiently induce stress while keeping the time constraint constant across the tasks. Finally, to further increase participants' level of stress in the study, an alarm went off to indicate that one, two and three minutes had passed during each task.

Design and procedure. Fifty participants from the same participant pool as in Study 1 (60% women) participated in a 2 (device: smartphone vs. laptop) x 3 (time: prestress induction [time 1] vs. post-stress induction/pre-device usage [time 2] vs. postdevice usage [time 3]) mixed-subjects design, with device as a between-subjects factor and time as a within-subject factor. Participants were led to believe that they were completing two separate studies that had been combined for greater efficiency. Before beginning "Study 1", participants were told that the researcher was first interested in understanding their current state of mind, and were asked indicate their situational feelings on paper using the same measures as in Study 1, including the four items of interest: "I feel relaxed", "I feel calm", "I feel at ease", and "I feel a sense of comfort" (on a 1: "Not at all"; 7: "Very much so" scale). Responses to these four items ($\alpha = .88$) were averaged into an index of felt sense of comfort for time 1.

Next, participants completed "Study 1: Task Performance Study" on paper, which actually served to administer the stress induction described in the prior section. Participants were told that:

> "In this study, we are interested in pretesting material for a future survey. Specifically, we are interested in understanding how people deal with various tasks under time constraints. On the following pages you will be presented with three different problem sets and are asked to solve as many problems as you can. Those who correctly solve the greatest number of problems will be entered into a lottery for the chance to win an additional \$20. You should therefore try to answer all of the questions correctly and as quickly as you can."

Once participants completed the stress induction, they again provided their responses to the same situational feeling measures including the four items of interest ($\alpha = .93$) that were averaged into an index of felt sense of comfort for time 2. The change in sense of comfort from time 1 to time 2 served as a check of the stress induction.

Next, the device manipulation was administered by asking participants to complete "Study 2: Social Media Survey," which was the same procedure used in Study 1. Specifically, participants received the same instructions to browse the Tumblr page "Things Fitting Perfectly Into Other Things" for five minutes either on their smartphone in one condition or on their laptop in the other condition. This random assignment occurred across sessions, so that all participants within a given session were assigned to the same device. After browsing the content on their assigned device, participants again provided their responses to the same four items of interest ($\alpha = .92$) that were averaged into an index of felt sense of comfort at time 3. The change in participants' felt sense of comfort from time 2 to time 3 served to measure the degree of relief from stress due to device usage.

To reinforce the cover story, participants were then asked to answer the same set of questions about the Tumblr blog as in Study 1, including the measures of preexisting familiarity with Tumblr and perceived user-friendliness of Tumblr page that were meant to address potential alternative explanations. Participants in Study 2 were also asked to complete two sets of measures that were included to address additional potential explanations. First, to control for the unlikely possibility that, despite random assignment, participants differed in their general smartphone usage behavior, participants indicated the average number of hours they spend on their smartphones per day on a nine-point scale ("30 minutes"; "> 4 hours"). Second, to preclude the possibility that any effects were driven by differences across conditions in the perceived difficulty of the stress induction tasks, participants were asked to indicate how difficult they found each of the three problem sets to be on a seven-point scale (1: "Very easy"; 7: "Very difficult"), as well as how much more time they would have liked to complete the tasks on a five-point scale ("50% of the time that was given"; "150% more time"). These served as additional checks of the stress induction. As a measure of engagement in the study, at the end of the study I counted the number of problems attempted on each cognitive task to ensure that the results were not driven by differences in engagement in the study.

Results

Preliminary analyses. The results of preliminary analyses confirm that participants did not differ across conditions in terms of their daily smartphone usage across conditions (F < 1) or in the number of problems they attempted to solve across the three tasks of the stress induction (all F-values < 1), which precludes the alternative explanations that differences in sense of comfort reported below were driven by differences in general smartphone usage or task engagement across conditions. Next, participants' situational feelings at time 1 (prior to the device manipulation) were submitted to a one-way ANOVA. The results confirm that participants did not differ in terms of their sense of comfort at time 1 (F < 1). However, unexpectedly, participants in the smartphone condition indicated that at time 1 they felt marginally more frustrated ($M_{Smartphone} = 2.6 \text{ vs. } M_{PC} = 1.88; F(1, 48) = 3.96, p = .05$) than participants in the PC condition, although additional analyses confirm that the main analysis still holds when controlling for reported frustration at time 1 (reported subsequently).

Stress induction checks. To verify that the stress induction worked similarly across conditions, participants' sense of comfort measures at time 1 and time 2 were submitted to a mixed ANOVA, with time as a within-subject factor and device as a between-subjects factor. The results reveal the expected main effect of time on sense of comfort, such that participants reported a decrease in their sense of comfort from time 1 (M = 4.91) to time 2 (M = 3.45; F(1, 48) = 100.81, p < .001) on average. Importantly, this effect was not qualified by a device × time interaction (F < 1), which confirms that the stress induction impacted participants similarly across conditions. Additional analyses confirm no difference across conditions in terms of the reported difficulty of each

problem set (largest F(1, 48) = 2.16, *NS*) or in the additional amount of time participants would have liked in order to complete the tasks (F(1, 48) = 2.84, *NS*). Taken together, the results of these checks mitigate the concern that the main findings reported below might have been driven by differences in the effect of the stress induction across conditions.

Stress relief due to device usage. To test the prediction that using one's smartphone provides greater relief from stress than using one's PC, participants' sense of comfort at times 1, 2 and 3 were submitted to a mixed ANOVA, with time as a within-subject factor and device as a between-subjects factor. The results reveal a significant main effect of time on sense of comfort (F(2, 96) = 68.60, p < .001). Simple effects analyses confirm that participants reported a decrease in sense of comfort from time 1 to time 2 (as reported above), followed by an increased sense of comfort from time 2 to time 3 (M = 5.02; F(1, 48) = 93.48, p < .001).

More importantly, the main effect of time was qualified by a significant device × time interaction (F(2, 96) = 3.95, p < .025; see Figure 2). As reported earlier, a simple-effects analysis of the change in participants' sense of comfort from time 1 to time 2 reveals no device × time interaction, confirming that participants across conditions showed a similar decrease in sense of comfort due to the stress induction. However, an analysis of participants' sense of comfort from time 2 to time 3 reveals a significant device × time interaction (F(1, 48) = 5.48, p < .025). As predicted, participants who used their smartphone reported a greater increase in their sense of comfort from time 2 to time 3 (M_{Time 2} = 3.35 vs. M_{Time 3} = 5.3; F(1, 24) = 65.89, p < .001) than participants who used their laptop (M_{Time 2} = 3.55 vs. M_{Time 3} = 4.74; F(1, 24) = 29.65, p < .001). Thus, whereas participants in the laptop condition reported an average increase of a 1.19 scale

point in their sense of comfort ratings, participants in the smartphone condition reported an average increase of 1.95 scale points in their sense of comfort ratings. In other words, after undergoing stress, smartphone usage led to an increase in sense of comfort that was about 64% greater than the increase in sense of comfort due to PC usage. These results support the prediction that using one's smartphone alleviates stress to a greater extent than comparable devices (H2). An additional analysis controlling for participants' feelings of frustration at time 1 shows that the device × time interaction on sense of comfort still holds, although the effect is now marginal (F(1, 48) = 3.9, p = .05).

Finally, participants' feelings unrelated to sense of comfort at times 1, 2 and 3 were also submitted to a mixed ANOVA, with time as a within-subject factor and device as a between-subjects factor. The results reveal a main effect of time on participants' reported anxiety, confidence, satisfaction, happiness, focus, sadness and frustration (smallest F(2, 96) = 4.79, p < .001; see Table 2). However, importantly, none of these main effects were qualified by a device × time interaction (largest F(2, 96) = 2.34, *NS*). This finding is consistent with those of Study 1 and again suggests that it is a sense of comfort in particular that is enhanced due to smartphone usage.

[Insert Figure 2]

[Insert Table 2]

Discussion

The results of Study 2 reveal that, after undergoing stress, participants showed a greater increase in their sense of comfort when they engaged with their smartphones vs. PCs. These findings suggest that in addition to providing a general sense of comfort (H1), engaging with one's smartphone can also serve to relieve stress (H2), which is another

defining characteristic of attachment objects. Importantly, as in Study 1 none of the other situational feelings differed across devices as a function of time, which again implies that smartphone use does not change people's affect in general but rather their sense of comfort in particular. Additional analyses confirm that these effects are not driven by differences across conditions in the impact of the stress induction or in the level of involvement during the tasks. The effects also cannot be explained by preexisting differences in situational feelings upon arrival to the study, familiarity with the content browsed, or general smartphone usage behavior across conditions. Since the content was held constant, and no differences in the perceived user-friendliness of the content were reported across conditions, the impact of smartphone usage also cannot be explained by differences in the content across devices.

In sum, the results of Studies 1-2 suggest that relative to comparable devices, smartphones exhibit two defining characteristics of attachment objects: namely, in addition to conferring a general sense of comfort (H1), engaging with one's smartphone can also serve to relieve stress (H2). The purpose of Study 3 was to provide an additional test of H2.

STUDY 3

The purpose of Study 3 was to provide a corollary test of the Adult Pacifier Hypothesis in the real world. A large body of research on cigarette cessation has identified stress as a major factor contributing to relapse (e.g., Shiffman 1985; Wynd 1992). Specifically, ex-smokers who encounter stress seek out other resources for coping known as "substitutive behaviors," such as increasing their consumption of food or other substances, (e.g., Sussman and Black 2008; Zweben 1987), and failure to do so often

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results in relapse (e.g., Burr 1984; Pomerleau and Pomerleau 1987). If smartphones indeed contain stress-relieving properties (H2), then relative to those still currently smoking, consumers who have recently quit smoking should engage with the device more intensely as a type of substitutive behavior.

To investigate this, in Study 3 I sampled a large population of current smokers as well as ex-smokers and measured their cigarette usage behavior as well as their smartphone usage behavior. I predicted that among *ex*-smokers, the *more* intensely they smoked cigarettes before quitting, the *more* intensely they would engage with their smartphones since quitting. In contrast, since they do not need a substitutive behavior to replace cigarettes, this effect should not hold among *current* smokers. This pattern of results would provide further support for the hypothesis that engaging with one's smartphone can provide relief from stress much like a cigarette would to a smoker, or a pacifier would to a child.

Method

Design and overview. Under the guise of a study on how cigarette smoking impacts consumers' behaviors and lifestyle, 881 participants from the Amazon Mechanical Turk panel were recruited on the basis that they were either current cigarette smokers or ex-smokers who quit smoking over the past twelve months (48.6%). Smoking status (current vs. ex-smoker) served as the primary predictor of interest.

After indicating their smoking status, participants responded to a set of questions about their smoking behaviors followed by a series of questions about their behaviors across three additional consumption domains: food, alcohol and smartphone use. Specifically, in order to provide a more precise understanding of the possible effects of smoking cessation on smartphone consumption, I also measured the change in other behaviors that could also theoretically be connected with recent smoking cessation and, perhaps, smartphone consumption – the consumption of food and alcohol. These questions were not intended to diagnose "addictive" behaviors in a clinical sense (i.e., whether the necessary diagnostic criteria for clinical dependence were met) but rather to more generally measure participants' intensity of consumption in each domain (these measures are described in the subsequent section). Current smokers were asked to describe their behaviors across all of the domains "over the past year (in the last 12 months)." In contrast, ex-smokers completed a version of the survey that asked the same set of questions about their "previous smoking behavior," and then asked about their behaviors across the other domains with respect to the time "since [they] quit smoking." It is worth noting that since participants were recruited on the basis that they had quit within the past 12 months, both the ex-smokers and current smokers were asked to report on their behaviors within a 12-month timeframe.

Procedure. Participants first answered a set of questions about their (current vs. prior) smoking behaviors. Responses to these items were used to measure participants' "cigarette consumption intensity," which was the second primary predictor of interest. Next, participants answered two additional sets of questions about their food and alcohol consumption patterns, which were used to measure their "food consumption intensity" and "alcohol consumption intensity," respectively. These two sets of questions served both as filler items as well as control variables. Finally, to measure the main dependent variable – participants' "smartphone consumption intensity" – participants responded to a set of questions about their smartphone usage behaviors.

Finally, participants provided responses to a number of additional measures included to control for factors that could influence participants' likelihood of quitting smoking or relapsing. First, two factors that are commonly associated with smoking relapse are high trait neuroticism and low trait perseverance (e.g., Terracciano and Costa 2004). Participants therefore completed the neuroticism subscale of the Big Five Inventory (John and Srivastava 1999) as well as the perseverance subscale of the UPPS Impulsive Behavior Scale (Lynam and Whiteside 2001). Participants also indicated whether or not their close friends smoke and whether or not they currently live with a smoker, which have also been shown to predict relapse rates (e.g., Garvey, Bliss and Hitchcock 1992).

Consumption intensity measures. To construct the consumption intensity measures, a variety of items were selected from scales measuring addiction to tobacco (e.g., Etter 2005; Fagerström 1978), food (Gearhardt, Corbin and Brownell 2009) and alcohol (Skinner and Allen 1982). The items measuring the smartphone consumption intensity were adapted from "smartphone addiction" scales (e.g., Bianchi and Phillips 2005) as well as the aforementioned (and better validated) cigarette smoking scales. As noted earlier, the purpose of these measures was not to diagnose disordered behaviors in a clinical sense but rather to more generally measure participants' intensity of consumption in each domain. A number of the questions were selected to be comparable across the domains; for example, participants indicated whether they had increased their consumption of food, alcohol as well as smartphone use, respectively.

To create the consumption intensity measures for each domain, I calculated a standardized sum across all relevant measures. For each participant a given measure was

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standardized by subtracting the average value of the measure and dividing by its standard deviation. The measure of cigarette consumption intensity was calculated as the standardized sum of the following six measures: the total number of cigarettes smoked in a typical day; the total number of years they smoked; the number of previous attempts they had made at quitting; the type of smoker they considered themselves to be (1: "Non-smoker" to 5: "Heavy smoker"); how often they craved a cigarette this past week (1: "Never" to 5: "All the time"); and an index of six items measuring their smoking engagement (e.g., "I enjoy[ed] the physical sensation of lighting and handling a cigarette," "I worry [worried] that smoking was bad for my health but still continued to smoke" on a 1: "Strongly disagree" to 7: "Strongly agree" scale) ($\alpha = .82$).

The measure of smartphone consumption intensity was similarly calculated as the standardized sum of the following four measures: the total number of times they used their phone in a typical day; the degree to which they agreed that the time spent on their smartphone has increased over the past year (since quitting) (1: "Not true at all" to 5: "Very true"); how they felt towards their smartphone (1: "I feel fine about my smartphone" to 5: "I love my smartphone"); and six items measuring their smartphone engagement (e.g., "When I'm tense or upset, using my smartphone helps me relax," "I feel more comfortable with my smartphone in my hand" on a 1: "strongly disagree" to 7: "strongly agree" scale) ($\alpha = .91$). All items, including those comprising the food consumption intensity and alcohol consumption intensity measures, are reported in the Appendix.

I predicted a significant smoking status (current vs. ex-smoker) × cigarette consumption intensity interaction on participants' smartphone consumption intensity,

such that among ex-smokers, the greater their (previous) cigarette consumption intensity had been, the greater their smartphone consumption intensity would be since quitting. In contrast, among current smokers, cigarette consumption intensity over the past year would not impact their smartphone consumption intensity over that same time period.

Results

Preliminary analysis. A preliminary analysis shows that current smokers were older (M = 35.36 years old) than ex-smokers on average (M = 33.29 years old; F(1, 871) = 8.54, p < .005). The results of the main analyses controlling for these measures is reported in the next section. Additionally, the results show that participants did not differ in their levels of trait neuroticism or trait perseverance across the smoking status groups (all F-values < 1). Finally, the results find no differences across the smoking status groups in terms of any of the other demographic variables (all F-values < 1).

Effects on smartphone consumption intensity. A regression analysis was conducted with smoking status (current smoker coded as -1, ex-smoker coded as +1), cigarette consumption intensity, and their interaction as the predictors and smartphone consumption intensity as the dependent measure. As predicted, the results reveal a significant smoking status × cigarette consumption intensity interaction (β = .53, *p* = .002; see Figure 3). Simple effects analyses confirm that, among ex-smokers, the higher their cigarette consumption intensity used to be, the higher their smartphone consumption intensity has been since quitting (β = .46, *p* < .035). This finding suggests that, as a result of their stress-relieving properties (H2), smartphones can be used as a substitute for consumers seeking to replace the alleviating function of cigarettes. Interestingly, the results reveal that among current smokers, the higher their cigarette consumption

intensity over the past year, the lower their smartphone consumption intensity had been over that time period ($\beta = -.60$, p < .03). Whereas I predicted a null effect, this result provides further evidence to suggest that there might be a compensatory relationship between smoking and smartphone use.

[Insert Figure 3]

Controlling for consumption intensity in other domains. The same regression analysis was conducted that now included participants' alcohol consumption intensity as a covariate. The results find a main effect of the covariate such that the higher the alcohol consumption intensity, the higher the smartphone consumption intensity on average (β = .07, *p* < .015). More importantly, the results confirm that the smoking status × cigarette consumption intensity interaction still held when controlling for alcohol consumption intensity (β = .53, *p* = .002), and that the simple effects also held.

Next, the same regression analysis was conducted that instead included participants' food consumption intensity as a covariate. First, a main effect finds that the higher the food consumption intensity, the higher the smartphone consumption intensity on average ($\beta = .212$, p < .001). Second, the results show that the smoking status × cigarette consumption intensity interaction is still significant ($\beta = .38$, *p* < .025) although the effect was reduced. Specifically, among current smokers, the greater the cigarette consumption intensity, the lower their smartphone consumption intensity over the past year ($\beta = .6$, *p* < .025). However, after controlling for their food consumption intensity, the prior cigarette consumption intensity of ex-smokers no longer predicted their smartphone consumption intensity since quitting ($\beta = .14$, *NS*). This pattern of results is discussed further in the discussion section of this study.

Controlling for other covariates. When controlling for participants' age in the regression analysis, the results show that while the interaction remains significant (β = .42, *p* < .015), the effect of cigarette consumption intensity no longer predicted the smartphone consumption intensity of current smokers (β = .28, *NS*). As noted earlier, current smokers were older than ex-smokers on average, which suggests that the negative relationship between their smartphone consumption intensity and cigarette consumption intensity was in part driven by their relatively older age. Finally, additional analyses confirm that the main findings held even after controlling for participants' trait neuroticism, trait perseverance, whether they lived with a smoker and whether their friends were smokers, respectively (smallest β = .38, *p* < .025).

Effects on consumption intensity in other domains. To get a better understanding of the processes at work, I analyzed the effects of participants' smoking behaviors on their consumption intensity in other domains that could be related either to the main dependent variable (smartphone consumption intensity) and/or the main predictor (cigarette consumption intensity) – namely, food and alcohol. Specifically, I ran a regression analysis in which smoking status, cigarette consumption intensity, and their interaction were regressed on alcohol consumption intensity. The results show only a main effect of smoking status such that on average ex-smokers reported lower alcohol consumption intensity than current smokers ($\beta = -.54$, p < .001). This effect was not qualified by a smoking status × cigarette consumption intensity interaction. Given that ex-smokers showed *less* intense consumption of alcohol than current smokers, this result suggests that people might not tend to use drinking as a substitutive behavior for smoking cigarettes.

Next, the results of a similar regression with food consumption intensity as the dependent measure show that on average ex-smokers exhibited higher food consumption intensity than current smokers ($\beta = .58$, p < .001). In addition, on average the higher participants' cigarette consumption intensity, the higher their food consumption intensity ($\beta = .70$, p < .001). Finally, a smoking status × cigarette consumption intensity interaction ($\beta = .68$, p < .001) reveals that among ex-smokers, the higher their previous cigarette consumption intensity, the higher their food consumption intensity since quitting ($\beta = 1.38$, p < .001). In contrast, the cigarette consumption intensity of current smokers over the past year did not impact their food consumption intensity over that time period ($\beta = .014$, *NS*).

Discussion

Study 3 confirms that, among people who recently quit smoking cigarettes, the intensity with which they used to smoke positively predicts the intensity with which they engaged with their smartphones since quitting. In other words, for consumers who recently quit smoking, smartphone use might provide the relief from stress that had been previously afforded by cigarettes, which is consistent with the proposition that smartphones contain stress-relieving properties (H2). In contrast, the more intensely current smokers consumed cigarettes over the past year, the less intensely they engaged with their device. Thus, the more they had been driven to smoke, the less current smokers relied on other types of behaviors that might have similarly served to alleviate stress. While I had predicted a null effect among current smokers a priori, this finding actually provides further evidence to suggest a compensatory relationship between smoking and smartphone use.

In addition, the results show that controlling for ex-smokers' food consumption intensity mitigated the effect of their cigarette consumption intensity on their smartphone consumption intensity since quitting. Similarly, among ex-smokers, cigarette consumption intensity positively predicted their food consumption intensity since quitting. What might account for these results involving the intensity of food consumption for ex-smokers? One possibility is that that ex-smokers similarly use their smartphones and food to compensate for the stress relief that used to be achieved through smoking. On the other hand, controlling for participants' alcohol consumption intensity did not impact the main pattern of results. This suggests that alcohol might not contain the properties that commonly underlie cigarette, smartphone and food consumption.

In sum, the findings of Study 3 are consistent with the hypothesis that, as a cigarette does for a smoker or a pacifier does for a child, one's smartphone can provide relief from feelings of stress (H2).

GENERAL DISCUSSION

As consumers increasingly use their smartphones in lieu of their other devices, firms are increasingly preoccupied with adjusting to this so-called "mobile revolution" (Ackley 2015). Advertisers are responding by increasingly diverting their ad budgets toward mobile advertising (eMarketer 2015) and pursuing "mobile-first" digital strategies (Forbes 2015). Although some research within the marketing modeling literature has begun to examine the implications of mobile platforms (e.g., Bart, Stephen and Sarvary 2014; Ghose et al. 2013), there is a surprising dearth of behavioral research examining the psychological aspects of mobile consumer behavior. The psychological research that does exist has been conducted outside of marketing and focuses on the negative consequences of smartphone addiction in particular (e.g., Bianchi and Phillips 2005; Walsh et al. 2011). The current research offers substantive implications for any firm concerned with the "mobile consumer," offering initial insights into the important and under-explored topic of smartphone usage psychology.

In the present research I argue that consumers form strong emotional attachments to their smartphones relative to comparable electronic devices. While the extant findings in the smartphone addiction literature provide preliminary support for the idea that consumers form emotional attachments to this device, the vast majority of this research is correlational in nature. I report results from two controlled lab experiments that provide direct experimental evidence that consumers form strong emotional attachments to their smartphones relative to comparable technology such as their PCs. This idea is further supported by the results of a large correlational study conducted amongst ex-smokers and current smokers (Study 3). Further, my results show that using one's smartphone can confer positive emotional benefits, which shows that the psychological consequences of smartphone use are not solely negative as the research on "smartphone addiction" might suggest.

More specifically, I propose that insight into the psychology of smartphone use can be found in the literature on attachment theory. I advance the proposition that smartphones can serve as an attachment object for adults, which I refer to as the Adult Pacifier Hypothesis. Consistent with this, I show that smartphones (vs. PCs) confer a greater sense of comfort and faster recovery from stress for owners, which are two defining characteristics of attachment objects. Notably, the attachment theory literature largely discusses "attachment objects" with respect to the attachments young children form towards objects, such as a pacifier or security blanket, as part of their transition away from their primary caretaker. In contrast, while the research on *adult* attachment theory acknowledges that adults are capable of feeling attached to nonsocial objects, this body of work largely focuses on the interpersonal attachments between an individual and an attachment figure, such as a significant other or close relative (e.g, Crowell and Treboux 1995; Hazan and Shaver 1987). The results of the present research therefore contribute to this literature by demonstrating that, in much the same way that a child becomes attached to a pacifier, people can become emotionally attached to their smartphone in adulthood and thus derive psychological benefits akin to those that a child would obtain from a pacifier.

More generally, the findings that smartphones can impart feelings of comfort and relief from stress bear a number of important implications for consumer welfare advocates as well as marketers. For one, although consumers' relationship to the device has mostly been conceptualized in terms of the detrimental consequences of "smartphone addiction," the results of the present research suggest that, at least in the short term, the device can also confer psychological benefits such as relief from negative feelings or distress. Given that smartphone usage seems to be particularly pronounced among segments of consumers that are more prone to anxiety (Study 3), medical professionals could consider implementing certain psychological wellbeing interventions (e.g., anxiety reduction interventions) using targeted mobile campaigns in particular.

Additionally, firms can leverage this insight for their user experience considerations when designing mobile content. While conventional wisdom might suggest that mobile content and advertisements should be flashier and more attentiongrabbing given the limited "real estate" afforded by smaller screens, these results suggest that firms might want to tailor their mobile (vs. web-based) content to conform more to the sense of comfort motivation that tends to be associated with smartphone devices.

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TABLES

 Table 1

 Study 1 Means (and Standard Errors) of Other Situational Feelings as a Function of Device and Time

Feeling:	Мс	obile	PC		
	Time 1	Time 2	Time 1	Time 2	
Anxious	2.75	2.32	3.02	2.30	
	(SE=.26)	(SE=.21)	(SE=.27)	(SE=.21)	
Confident	5.30	5.16	4.98	5.05	
	(SE=.18)	(SE=.18)	(SE=.18)	(SE=.18)	
Satisfied	5.09	5.25	5.02	5.09	
	(SE=.20)	(SE=.17)	(SE=.20)	(SE=.18)	
Bored	2.66	2.86	3.19	3.37	
	(SE=.23)	(SE=.25)	(SE=.20)	(SE=.25)	
Нарру	4.82	4.96	4.88	4.81	
	(SE=.17)	(SE=.16)	(SE=.17)	(SE=.16)	
Focused	5.07	5.02	4.84	4.81	
	(SE=.21)	(SE=.21)	(SE=.21)	(SE=.21)	
Excited	3.71	4.00	3.81	3.65	
	(SE=.21)	(SE=.23)	(SE=.21)	(SE=.23)	
Sad	1.86	1.66	2.07	1.80	
	(SE=.17)	(SE=.18)	(SE=.21)	(SE=.19)	
Frustrated	2.27	1.80	2.47	2.05	
	(SE=.21)	(SE=.19)	(SE=.21)	(SE=.20)	

Table 2						
Study 2 Means (and Standard Errors) of Other Situational Feelings as a Function of						
Device and Time						

Feeling:	Mobile			PC			
	Time 1	Time 2	Time 3	Time 1	Time 2	Time 3	
Anxious	3.52	4.52	2.56	3.04	3.52	2.52	
	(SE=.30)	(SE=.30)	(SE=.23)	(SE=.30)	(SE=.30)	(SE=.23)	
Confident	5.04	3.24	4.40	4.56	3.20	4.00	
	(SE=.29)	(SE=.23)	(SE=.24)	(SE=.29)	(SE=.23)	(SE=.24)	
Satisfied	4.88	2.88	4.72	4.76	2.96	4.60	
	(SE=.29)	(SE=.23)	(SE=.25)	(SE=.29)	(SE=.23)	(SE=.25)	
Bored	2.72	2.56	3.08	2.76	2.72	2.88	
	(SE=.28)	(SE=.28)	(SE=.34)	(SE=.28)	(SE=.28)	(SE=.34)	
Нарру	4.88	3.44	4.60	4.72	3.48	4.20	
	(SE=.25)	(SE=.26)	(SE=.24)	(SE=.25)	(SE=.26)	(SE=.24)	
Focused	5.16	4.36	4.32	4.72	4.52	4.08	
	(SE=.33)	(SE=.31)	(SE=.24)	(SE=.33)	(SE=.31)	(SE=.24)	
Excited	3.76	3.40	3.80	3.40	3.00	3.16	
	(SE=.30)	(SE=.30)	(SE=.26)	(SE=.30)	(SE=.30)	(SE=.26)	
Sad	2.20	2.68	2.04	1.88	3.08	2.00	
	(SE=.24)	(SE=.29)	(SE=.22)	(SE=.24)	(SE=.29)	(SE=.22)	
Frustrated	2.60	4.16	2.20	1.88	3.88	2.36	
	(SE=.26)	(SE=.36)	(SE=.23)	(SE=.26)	(SE=.36)	(SE=.23)	



Figure 1 Study 1: Change in Sense of Comfort Over Time as a Function of Device

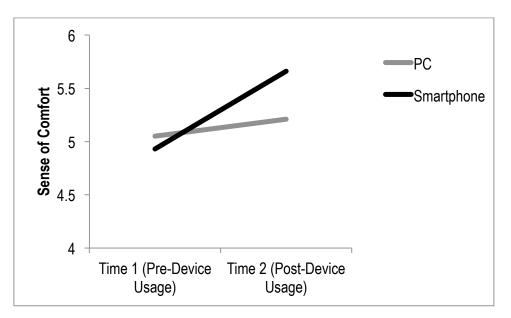
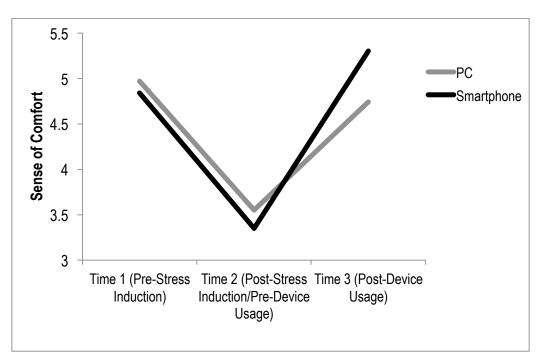
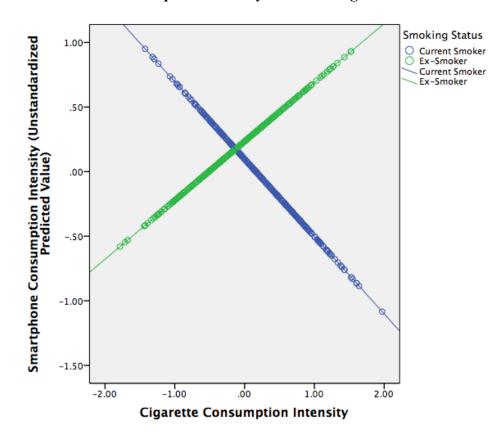


Figure 2 Study 2: Change in Sense of Comfort Over Time as a Function of Device



FIGURES

Figure 3 Study 3: Smartphone Consumption Intensity as a Function of Cigarette Consumption Intensity and Smoking Status



I. Cigarette Consumption Intensity Measures

- 1. In total, <u>how many years did you smoke</u>? (Please provide the number of years in numerical response only, e.g. 0.5 [i.e. for 6 months] or 10 [i.e. for 10 years])
- 2. Over this time period, <u>how many times did you attempt to quit smoking</u>? (Please provide the number of years in numerical response only, e.g. 0 or 5)
- 3. What type of smoker did you consider yourself to be?
 - Non-smoker
 - Social smoker
 - Light smoker
 - Moderate smoker
 - Heavy smoker
- 4. Please estimate how many cigarettes you smoked during the following time periods during a typical day (in numerical response only, e.g. 0 or 3):
 - 6:00 AM 9:00 AM
 - 9:00 AM Noon
 - Noon 3:00 PM
 - 3:00 PM 6:00 PM
 - 6:00 PM 9:00 PM
 - 9:00 PM Midnight
 - Midnight 3:00 AM
 - 3:00 AM 6:00 AM
- 5. Over the past week (in the past 7 days), how often did you find yourself craving a cigarette?
 - Never
 - Rarely
 - Sometimes
 - Most of the time
 - All the time
- 6. <u>Please indicate the extent to which you agree with the statements below</u>: When I was <u>smoking cigarettes</u>: (1 Strongly Disagree to 7 Strongly Agree)
 - 1. When I hadn't smoked in a while, I started craving a cigarette
 - 2. I enjoyed the physical sensation of lighting and handling a cigarette
 - 3. I automatically had a cigarette at certain times or activities, such as after meals
 - 4. I worried that smoking was bad for my health but still continued to smoke
 - 5. The biggest reason I couldn't stop smoking was because I was addicted
 - 6. My friends thought of me as a smoker

II. Food Consumption Intensity Measures

- 1. What type of diet do you consider yourself to have since you've quit smoking?
 - 1-Very Healthy
 - Moderately Healthy
 - 3-Somewhat Healthy
 - Moderately Unhealthy
 - 5-Very Unhealthy (i.e. I eat lots of junk food)
- Please indicate the extent to which you agree with the statements below about your <u>eating habits since you quit smoking</u>: (1 - Strongly Disagree to 7 - Strongly Agree)
 - I find myself consuming certain foods even though I am no longer hungry
 - When I start eating certain foods I end up eating more than I had planned
 - My behavior with respect to food and eating causes me significant distress
 - I often feel sluggish or fatigued from over-eating

3. <u>Indicate the extent to which you agree with the statements below:</u> Since I quit smoking, I have started eating more junk food.

- 1-Not true at all
- 2
- 3-Somewhat
- 4
- 5-Very true

4. <u>Indicate the extent to which you agree with the statements below:</u> Since I quit smoking, I have started eating more in general.

- 1-Not true at all
- 2
- 3-Somewhat
- 4
- 5-Very true

III. Alcohol Consumption Intensity Measures

- 1. How often have you had any kind of alcoholic drink since you've quit smoking?
 - Never
 - Monthly or less
 - 2 4 times a month
 - 2 3 times a week
 - 4 5 times a week
 - 6 or more times a week
- 2. <u>Since you've quit smoking</u> how many drinks do you have on a typical day of drinking?
 - 1 2 drinks
 - 3 4 drinks
 - 5 6 drinks
 - 7 9 drinks
 - 10 or more drinks
- 3. In total, <u>how many years have you been drinking alcohol</u>? (Please provide the number of years in numerical response only, e.g. 0.5 [i.e. for 6 months] or 7 [i.e. for 7 years]).
- Please indicate the extent to which you agree with the statements below about <u>drinking alcohol since you've quit smoking</u>: (1 - Strongly Disagree to 7 - Strongly Agree)
 - When I'm depressed I drink to feel better
 - When I drink I often lose track of how much alcohol I'm consuming
 - I have tried to cut down on my drinking and failed
 - I usually cannot stop drinking after taking 1 to 2 drinks

IV. Smartphone Consumption Intensity Measures

- 1. How do you feel about your current smartphone?
 - 1-I feel fine about my smartphone
 - 2
 - 3
 - 4
 - 5-I love my smartphone
- Please estimate how many times you use your smartphone during the following time periods during a typical day since you quit smoking (in numerical response only, e.g. 0 or 3):
 - 6:00 AM 9:00 AM
 - 9:00 AM Noon
 - Noon 3:00 PM
 - 3:00 PM 6:00 PM
 - 6:00 PM 9:00 PM
 - 9:00 PM Midnight
 - Midnight 3:00 AM
 - 3:00 AM 6:00 AM
- 3. Please indicate the extent to which you agree with the statements below about <u>your</u> <u>smartphone use since you've quit smoking</u>: (1 Strongly Disagree to 7 Strongly Agree)
 - When I run out of battery it's almost unbearable until I recharge my smartphone
 - When I'm tense or upset, using my smartphone helps me relax
 - Using my phone helps me deal with an overly stimulating environment
 - Using my phone helps me feel comfortable in social situations
 - When I see other people using their phones I want to use my phone
 - I feel more comfortable with my smartphone in my hand
- 4. <u>Indicate the extent to which you agree with the statement below</u>: Since I quit smoking, the time I spend on my smartphone has increased.
 - 1-Not true at all
 - 2
 - 3-Somewhat
 - 4
 - 5-Very true