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The Mere Presence Effect: Attentional Bias Promoted by Smartphone Presence

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THE MERE PRESENCE EFFECT: ATTENTIONAL BIAS PROMOTED BY SMARTPHONE PRESENCE

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THE MERE PRESENCE EFFECT: ATTENTIONAL BIAS PROMOTED BY SMARTPHONE PRESENCE

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ABSTRACT

THE MERE PRESENCE EFFECT: ATTENTIONAL BIAS PROMOTED BY SMARTPHONE PRESENCE

by María del Pilar Bianchi Bosch

Smartphones have become an essential part of modern life, offering access to entertainment, information, and social connections from anywhere, at any time. However, research has associated interactions with these devices with maladaptive behaviors and cognitive impairments. Furthermore, recent research has suggested that the mere presence of a smartphone can deplete cognitive resources. We sought to test the hypothesis that the perceptual salience of smartphones would negatively impact perceptual processes. Using a sample of college-aged students ($N = 71$), we tested whether the mere presence of a smartphone might affect reaction time and accuracy in a lateralized spatial configuration visual search task, and how the location of the phone might bias attention on this task. Additionally, we tested how individual differences in amount of smartphone and social media usage, smartphone attachment, and fear of missing out correlate with the behavioral measures. The presence of a smartphone neither distracted nor biased attention of participants and was not related to any the variables exploring individual differences. We did find that a large proportion of our sample, especially females, self-reported high levels of smartphone attachment, qualifying as at risk of smartphone addiction. Additionally, we found a positive relationship between fear of missing out, smartphone attachment, and social media usage. Based on these findings, we argue that patterns of smartphone dependence are not related to the amount of time people spend with their smartphones, but the type and amount of social rewards acceded using them.

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Introduction

Smartphones – mobile phones that perform functions traditionally associated with computers – have revolutionized the way people use and relate to technology[1]. These devices have allowed the world to get closer, offering access to information and communication anywhere, at any time. With the possibility of constant connectivity and the potential to become an all-purpose device, we have integrated smartphones into almost every aspect of our lives (M. Anderson, 2015). Furthermore, more than any other media delivery device, smartphones have become ubiquitous in society. In 2017, the Pew Research Center surveyed 40 countries, and found that 42% of the population in developing economies and 72% of the population in advanced economies reported owning a smartphone. In the United States alone, 77% of adults were owners of one of these devices (Poushter, Bishop, & Chwe, 2018). This rapid adoption has brought concerns to individuals, institutions, and governments, about the impact of smartphone on cognitive processes.

Research has shown that interacting with cell phones can substantially impair cognitive processes in various settings (e.g., End, Worthman, Mathews, & Wetterau, 2010; Hyman, Boss, Wise, McKenzie & Caggiano, 2010). Furthermore, new research has noted that the mere presence of a smartphone has the potential to impair cognitive processing and have emotional effects, such as impacting how close people feel to others in a conversation (e.g., Przybylski & Weinstein, 2013; Thornton, Faires, Robbins, &

[1] Note that we will use the term "smartphone" to refer to cellular communication devices with both telephone and internet capabilities and the term "cell phone" to refer to cellular communication devices with only telephone capabilities.

Rollins, 2014). This raises the question of why would people pay attention to these devices at the expense of other, more relevant, contextual goals. The theory of attentional control is concerned with how attention is directed and suggests that stimuli that have gained great significance to the person have the potential to guide and bias attention (Anderson & Yantis, 2013). As such, the attentional control theory provides a valid framework to explore the root of the mere presence effect. Specifically, considering the ubiquity of smartphones, the proposed study explored the possibility that these otherwise non-salient devices could be dominating our daily attention due to the rewarding value with which we have imbued them.

Smartphones and Everyday Impairment

Smartphones have become the most commonly owned technological device in America (M. Anderson, 2015). Their multi-purpose nature has allowed these devices to perform an almost limitless range of activities, replacing cognitive processes and satisfying many of our affective urges. They are our alarm clock, calendar, encyclopedia, phone book, navigation tool, and source of entertainment and social interaction. However, this technological marvel has also brought with it concerns about the adverse consequences of becoming accustomed to its use.

Extrinsic interruptions. The ubiquitous nature of smartphones provides the opportunity for these devices to interfere with or interrupt ongoing mental and physical tasks (Wilmer, Sherman, & Chein, 2017). They can cause interruptions because they are designed to capture our attention with various auditory and haptic cues (Eyal, 2014).

Notifications can produce sounds, vibrate, and light up with colors and information, which prompts the user to interact with his or her phone.

Regardless of their intended nature, exposure to smartphone notifications has been related to significantly decreased academic performance and poorer long-term memory formation (End et al., 2010). Smartphone notifications also decrease performance on attention-based tasks, even when participants do not view or interact with the notifications (Stothart, Mitchum & Yehner, 2015). Simply hearing the sound or feeling a notification is enough to distract participants from their primary task. Stothart and his colleagues hypothesized that the notifications prompt task-irrelevant thoughts related to the content of the messages.

Intrinsic interruptions. Smartphones may capture attention even when they are not beeping and buzzing, as when an individual checks his or her smartphone to see if they have missed any notifications. We are calling the tendency of checking a smartphone intrinsic interruptions, as the motivation to interact with the device comes from the user, and not external signals. This interrupting nature is especially clear when individuals actually interact with his or her smartphones at the expense of contextually relevant ongoing tasks. Researchers have become worried about the habit of using smartphones while studying, finding that it impairs academic productivity (Cutino & Ness, 2017; Fox, Rosen, & Crawford, 2009) and is associated with poor academic performance (Duncan, Hoekstra, and Wilkox, 2012; Rosen, Carrier, & Cheever, 2017). Furthermore, higher overall levels of smartphone use can predict poorer academic performance (Wilmer et al., 2017). The extent of this effect could be explained by the nature of smartphone use. The initial shift of attention caused by a notification or self-motivated interaction that results in checking one's smartphone serves as a "gateway" to other task-irrelevant uses and applications (Oulasvirta, Rattenbury, Ma, & Raita, 2012). In this case, intrinsic motivations could drive the user to a chain of other smartphone-related activities, potentially perceived as more rewarding than the concurrent goal-oriented tasks, extending the period of disruption (Wilmer et al., 2017).

Even before smartphones were in existence, the potential of a negative impact of mobile phones on human behavior and cognition has not escaped researchers, institutions, or even governments. One example of this relationship between researchers and the government is the body of research exploring the impact of cellphones on road safety, which has inspired laws concerning cellular phone use and texting while driving. Cell phone use has been consistently implicated in distracted driving, decreased attention to the road, and slowed reaction to potential hazards, resulting in significantly increased accident risk (Cair, Willness, Steel, & Scialfa, 2008). Even pedestrians can show impairment while talking on cell phones, allocating fewer attentional resources to their environments, which can make them less likely to notice unusual events (Hyman et al., 2010) and have a higher tendency to compromise their safety while trying to cross roads in simulations (Stavrinos, Byington, & Schwebel, 2011).

The mere presence effect. Importantly, recent studies have observed that the mere presence of a smartphone, even when not in use, can have an impact on cognitive and emotional processes. Thornton and his team (2014) had participants complete a series of cognitive tasks while in the presence of the experimenter's smartphone or, in the control condition, a notebook. They found that people performed worse when the phone was present and the task required greater attention for optimal performance. Later, they replicated these results using participants' own phones in a classroom setting. They hypothesized that the presence of a smartphone could promote thoughts unrelated to the primary task, recruiting cognitive resources that otherwise would have been allocated to the task at hand (Thornton et al., 2014). In a similar vein, Ward, Duke, Gneezy and Bos (2017) found that mere presence of a participant's smartphone impaired their performance on measures of cognitive capacity (available working memory and functional fluid intelligence). Furthermore, the effects of smartphone presence were moderated by the personal relevance of these devices; those who depended more on their devices performed worse than those who depended less on them. Lyngs (2017) tried to replicate Thornton and his team's study, addressing sample size and procedure issues to better study effects of the presence of participants' own smartphones, as opposed to one provided by a researcher, without arousing suspicion of the experimental manipulation. Unfortunately, Lyngs was not able to replicate the original experiment's result, finding no effect of smartphone presence in participant's performance. Nevertheless, analogous to Ward et al.'s results, Lyngs found a moderation effect for smartphone attachment. Participants who were more attached to their phones found the experiment more fun and easier when they had their devices next to them. Finally, the mere presence of cell phones has also been related to negative effects on social interaction, lower relational quality, and closeness (Przybylski & Weinstein, 2013), and lower levels of empathy with participants' conversation partner (Misra, Cheng, Genevie, & Yuan, 2016).

Taken together, these results form a pattern. With the opportunity of unlimited access and use, smartphones give rise to problems that are increasingly affecting daily life (Gutiérrez, Rodríguez de Fonseca, & Rubio, 2016). In exchange for the opportunity to access and use these devices, people might be exposing themselves to adverse consequences and even risking their own and others' lives (in the case of driving). Some people have even started to show signs of dependency, a sentiment reflected by a recent poll conducted by Pew Research, in which nearly half of Americans reported that they could not live without their smartphones (Smith, 2015). This research raises the question of why people are paying attention to their cell phones, even when they should not. One explanation lies in the potential value that our society, and in turn, ourselves, have given to this device.

The Value of a Smartphone

Lyngs (2017) and Ward et al. (2017) found that the observed effects of the mere presence of participants' smartphones were moderated by their attachment to the device. The origin of this attachment could be related to the practical, social, and emotional value given to these devices. Smartphones can be tailored to fulfill our individual needs anywhere at any time -- one of the greatest values of smartphones in today's society. All of the students surveyed in a recent study reported that their smartphones were an essential tool for their daily life, facilitating communication, entertainment, and getting instant information, even if that information is almost half of the time not perceived as relevant (Gutiérrez-Rentería, Santana-Villegas, & Pérez-Ayala, 2017).

Smartphone usage. Given the practical utility of these devices, people may be adapting their behavior to include smartphones in almost every part of their lives. For most people, their smartphone is one of the first and last things they see every day (Andrews, Ellis, Shaw, & Piwek, 2015; IDC, 2013), and it dominates a great portion of their time awake. Surveys indicate that people use their phones around 5 hours a day (Andrews et al., 2015; Gutiérrez-Rentería et al., 2017), and although not in active use, 25% of respondents did not remember a time that their phone was not close to them (IDC, 2013).

Furthermore, smartphones have generated usage patterns that differ from other technological devices. They are characterized by checking habits, with interactions that are shorter (as brief as a second) but more abundant, reflecting the time needed to obtain fast feedback and information (Andrew et al., 2015; Oulasvirta et al., 2012). Andrew and his colleagues reported that smartphone users interacted with their phone an average of 84.68 times a day; Smith (2012) found that people between the ages of 18 and 24 exchange an average of 110 texts per day.

Importantly, the sheer frequency and amount of time that we spend on our smartphones is a product of conscious design. In his book *Hooked*, Eyal (2014) describes guidelines for designing habit-forming products. These design guidelines are based on conditioning frameworks. Behavioral learning is facilitated through the repeated association of external triggers, like notifications or vibrations, with the satisfaction of internal motivations (rewards), like the need for connectedness, entertainment, or to find useful information. Learning is a crucial process that favors the repetition of goal-directed and automatic behaviors that have a higher probability of resulting in reward (Schultz, 2015). Under this premise, the constant interaction with a smartphone, in which each email, text, or meme can produce short-term rewards, can positively reinforce smartphone use, making further use more likely, as we learn that it provides a seemingly unlimited stream of rewards.

Addiction. The mesolimbic pathway is composed of neural structures that are activated by reward-associated stimuli, namely the ventral tegmental area – the primary production area of dopamine in a pathway that includes the hippocampus, amygdala, medial prefrontal cortex, and nucleus accumbens (Pierce & Kumaresan, 2006). When associated with rewarding stimuli or behaviors such as sustenance and mating, the release of dopamine can contribute to survival, given that it is experienced as pleasurable and supports the learning and repetition of evolutionarily adaptive behaviors (Schulz, 2015). However, consuming foods high in carbohydrates and fats, or stimulants like cocaine and amphetamines, also increases dopamine release and produces short-term rewards, which have the potential to cause persistent maladaptive behaviors despite the knowledge that these behaviors have adverse consequences (Grant, Potenza, Weinstein, & Gorelick, 2010). With respect to smartphones, however, there is rarely a necessity to suppress the desire of use, as checking one's smartphone and using it has become a common behavior in many contexts that is rarely punished, opening the opportunity for indiscriminate use.

The frequency and indiscriminate use of these devices has generated an increasing preoccupation with their psychological and emotional consequences. Higher frequency of smartphone use has been associated with changes at neurological level. Hadar et al.

(2017) found that long-term use of a smartphone can reduce levels of sustained attention and is related to higher impulsivity at a behavior and neurological level, reflected in reduced right prefrontal cortex (rPFC) excitability, a neurological pattern also found in patients with attention deficit hyperactivity disorder (ADHD). Additionally, a growing body of research is concerned with the possibility of becoming addicted to mobile phones (De-Sola Gutiérrez, Rodríguez de Fonseca, & Rubio, 2016). Although smartphone addiction is not an official diagnosis, new research is exploring the consequences of having a pathological relationship with these devices. Smartphone dependency has been associated with lower white matter integrity (Hu, Long, Lyu, Zhou, & Chen, 2017) and higher sensitivity to push notifications associated with impaired concentration (Kim, Kim, & Kang. 2016).

Although cell phone addiction has not been consistently related to the amount of usage (Andrew et al., 2015), it has been related to a number of cognitive and emotional consequences, such as anxiety and emotional responses to the inability to send and receive messages (De-Sola Gutiérrez et al., 2016), indicating that although increased use does not necessarily represent a problem in itself, the high value associated with the device could underlie the excessive attention and attachment given to one's phone.

Social interaction. People can interact with their smartphones in different ways, and as such, the valence given to these devices can vary. Among all the possible uses of a smartphone, uses that revolve around establishing and maintaining social relationships are of particular interest to the current study. Not only are social interactions the most valued by users (IDC, 2013) and highlighted as one of the strongest motivators that cultivates habits of product use (Eyal, 2014), they also have been found to be the strongest predictor for smartphone addiction (De Sola-Gútierrez, 2016; Jeong, Kim, Yum, & Hwang, 2016). In addition, using smartphones can increase people's preoccupation of how others see them (Hadar et al., 2017).

This finding is perhaps not surprising, given that online socialization provides tailored and simplified social interactions, increasing the possibility of a positive experience (Greenfield, 2011). Receiving texts, likes, and other notifications from social media are all examples of social rewards (Cutino & Nees, 2017). Virtual social rewards have been implicated in the recruitment and activation of the thalamus and the medial prefrontal cortex, involved in higher cognitive functions like theory of mind and self-reflection, which are essential for processing the way others view us (Izuma, Saito, & Sadato, 2008). For example, higher frequency of checking Facebook on daily basis has been linked with smaller gray matter volumes of the nucleus accumbens, which is involved in reward processing (Montag et al., 2017). These results indicate that, across all of the possible use habits associated with smartphones, social interactions may be the most valuable as they focus on providing social rewards.

Fear of missing out. Additionally, social media provides abundant forms of social information about activities, events, and conversations, opening the opportunity for greater social involvement. For many, the abundance of this information causes anxiety, as it can generate apprehension that others might be having rewarding experiences from which one is absent (Przybylski, Murayama, DeHaan, & Gladwell, 2013). This phenomenon has been termed *Fear of Missing Out* (FoMo) and is reflected in the need to frequently stay connected to social networks (Elhai, Levine, Dvorak, & Hall, 2016). FoMo is of particular relevance to the current project, as it has been strongly related to problematic smartphone use (Elhai et al., 2016) and could represent a form of negative reinforcement, in which the anxiety associated with missing out might motivate people to frequently check social media through their phones, which would relieve anxiety. The relieve of anxiety would be the reward that motivates further use.

How do the rewards experienced with smartphone use relate to the indiscriminate use of these devices, and why would the mere presence of a smartphone cause cognitive impairment? Past research on attentional learning and associated processes might provide a framework to inform the root of the mere presence effect. A possibility is that the value associated with smartphones can bias their owner's attention, interfering with other cognitive processes.

Attentional Bias and Reward

Attention determines what elements of our perceptual world are brought to awareness or subjected to further processing. Two models of attentional control are believed to determine perceptual priority in the world. On the one hand, voluntary attentional control, also called endogenous or top-down attentional control, refers to the deliberate orientation of attention guided by contextual goals (Theeuwes, 2010). In this process, we know that we are looking for and search for it in the environment. On the other hand, stimulus-driven attentional control, sometimes called exogenous or bottom-up attentional control or attentional capture, refers to the involuntary capture of attention by perceptually salient stimuli (Theeuwes, 2010). Involuntary attentional capture can unexpectedly direct our attention to stimuli that represent danger or opportunity (B. A. Anderson, Laurent, & Yantis, 2011).

Consequently, attentional processes select stimuli that are relevant for promoting survival and well-being, and as the brain is designed to learn from rewards, past rewarding experiences can influence perception and behavior (B. A. Anderson et al., 2011; Seitz, Kim, & Watanabe, 2009; Shultz, 2013). Stimuli related to goal achievement can be prioritized during voluntary searches, and otherwise non-salient stimuli can become salient, as they acquire value through the repeated association with rewarding experiences (B. A. Anderson & Yantis, 2013; B. A. Anderson et al., 2011; Field, Munafó, & Franken, 2009; Pool, Brosch, Delplanque, & Sander, 2016). Neurologically, the automatic orienting of attention to previously reward-associated stimuli has been positively correlated with the release of dopamine within the caudate and marginally the posterior putamen, both sub-areas of the ventral striatum, which plays an important role in reward learning. Dopamine release appears to be involved in the expectation of reward associated with a cue (B. A. Anderson et al., 2016; Shultz, 1992). As reward-related cues acquire motivational properties and increasing perceptual priority, they can induce attentional bias (Garavan & Hester, 2007).

Traditionally, attentional bias has been measured using visual perception tasks, in which the capture effect of valuable stimuli is associated with slower reaction times in goal-oriented tasks (Garavan & Hester, 2007). This phenomenon has been observed with drug-related stimuli for several substance and behavioral addicted populations (Field & Cox, 2008), food-related stimuli in obese and hungry populations (Castellanos et al., 2009), and in experiments in which monetary value has been associated with visual stimuli, making them effective distractors in visual search tasks (e.g., B. A. Anderson et al., 2011; Hickey, Kaiser, & Peelen, 2015).

Through the same process, smartphones and related cues could have acquired perceptual priority for their owners. Through the repeated experience of satisfaction achieved through smartphones, people could learn that each notification and interaction has the potential for reward, increasing motivation for interaction and use. As a consequence, smartphones could gain perceptual salience for users over time. The cognitive effect of the mere presence of a smartphone (Thornton et al., 2016; Ward et al., 2016), as well as the emotional effect (Misra et al., 2016; Lyngs, 2017; Przybylski & Weinstein, 2013), could be partially explained by the development of visual salience. The mere presence of a smartphone in the visual field could be impacting these different processes through its potential capacity to capture people's attention.

Ito and Kawahara (2017) were inspired by Thornton et al.'s (2014) results and tried to explore if the mere presence effect of a smartphone could be explained by its salient and distracting nature. To test this hypothesis, they attached an iPhone or a Notebook to the side of a screen and had participants complete a lateralized visual search task. They found that the mere presence of an iPhone was able to distract participants from the task. They did not find a bias to the location of the smartphone. Additionally, they found that participants with lower levels of internet attachment were more influenced by the presence of smartphone, such that the effect of the presence of a smartphone was stronger in those that had lower levels of smartphone attachment.

Gaps in the Literature

Although there is considerable interest in the impact of smartphones on how people act, feel, and think, most of the research is concerned with the ways in which the active use of these devices and exposure to notifications can impair cognitive processes and have maladaptive consequences for their users. Few studies are concerned with the effect of the mere presence of smartphones, in which there is likely little awareness that cognitive resources are being allocated to the devices.

Researchers studying the mere presence effect of smartphones have controlled for differences between users, such as frequency of use and attachment to their device, but not variables concerned with the value given to virtual social interaction. Previous research has related social media use and FoMo with problematic smartphone use, providing evidence of the importance of potential social interaction to the value given to these devices. However, no research on the mere presence effect of smartphones has controlled for participants use of social media and their degree of FoMo.

Finally, even though there is a considerable amount of research exploring the effect of high value objects on attentional processes, to our knowledge, only Ito and Kawahara (2017) have tested the hypothesis that the mere presence effect could be explained by the perceptual salience attained by smartphones. But, as noted previously, they did not use participants' own smartphones, limiting the external validity of their results.

Relevance of the Study

Considering the degree to which smartphones have permeated our society and are incorporated into our everyday life, it should be an essential goal of researchers to study and further understand how these pervasive technologies are changing the way we interact, think, and see the world. Specifically, further studying the mere presence effect has potential wide-reaching implications. Taking into consideration the common occurrence of people leaving their smartphones within view, understanding the attentional effects of the mere presence of smartphones could inform the increasing number of owners about the consequences of having one in close view, potentially impairing their productivity and goals. This knowledge could be reflected in users' decisions to store their device away, helping to prioritize their attentional resources to contextual goals. A student could hide his or her cell phone from sight to focus on finishing a paper, and drivers could put their phones out of sight and prioritize auditory signals for navigation, potentially avoiding unnecessarily moving her gaze away from the road and decreasing driving errors.

On a bigger scale, governments, employers, and educators could benefit from understanding the passive effects of cell phone presence. This way, those who worry about distracted driving, working, or learning could make interventions or policies that recommend storing smartphones away from the visual field, helping to prioritize attentional resources to contextually relevant tasks.

Additionally, with increasing worry about smartphone addiction and overuse, understanding how this device is shaping how we attend to the world is essential. Finding that smartphones have the capacity to produce attentional bias, a phenomenon already observed in other substance and behavioral addictions, could support research on smartphone addiction. Similarly, understanding how individual differences in use and attachment to smartphones is related to the mere presence effect could help to develop prevention programs and treatment of problematic smartphone use. Finally, from an academic perspective, knowing that the mere presence of a smartphone could implicate the recruitment of attentional resources could inform research on smartphone use and the mere presence effect.

Experiment and Hypotheses

The main purpose of this study was to test the theory that the mere presence of a smartphone can impact visual attention. Additionally, we were interested in exploring if the impact of smartphone presence and location is related to individual differences in amount of smartphone use, preferences for social usages, FoMo, and smartphone attachment. We attempted to replicate the mere presence phenomenon reported by previous studies, and to explore factors that could explain this phenomenon, in the hope of further understanding how smartphones are impacting humans.

Hypothesis 1: The mere presence of a smartphone will influence participant performance on a visual attention task.

> ***Hypothesis 1a:*** Participants will demonstrate slower reaction times to find targets when in the presence of their smartphone.
>
> ***Hypothesis 1b:*** Participants will demonstrate decreased accuracy to find targets when in the presence of their smartphone.

Hypothesis 2**:** The location of the smartphone will differentially bias participant attention.

Hypothesis 2a: Participants will demonstrate slower reaction times in response to targets on the same side of the screen as their smartphone.

Hypothesis 2b: Participants will demonstrate decreased accuracy for targets on the same side of the screen as their smartphone.

Hypothesis 3: The mere presence effect of a smartphone on participants' performance will relate to individual variables of smartphone use.

***Hypothesis 3a*:** Frequency of smartphone use will be positively related to the presence effect of the smartphone.

***Hypothesis 3b*:** Smartphone attachment will be positively related to the presence effect of the smartphone.

***Hypothesis 3c*:** Fear of missing out will be positively related positively related to the presence effect of the smartphone.

***Hypothesis 3d*:** Individuals' preferred usage of their smartphone will be positively related to the presence effect of the smartphone.

***Hypothesis 4*:** Individual variables of smartphone use will be related to attentional bias to the smartphone when present.

***Hypothesis 4a*:** Amount of smartphone use will be positively related to attentional bias.

***Hypothesis 4b*:** Smartphone attachment will be positively related to attentional bias.

***Hypothesis 4c*:** Fear of missing out will be positively related to attentional bias.

***Hypothesis 4d*:** Individuals' preferred usage of their smartphone will be positively related to attentional bias.

Method

Participants

Participants were recruited from the San José State University SONA subject pool. All participants provided informed consent in accordance with the Institutional Review Board of San Jose State University and received course credit for participating in the experiment. Sample size was calculated a priori using G*Power 3.1 software (Faul, Erdfelder, Lang, & Buchner, 2007), for repeated measures analysis of variance (ANOVA) with four measurements. Values were established with an alpha of .05, power of 0.8, and moderate effect size (0.25), estimated using the results of similar research on attentional bias (Garavan & Hester, 2007; Miranda & Palmer, 2013). The calculated required total sample size was N = 61. A larger sample size of N = 71 was planned to be collected to allow for the potential removal of participants, due to the possibility of errors and technical difficulties during data collection. Additionally, with a lateralized search task like the one used in this study, there is the possibility that participants will only search one side of the screen, and that if they do not find the target, they will respond that it is present on the other side of the screen. Such a strategy would result in a large number of errors on target absent trials. Accordingly, it was determined prior to data collection that participants would be screened for non-compliance with experiment instructions if they had a target absent accuracy that was three standard deviations worse than the mean of other participants.

Seventy-nine undergraduate students participated in the study. Of these, four were eliminated because of technical difficulties with the experiment, and one participant was eliminated from the analysis because he or her did not carry a smartphone. Additionally, three participants had accuracy scores more three standard deviations below the average on target-absent trials and were subsequently excluded from the sample (note that all analyses were performed both with and without these three participants, and that results were not impacted by their exclusion). The final sample for the two-factor ANOVA consisted of 71 participants (47 females, 23 males, *mean age* = 18.93 , *SD* = 3.47).

After data collection and when reviewing participants' answers to the survey for use in a correlation analysis, one participant file was missing, and six participants were removed as they reported unrealistic numbers of hours using their smartphone. The threshold for exclusion was established after reviewing the data and determined to be 16 hours per day, to allow for the possibility of sleep and other essential activities. Importantly, all excluded participants reported more than 20 hours of daily smartphone use. After this cleaning process, 64 participants were included in the correlation (44 females, 20 males, *mean age* = 18.92, *SD* = 3.58)

Materials and Measurements

Lab setup. The experiment was conducted in two adjacent computer stations separated by a carrel, preventing participants from seeing any object or stimulus on the other station. Each computer station had a Mac Mini computer (two 1.4 GHz, one 2.4 GHz) with 4 GB RAM and Apple Extended Keyboards and mouse. The Mac Mini computers were attached to two identical 23" Dell P2317H monitors at 1920 x 1080 pixel resolution running at 60 Hz. Additionally, each station had a black mesh tray, which was used to store smartphones or sticky notes during the experiment. Distribution of objects on each station was kept equal between participants, only interchanging the location of the tray containing smartphones or sticky notes and the Mac Mini computers.

The experiment was programmed in MATLAB 2017A (Natick, MA) using the open-source Psychophysics Toolbox extension (Brainard, 1997; Kleiner et al, 2007; Pelli, 1997). Stimuli were presented and responses gathered on the Mac Mini computers.

Mere presence effect and attentional bias. The mere presence effect and attentional bias were measured through two lateralized spatial configuration search tasks, similar to Ito and Kawahara (2017). The mere presence effect was represented by a general measure of distraction, operationalized as reaction time and accuracy when a smartphone was present versus when it was not. Second, attentional bias was represented by the effect of smartphone location on reaction time and accuracy when attempting to find targets on the same versus opposite side of the screen as the distractors.

Amount of smartphone usage. Participants were asked to estimate the amount of time spent using their smartphone for both an average week and weekend day. Specifically, the question was “As accurately as possible, please estimate the total amount of time you spend using your mobile phone each day. Please consider all uses, except listening to music. For example, consider calling, texting, using social media, email, sending and receiving photos, gaming, and surfing the Internet. To answer this question, you can try to remember a typical day of your life” (Adapted from Lepp, Barkley, & Karpinski, 2014). Although participants have been shown to underestimate smartphone usage (Andrews et al., 2015, De-Sola Gutiérrez et al., 2016), objective measures of smartphone use have a moderately positive relationship with estimated measures of smartphone use, suggesting that estimations of smartphone use can be a valid measure (Andrews et al., 2015).

Smartphone attachment. Similar to Ward et al. (2017), we operationalized smartphone attachment with a measure of smartphone dependence. We used the Smartphone Addiction Scale short version (SAS-SV; Kwon, Kim, Cho, & Yang, 2013), given its simplicity and time efficiency. The SAS-SV is a 10-item self-report scale meant to measure the risk of smartphone addiction (Cronbach's alpha = 0.83). Each item is rated on a 6-point Likert scale ranging from “Strongly Disagree = 1” to “Strongly Agree = 6”. Cutoff values of 31 for males and 33 for females have been previously considered indicative of smartphone addiction risk.

FoMo scale. We used the FoMo scale developed by Pryzbylski et al. (2013), a 10 item self-report measure meant to reflect people’s fears, worries, and anxieties relating to being out of touch with the events, experiences, and conversations happening across their extended social circles. In this scale items are answered on a Likert scale ranging from “Not at all true of me = 1” to “Extremely true of me = 5”. Pryzbylski and his team reported good internal consistency for the scale with alphas ranging from 0.87 to 0.90.

Frequency of Smartphone Content Use. Similar to Elhai et al. (2016), we asked participants to indicate the frequency of using eleven types of smartphone features, including “video and voice calls” (making and receiving), “text/instant messaging” (sending and receiving), “email” (sending and receiving), “social networking sites” (visiting and participating), “navigating internet/websites”, “games”, “music/podcast/radio”, “taking pictures or videos”, “watching videos/TV/movies”, “reading books/articles/magazines”, and “maps/navigation”. We used a six-point Likert scale, ranging from “Never = 1” to “Very often = 6”. Elhai and his team reported good internal consistency for this measure (a = .86). We only included in the analyses responses to social networking sites.

Procedure

The experiment followed a 2 x 2 (Distractor [smartphone, sticky notes] x Target Location [same, opposite]) within-subjects factorial design, with all participants receiving all manipulations. Prior to the participants’ arrival, the researcher determined the experimental condition for that session and organized the lab accordingly. There were a total of eight experimental conditions that counterbalanced all possible combinations of smartphone and sticky notes locations (left or right), computer (left and right), and task assignment to computer (2v5 and 5v2) (See Appendix C for a detailed description of these conditions).

Participants arrived in pairs or alone to the lab and were greeted by a research assistant. As they arrived, they were invited to sit at one of the two computers, that, without their knowledge, determined their experimental condition. After participants signed their consent form, the research assistant requested that they switch their smartphones to airplane mode and to place the devices in a container. Although, Ward et al. (2017) found that having a smartphone on or off did not interfere with the mere presence effect, participants were asked to put their phones in airplane mode to prevent the possibility of receiving notifications during the experiment. All participants complied with the request. Next, the research assistant placed the container with both participants’ phones next to one of the experimental computers, making sure that they were both visible with the screens facing up.

Computer stations were separated by a carrel, preventing participants from seeing any object or stimulus on the other side. In other words, only one participant at a time could see the smartphones, while the other participant saw a pile of sticky notes in the comparable location. The main difference between conditions was that in the smartphone-present condition, the container with the phones was placed in the participant's visual field, whereas in the control condition, a stack of sticky notes was in the field of view, akin to the manipulations of Thornton et al. (2014) and Lyngs (2017).

The experimental task measuring visual attention for the two test phases of the experiment was the same. Visual attention was measured using a visual search for spatial configuration targets (digital 2s and 5s), which has been previously applied to study selective attention (e.g., Palmer, Horowitz, Torralba, & Wolfe, 2011). Specifically, two versions of a lateralized spatial configuration search tasks were used, measuring the reaction time and accuracy of participants to find a target among distractors and to determine on what side of the screen it was located (right or left). The two task versions differed only in the specific targets and distractors used, as described in more detail below.

On each trial, 10 randomly arranged items were presented on both the right and the left side of the screen, for a total of 20 items on the screen. On one of the computers, participants had to search for a digital number 2 (target) among digital 5s (distractors) (See Figure 1). On the other computer, participants had to search for a digital 5 (target) among digital 2s (distractors) (See Figure 2). Participants indicated that a target was absent by pressing the spacebar, or, if a target was present, they indicated the side of the screen containing the target by pressing the <?> key for the right side of the screen, or the <Z> key for the left side of the screen. The search array was displayed on the screen until the participant gave an answer or 10000 ms passed, and each trial was followed by a 500 ms interstimulus interval in which the accuracy (correct or incorrect) and reaction time for the trial were presented.

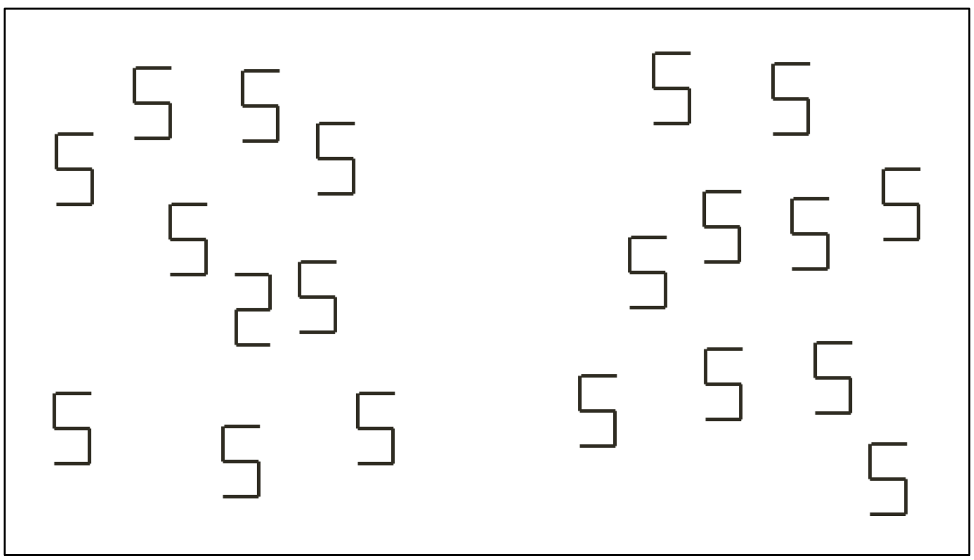

Figure 1. Example of stimuli presented during the 2 vs 5 lateralized visual search task, in which 2s are targets.

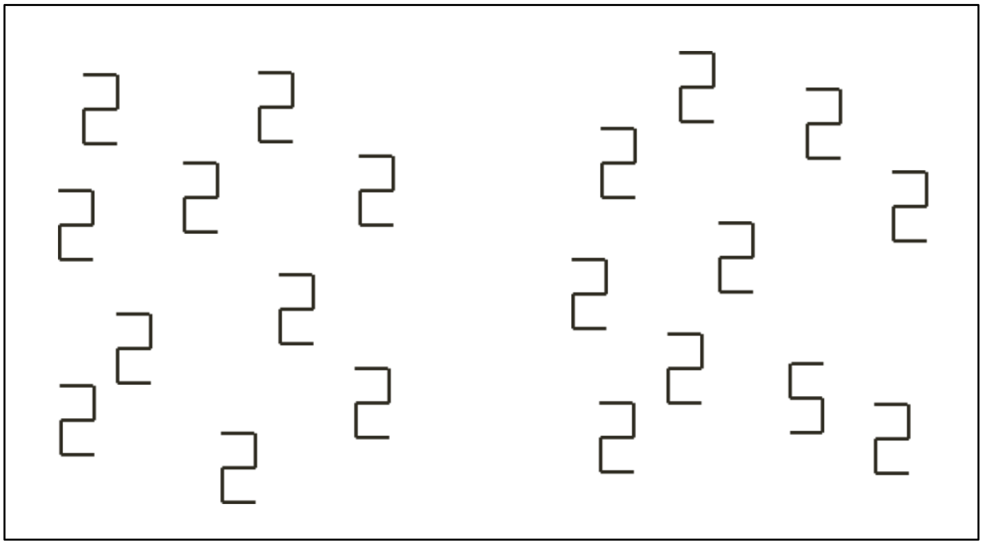

Figure 2. Example of stimuli presented during the 5 vs 2 lateralized visual search task, in which 5s are targets.

Before each phase of the experiment, participants had a practice session to facilitate familiarity with the procedure and stimuli, which was followed by the experimental session. There were three types of trials: target absent (practice: 2 trials, experiment: 32 trials), target on the same side as the smartphone/ sticky notes (practice: 9 trials, experiment: 66 trials), and targets on the opposite side (practice: 9 trials, experiment: 66 trials). Target absents trials were removed from the statistical analyses.

Before starting each experimental phase, the research assistant filled a demographic questionnaire with participant's demographic information and conditions. Additional participants were asked to silently stay at their stations if they finished before the other participant, to avoid distracting them. After both participants had finished the first part of the experiment, they took a break for a couple of minutes. Afterwards, they were asked to switch computers. Next, participants completed the second phase of the experiment, which was equivalent to the first phase in timing, number of trials, and position of the stimuli on the screen. The only differences were the task version and the presence of the smartphone or sticky notes.

Right after both participants finished the experimental task, they completed a questionnaire on Qualtrics. First, to check participant's suspicious concerning the purpose of the study and prevent the use of biased data, participants answered a free response question regarding their ideas of the intention behind the study. Then, they answered the FoMo scale, SAS-SV, self-reported measures of amount of smartphone usage, and smartphone content use. Upon completion, participants were debriefed about the true purpose of the study and asked to refrain from discussing the study with their classmates until the end of data collection.

Results

The study intended to answer the question of whether the mere presence of a smartphone could impact visual search processes and bias visual attention. Additionally, the study attempted to explore if the presence of a smartphone was related to individual differences in relationships with smartphones, including the degree of Fear of Missing Out, smartphone attachment, number of weekly hours using the smartphone, and extent of social media use. For this purpose, descriptive statistics, two 2x2 repeated measures ANOVA, and a correlation analysis were performed. Assumptions for all statistical analyses were checked using SPSS software version 24 and subsequent statistical analyses were conducted using JASP version 0.9.

Planned Analyses

A 2x2 (distractor type [smartphone vs. sticky notes] x distractor location [same side vs. opposite side]) repeated measures ANOVA was employed to assess if the mere presence of a smartphone could influence the speed with which participants found targets on the screen and if the location of the smartphone was associated with a slower reaction time when a target was close to it. The dependent variable was reaction time on correct trials. Figure 3 depicts mean reaction time given correct for the different conditions.

The ANOVA failed to detect any significant effects or interactions. There was no significant main effect for Distractor type, $F(1, 73) = 3.136$, $p = .081$, $\eta_p^2 = .041$, nor was there a significant main effect for Distractor location, $F(1, 73) = .357$, $p = .552$, $\eta_p^2 = .005$. Finally, there was no significant interaction between Distractor type and Distractor location, $F(1, 73) = .153$, $p = .697$, $\eta_p^2 = .002$.

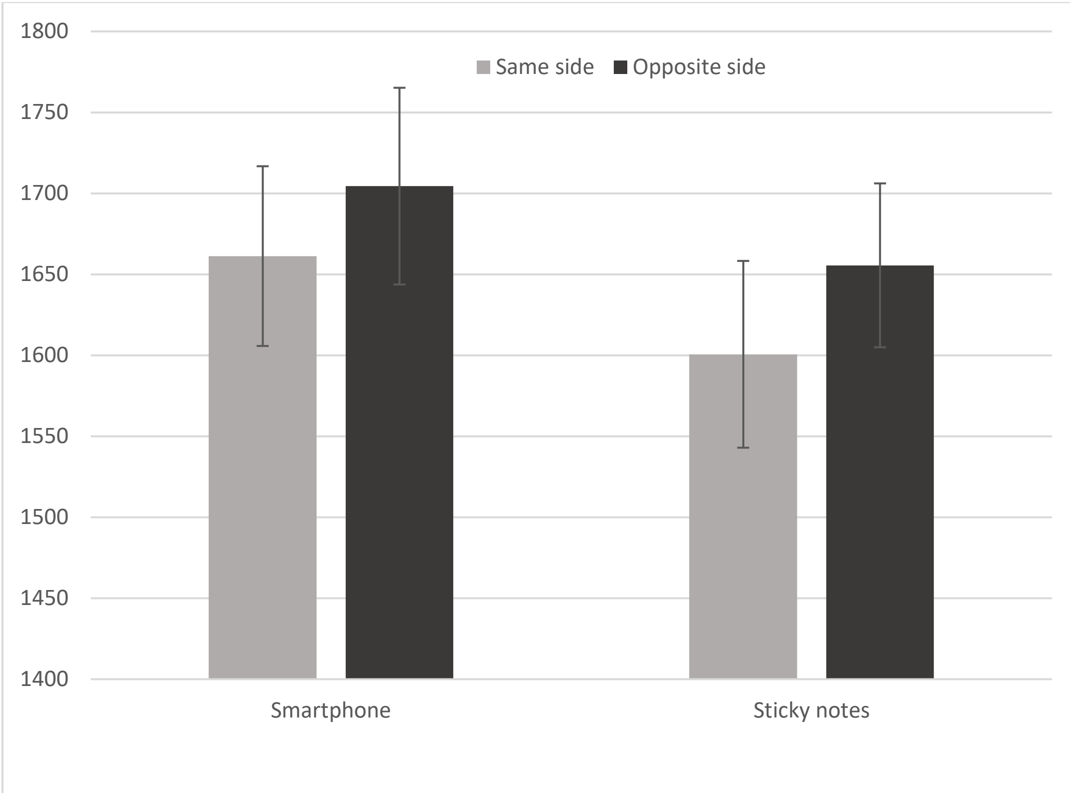

Figure 3. Comparison of mean reaction time given correct between the difference conditions. Error bars represent standard error of the mean.

Similar to the previous analysis, A 2x2 (distractor type [smartphone vs. sticky notes] x distractor location [same side vs. opposite side]) repeated measures ANOVA was used to determine if the presence and location of a smartphone could influence performance, but in this case, the dependent variable was accuracy. Figure 4 depicts mean accuracy for the different conditions.

In line with the previous analyses, no significant effects were found. There was no significant main effect for Distractor type, $F(1, 73) = .650$, $p = .423$, $\eta_p^2 = .009$, nor was there a significant main effect for Distractor location, $F(1, 73) = .609$, $p = .438$, $\eta_p^2 =$

.008. Finally, there was no significant interaction between Distractor type and Distractor location in terms of accuracy, $F(1, 73) = 1.349$, $p = .249$, $\eta_p^2 = .018$.

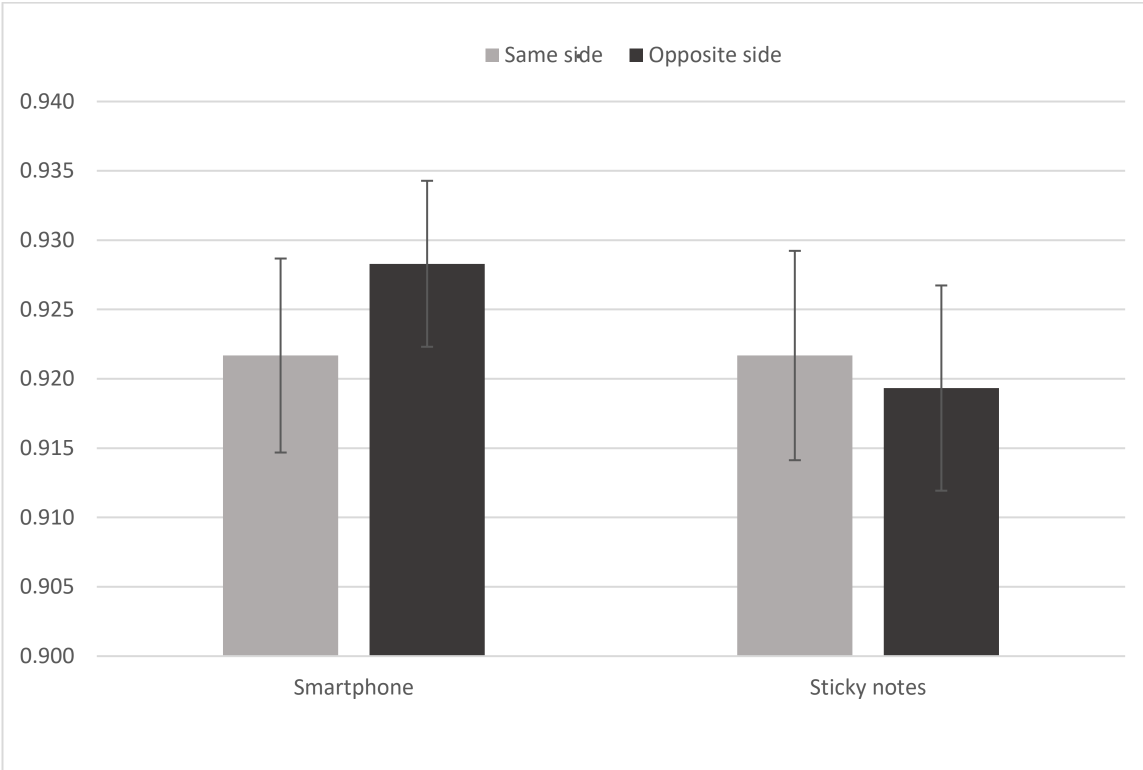

Figure 4. Comparison of mean accuracy given correct between the difference conditions. Error bars represent standard error of the mean.

To test the third and fourth hypotheses, Pearson's correlations were calculated. As correlations in this study were exploratory, no correction for multiple comparisons was made. First, to represent the mere presence effect, two new variables were calculated by subtracting the mean reaction time and mean accuracy between the smartphone and sticky notes conditions. Second, two new variables were also calculated for attentional bias by computing the difference in mean reaction time and mean accuracy of finding targets on the same versus opposite side of the screen when a smartphone was present. Finally, the correlation also included the variables representing behavioral and emotional differences in participants' relationship with their smartphones. These variables were: the amount of smartphone use, FoMo, smartphone attachment, and frequency of social media use. Table 1 displays the means and standard deviations of all included variables.

Table 1

Descriptive Statistics From Variables Included in Correlation (N = 64).

Variable	*M*	*SD*
Δ presence RT	58.92	268
Δ smartphone location RT	-52.28	656
Δ presence accuracy	-0.002	0.05
Δ smartphone location accuracy	-0.07	0.05
FoMo	22.94	6.99
Smartphone attachment	31.20	9.80
Amount of smartphone usage*	33.26	14.68
Social media use*	5.20	0.98

Before conducting the Pearson's correlations, assumptions were checked. Two variables, amount of smartphone usage and frequency of social media use, did not meet the assumption of normality. Amount of smartphone usage was positively skewed ($Z = 4.24$) and leptokurtotic ($Z = 5.28$). These deviations from normality were associated with two outliers; as such, it was decided to remove those data points from the correlation analysis (note that all analyses were performed both with and without these outliers, and that results were not impacted by their exclusion). Frequency of social media use was negatively skewed ($Z = - 6.43$) and leptokurtotic ($Z = 3.83$). These deviations from normality were associated with most participants reporting to use social media 'very frequently' (*N* = 30), which was

the maximum possible value. It was determined that, in this case, the observed deviation from normality had to do with a ceiling effect associated with the chosen scale to measure social media use, which did not reflect the expected variance. As the correlations were exploratory, social media use was included in the analyses, but results and conclusions including this variable should be taken with care.

Table 2 displays the results of the Pearson's correlation coefficients. None of the relationships associated with our hypotheses were significant. Individual differences in performance when a smartphone was present and when targets were closer to it were not significantly associated with any of the variables representing participant's relationship with their smartphones.

Table 2.

Pearson Correlations With Performance and Smartphone Relationship Variables (N = 64).

Variable	1	2	3	4	5	6	7	8
1. Δ presence RT	--							
2. Δ smarpthone location RT	-.21	--						
3. Δ presence accuracy	-.03	-.07	--					
4. Δ smartphone locatio accuracy	-.01	-.04	.67 ***	--				
5. FoMo	.00	.18	.08	.19	--			
6. Smarpthone attachment	-.15	-.09	.04	.11	.35 **	--		
7. Amount of smarpthone usage	-.16	.05	.10	.03	.18	.13	--	
8. Frequency of social media use	-.04	.07	.16	.12	.36 **	.36 **	.18	--

* p < .05   ** p < .01   *** p < .001

Unplanned Analyses

Participants in this study reported being moderately worried about missing out on events (FoMo) (*M* = 22.94, *SD* = 6.98). When it came to their emotional attachment to their smartphones, participants reported being highly attached (*M* = 31.20, *SD* = 9.80). Importantly, the addiction cut off score suggested by Kwon et al. (2013) when using their scale was proposed to be 31 for males and 33 for females, meaning that this sample reported being on average on the threshold of addiction risk towards their smartphones. Looking into gender differences, females reported higher attachment to their smartphones (*M* = 33.52, *SD* = 9.71) than did males (*M* = 26.10, *SD* = 8.06). From this sample, 56.82% of females and 25% of the males scored above the cutoff to be considered at risk of smartphone addiction. A chi-square test was performed and a relationship was found between gender and been at risk of smartphone addiction, X^2 (1, *N* = 64) = 5.59, *p* =.018.

A moderate positive relationship was found between FoMo and smartphone attachment, such that participants that reported higher levels of FoMo, also reported higher levels of smartphone attachment, r(62) = .354, *p* = .004. Additionally, the use of social network had a moderate positive relationship with FoMo, r(62) = .355, *p* =.004, and smartphone attachment, r(62), =.360, *p* = .004. Participants that reported higher frequency of social media use had higher levels of FoMo and smartphone attachment. Finally, a strong positive correlation was found between accuracy when a smartphone was present and accuracy when targets were closer to the location of the smartphone in comparison to when it was not, r(62) = .673, p < .001. Participants that were more accurate when their smartphone was present were also more accurate when targets where closer to their smartphone.

Discussion

The main goal of this study was to explore the possibility that smartphones would negatively impact perceptual processes. We hypothesized that the mere presence of a smartphone would be related to slower reaction times and lower accuracy when trying to find targets on a screen. Additionally, we hypothesized that the location of the smartphone would bias visual attention by being associated with slower reaction times and lower accuracy when it was closer to targets. Our findings do not support our hypotheses. As such, we did not find evidence relating the mere presence of the smartphone with a perceptual phenomenon. The mere presence of a smartphone was not strong enough to distract participants from a perceptual task, nor was the smartphone able to bias the attention of their owners by just being present. However, we observed an unpredicted relationship between accuracy when smartphones were present and when targets were closer to the device. As such, participants that had better accuracy when smartphones were present were also more likely to correctly locate targets when they were closer to their smartphone. In this case, we can hypothesize that smartphones do not inherently decrease accuracy. For some people, the presence of a smartphone might burst accuracy, whereas for others it might serve as a deterrent. We cannot draw conclusions about the reason behind this finding, as accuracy was not related to any other variables in our study.

In line with Lyngs' (2017) results, we were not able to replicate the mere presence effect of a smartphone. Thornton et al. (2014) and Ward et al. (2017) concluded that the mere presence of a smartphone might be associated with mental wandering and necessity to suppress the desire to use the device. In this case, participants would have had to be aware of the presence of the device during the experiments, which we cannot conclude by our study.

We were not able to replicate the results of Ito and Kawahara (2017) even though our experiment had a larger sample size and we used participants' own smartphones. It could be that moving the smartphone location from the side of the screen to the desk would have lowered participants' awareness of the presence of the smartphone. But the decision of positioning the smartphone on the desk was to follow the original design of the experiments that studied the mere presence effect and to imitate a more naturalistic situation in which people often place their phones next to them.

Smartphone attachment was not related to the mere presence effect and attentional bias to a smartphone. Importantly, we did not find an effect even though we had a high proportion of participants at risk of smartphone addiction. Past research on the mere presence effect of smartphones has found that participants that were more attached to their devices experienced a higher impact on available cognitive capacity by the presence of their smartphone (Ward et al., 2017). Additionally, research on substance addiction has found that stimuli related to participants' addictions are able to capture and bias participants' visual attention (Field & Cox, 2008). In our case, even though 47% of the surveyed population scored high enough to be classified as at risk of smartphone addiction by the SAS-SV, we did not observe its influence on the mere presence effect and attention bias. Kwon et al. (2013) originally found that 16.6% boys and 26.6% girls in their sample scored as at risk of addiction. Studies validating the scale in other countries have found a prevalence of potential smartphone addiction on 12.5% of the surveyed Spanish population, 21.5% for francophone Belgians (Lopez-Fernandez, 2015), and 16.9% of the Switzerland youth (Haug, Castro, Kwon, Filler, Kowatsch, & Schaub, 2015). All of these percentages are smaller than our findings. The sample of mostly 18-year-old American college students in Silicon Valley included in this study might bias the conclusions made, since the area is well-known for being at the forefront of technological innovation and, as a consequence, may have had longer exposures to this new technology than other regions of the country. This population might serve as a warning sign of how new generations in America will be interacting with smartphones.

An interesting finding in the current study was the relationship observed between FoMo, use of social media, and smartphone attachment. Specifically, participants with higher degrees of FoMo tended to have higher degrees of smartphone attachment, parallel to Elhai et al's (2016) findings. Participants that reported higher frequency of social media use also reported higher degrees of FoMo, as Przybylski et al. (2013). Additionally, those that reported higher frequency of social media use also reported higher degrees of smartphone attachment, a finding that is also supported by past research (De-Sola Gútierrez et al., 2016; Jeong et al., 2016). Additionally, we did not find a relationship between the amount of smartphone use and these variables. This finding also reinforces the results of past studies on cell phone addiction (De-Sola Gútierrez et al., 2016). Consequently, our findings support the notion that what characterize patterns of smartphone dependence is not the amount of time people spend with their smartphones, but the type of use and rewards they receive when using them. Social rewards accessed through social media could be one important factor in the development of smartphone addiction.

Furthermore, although we cannot make conclusions about the significance of the difference on smartphone attachment between males and females on our sample, it was not surprising to see the large proportion of females that had high scores of smartphone attachment. Previous research has also found that females are at a higher risk of cell phone addiction because of their preference for using their phones for socializing (De-Sola Gutiérrez et al., 2016). As mentioned previously, social rewards are one of the stronger motivators for developing habits of technological use as it can give tailored and frequent social rewards, which appear to be a major factor behind developing pathological relationships with technology.

Limitations

We cannot discard the notion that our participants were capable of suppressing the desire to look or think about their smartphones for the 30 minutes that the experimental session lasted. At the same time, we asked our participants to put their phones in airplane mode, which stopped the reception of notifications and calls. Although Ward et al. (2017) found that the mere presence effect occurred even when phones were turned off, it is a possibility that, for our participants, turning off their notifications was enough to suppress any effect that the presence of their smartphones could have in their attentional processes. In that case, turning off notifications might help individuals to keep smartphones out of mind.

Additionally, because of the decision to create an experiment that controlled for many confounding variables present on the contexts in which people naturally use their smartphones, it is possible that the context of the experiment was strong enough to suppress the effect of the presence of a smartphone. Participants could have been motivated by the novelty of the experimental context to perform well, or the change of context could have impacted attentional and mental processes that are associated with more natural environments. For example, participants might be biased to look at their smartphones when they are bored in a classroom, as they have previously established reward seeking patterns associated with their smartphone in that context. But these patterns might not necessarily be transferable to a different and novel context.

Another limitation of our study was the decision to use self-report measures for all our variables of individual differences. An overall limitation of self-report measures is their inherent subjectivity, which might not represent reality. Regarding our findings concerning smartphone attachment, past research on cell-phone addiction has found a trend in which cell-phone users tend to self-attribute more signs of addiction than objective or other validated criteria suggest (De-Sola Gútierrez, 2016). Additionally, the SAS-SV cut-off scores as proposed by Kwon et al. (2013) might be too strict for the American population. It could be that Americans have different patterns when self-attributing smartphone addiction symptoms, which could stem from cultural differences. For example, variation in responses could be associated with differences in technology access. South Korea is the country with the highest proportion of smartphone ownership in the world at 96% (Poushter et al., 2018), which might influence how respondents evaluate their behavior as being pathological or not.

Asking participants to self-report the amount of time they use their smartphone also proved to be problematic. As mentioned before, six participants were eliminated to report unrealistic amounts, and we cannot be sure if other participants reported their hours correctly. The decision to use a self-report measure for this variable was motivated by convenience. At the moment the study was designed, accessing objective data would have required installing tracking apps on participants smartphones, which came with their own limitations. Today, many smartphones have the functionality of accessing usage data easily, including the time users spend on each app installed on their phone. Future studies could, with the participants' consent, collect smartphone usage data directly to reflect a more objective measure of time spent.

Similarly, the measure for the frequency of different types of smartphone uses also proved to be problematic. Participants tended to report high frequency for many of the possible uses. Participants might be overestimating the amount of time they spend on each possible activity or might not be able to discriminate differences between different types of uses. Additionally, this measure, which is based on a single question for each possible use case, that might not reflect the true variability between and within participants. Two participants might both feel that they are listening to music 'very frequently' but the actual proportion of time they listen to music might vary greatly.

Future Directions

As smartphones become more prevalent in today's society, studying how people interact with them and the impact that these devices are having in society should still be a priority for researchers. Future research should explore both the positive and negative effects of the use of these devices, aiming to inform future designs around the ways in which individuals and society develop patterns of use. In particular, considering the high proportion of participants in this study that had high levels of attachment and risk of smartphone addiction, conducting studies with larger sample sizes and with a more diverse population would be of importance to understand the degree of pathology in the population. In particular, studying how new generations growing up with these devices develop adaptive and maladaptive patterns around these devices should be a priority. These efforts should inform future studies focusing on treatment and prevention of maladaptive consequences of smartphone use.

Even though we were not able to replicate the mere presence effect of a smartphone, nor observe attentional capture by a smartphone, we did observe a relationship of smartphone presence with accuracy. As mentioned before, we cannot make conclusions about the reason of our observation, but future research should continue to explore the possibility of a perceptual impact by the presence of a smartphone. As smartphones become ubiquitous in daily life, new experiments should continue to explore the contexts in which a smartphone could impact cognitive processing by its mere presence. For example, comparing situations in which notifications are activated to when they are off, or conducting studies with a more naturalistic task and context, such as while people are studying.

When it comes to evaluating the possibility that smartphones could capture or bias attention, researchers could choose to prioritize more direct measures of attentional bias. Research has suggested eye-tracking technology and electrophysiological signals, in particular, event-related potentials (ERPs), as ideal to explore the attentional bias towards stimuli associated with addiction (Field & Cox, 2008).

Additionally, new research concerning smartphones should strive to take advantage of technological advances that allow for the collection of objective data related to smartphone use. The prioritization of objective variables over subjective variables would help in understanding the ways in which people are interacting with these devices and its consequences. As the world moves forward, researchers should continue moving with it. As technology continues to evolve and integrate with life, researchers should strive to follow the impact of technological developments.

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APPENDIX A

Consent Form

REQUEST FOR YOUR PARTICIPTION IN RESEARCH

TITLE OF THE STUDY:	Looking for 5s and 2s
NAME OF THE RESEARCHERS:	Pilar Bianchi, San Jose State University graduate student. Evan Palmer, Ph.D., Supervising Professor

PURPOSE

This study investigates how different elements can facilitate or make more difficult a visual search for a target among distractors.

PROCEDURES

You will be asked to search for a target among distractors and answer a survey at the end of the experimental session. The study will last approximately one hour and will be done in Hugh Gillis Hall 242 or 244.

POTENTIAL RISKS

This study presents no more than minimal risks of fatigue and eye strain.

POTENTIAL BENEFITS

You will receive no direct benefits from participating in this study. There is an indirect benefit of generalizable knowledge in the research area of perception.

COMPENSATION

Students in the psychology research subject pool will receive partial credit towards their Psychology class even if they decide to withdraw or otherwise not complete the study. No other compensation is provided for participation in this study.

CONFIDENTIALITY

Although the results of this study may be published, no information that could identify you will be included.

PARTICIPANT RIGHTS

Your consent is being given voluntarily. You may refuse to participate in the entire study or in any part of the study. If you decide to participate in the study, you are free to withdraw at any time without any negative effect on your relations with San Jose State University. You also have the right to skip any question you do not wish to answer. This consent form is not a contract. It is a written explanation of what will happen during the study if you decide to participate. You will not waive any rights if you choose not to participate, and there is no penalty for stopping your participation in the study.

QUESTIONS OR PROBLEMS

You are encouraged to ask questions at any time during this study.

- For further information about the study, please contact please contact Pilar Bianchi, pilar.bianchi@sjsu.edu, or Evan Palmer, Ph.D., evan.palmer@sjsu.edu.
- Complaints about the research may be presented to Dr. Lynda Heiden (Chair, Department of Psychology, SJSU) at (408) 924-5547.
- For questions about participants' rights or if you feel you have been harmed in any way by your participation in this study, please contact Dr. Pamela Stacks, Associate Vice President of the Office of Research, San Jose State University, at 408-924-2479.

SIGNATURES

Your signature indicates that you voluntarily agree to be a part of the study, that the details of the study have been explained to you, that you have been given time to read this document, and that your questions have been answered. You will receive a copy of this consent form for your records.

Participant Signature

____

Participant's Name (printed)

____________________________ ____________

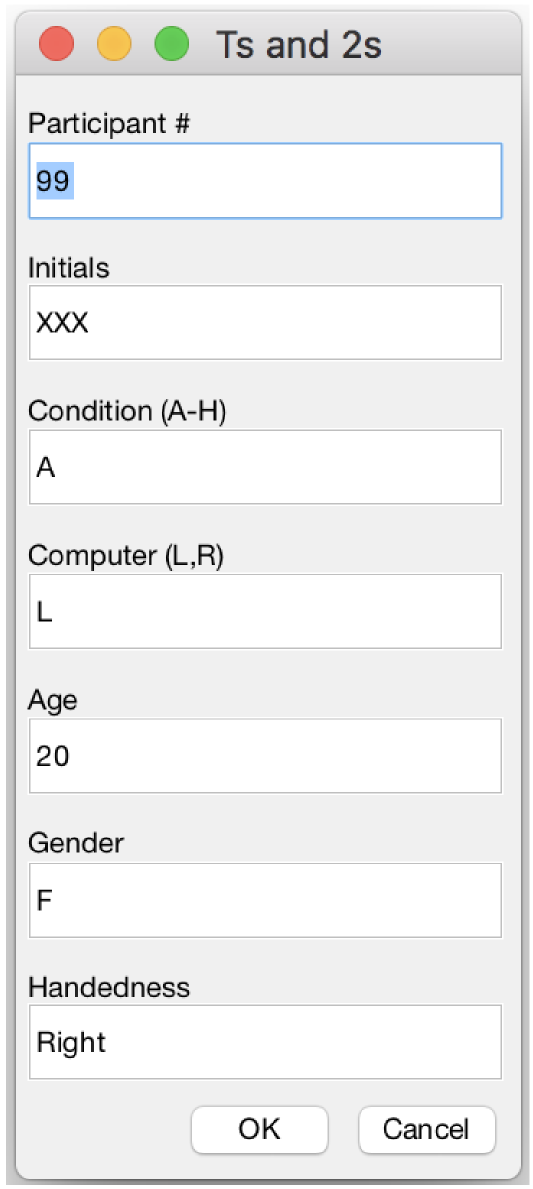
Participant's Signature Date

Researcher Statement I certify that the participant has been given adequate time to learn about the study and ask questions. It is my opinion that the participant understands his/her rights and the purpose, risks, benefits, and procedures of the research and has voluntarily agreed to participate.

______________________________________ ____________

Signature of Person Obtaining Informed Consent Date

APPENDIX B
Demographic Survey



APPENDIX C
Experimental Conditions

Condition	Left Computer	Right Computer	Distractor Position	Left Computer	Right Computer
A	Cell	Stickies	L	52	25
B	Cell	Stickies	L	25	52
C	Cell	Stickies	R	52	25
D	Cell	Stickies	R	25	52
E	Stickies	Cell	L	52	25
F	Stickies	Cell	L	25	52
G	Stickies	Cell	R	52	25
H	Stickies	Cell	R	25	52

APPENDIX D

Participant information and Control Question

1

Participant ID

2

Please, enter your initials:

3

What do you think is the purpose of the study?

APPENDIX E

Fear of Missing Out (FoMo) Scale

Below is a collection of statements about your everyday experience. Using the scale provided please indicate how true each statement is of your general experiences. Please answer according to what really reflects your experiences rather than what you think your experiences should be. Please treat each item separately from every other item.

	Not at all true of me (1)	Slightly true of me (2)	Moderately true of me (3)	Very true of me (4)	Extremely true of me (5)
1. I fear others have more rewarding experiences than me.	○	○	○	○	○
2. I fear my friends have more rewarding experiences than me.	○	○	○	○	○
3. I get worried when I find out my friends are having fun without me.	○	○	○	○	○
4. I get anxious when I don't know what my friends are up to.	○	○	○	○	○
5. It is important that I understand my friends ''in jokes''.	○	○	○	○	○

6. Sometimes, I wonder if I spend too much time keeping up with what is going on.	○	○	○	○	○
7. It bothers me when I miss an opportunity to meet up with friends.	○	○	○	○	○
8. When I have a good time it is important for me to share the details online (e.g. updating status).	○	○	○	○	○
9. When I miss out on a planned get-together it bothers me.	○	○	○	○	○
10. When I go on vacation, I continue to keep tabs on what my friends are doing.	○	○	○	○	○

APPENDIX F

Smartphone Addiction Scale short version (SAS-SV)

Below is a collection of statements about your everyday experience with your smartphone use. Using the scale provided please indicate to what degree you agree or disagree with the statement. Please answer according to what really reflects your experiences rather than what you think your experiences should be. Please treat each item separately from every other item.

	Strongly disagree (1)	Disagree (2)	Somewhat disagree (3)	Neither agree nor disagree (4)	Somew hat agree (5)	Agree (6)
1. Missing planned work due to smartphone use.	○	○	○	○	○	○
2. Having a hard time concentrating in class, while doing assignments, or while working due to smartphone use.	○	○	○	○	○	○
3. Feeling pain in the wrists or at the back of the neck while using a smartphone.	○	○	○	○	○	○
4. Couldn't stand not having a smartphone.	○	○	○	○	○	○
5. Feeling impatient and fretful when I am not holding	○	○	○	○	○	○

my smartphone.						
6. Thinking about my smartphone even when I am not using it.	○	○	○	○	○	○
7. I will never give up using my smartphone even when my daily life is already greatly affected by it.	○	○	○	○	○	○
8. Constantly checking my smartphone so as not to miss conversations between other people on social media.	○	○	○	○	○	○
9. Using my smartphone longer than I had intended.	○	○	○	○	○	○
10. The people around me tell me that I use my smartphone to much.	○	○	○	○	○	○

APENDIX G

Amount of Smartphone Usage

As accurately as possible, please estimate the total amount of hours you spend using your mobile phone each day.

Please consider all uses, **except listening to music**. For example, consider calling, texting, using social media, email, sending and receiving photos, gaming, and surfing the Internet. To answer this question, you can try to remember a typical day of your life.

On a typical week day (hours):

On a typical weekend day (hours):

APENDIX H

Smartphone Content Use

How often do you typically use these smartphones feature?

	Never (1)	Very rarely (2)	Rarely (3)	Occasionally (4)	Frequently (5)	Very Frequently (6)
Video and voice calls (making and receiving)	○	○	○	○	○	○
Text/instant messaging (sending and receiving)	○	○	○	○	○	○
Email (sending and receiving)	○	○	○	○	○	○
Social networking sites (visiting and participating)	○	○	○	○	○	○
Browsing the internet/websites	○	○	○	○	○	○
Games	○	○	○	○	○	○
Listening to music/podcast/radio	○	○	○	○	○	○
Taking pictures or videos	○	○	○	○	○	○
Watching videos/TV/movies	○	○	○	○	○	○
Reading books/articles/magazines	○	○	○	○	○	○
Maps/navigation	○	○	○	○	○	○