

Are Smart Phones Inhibiting Smartness? Smart Phone Presence, Mobile Phone Anxiety, and Cognitive Performance

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Abstract

In recent years, increased smart phone ownership and usage has resulted in nomophobia, or anxiety experienced when away from a smart phone. Compulsive smart phone usage has been shown to interfere with task productivity. Therefore, in the current study we predicted that individuals who have their smart phone removed during a cognitive task will experience more anxiety and worsened performance than those who kept their phones during the task. Undergraduates completed a word search that acted as the cognitive task, and completed measures of compulsive usage and anxiety. Results did not support our hypothesis. However, implications discussed show that future studies could be beneficial to understanding how smart phones are changing our cognitive performance, especially in regards to academics.

Key Words:

smart phone, anxiety, cognitive performance, college students, nomophobia.

As of January 2014, 90% of American adults owned a mobile phone, and of this demographic 58% had smart phones (Pew Research Center, 2014). This was a notable increase since 2009 in which 82% owned a mobile phone, and of those mobile phone owners, 31% had smart phones (Lenhart, 2010). This rapid increase in cell phone ownership, especially regarding smart phones, has shaped society's interactions with technology as it has evolved (Smith 2012). These various technologies have clear practical advantages. For example, Coyne and colleagues (2011) found that texting can lead to positive relationship outcomes. Additionally, increased texting with family members is associated with stronger family connections (Padilla-Walker, Coyne, & Fraser, 2012). Despite the benefits, smart phones carry potential risks as they also contain numerous distracting features (e.g., social media connectivity, games). In the current study, we examine one potential consequence of smart phone use, specifically, that individuals may become overly attached to their devices and

have impaired concentration and subsequently poorer performance on a cognitive task when their smart phones have been removed from them.

There is emerging evidence that individuals develop psychological attachments to technological objects such as smart phones (Liker, Haddad, & Karlin, 1999). These attachments have various consequences, and there is evidence that they are associated with anxiety. For example, previous studies have reported that attached individuals feel controlled by their phone and experience dependency and compulsive behaviors which mirror those of drug and alcohol addicts (Carbonell, Oberst, & Beranuy, 2013; Yu-Kang Lee & Zhao-Hong Cheng, 2014). Some attached individuals suffer from nomophobia (a portmanteau for "no mobile phobia"), a fear or anxiety stemming from the thought of losing or being away from one's mobile device (Barney, 2008). The term first appeared in a 2008 survey in the United Kingdom to determine mobile phone reliance amongst individuals. Results suggest that

approximately 58% of men and 48% of women, in a sample of over 2000 subjects, suffer anxiety when their mobile phone is not within arm's reach (Barney, 2008). Further research has supported the prevalence of nomophobia in the classroom as well, suggesting that 18.5% of students surveyed at an Indian medical university are nomophobic (Dixit et al., 2010). Nomophobic individuals report feelings of higher anxiety when they do not have their mobile device on them or in their presence.

Beyond addiction, cell phone use is associated with various other outcomes. More recent research on attachment identifies a relationship between the use of technology and participants' need for task switching (Whaling, Carrier, Cheever, & Rokkum, 2013). Furthermore, people who report being more reliant on their smart phones tend to experience more stress because they feel obligated to have their phone on them and be accessible at all time. As a result, compulsive smart phone usage has been observed. Additionally, compulsive usage is positively related to psychological traits, such as locus control, materialism, social anxiety, and the need for touch (Lee, Chang, Lin, & Cheng, 2014), all of which can factor into an individual's dependency on his or her smart phone.

As individuals own cell phones at younger ages than in the past, the impact of compulsive usage and anxiety have begun to seep into aspects of social life as well as tasks that require cognitive resources, such as academic achievement. For example, the increasing availability of mobile technology has led to a decrease in time students spend during "on-task" behaviors, such as studying, compared to time "on-task" without the presence of technology (Rosen, Carrier, & Cheever, 2012). Rosen and colleagues also observed that when high school students had a technological device easily accessible, they switched from a productive task to a nonproductive task, like texting or social media use, approximately every 5 min, and some students could not persist past 2 min without task-switching. Furthermore, students with more technologies available had increased instances of task switching, and those who accessed social media sites such as Facebook

during the study had lower grade point averages (Rosen et al., 2012). Somewhat ironically, college students who use their phones while studying or in class anticipate lower test scores (Elder, 2012), ultimately implying that students consciously sense the distracting nature of smart phones and other technology.

Current Study

The literature reveals growing issues regarding how technology impairs productivity and task completion, as well as how technological dependence is associated with stress and anxiety. However, several questions remain unaddressed. Specifically, it is unclear whether the presence of technology actively interferes with individuals' ability to focus on and complete tasks, and if so, whether this decrease in productivity occurs for all individuals or only those who report being nomophobic. Thus, in the current study, we attempt to directly answer these questions. We conducted this study to observe the relationship between nomophobia and smart phone distraction on cognitive tasks. In this study we examined the effects of cell phone location (i.e., within reach of the participant or removed by the researcher) in order to determine if performance was affected during a relatively simple cognitive task. We hypothesized that anxiety induced by the absence of a smart phone would negatively affect productivity, more so than distractions caused by keeping it within reach during this cognitive task. We expected that participants who did not have their phone during the cognitive task would experience more anxiety than those who kept their phones, leading to lower scores within the no phone condition.

Method

Participants

Seventy-seven undergraduates participated in the study for extra credit. Participants were randomly assigned to one of two experimental conditions (participants gave phone to experimenter during session [*no phone condition*] vs. participants retained phone during

session [*kept phone* condition]). Responses from participants who did not have smart phones ($n = 3$) or did not complete all parts of the experiment ($n = 9$) were not used during data analysis, giving us a final sample of 65. All 9 participants with missing information were from the *no phone* condition. The *no phone* group consisted of 29 participants (12 females, 17 males), ranging in age from 18 to 21 ($M = 19.00$, $SD = 0.93$). The *kept phone* group consisted of 36 participants (22 female, 13 male, 1 did not respond), ranging in age from 18 to 21 ($M = 19.06$, $SD = 0.79$).

Procedure and Materials

Technology dependence scale. Upon arrival all participants were asked to sign a document of informed consent and *kept phone* participants were taken to a different room. Participants in both groups were given a technology dependence questionnaire, adapted from Lee and colleagues' (2014) measure. The administered scale consists of 32 questions rated on a 6-point Likert-scale (1 = strongly agree, 6 = strongly disagree) and contains six subscales. Of importance to the current study, we focused on the compulsive usage subscale, which assessed participants' reliance on their cellphone as well as the preexisting presence of anxiety and addictive or compulsive behavior. Sample items include "I can't concentrate in class because of my mobile phone use," and "I feel lost and frustrated without my mobile phone". The remaining questions served as fillers. Participants had unlimited time to complete the questionnaire.

Manipulation implementation. Upon completion of the technology dependence questionnaire, participants in the *no phone* condition were asked to put their smart phones in small sealable bags which were then collected and stored in a large bag in view of participants for the remainder of the experiment. Students were not told how long they would be without their smart phone. The participants in the *kept phone* condition were not asked to hand in their smart phones and instead immediately began to work on the cognitive task after completing the technology dependence questionnaire.

Cognitive task and post-test. All participants were given a word search with 25 possible targets, and had 5 min to find as many words as they could before turning it in to the researchers. Subjects then completed a short set of questionnaires consisting of demographic information. Finally, they completed a measure of their current level of anxiety, as well as the 7-item Generalized Anxiety Disorder scale (GAD-7; Spitzer, Kroenke, Williams, & Lowe, 2006). All items were rated on a 5-point Likert scale (0 = not at all sure, 4 = nearly every day). The *kept phone* participants left upon completion and *no phone* participants had their smart phones returned before leaving.

Results

To test our prediction that individuals in the *no phone* condition would perform worse on the cognitive task than the *kept phone* condition, we conducted an independent samples *t*-test. Contrary to our predictions, the manipulation did not have a significant effect on participant's cognitive performance. Those who kept their phone on them ($M = 8.81$, $SD = 2.95$) scored slightly higher than the participants who had their phone removed from them ($M = 8.31$, $SD = 3.08$), $t(63) = 0.66$, $p = .512$. This result indicates that whether one's smart phone is present or not does not alter cognitive performance significantly. We conducted another independent samples *t*-test to investigate whether participants' reported general anxiety differed in response to their phone location during the experiment. Participants in the *kept phone* condition ($M = 0.91$, $SD = 0.59$) reported similar levels of anxiety as those in the *no phone* condition ($M = 0.81$, $SD = 0.55$), $t(63) = 0.74$, $p = .464$.

We then examined whether participants' smart phone attachment was associated with cognitive performance. A correlation between compulsive usage and cognitive performance revealed a weak, non-significant, negative association, $r = -.01$, $p = .920$. This implies that compulsive phone usage is not an adequate predictor of cognitive performance. A separate correlational analysis between compulsive

phone usage and general anxiety similarly revealed a non-significant association, $r = .09$, $p = .500$.

We next examined whether the effect of phone location condition on cognitive performance and anxiety would be moderated by compulsive usage. That is, the theorized decrements in cognitive performance may only occur when individuals show strong attachments to their phones. To test this, we conducted a multiple regression analysis (Aiken & West, 1991). First, we recoded phone location condition ($-1 = \textit{kept phone}$; $1 = \textit{no phone}$). Next, we mean-centered compulsive usage scores, such that positive values indicated greater compulsive usage and negative values indicated less compulsive usage. Then, we created a phone location \times compulsive usage interaction term. In the multiple regression, the predictors were phone location condition, compulsive usage scores, and the phone location \times compulsive usage interaction term, and the outcome variable was cognitive performance. None of the three predictors were significant: phone location ($\beta = -.08$, $p = .527$), compulsive usage ($\beta = -.01$, $p = .940$), and phone location \times compulsive usage ($\beta = -.03$, $p = .839$). We conducted a similar analysis using anxiety scores as the outcome, and again, none of the predictors were significant: phone location ($\beta = -.10$, $p = .449$), compulsive usage ($\beta = .09$, $p = .483$), and phone location \times compulsive usage ($\beta = -.01$, $p = .923$). Taken together, these results indicate that the compulsive usage did not moderate the effect of phone location on cognitive performance or anxiety levels.

Discussion

Smart phone ownership has increased by 27% in American adults over the last five years (Pew Research Center, 2014). Nomophobia, the fear or anxiety felt when one is unable to use their mobile phone, and increased feelings of attachment toward one's mobile phone are consequences of this change. Previous research suggests that greater anxiety has a negative impact on working memory and cognitive test performance (Owens, Stevenson, Hadwin, & Norgate, 2014). Therefore, we examined

whether inducing nomophobia would also undermine cognitive performance above and beyond the inherent distracting aspects of smart phones (e.g., social media applications).

In the current study, we examined the relationship of smart phone presence or absence with compulsive usage, anxiety, and cognitive productivity. Results indicated that productivity was unaffected by smart phone presence or absence. Additionally, anxiety was unchanged when smart phones were removed from participants. Participants' reported compulsive usage was not determined to be a moderator of anxiety or productivity within the sample. Even though these results were contrary to the hypothesis, it is possible that further investigation could provide a foundation for new beliefs about smart phones within the classroom.

One alternate explanation for our results is that multitasking could instead result in cognitive decline. Multitasking decreases the chances of retaining content as a result of information overload. In regards to academics, studies show that texting and using social media applications have a significant negative relationship with students' GPAs (Junco, 2012). Additionally, Ellis, Daniels, and Jauregui (2010) found that students who text message during class receive significantly lower grades than those who do not. Because the most common tool used to text message and access social media sites is a smart phone, the presence of a phone leads to multitasking interference over the applications themselves. This could be a plausible explanation for the results of this study if distractions caused by multitasking were equivalent to distractions from nomophobia, leading to similar performance on the cognitive task. Future research should explore this possibility.

Strengths and Limitations

Though our results did not support our hypotheses, our study still contained several strengths. The demographics of the sample and the method implemented are two noteworthy strengths. The age range of the cohort in this study largely reflects the most affected population of smart phone consumers (Pew

Research Center, 2014). Unlike younger individuals, college aged individuals have not grown up with smart phones in the classroom. Given the rapid change in technology during their academic progression, students have not had the chance to learn to self-regulate smart phone usage within this context. These factors escalate the subjects' susceptibility to compulsive usage and increased anxiety within this cohort. Additionally, the mechanism used to measure the effect of smart phone presence or absence was to physically remove the subjects' smart phone in the no phone condition, rather than asking subjects to theorize feelings of being without their smart phone. The advantage of this methodology is that we were able to measure actual (vs. hypothetical) responses to smart phone absence. The cognitive task implemented was meant to ensure that performance was assessed in a quantifiable manner.

As with any research, this study had some limitations. First, the cognitive task (i.e., word search) may not have required sufficient cognitive resources for our manipulation to interfere; however, no ceiling effect was observed, thus minimizing this potential limitation. The average words found in both conditions was between 8 and 9 of the 25 possible targets. Regardless, future research may benefit from increasing the difficulty of the task (e.g., expert-level Sudoku) and time given to participants to complete the task. Since data suggests it takes an average of 5 min for task switching to occur (Rosen et al., 2012), increasing time to 10 min would make it more plausible that participants feel the full effects of nomophobia. Second, a noteworthy limitation of this study was that 9 of the subjects in the no phone condition did not hand in completed cognitive tasks and/or questionnaires. Outcomes could not be measured for almost a quarter of participants in the *no phone* condition because of this limitation. If these data had been obtained, our analyses may have supported our predictions. Importantly, it is possible that the subjects who did not hand in their surveys and cognitive tasks were distracted by the absence of their smart phone; however there is currently no

tool to assess this hypothesis. Future research should take this into consideration and attempt to prevent or quantify this unforeseen circumstance.

Conclusion

Instances of nomophobia, social anxiety or feelings of isolation caused by excessive mobile phone use, have been steadily increasing with the evolution of technology. Students belonging to the cohort studied were not born into a generation of smart phones, but have had to learn to adapt due to their growing popularity through students' lifetimes. Gaining a complete understanding of what the effects are in terms of social, psychological, and cognitive development will be crucial for society in the future. Without an understanding of the impact technology has on individuals' lives, it will be difficult to fix problems or capitalize on opportunities presented as technology advances.

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