DIFFERENCES IN SPATIAL MEMORY BETWEEN CHRONIC VS. NORMATIVE SMARTPHONE USERS AND TEXTING DISTRACTIONS

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Submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy
in the Department of Psychology
in the Graduate School of
The University of Alabama

TUSCALOOSA, ALABAMA

2021

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ABSTRACT

Excessive smartphone usage affects daily life (i.e., interpersonal relationships, sleeping patterns, exercise, and physical health). With frequent phone use on the rise, researchers have developed several ways to distinguish normative phone use from unhealthy and problematic phone use. Also, research has found that relying on an external source of information, such as a GPS has resulted in a decrement of spatial ability and spatial memory. However, most individuals use their smartphones to access a GPS. By having their smartphone readily available, they might also be prone to experiencing other smartphone-related distractions from social media apps that further decrease attention and subsequent spatial and memory abilities. This study hypothesized that both chronic smartphone usage and short-term (in the moment) smartphone usage have independent and compounding influences on cognitive functions in daily life; specifically, remembering details about a route travelled. This study had two aims. The first was to investigate the extent to which both chronic and short-term social media usage negatively affects episodic and location memory for environmental landmarks. The second was to understand whether individual differences related to smartphone use would better predict memory than short-term distractions. Chronic smartphone use did not have an effect on episodic or location memory for environmental landmarks. However, the level of distractions did have an adverse effect on location memory, but no effect on episodic memory. Lastly, none of the possible underlying mechanisms predicted the relation between level of distractions and location memory.

DEDICATION

This dissertation is dedicated to my family who has always been supportive of my career and who always encourage me to move forward in pursuit of my dreams. It is also dedicated to my friends who have supported me throughout this journey. Thank you.

LIST OF ABBREVIATIONS AND SYMBOLS

a	Cronbach's index of internal consistency
β	Beta: standard regression coefficient
F	Fisher's *F* ratio: A ration of two variances
M	Mean: the sum of a set of measurements divided by the number of measurements in the set
N	Sample Size
η^2	Eta squared: measure of effect size
p	Probability associated with the occurrence under the null hypothesis of a value as extreme as or more extreme than the observed value
r	Pearson product-moment correlation
SD	Standard deviation: value of variation from the mean
<	Less than
>	Greater than
=	Equal to
Ɛ	Epsilon
χ^2	Chi-Square

ACKNOWLEDGEMENTS

I am extremely grateful to all who supported me in the completion of this project. I would like to thank my committee chairs Dr. Beverly Roskos and Dr. Ian McDonough, as well as my committee members, Drs. Matthew Jarret, Ed Merrill, and Joe Weber for their helpful feedback throughout the process. I would also like to thank my research assistants: Courtney Diebold, Ben Lennartz, Bryant Long, & Elicia Walker for their assistance in piloting and collecting data from start to finish. Finally, I would like to thank my family and friends who have offered me endless support throughout this journey.

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INTRODUCTION

When traveling in an environment for the first time, paying attention to environmental landmarks can help the individual remember where to make turns. In general, landmarks are visual points of reference that are simple, identifiable from a distance, and stand out from the rest of their surroundings (Kattenbeck, 2015, Lynch, 1960). In urban settings, theses landmarks are typically close to the street from which the individual is navigating (Cornell, Heth, & Broda, 1989). These visual points of reference are critical pieces of information that help individuals get to their destination and trace their way back to their starting point. They are part of broader processes known as *wayfinding* and *spatial memory* -- the ability to remember the position and location of objects or places (VandenBos, 2015). In some instances, knowing at which landmarks to turn can determine whether an individual makes it on time for an important event such as getting to work, an interview, or arriving to the airport in time for a flight. As mentioned above, using landmarks to inform where to turn can aid navigation on the return to their point of origin. Fortunately, advances in technology, such as smartphones, have made the task of getting from one place to another easier by decreasing the mental effort involved in learning routes and environmental landmarks. A smartphone activities survey found that nine out of ten individuals claim to use their smartphones to get directions. The survey also found that getting directions and searching for location-based data was the topmost mobile activity aside from texting (Anderson, 2016). With the prevalence of smartphones in daily life, it's important to consider how these devices are shaping behavior and to understand when this behavior is most detrimental to daily

cognitive process such as spatial memory. Might relying on a smartphone for spatial navigation come with a dark side?

Smartphones – Multimedia Devices of Distraction, Poor Attention, and Mood Changes

One side effect of using a smartphone for navigating is the possible influence of other apps during the navigation process. Smartphones also serve as a convenient and an important role in socializing, accessing and sending information, and staying connected with others. (King, Valença, & Nardi, 2010; Yildirim, & Correia, 2015). As such, research has elaborated on the extent to which smartphone usage influences several domains of cognition and human behavior such as driving, attentional decline in a classroom setting, addictive behaviors, changes in mood (i.e., anxiety), and poor sleeping habits (Cheever, Rosen, Carrier, & Chavez, 2014; Demirci, Akgönül, & Akpinar, 2015; Lee, Chang, Li, Cheng, 2014; Lee, Kim, McDonough, Mendoza, Kim, 2017; Mendoza, Pody, Lee, Kim, & McDonough, 2018; Rosen, Carrier, Miller, Rokkum, & Ruiz, 2016; Strayer, Drews, & Johnston, 2003). Student populations have also reported feeling stressed and having a loss of concentration when they do not have their mobile phone around (Pavithra, Madhukumar, & Mahadeva, 2015). Although smartphones bring about several conveniences, the extent to which users depend on them may come with a cost to emotional regulation and cognitive processes.

The absence of smartphones has been shown to increase individuals' level of anxiety. Researchers hypothesized that individuals who had their phone removed would experience more anxiety than individuals who had their phones close by but out of sight (Cheever, Rosen, Carrier, & Chavez, 2014). More specifically, anxiety levels were expected to be higher for those who use technology daily for hours at a time. In this study, individuals who were restricted from their phones had higher anxiety scores over the three intervals at which they were administered. This

was especially true for participants with high scores on a measure of mobile device usage. An important point to draw from this study is that the absence of a phone can induce a type of anxiety even when individuals do not have anything at risk (i.e., information to pay attention to and learn). This anxiety that stems from the absence of one's phone may be explained by a type of separation anxiety that is tied to social aspects of mobile devices (King, Valença, & Nardi, 2010). Texting, a feature used to socialize, is one of the topmost uses of a smartphone (Anderson, 2016). The anxiety that results from being without one's smartphone has been *nomophobia* (King, Valença, & Nardi, 2010; Yildirim, & Correia, 2015). A survey meant to quantify the degree of nomophobia of an individual separated it into four constructs: 1) not being able to communicate 2) losing connectedness 3) not being able to access information and 4) giving up convenience. These four dimensions may partially explain why there may be a change in mood when one's phone is not present.

In instances where attention is needed, anxiety impairs the ability to process information efficiently (Janelle, 2002). According to Williams, Vickers, and Rodrigues (2002), decrements in performance are more pronounced in tasks that involve high-working-memory compared to tasks that involve low-working-memory. A more recent theory that evolved from the processing efficiency theory is known as *attentional control theory* (Eysenck, Derakshan, Santos, & Calvo, 2007). This theory posits that anxiety impairs the inhibition of attention to task-irrelevant stimuli and the flexibility involved in switching between/within tasks to maximize performance. Thus, to the extent that not having access to one's smartphone increases anxiety, decreases in performance might be found for tasks requiring a high degree of working memory, inhibition, or task switching.

However, competing evidence suggests that the mere presence of a phone (in the absence of receiving notifications) can also yield negative consequences, specifically in attention and task performance (Thornton, Faires, Robbins, & Rollins, 2014). In this study, findings demonstrated that the presence of a phone was enough to decrease attention, especially when the task was complex (Thornton et al., 2014). According to Thornton et al. (2014), the presence of a phone can shift attention to the fact that the individual is currently not a part of their wider social network. This in turn, takes attention away from the task at hand. This finding aligns with the concept of FOMO, an acronym for *fear of missing out* (Able, Buff, & Bur, 2016; Blackwell, Leaman, Tramposch, Osborne, & Liss, 2017; Dossey, 2014; Przybylski, Murayama, & Gladwell, 2013). An individual who experiences FOMO may believe that they are missing out on social interactions, meaningful events, or the notion that one's friends are having rewarding experiences that the individual is not a part of. This occurs even when the phone that is present does not belong to the individual performing the task. Thus, individuals might also have impaired cognition when a phone is present because a phone serves as a reminder as to what might be going on in the world rather than the current task, thus decreasing the available resources for the task at hand.

Even when a phone is not visibly present, an attentional cost also occurs when receiving a cellphone notification (Stohart, Mitchu, & Yehnert, 2015). Just as the presence of a smartphone might serve as a reminder to other social events, notifications also can serve as reminder and lead to task-irrelevant-thoughts (i.e., mind wandering). These reminders disrupt sustained attention, which is the ability to maintain one's focus over time on a given task (Parasuraman, 1986). Evidence suggests that switching between tasks puts a toll on working memory maintenance. By switching tasks, there is a lapse in time spent towards reconfiguring attentional resources that

would otherwise be directed towards carrying out the primary task of interest (Liefooghe, Barrouillet, Vandierendonck, & Camos, 2008; Wei, Wang, & Klausner, 2012). An important theory to consider when considering attentional costs due to distractors that result from mobile devices is that of *threaded cognition* (Salvucci & Taatgen, 2008). This theory posits that conflicts in carrying out a task arise when multitasking, specifically when the multiple tasks require the same resource, such as vision. In a classroom setting, interacting with one's phone or laptop during a lecture is a perfect example of the demand of visual resource being required from both the lecture material (i.e., PowerPoint) and a mobile device (i.e., briefly checking one's phone for notifications). Multitasking behavior also occurs when individuals are navigating outdoors. Evidence shows that pedestrians engage in multitasking behaviors when navigating by engaging in social media usage while crossing streets which may put them at risk for injuries (Lin & Huang, 2017).

Smartphones are digital tools that individuals use daily. Two of the most features that are used are to access socializing, which extends beyond social medial platforms such as using phones for texting, calling, emailing, and planning calendar events. The second most used feature is for retrieving directions to places and searching for location-based information (Anderson, 2016). The absence of smartphones can be just as detrimental as the distractions that are causal of a smartphone being present (Thornton et al, 2014; Liefooghe et al., 2008; Stohart, Mithu, & Yehnert, 2015). An accumulating body of evidence suggests that negative effects of mobile device usage are present in classroom settings, driving scenarios, and emotion regulation (Lee et al., 2017; Mendoza et al., 2018; Nasar & Troyer, 2013; Strayer, Drews, & Johnston, 2003; WHO, 2011). What these studies have in common is that the demand to use the social component of mobile devices, namely, smartphones, seems to be a mediating variable that

contributes to negative smartphone behaviors. The time spent on smartphones for socializing and the extent to which this behavior is problematic has not been looked at in the context of spatial and landmark memory.

Smartphone Use for Convenience vs. Problematic Behavior

Studies that have investigated the amount of time spent on mobile devices have found that frequent use of mobile devices correlates strongly with measures of impulse and behavioral addiction (Jenaro, Flores, Gomez-Vela, Gonzalez-Gil, & Caballo, 2007; Park & Lee, 2011; Wu, Cheung, Ku, & Hung, 2013). Several questionnaires have been developed to examine when smartphone use can be classified as problematic or addictive behavior (Bianchi & Phillips, 2005; Jenaro et al., 2007; Kwon, Lee, Won, Park, Min, Hahn, Choi, & Kim, 2013). These measures have been correlated with existing measures of anxiety such as Beck's Anxiety Inventory (BAI), general health, and other factors that meet criteria from the DSM-IV which of indicative of mental well-being (Beck, Rush, Shaw, Emery, 1979, Beck, Brown, Epstein, Steer, 1988; Goldberg & Hiller, 1979; Goldberg & Williams, 1988). These mobile device usage measures enable researchers to determine when phone use falls within a normative range in comparison to a problematic behavior that could result in detriments to other areas of behavior such as sleep, anxiety, mood, and memory. Because of the lack of longitudinal and experimental research manipulating phone use over time, it is not clear whether individuals with problematic phone use have pre-existing psychological disorders that may contribute to the cyclical behavior of frequent phone use or whether problematic phone use causes psychological disorders. Correlational research has informed us that individuals who do report feelings of loneliness and report poor social skills are likely to develop compulsive Internet use behaviors (Davis, 2001; Kim, LaRose,

Peng, 2009; Whang, Lee, & Chang, 2003). Long term effects of compulsive phone use may have negative consequences that may augment learning and memory.

Long-term Smartphone Use

Plenty of research that has discovered the ways in which smartphone dependency influences daily life, but few studies have been curated on how this dependency plays a role in spatial and landmark memory. One of the reasons why smartphones and other mobile devices become problematic is due to the instantaneous access to the Internet (Cheever, Moreno, & Rosen, 2018; Griffiths, 2000, Rosen, Cheever, & Carrier, 2015; Young, 1998). Frequent mobile device usage can have a lasting influence on the way in which individuals think, focus their attention, and regulate their mood. Here, we will define chronic smartphone use as overall historical use of smartphones use that is related to problematic behavior.

Scales such as the Mobile Phone Problematic Use Scale (Bianchi & Philips, 2005) has been used to identify relationships between academic performance, anxiety, and satisfaction with life (Lepp, Barkley, Karpinski, 2014). Considering that large amounts of time are spent on screens, it's questionable as to how much time individuals spend outdoors to navigate naturally. The need of learning an environment via direct exposure appears to be diminished with the convenience of having knowledge on a given location at one's fingertips (Anderson, 2016). Socially anxious individuals are more likely to prefer online social interactions (Caplan, 2006). Thus, the continued use of online social media may continue to contribute to problematic mobile device use.

Some of the negative influences of frequent technology usage has found that excessive smartphone usage is linked to poor sleep quality, depression, anxiety, and poor physical health (Demirci, Akgönül, & Akpinar, 2015; Rosen, Lim, Felt, Carrier, Cheever, Lara-Ruiz, Mendoza,

& Rokkum, 2014; Rosen, Carrier, Miller, Rokkum, Ruiz, 2016). Self-report measures of sleep quality, daytime dysfunction, depression, and anxiety showed that individuals with high smartphone usage scored higher in depression, anxiety, and daytime dysfunctions such as irritability, fatigue, and inability to concentrate on daily tasks, when compared to individuals with low smartphone usage. Studies suggest that sleep problems predict the amount of time spent on phone but not the opposite. (Tavernier & Willoughby, 2014). Although mobile device use was not linked to poor sleep, another study linked night-time awakening behaviors to a subscale that measures individuals' anxiety/dependency of one's mobile device (Rosen et al., 2016). This might be explained by the notion that individuals who receive messages during the night feel the need to check their phones as they may feel a sense of *fomo* (King, Valença, & Nardi, 2010; Przybylski, Murayama, & Gladwell, 2013). However, another study points that using a phone for calling and texting after a "bedtime" was strongly associated with sleep disturbances (Munezawa, Kaneita, Osaki, Kanda, Minowa, Suzuki, Higuchi, Mori, Yamamoto, & Ohida, 2011). This study explained sleep disturbances to be related to electromagnetic fields that are emitted by mobile phones prior to falling asleep are linked to a decrease of rapid eye movement (REM) sleep (Loughran, Wood, Barton, Croft, Thompson, & Stough, 2005). Although more knowledge is being gathered to understand the long-term effects of mobile device use in areas such as classroom settings, driving, and emotion regulation, researchers call forth the need to examine repeated use of mobile devices (i.e., GPS) to understand what the long-term effects may be (Ishikawa et al., 2008; Willis et al., 2009). This study aims to bridge the gap between understanding the long-term psychological effects of smartphone use on spatial memory. Looking closely at the directionality of smartphone use on psychological well-being is of importance because smartphone use has been linked with mental health problems such as

depression and loneliness. Taking a step back, these links are alarming as they are often time related to chronic diseases and suicidality (Hawkley & Cacioppo, 2010). A recent study has demonstrated that smartphone usage is a predictive of depressive symptoms (Lapierre, Zhao, & Custer, 2019). The findings from this study may perhaps be explained by the *displacement hypothesis* which posits that spending time online [via the Internet] displaces the time spent offline. As such, time spent online is may result in an isolating despite the presence of online social engagements which may have online lack a sense of intimacy may further contribute to feeling isolated (Lapierre, Zhao, & Custer, 2019).

As mentioned previously, psychological symptoms can be imperative to cognitive functions (i.e., memory). New insight on smartphone use and its directional relationship to depressive symptoms paves a path to the possibility of what smartphone usage can do to memory. If smartphone use can alter psychological well-being, and components of psychological well-being can influence memory, then perhaps it is possible draw a conclusion that excessive smartphone usage leads to poor memory.

Consequences of Smartphone Use for Spatial Memory

In contrast to frequent mobile device usage, momentary smartphone use can have a short-term influence on the way in which individuals think, focus their attention, and regulate their mood. For example, reliance on a GPS might make individuals no longer feel the need to actively pay attention to their surroundings when navigating or mentally rotating one's position or the position of environmental landmarks in respect to one's directional goal. A consequence of not attending to one's environment during wayfinding is a decreased likelihood of encoding into memory environmental information, such as landmarks and/or routes (Hejtmánek, Oravcová, Motýl, Horáček, & Fajnerová, 2018; Ishikawa, Fujiwara, Imao, & Okabe, 2008;

Parush, Ahuvia, & Erev, 2007; Münzer, Zimmer, & Baus, 2012;Willis, Hölscher, Wilbertz, & Li, 2009). One study investigated the effectiveness of GPS presentation for navigating outdoors in comparison to users who used maps and individuals who navigated via direct experience (Münzer, Zimmer, & Baus, 2012). This study found that presentation modes that provide comprehensive configural knowledge via estimation between visited locations and sketch map drawings of the environment. However, this is at the cost of wayfinding accuracy (i.e., number of turns at intersections that deviate from a precalculated route). In other words, using a GPS may have helped individuals learn more about their surrounding environment but at the cost of their ability to effectively navigate through an environment. It appears that the GPS presentation of information is provided in a way that is ready-to-use which means that the user does not have to manipulate information mentally. Another possible explanation to this is that the screen on a GPS is relatively small (4 x 5 cm) and displays a limited view of the area around the user's position. According to Ishikawa et al. (2008), having a local focus can interfere with the global processing of spatial information which may impede user's ability to pay attention to surrounding detail (Field, O'Brien, & Beale, 2011; Ishikawa et al., 2008). Furthermore, GPS presentations of the environment likely do not provide images of landmarks that guide the users to their destination. A GPS may provide something such as a street name which may serve as a point of reference but it may not be as memorable as a landmark that contrasts the environment such as a bridge or a building with interesting architecture (Lynch, 1960). This is also true for paper maps, but paper maps lack the convenience of continuous updates on directions, individuals pay less attention to their surroundings and routes that lead to their destination.

One study aimed to understand how different levels of automation in mobile maps may impact navigation performance and spatial knowledge of landmarks in the environment

(Brügger, Richter, & Fabrikant, 2016). The goal of the study was to increase user autonomy by lowering the system automation so that there would be an increase of spatial knowledge when the individual was actively engaged in the navigational task using the application, which had information on the environment. Half of the participants used a mobile map that continuously updated the user's location on the map (high-level of engagement condition) while the second half was instructed to press a button to receive location-based data on the surrounding environment every 10 seconds (low-level of engagement condition). The participants in the low-level condition, who manually received updates by pressing the button during the navigation task, had no problems when navigating to and from the destination and made little to no errors when finding their way back from the destination while participants who continuously received updates made more stops and even failed to identify the starting point. In other words, the less play-by-play information an individual is receiving from their mobile device, the more attentive individuals were of their environment. Therefore, it is possible to moderate the effects of technology dependency on spatial knowledge (Brügger, Richter, & Fabrikant, 2016). Although this study demonstrated that technology can be effective for wayfinding under certain circumstances, evidence continues to suggest that relying heavily on technology can result in unfavorable consequences for spatial memory. It's possible that having a condition with direct experience alone, without the help of any sort of navigational assistance, could result in better spatial and landmark memory (Ishikawa et al., 2008; Parush, Ahuvia, & Erev, 2007).

Evidence shows that navigational aids impair spatial memory of environmental landmarks. Researchers argue that acquisition of spatial memory may degenerate when relying on mobile devices (Gardony, Brunyé, Mahoney, & Taylor, 2013). Gardony et al. (2013) tested this by having participants navigate through a virtual environment. Participants were asked to

navigate to certain sets of landmarks (e.g., “go to the bank”). Participants navigated in one of three conditions – using a tonal aid (a tone would play when the participant was approaching the landmark), using no tone (control), or using verbal assistance such as “slightly to the left 400 ft.” Although both methods of receiving navigational assistance helped in getting to the landmark when compared to the control, both forms of assistance (tonal and verbal) resulted in poorer memory for landmarks during through route. Thus, cognitive functions that support navigation in wayfinding are influenced by technology. Gardony et al. (2013) proposed that the theory of divided attention could account for the variability in spatial memory such that navigational aids may decrease attention from the environment being navigated in so that the individual may be attentive to visual and/or audio cues provided by navigational assistance. Another possible explanation for the decrease of spatial memory may be guided by transactive memory theory.

The theory of *transactive memory* suggests that memory for information declines when individuals rely on an external source (Sparrow, Liu, & Wegner, 2011; Wegner, 1987; Wegner, 1995). Transactive memory is defined by a shared system for encoding storing and retrieving information (Wegner, 1987). Initially, this theory sought to explain how communicating knowledge between individuals can have an influence over how that knowledge is learned and recalled. Transactive memory enables individuals to remember information on the breadth of knowledge possessed by a particular group member and knowing who in their group knows a specific type of knowledge. In terms of mobile media usage, Sparrow et al., (2011) sought to see if there is a similar type of relationship that exists for individuals who are aware of knowledge being stored by a particular external source (i.e., a computer) and knowing where (akin to the who-knows-what portion of transactive memory) to find particular pieces of information. According to transactive memory, when individuals know that they can rely on a computer to

store information for them, they are less likely to encode that piece of information using their own attentional and encoding strategies. Instead, they are better able to recall where the information can be found such as a specific folder or location within an digital source. Another theory that better explains for why memory for information fails to be encoded is the cognitive offloading theory (Risko & Gilbert, 2016). Further research argues that the tendency to look up information before attempting to recall it can prevent encoding and thus prevent information from being stored into long-term memory (Moledina & Khoja, 2018).

Mobile devices are an external source for individuals to access information. Consequentially, having access to the internet for information makes it less likely for individuals to encode information, which results in poorer recall of information. Instead, individuals are more likely to know where to find necessary information. This phenomenon has also been noted in studies of cognitive offloading. The practical mechanism for cognitive offloading is to eliminate the need to internally represent information that we will need later (Risko & Gilbert, 2016).

Although navigational devices are highly accessible and bring convenience to getting from one location to the next, some researchers believe that spatial knowledge remains (Münzer, Zimmer, Schwalm, Baus, Aslan, 2007). First, acquiring spatial knowledge is important as individuals may want to learn about the environment they are moving through, they may want to learn various routes within the environment to get around. Second, having spatial knowledge is important when planning routes over a sequence of locations. Lastly, individuals may not always want to rely on navigation aids are they are prone to fallacy and/or failure (Münzer et al., 2007).

Current Study

I proposed that both chronic and short-term smartphone use will have independent and compounding influences on cognitive functions in daily life. This study had two specific aims. The first was to investigate the extent to which both chronic and short-term smartphone usage negatively affects spatial memory for environmental landmarks. The second was to understand the underlying mechanisms such as addiction, anxiety, or depression that may explain why chronic and short-term use of smartphones may influence spatial memory.

According to multiple theories outlined above spanning attention and transactive memory theory, chronic smartphone use should degrade one's overall ability to sustain attention, manipulate information in working memory, and inhibit distractions. Because these three cognitive processes have been hypothesized to impact the memory encoding process (Eysenck et al., 2007; Sparrow et al., 2011; Williams et al., 2002), individuals with higher chronic smartphone use should successfully encode fewer landmarks during a wayfinding task than individuals with lower chronic smartphone use. That is, when compared as whole, chronic smartphone users (whether in high or low distracting text conditions) will have poorer scores on the spatial memory task when compared for the normative smartphone users (no matter the high or low frequency of distracting texts)

The aforementioned theories also predict that short-term (momentary) smartphone use should lead to lapses in attention when an individual is navigating through an environment. This perspective is different from that involving chronic smartphone use because temporary lapses in attention should occur for individuals of all cognitive ability levels. Thus, the individual who is interrupted by texts many times will be more likely to fail to encode landmarks and spatial memory of where those landmarks are in respect to the environment of which they are navigating

through, compared to when they are interrupted less (Eyesnick et al., 2007; Salvucci & Taatgen, 2008; Willians et al; 2002).

To address how levels of distraction (high vs. low) and chronic smartphone use (chronic vs. normative) influences spatial memory, I made the following predictions:

H1: Overall, normative smartphone users will have better spatial memory than chronic smartphone users.

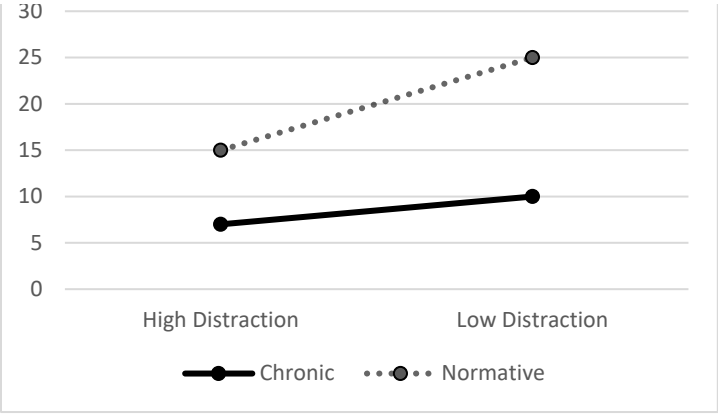
H2: Individuals exposed to the condition with a high frequency of distractions via smartphone notifications will have poorer spatial memory than those exposed to the condition with a low frequency of distractions

H3: The difference between spatial memory for high and low distraction will be smaller for chronic smartphone users than the difference in spatial memory for distractions for normative smartphone users.

Figure 1.

Figure 1

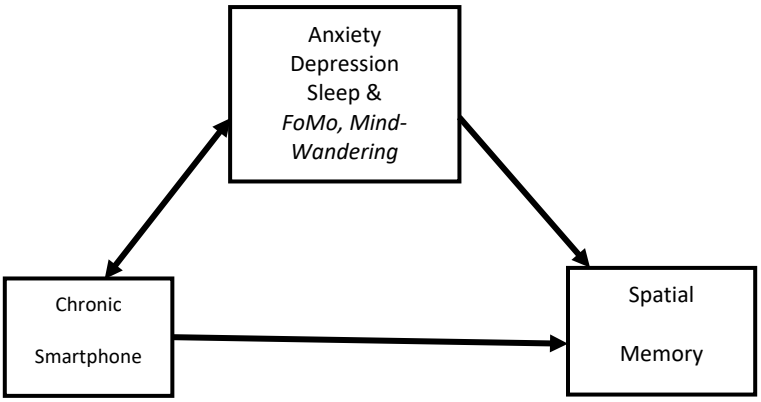
Predicted Effects of High vs. Low Number of Distractors on Spatial Memory Performance Among Chronic vs. Normative



The secondary aim was to investigate the explanation for chronic effects (chronic vs. normative) vs. short-term effects (high vs. low distraction) in spatial memory. This study sought to examine the underlying mechanism that may best explain why the level of distractions may influence spatial memory for chronic vs. normative smartphone users. For chronic phone users, poorer landmark memory may be explained by unhealthy behaviors that have been related to excessive phone use such as lack of sleep, inability to regulate mood, anxiety or other comorbid psychological disorders. Normative smartphone users are expected to have better memory than chronic smartphone users. Momentary explanations for the difference in performance between chronic vs. normative smartphone use may be task-irrelevant thoughts, mind wandering, or fear of missing out. As such, I predicted the following:

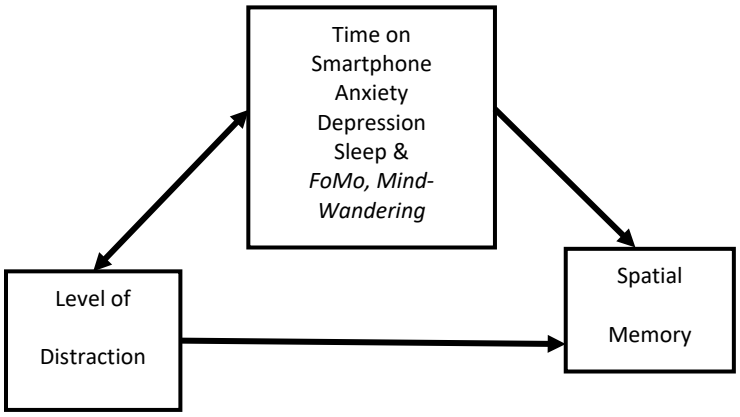
H4: The relation between chronic smart phone use (chronic vs. normative) and spatial memory will be explained best by anxiety, depression, and poor quality of sleep, followed by fear of missing out and task-unrelated thoughts (mind wandering).

Figure 2.



H5: The relation between short-term distractions (high vs. low frequency of notification) and spatial memory will explained best by time spent on the phone, followed by fear of missing out and task-unrelated thoughts (mind wandering).

Figure 3.



METHODOLOGY

Participants

Using G*Power software (Faul, Erdfelder, Lang, & Buchner, 2007), an a priori power analysis for a 2 (smart phone use) x 2 (distractions) between-subjects ANOVA with interactions was conducted. It suggested that a sample size of 182 would be sufficient to detect a medium effect (Cohen's $f = .25$) with a power of .80 and an alpha level of .05

Each participant was recruited via the psychology subject pool. Students enrolled in the introductory psychology course received credits towards the research requirement for the course. Other participants did not receive anything. Deception and concealment of the study's main purposes was necessary to eliminate participant bias for the memory task. Researchers stated that the study was regarding the relationship between the campus atmosphere and students' psychological well-being. Therefore, the study was advertised as such. The study also contained information about the researcher needing to text the participant while they are walking outside so that the researcher can check and see how the participant is doing. Upon arriving to the laboratory, the researcher provided the participant with a verbal overview of the study (as described on the subject pool webpage and consent form) and then let the participant read the information sheet and consent form independently. After they agreed to participate in the study, the researcher provided the participant with a participant ID and then logged their contact information (i.e., phone number, email address) onto an excel sheet. Their personal information was used solely for the purposes of providing them with credit for completion of the study, but the phone number was used for

texting the participants during the study as stated in the consent form. All identifying information was deidentified before transferring the data to the analysis software. Thus, their personal information was not linked to their data.

Participants were 116 students enrolled in PY 101 at The University of Alabama and received research credit for participating in the study. Ages of the participants ranged from 18-25 years old. In the sample, 41 identified as males, 74 as females and 1 as non-binary. The ethnic composition of the participants consisted of 21.6% African American, 1.7% Asian, 3.4% Latinx, and 72.4% Caucasian participants.

Design

To accomplish the aims of the current study, a 2 (chronic vs. normative smartphone users) x 2 (high vs. low frequency of distractions) factorial design was used to test how chronic smartphone usage and short-term distractions from one's smartphone affects the dependent variables of landmark recollection and landmark location memory. The first factor was between-subjects and divided participants into chronic vs. normative smartphone users using the cutoff scores from the Smartphone Addiction Scale Short Version (Kwon, Lee, Won, Park, Min, Hahn, Choi, & Kim, 2013). The second factor was a between-subjects manipulation of the amount of distracting text notifications (18 vs. 36) that were sent at pre-determined points during the navigation task.

Navigation Task

A portion of the campus environment at the University of Alabama was selected as the real environment that participants navigated through. A route that is approximately one mile in length through the campus was selected as the walking path for participants (see map in Appendix B). The route began and ended at the building in which the lab was located.

Participants were randomly assigned to the experimental condition which determined how many texts they received while navigating the route.

In the lab, each participant first completed a brief survey to ensure that the participant provided their phone number, which was necessary to introduce distractors during the task. The survey also collected participants' current year in school, current major/minor, racial/ethnic background, gender identity, and biological gender.

Next, the participant was presented with a map on a computer screen that displayed a portion of the UA campus. The map included the path that they would be walking along. The map was developed through Maps.Me. It included general labels and arrows that indicated the clock-wise path that the participant would be navigating. Participants were provided the following instructions.

> *"Please take the next 5 minutes to study the path depicted in the image below. You will be walking on this path for part of the study.*
>
> *The assigned path takes about 30 minutes to complete. A researcher will be nearby as you walk on the assigned path, but they will solely be there to take notes (i.e., time taken to complete path). Please refrain from interacting with the researcher regarding directions as they are only there for the purpose of taking notes on the time and distance traveled.*
>
> *The researcher will contact you via text as you are walking on this path. Please reply as soon as you get this message as it will help keep the researcher informed on the progress of the study.*
>
> ***Note**: When you are walking this path, please be sure to pay attention to everything within your 180 view. Your safety is always important to us so please be cautious and follow all traffic rules (i.e., look both ways before crossing any streets).*
>
> ***While you're on the path, be sure that you are moving in the same direction as the arrows you saw on the map and stay on the sidewalks. Try your best to stick to what you saw on the path."***

After studying the map for around 5 min, the researcher and participant went outside to begin navigation. All participants were equipped with their personal smartphones.

The researcher trailed behind the participant by 5 ft. They had a copy of the map to ensure that the participants were navigating the assigned route. In case the participant deviated from the path, researchers intervened: “You’re doing a good job so far but try to remember what you saw on the path and stick to you studied earlier.” An open-ended note section was provided for researchers to leave notes on anything that stood out during the wayfinding portion of the study such as major deviations.

Also on the researcher’s map were 6 X’s where texts should be sent and either 3 or 6 boxes next to the X’s. The X’s were spread out evenly along the route. Participants received either a low number (3) or high number (6) of texts at each marked point on the researcher’s map, depending on the condition. In sum, a total of 18 or 36 text messages were sent. Researchers arrived at this number of notifications through pilot and brief interviews with piloted participants (data excluded from analyses), ensuring that there were enough texts for distraction and still keep the study under an hour.

The text messages consisted of simple questions such as “Please reply Y or N: I look for opportunities to spend my time indoors whenever possible” or “Please reply Y or N: Most of the activities I choose to do for fun can be done indoors (i.e., watching movies, videogaming, web browsing etc.)” or “Please reply Y or N: Most of the activities that I choose to do for fun can be done indoors (i.e., watching movies, video gaming, web browsing, etc.)”.The researcher had the list of these texts on their phones prior to beginning the study so that they could easily copy, paste, and send the messages. When the researcher sent each text, they marked a box with an “/”. When the participant replied to the text, the researchers marked the box with a “\” so that a full “X” was marked in the box.

Researchers started the timer to record the length of the wayfinding task as soon as the participant reached the starting point (the front steps of the lab building). Researchers stopped the timer once the participant arrived at the ending point (which was also the startpoint). The participant was given a moment to catch their breath, get water, or use the restroom if needed.

Episodic and Spatial Location Memory Tasks

When participants completed the navigation task, they went back to the lab where they completed the memory tasks. Performance on the episodic and spatial location memory tasks was gathered based on the same overall task, but each memory memory measure involved different materials and procedures. Both tasks were presented simultaneously on a split computer screen.

For the episodic memory task, a set of 33 photos were used. Photos contained images of buildings on campus and general scenes that one might encounter along the assigned path (e. g., a bike rack, a lunching area, lunch benches, etc.). Eleven of the photos were images that could be seen on the path during (clockwise) navigation (Target). Eleven additional photos were taken of the same scenes or buildings from a counter-clock-wise angle (Difficult Lure). Eleven more photos were of scene/buildings that were not on the path (Easy Lure). Three out of the 33 photos, one from each category, were used during a practice trial to ensure participants understood the entirety of the memory task, leaving 10 of each for the memory test. Each photo was numbered for use with the spatial location task.

For the spatial location task, participants were shown the same map that was displayed before but without the route drawn on it. Instead, 33 numbered boxes were scattered on the map; the numbers corresponded to the landmarks shown in the photos. Participants could drag and drop the boxes (landmarks) to their locations on the map. The accuracy of the landmark

placement was measured using the Gardony Map Drawing Analyzer (GMDA) (Gardony, Taylor, & Brunyé, 2016). The GMDA is a map analysis program that compares landmark locations on the participant's map to the landmarks locations in the target environment (key). It produces a measure of configural accuracy based on the differences between the coordinates of the placed landmark and its actual location. The equation (below) produces a score that ranges from 0 – 1, with higher scores indicating better configural accuracy for the placed landmarks.

$$\left(2\binom{nDL}{2}\right)$$

On the split screen, the photos were presented on one half and the map with numbered boxes was on the other half. The photos were presented in random order, one at a time. The following script was read by the researcher during this task:

> *"For each image, we'd like to know if you recollect specific details from the outdoor task today that are found in each image. If you do recollect specific details from the task, please respond 'I remember seeing this on the path that I walked for this study.'* [Recollect] *Sometimes, you might not recollect any details from the image, but you might be familiar with the image because you have walked by the area at other times. If you "just know" that you passed by the objects in the image without recollecting any specific details from the outdoor task, then respond 'I know that this is the image because I walk by here a lot in general.'* [Know] *Alternatively, you may find that sometimes you might feel that a combination of the two options we just mentioned best describe how you drew a conclusion, in that instance, please select 'both'.* [Both] *If you do not recognize any part of the image, whether from the outdoor task or previous walks on the path outside of this experiment, then respond 'I don't recognize any part of the image from the outdoor task or previous walks on campus outside of this experiment -- this was new to me..'* [IDR] *"I know this image and I know that it was NOT on the path that I walked on today"*[No]. *These judgments do not relate to your confidence in your memory, but rather correspond to different types of knowledge that you have about each image. If you have any questions about the differences the options we discussed, please let us know."*

When participants recognized a landmark photo that was on their route, regardless of their episodic memory response, they were to drag and drop the corresponding numbered box on the

map onto its correct location. The researcher emphasized that they should drag and drop only for landmark photos that they recollected were on the route. However, sometimes the participant placed the wrong landmark (the lures). Accuracy was calculated only for photos that were of target landmarks.

From this procedure, episodic memory was calculated as the average proportion of targets that were recollected [Target Recollect; Hit]. Also calculated were the proportion of easy lures that were incorrectly recollected [Easy Lure False Alarm] and the proportion of difficult lures that were incorrectly recollected [Difficult Lure False Alarm]. Spatial location memory was calculated as the average configural accuracy for placed target landmarks [Canonical Accuracy].

Questionnaires

After completing the navigation and memory tasks, participants completed a series of questionnaires regarding smartphone use and other measures.

Smartphone Addiction Scale, Short Version (SAS-SV). To create groups of chronic vs. normative smartphone addiction, participants completed the short version of the Smartphone Addiction Scale (SAS-SV). The SAS-SV has 10 items and uses a 6-point Likert scale (1 "strongly disagree" to 6 "strongly agree"). The total score ranges from 10 to 60, with the highest score being the maximum presence of smartphone addiction within the past year. Overall, the SAS-SV holds content, concurrent validity, and internal consistency with a Cronbach's alpha of 0.91 This questionnaire holds internal consistency for each question and for the 10 items. All ten items show a Cronbach's alpha of more than 0.90. In terms of concurrent validity, the SAS-SV was found to be strongly correlated with the original Smartphone Addiction Scale (SAS), Smartphone Addiction Proneness Scale (SAPS), and KS-Scale, the Korean self-reporting internet addiction short-form scale (Kwon, Kim, Cho, & Yang, 2013). The SAS-SV also holds diagnostic

ability and includes cut-off values that were determined based on consultation results with a panel of clinical psychologists. There are different cut-off values for each gender. For males, the cut-off value is 31 with a sensitivity value of 0.867 and a specificity value of 0.893. For females, the cut-off value is 33 with a sensitivity value of 0.875 and a specificity value of 0.886. These cut-off scores were intended for use to create groups of *chronic* vs. *normative* smartphone addiction (Kwon, Kim, Cho, Yang, 2013; cf. Lopez-Fernandez, 2017). These cutoff values were used in the current study [Chronic/Normative Addiction/Use].

Beck's Anxiety Inventory (BAI). Beck's anxiety inventory is a self-report instrument that consists of 21-items that measures for symptoms of anxiety. Individuals respond to a series of statements and rate how bothered they are by each item using a four-point scale (0-3), with higher scores indicating more symptoms of anxiety. Some example items are "fear of worst happening" and "difficulty in breathing." The BAI holds a Cronbach's alpha of 0.92, suggesting adequate internal consistency. The total scores are calculated by finding the sum of the 21 items. A score of 0-21=low anxiety, a score of 22-35 = moderate anxiety, and a score of 36 and above indicates potentially concerning levels of anxiety (Beck, Epstein, Brown, & Steer, 1988). The sum was used in the current study.

Beck's Depression Inventory II (BDI). Beck's depression inventory II is a self-report instrument that consists of 21-items that measure for symptoms of depression. Participants respond to a 4-point scale (0-3), with higher scores indicating more severe symptoms of depression. Some item examples are "I feel my future is hopeless and will only get worse" and "I feel I may be punished." The BDI-II holds a Cronbach's alpha of .90, which suggests adequate internal consistency. Total raw scores range from 0 to 63. These scores can be converted into descriptive classifications based on cut-off scores: 0-13 is considered minimal range, 14-19 is

mild, 20-28 is moderate, and 29- 63 is severe. (Beck, Steer, & Brown, 1996). The sum was used in the current study.

Pittsburgh Sleep Quality Inventory (PSQI). The PSQI is a questionnaire that consists of 19 self-rated questions and 5 questions rated by the individuals' bed partner. The 19 items are categorized into scores with the following seven components: sleep disturbances, sleep efficiency, sleep durations, sleep dysfunction, sleep latency, sleep quality, and use of sleep medication. Only self-rated questions are used as a part of scoring. The 19-self rated items are combined to form seven "component" scores, each component is scored on a scale of 0 – 3 points where 0 indicates having "no difficulty" and 3 indicates having "severe difficulty" with sleeping. The seven components are then added to yield a total score that ranges from 0-21 points. Higher scores indicated poorer sleep quality. The component scores of this measure has a Cronbach's alpha of 0.83 overall and each item independently averages a reliability coefficient of 0.83 (Buysse, Reynolds, Monk, Berman, & Kipfer, 1989).

Mind Wandering Questionnaire (MWQ). The mind wandering questionnaire is a five-item questionnaire that holds good internal consistency among the items and is intended to measure the frequency of mind-wandering (regardless if mind wandering is deliberate or spontaneous). This questionnaire holds a Cronbach's alpha of 0.850. Each item is based on a 1 – 5 Likert Scale where; 1: completely on-task; 2: mostly on-task; 3: both on the task and unrelated concerns; 4: mostly on unrelated concerns; 5: completely on unrelated concerns. Some examples of the items are "I mind-wander during lecture presentations" and "I find myself listening with one ear, thinking about something else at the same time". Total scores for the MSQ is the sum of

the five items which range from 5 to 30 – higher scores suggest a higher frequency of mind-wandering (Mrazek, Phillips, Franklin, Broadway, & Schooler, 2013).

Fear of Missing Out Questionnaire (FoMo). The FoMo Questionnaire is a 10-item questionnaire that uses a 5-point likert scale where 1 is *not true at all* and 5 is *extremely true*. Some of the questions include "I fear others have more rewarding experiences than me. "and "I get worried when I find out my friends are having fun without me." This scale holds a Cronbach's alpha of 0.92. Scores are computed by averaging the scores across the ten items resulting in an overall score that ranges from 1-5; higher scores indicate a greater levels of FoMO (Przybylski Murayama, DeHaan & Gladwell 2013).

Sense of Direction. One question assessing sense of direction was used to analyze participants' sense of direction. The question is based on a 7-point Likert Scale (1 = *very poor*, 7 = *very good*) and reads as follows: "*How good is your sense of direction?"* This one-item survey has a high test-retest reliability across 2 weeks and 3 months from initial completion, r = .93. (Kozlowski & Bryant, 1977).

Familiarity of UA Campus Questionnaire. For the purpose of the current study, a questionnaire was devised to assess the participants' familiarity with the campus. There are 12 questions. Examples of questions are: "How familiar are you with the UA Campus?" "How familiar are you with the campus layout?" "How frequently do you walk around campus?" It uses a 1 = not familiar to 5 = extremely familiar scale. The average of the items was calculated, with higher scores indicating greater familiarity.

Media and Technology Usage and Attitudes Scale (MTUAS). The media and technology use and attitudes scale is made up of 11 usage subscales and four attitudes subscales. The scales are as follows: Smartphone Usage (9 items), General Social Media Usage (9 items),

Media Sharing (4 items), Internet Searching (4 items), E-Mailing (4 items), Text Messaging (3 items), Video Gaming (3 items), Online Friendships (2 items), Facebook Friendships (2 items), Phone Calling (2 items), TV Viewing (2 items), Positive Attitudes Toward Technology (6 items), Anxiety About Being Without Technology or Dependence on Technology (3 items), Negative Attitudes Toward Technology (3 items) and Preference for Task Switching (4 items). The usage subscales are rated on a 10-point frequency scale ranging from (1) never to (10) all the time. Ratings are summed across items for each subscale. The MTUAS can be used together or separately, as each subscale is internally reliable and externally valid (Rosen, Whaling, Carrier, Cheever, & Rokkum, 2013). Only the Smartphone Usage subscale was used for the purpose of this research [Smartphone Use/Time on Smartphone]. Scores on the subscale range from 9-90.

RESULTS

All variables were inspected for normality. All measures were deemed normal. The descriptive statistics for all measures are presented in Tables 1 and 2. Correlations among the dependent variables are presented in Table 3. Differences between the low and high distraction conditions and the chronic and normative smartphone addiction conditions are in Table 4

.

Table 1.

Descriptive Statistics for All Dependent Variables

	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Anxiety (BAI)	.00	45.00	11.2845	10.15344	1.162	1.004
Depression (BDI)	.00	34.00	10.7931	7.72857	.922	.725
Sleep (PSQI)	2.00	13.00	7.0776	2.64789	.112	-.558
Fear of Missing Out (FoMo)	1.00	4.40	2.1836	.74167	.648	-.156
Familiarity with Campus	12.00	35.00	22.35	4.17	.225	.025
Mind Wandering ((MWQ)	5.0	27.00	17.3103	4.41029	-.323	-.293
Smartphone Addiction (SAS-SV)	13.00	44.00	. 27.5000	. 6.79706	.235	-.359
Smartphone Use (Time on Smartphone) (MTUAS)	5.00	10.00	7.3429	.98606	.064	.615
Sense of Direction	1.00	7.00	4.8793	1.57786	-.433	-.469
Canonical Accuracy (GMDA)	.41	1.00	.8558	.10476	-2.244	5.850
Target Image Recollect (Hit)	.00	1.00	.3207	.25623	.794	.225
Easy Lure Recollect (Easy FA)	.00	.70	.2078	.17847	.965	.225
Difficult Lure Recollect (Difficult FA)	.00	.70	.2681	.20751	.537	.225
Hits-Easy FAs	-.20	.70	.1129	.18814	.790	.225
Hits-Difficult FAs	-.40	.70	.0526	.17419	.488	.225

FA = false alarm. Canonical Accuracy is a measure of spatial location memory. Episodic memory measures comprise the Target and Lure measures. Difficult Lure = image was not on the route but is similar to the target image. Easy Lure = image was not on the route and is not similar to the target.

Table 2. Episodic Memory Results: Proportion of Responses by Type of Image and Response Category

Type of Image	Recollect	Know	Both	IDR	No
Target					
Mean	.3207	.0362	.4207	.1112	.1155
Median	.3000	.0000	.5000	.1000	.1000
Std. deviation	.25623	.07621	.27172	.11016	.11542
Easy Lure					
Mean	.2078	.0603	.2017	.2457	.2836
Median	.2000	.0000	.2000	.2000	.3000
Std. deviation	.17847	.10374	.17244	.16805	.18366
Difficult Lure					
Mean	.2681	.0526	.2888	.1224	.2698
Median	.2000	.0000	.3000	.1000	.2000
Std. deviation	.20751	.09909	.22410	.12307	.21997

Recollect = remember seeing image on route; Know = know that image is on route but don't remember seeing it; Both = remember seeing image on route and know that it is on route; IDR = I don't recognize; No = Image is not on the route.

Table 3.

Zero Order Correlations Among Dependent Variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Fear of Missing Out	_												
2. Sleep	.341**	_											
3. Anxiety	.474**	.280**	_										
4. Depression	.505**	.368**	.670**	_									
5. Mind Wandering	.267**	.254**	.367**	.392**	_								
6. Sense of Direction	-.122	-.331**	-.310**	-.237*	-.283**	_							
7. Familiarity with Campus	-.081	-.209*	-.230*	-.086	-.303**	.581**	_						
8. Smartphone Use (Time on Smartphone)	-.021	.083	-.216*	-.133	-.200*	-.084	.015	_					
9. Smartphone Addiction	.227*	.073	.209*	.193*	.318**	-.127	-.166	.058	_				
10. Canonical Average	.051	-.164	-.041	.017	-.119	.252**	.302**	-.198*	.056	_			
11. Target Image Recollection	.069	-.036	-.062	-.045	-.140	.359**	.317**	.056	-.058	.279**	_		
12 Easy Lure Recollection	-.098	-.039	-.124	.037	-.073	.367**	.179	-.034	-.129	.219*	.540**	_	
13. Difficult Lure Recollection	.111	-.015	-.061	.072	-.094	.275**	.214*	.074	-.098	.122	.512**	.524**	_

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Both = Recollect seeing the image and know that image is on the route.

Table 4.
High/Low Distraction and Chronic/Normative Smartphone Addiction: Means and Standard Deviations

Measures	**Normative Smartphone User**	**Chronic Smartphone Users**
Canonical Accuracy		
Low Distractions	.866 (.096) N = 26	.886 (.054) N = 33
High Distractions	.847 (.114) N = 28	.815 (.137) N = 28
Target Image Recollection		
Low Distractions	.319 (.240) N = 26	.336 (.261) N = 33
High Distractions	.339 (.281) N = 28	.286 (.247) N = 29

Tests of Hypotheses

The main hypotheses were tested with a 2 (high, low distractions) x 2 (chronic vs. normative smartphone use) analysis of variance for each of the dependent variables (canonical accuracy and target recollection).

Table 5.

Tests of Between-Subjects Effects for Canonical Accuracy

Dependent Variable: Canonical Accuracy

Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Chronic/Normative Smartphone Use	.001	1	.001	.088	.767	.001
High/Low Distractions	.057	1	.057	5.391	.022	.047
Chronic Smartphone Use * Distractions	.019	1	.019	1.812	.181	.016

Table 6.

Tests of Between-Subjects Effects for Target Image Recollection

Dependent Variable: Target Image Recollect

Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
High/Low Distractions	.007	1	.007	.097	.756	.001
Chronic/Normative Smartphone Use	.009	1	.009	.139	.710	.001
Chronic Smartphone Use * Distractions	.035	1	.035	.530	.468	.005

Hypotheses 1: Overall normative smartphone users will have better spatial memory than chronic smartphone users.

Hypotheses 1 involved assessing differences in spatial memory between normative and chronic smartphone users. There was not a main effect of normative vs. chronic smartphone use for either of the main spatial dependent measures: canonical accuracy, $F(1, 113) = .088$, $p = .767$, $MSE = .001$, $\eta^2 = .001$; recollection of target images, $F(3, 112) = .139$, $p = .710$, $MSE = .009$, $\eta^2 = .001$. Thus, this hypothesis was not supported.

Hypotheses 2: Individuals exposed to the condition with high frequency distractions via smartphone notifications will have poorer spatial memory than those exposed to the condition with low frequency distractions.

Hypotheses 2 involved assessing for differences in the two measures of spatial memory (recollection of target images and canonical accuracy) between high vs. low amounts of distraction There was a significant effect of distraction on canonical accuracy, $F(1, 114) = 5.391$, $p = .022$, $MSE = .057$, $\eta^2 = .047$. However, there was not a main effect of distraction on recollection of target images $F(3, 112) = .097$, $p = .756$, $MSE = .007$, $\eta^2 = .001$. Thus, hypothesis 2 was only partially supported.

Hypotheses 3: The difference between spatial memory for high and low distraction will be smaller for chronic smartphone users than the difference in spatial memory for distractions for normative smartphone users.

Support for this hypothesis would come from a significant interaction between chronic vs. normative smartphone use and high vs. low distractions. However, the interaction was not significant for either of the spatial memory measures: Canonical accuracy: $F(1, 109) = 1.812$, $p =$

.181, *MSE* = .019, η^2 = .016; and Target recollection, $F(1, 112) = .530$, $p = .468$, *MSE* = .035, η^2 = .005. This hypothesis was not supported.

H4: Among chronic smartphone users, anxiety will be found to best explain the effects of high vs. low distractions that influence spatial memory, followed by depression, sleep, fear of missing out, & task-unrelated thoughts (mind wandering).

To test this hypothesis, a serial mediation analysis was intended but not completed as there were no basic correlations between chronic smartphone use and measures of spatial memory; canonical accuracy: $r = -.006$, $p = .952$; target recollection: $r = -.058$, $p = .533$. Nonetheless, we conducted two hierarchical linear regression analyses, one for each dependent measure. The first hierarchical linear regression analysis was applied to evaluate the prediction of target recollection from chronic smartphone use (Model 1). Model 1 was not significant, $F(1, 60) = 0.596$, $p = .443$. In Model 2 we added anxiety, depression, and sleep. Model 2 also was non-significant, $F(2, 59) = 1.22$, $p = .302$, and did not add prediction power compared to Model 1, $F(1, 60) = .596$. Finally in Model 3 we added mind wandering and fear of missing out. Model 3 was non-significant, $F(6, 55) = 1.07$, $p = .390$. The overall regression model (Model 3) predicted approximately 10.5% of variance in target image recollection. We expected that the high distraction conditions would have higher levels of anxiety than lower distractor conditions. We predicted that anxiety levels would be better predictors of performance than the conditions with high or low distractions, however this expectation was not supported.

Table 7.

Model Summary for Hypothesis 4: Target Image Recollection

Chronic Smartphone Users	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
						R Square Change	F Change	df1	df2	Sig. F Change
	1[b]	.099[a]	.010	-.007	.25531	.010	.596	1	60	.443
	2[c]	.199[b]	.040	.007	.25353	.030	1.841	1	59	.180
	3[d]	.324[d]	.105	.007	.25355	.065	.998	4	55	.417

a. Dependent Variable: Target Image Recollection

b. Predictors: (Constant), Distractions

c. Predictors: (Constant), Distractions, Anxiety

d. Predictors: (Constant), Distractions, Anxiety, Mind Wandering, Sleep, Fear of Missing Out, Depression

Table 8.

ANOVA[a]

Chronic Smartphone Use	Model		Sum of Squares	df	Mean Square	F	Sig.
High	1[b]	Regression	.039	1	.039	.596	.443[b]
		Residual	3.911	60	.065		
		Total	3.950	61			
	2[c]	Regression	.157	2	.079	1.223	.302[c]
		Residual	3.792	59	.064		
		Total	3.950	61			
	3[d]	Regression	.414	6	.069	1.073	.390[e]
		Residual	3.536	55	.064		
		Total	3.950	61			

a. Dependent Variable: Target Image Recollection

b. Predictors: (Constant), Distractions

c. Predictors: (Constant), Distractions, Anxiety

d. Predictors: (Constant), Distractions, Anxiety, Sleep, Fear of Missing Out, Mind Wandering, Depression

a. Dependent Variable: Target Image Recollection

Table 9.

Beta Coefficients for Hypothesis 4: Target Image Recollection

Chronic Smartphone Users	Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
			B	Std. Error	Beta		
	1	Distractions	-.050	.065	-.099	-.772	.443
	2	Distractions	-.051	.065	-.100	-.788	.434
		Anxiety	-.004	.003	-.173	-1.357	.180
	3	Distractions	-.036	.065	-.071	-.547	.587
		Anxiety	.000	.004	.006	.030	.976
		Depression	-.011	.006	-.350	-1.850	.070
		Sleep	.013	.016	.125	.839	.405
		Fear of Missing Out	.022	.053	.068	.414	.681
		Mind Wandering	-.003	.009	-.045	-.323	.748

a. Dependent Variable: Target Image Recollection

The second hierarchical linear regression analysis was applied to evaluate the prediction of canonical accuracy from chronic smartphone use which was entered at the first step (Model 1), anxiety, depression, sleep, which were entered at the second step (Model 2), and fear of missing out and mind wandering, which were entered at the third step (Model 3).Model 1 was significant, $F(1, 57) = 7.43$, $p < .05$. As indicated in the ANOVA, more distractions led to lower canonical accuracy. Model 2 was also significant $F(2, 56) = 3.85$, $p < .03$., displaying that distractions still predicted canonical accuracy but anxiety did not significantly increase predictive power $\Delta F(1, 56) = .36$, $p = .54$. Model 3 was also significant $F(6, 52) = 2.73$, $p = .02$. However, this was because distraction predicted canonical accuracy ($\beta = -.37$, $p = .004$), but the other predictors did not. Overall, the variables in Model 3 predicted 15.2% of the variance in canonical accuracy scores. We predicted that anxiety levels would be better predictors of performance than the conditions with high or low distractions, however this expectation was also not supported for canonical accuracy.

Table 10.

Model Summary for Hypothesis 4: Canonical Accuracy (Spatial Location Memory)[a]

Chronic Smartphone Users	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
						R Square Change	F Change	df1	df2	Sig. F Change
	1[b]	.340	.115	.100	.09962	.115	7.436	1	57	.008
	2[c]	.348	.121	.090	.10018	.006	.363	1	56	.549
	3[d]	.490[d]	.240	.152	.09668	.119	2.032	4	52	.103

a. Dependent Variable: Canonical Accuracy

b. Predictors: (Constant), Distractions

c. Predictors: (Constant), Distractions, Anxiety

d. Predictors: (Constant), Distraction, Anxiety, Mind Wandering, Sleep, Fear of Missing Out, Depression

Table 11.

ANOVAs for Hypothesis 4: Canonical Accuracy (Spatial Location Memory)[a]

Chronic Smartphone Users		Sum of Squares	df	Mean Square	F	Sig.
1[b]	Regression	.074	1	.074	7.436	.008[b]
	Residual	.566	57	.010		
	Total	.640	58			
2[cc]	Regression	.077	2	.039	3.858	.027[c]
	Residual	.562	56	.010		
	Total	.640	58			
3[d]	Regression	.153	6	.026	2.735	.022[e]
	Residual	.486	52	.009		
	Total	.640	58			

a. Dependent Variable: Canonical Accuracy

b. Predictors: (Constant), Distractions

c. Predictors: (Constant), Distractions, Anxiety

d. Predictors: (Constant), Distractions, Anxiety, Sleep, Fear of Missing Out, Mind Wandering, Depression

Table 12.

Beta Coefficients for Hypothesis 4: Canonical Accuracy (Spatial Location Memory)

			Unstandardized Coefficients		Standardized Coefficients		
Chronic Smartphone Users			B	Std. Error	Beta	t	Sig.
	1	Distractions	-.071	.026	-.340	-2.727	.008
	2	Distractions	-.072	.026	-.341	-2.725	.009
		Anxiety	-.001	.001	-.075	-.602	.549
	3	Distractions	-.077	.026	-.369	-3.020	.004
		Anxiety	-.001	.002	-.095	-.546	.588
		Depression	.001	.002	.112	.629	.532
		Sleep	-.012	.006	-.274	-1.938	.058
		Fear of Missing Out	.020	.020	.154	.996	.324
		Mind Wandering	-.005	.003	-.187	-1.394	.169

a. Dependent Variable: Canonical Accuracy

H5: Regarding the short-term effects of distractions (high vs. low frequency of notification), time spent on phone will be found to best explain effects of high vs. low distractions that influence spatial and landmark memory, followed by fear of missing out and task-unrelated thoughts (mind wandering).

To test this hypothesis, two hierarchical linear regressions were applied. In the first hierarchical linear regression, recollection of target images was applied as the dependent variable. Distractions were entered at the first stage (Model 1) and time spent on phone was entered at the second stage (Model 2); in the third stage, fear of missing out and mind wandering were entered (Model 3). None of the models predicted target recollection. The overall regression model (Model 3) predicted approximately 3.3% of variance in target recollection $F(4, 111) = 0.94$, $p = .443$). We expected that the distractors would have a bigger impact on those who use their phones at higher frequencies than those who use their phones for lesser amounts of time.

We predicted that smartphone use levels would be better predictors of performance than the conditions with high or low distractions, however this expectation was not supported.

Table 13.

Model Summary for Hypothesis 5: Target Image Recollection[a]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1[b]	.006	.000	-.009	.01574	.000	.005	1	114	.947
2[c]	.056	.003	-.014	.01578	.003	.357	1	113	.551
3[d]	.181	.033	-.002	.01569	.030	1.701	2	111	.187

a. Dependent Variable: Target Image Recollection

b. Predictors: (Constant), Distractions

c. Predictors: (Constant), Distractions, Smartphone Use (Time on Smartphone)

d. Predictors: (Constant), Distractions, Smartphone Use (Time on Smartphone), Fear of Missing Out, Mind Wandering

Table 14.

ANOVAs for Hypothesis 5: Target Image Recollection[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1[b]	Regression	.000	1	.000	.005	.947[b]
	Residual	.028	114	.000		
	Total	.028	115			
2[c]	Regression	.000	2	.000	.181	.835[c]
	Residual	.028	113	.000		
	Total	.028	115			
3[d]	Regression	.001	4	.000	.942	.443[d]
	Residual	.027	111	.000		
	Total	.028	115			

a. Dependent Variable: Target Image Recollection

b. Predictors: (Constant), Distractions

c. Predictors: (Constant), Distractions, Smartphone Use (Time on Smartphone)

d. Predictors: (Constant), Distractions, Smartphone use (Time on Smartphone), Fear of Missing Out, Mind Wandering

Table 15.

Beta Coefficients for Hypothesis 5: Target Image Recollection[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	Distractions	.000	.003	.006	.067	.947
2	Distractions	-2.104E-005	.003	-.001	-.007	.994
	Smartphone Use (Time Spent on Phone)	.001	.002	.057	.597	.551
3	Distractions	.000	.003	-.015	-.161	.872
	Smartphone Use (Time Spent on Phone)	.000	.002	.027	.287	.775
	Fear of Missing Out	.002	.002	.115	1.182	.240
	Mind Wandering	-.001	.000	-.167	-1.682	.095

a. Dependent Variable: Target Image Recollect

In the second hierarchical linear regression, canonical accuracy was applied as the dependent variable. Distractions were entered at the first stage (Model 1) and time spent on phone was entered at the second stage (Model 2); in the third stage, fear of missing out and mind wandering were entered (Model 3).

Model 1 was significant, $F(1, 111) = 5.59$, $p = .20$. As indicated in the ANOVA, more distractions led to lower canonical accuracy. Model 2 was also significant, $F(2, 110) = 6.09$, $p = .003$. Smartphone use added significantly more predictive power than distractions alone, $\Delta F(1, 110) = 6.19$, $p = .014$. The more participants used their smartphone in general, the lower their accuracy score was ($\beta = -.23$, $p = .014$). Model 3 was also significant, $F(2, 110) = 4.45$, $p = .002$, but mind wandering and fear of missing out combined did not significantly increase predictive power, $\Delta F(2, 108) = 2.69$, $p = .073$. However, this was because mind wandering significantly predicted accuracy ($\beta = -.22$, $p = .024$), but fear of missing out did not ($\beta = .09$, $p = .313$). The more people's minds wandered in general, the lower their accuracy was. Overall, the variables in Model 3 predicted 11.0% of the variance in canonical accuracy scores. We predicted that

smartphone use levels would be better predictors of performance than the conditions with high or low distractions, however this expectation was also not supported for canonical accuracy.

Table 16.

Model Summary for Hypothesis 5: Canonical Accuracy (Location Memory)[a]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1[b]	.219	.048	.039	.10268	.048	5.588	1	111	.020
2[c]	.314	.099	.082	.10036	.051	6.188	1	110	.014
3[d]	.376	.141	.110	.09886	.043	2.688	2	108	.073

a. Dependent Variable: Canonical Accuracy

b. Predictors: (Constant), Distractions

c. Predictors: (Constant), Distractions, Smartphone Use (Time on Smartphone)

d. Predictors: (Constant), Distractions, Smartphone Use (Time on Smartphone), Fear of Missing Out, Mind Wandering

Table 17.

ANOVAs for Hypothesis 5: Canonical Accuracy (Location Memory)[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1[b]	Regression	.059	1	.059	5.588	.020[b]
	Residual	1.170	111	.011		
	Total	1.229	112			
2[c]	Regression	.121	2	.061	6.019	.003[c]
	Residual	1.108	110	.010		
	Total	1.229	112			
3[d]	Regression	.174	4	.043	4.445	.002[d]
	Residual	1.055	108	.010		
	Total	1.229	112			

a. Dependent Variable: Canonical Accuracy

b. Predictors: (Constant), Distractions

c. Predictors: (Constant), Distractions, Smartphone Use (Time on Smartphone)

d. Predictors: (Constant), Distractions, Smartphone Use (Time on Smartphone), Fear of Missing Out, Mind Wandering

Table 18.

Beta Coefficients for Hypothesis 5: Canonical Accuracy (Location Memory)[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	Distractions	-.046	.019	-.219	-2.364	.020
2	Distractions	-.039	.019	-.187	-2.049	.043
	Smartphone Use (Time on Smartphone)	-.024	.010	-.227	-2.488	.014
3	Distractions	-.043	.019	-.204	-2.262	.026
	Smartphone Use (Time on Smartphone)	-.028	.010	-.268	-2.921	.004
	Fear of Missing Out	.013	.013	.094	1.013	.313
	Mind Wandering	-.005	.002	-.218	-2.287	.024

a. Dependent Variable: Canonical Accuracy

Other Correlations

Although not all hypotheses were supported in this study, a few other findings were extracted from the data set as seen on Table 3. The personality variables of fear of missing out, anxiety, depression, sleep quality, and mind wandering. The personality variables all correlated with one another significantly. Significant correlations were found between chronic smartphone use and fear of missing out ($r = .277$, $p < .05$), anxiety ($r = .209$, $p < .05$), depression ($r = .195$, $p < .05$), and mind wandering ($r = .318$, $p < .01$).

Correlations with the individual difference variables related to spatial memory—familiarity and sense of direction—were interesting. Significant correlations were found between familiarity and sleep quality ($r = -.209$, $p < .05$), anxiety ($r = -.230$, $p < .05$), mind wandering ($r = -.303$, $p < .05$), and sense of direction ($r = .581$, $p < .01$). Significant correlations were also found between sense of direction and sleep quality ($r = -.331$, $p < .01$), anxiety ($r = -.310$, $p < .01$), depression ($r = -.237$, $p < .05$), and mind wandering ($r = -.283$, $p < .01$).

Exploratory Analyses

Exploratory analyses tested hypotheses 1 through 3 with a 2 (high, low distractions) x 2 (chronic vs. normative smartphone use) analysis of variance for each of the exploratory dependent variables involving target image recollection: Hits – Easy Lure False Alarms (Hits – Easy FAs) and Hits – Difficult Lure False Alarms (Hits – Difficult FAs).

Table 19.

Tests of Between-Subjects Effects for Target Recollection Hits – Easy False Alarms

Dependent Variable: Hits – Easy FAs

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Chronic Smartphone Use	.001	1	.001	1.946	.166	.017
Distractions	7.671E-005	1	7.671E-005	.229	.633	.002
Chronic Smartphone Use * Distractions	.000	1	.000	.411	.523	.004

Table 20.

Tests of Between-Subjects Effects for Target Recollection Hits – Difficult False Alarms

Dependent Variable: Hits – Difficult FAs

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Chronic Smartphone Use	.001	1	.001	1.145	.287	.010
Distractions	.000	1	.000	.303	.583	.003
Chronic Smartphone Use * Distractions	3.669E-006	1	3.669E-006	.007	.932	.000

Hypotheses 1: Overall normative smartphone users will have better spatial memory than chronic smartphone users.

Hypotheses 1 involved assessing differences in spatial memory between normative and chronic smartphone users. There was not a main effect of normative vs. chronic smartphone use for either of the dependent measures: hits – difficult false alarms, $F(1, 112) = 1.14$, $p = .287$,

MSE = .001, η^2 = .010; hits – easy false alarms, *F*(1, 112) = .1.94, *p* = .166, *MSE* = .001, η^2 = .017. Thus, this hypothesis was not supported.

Hypotheses 2: Individuals exposed to the condition with high frequency distractions via smartphone notifications will have poorer spatial memory than those exposed to the condition with low frequency distractions.

Hypotheses 2 involved assessing for differences in the two exploratory measures of spatial memory (hits – easy false alarms and difficult false hits) between high vs. low amounts of distraction There was not a significant effect of distraction on hits – easy false alarms, *F*(1, 112) = .229, *p* = .633, *MSE* = 7.671E-005, η^2 = .002. There was also not a main effect of distraction on hits – difficult false alarms *F*(1, 112) =.303, *p* = .583, *MSE* = .000, η^2 = .003. Thus, Hypothesis 2 was not supported in the exploratory analysis.

Hypotheses 3: The difference between spatial memory for high and low distraction will be smaller for chronic smartphone users than the difference in spatial memory for distractions for normative smartphone users.

Support for this hypothesis would come from a significant interaction between chronic vs. normative smartphone use and high vs. low distractions. However, the interaction was not significant for either of the exploratory spatial memory measures: hits – easy false alarms: *F*(1, 112) = .411, *p* = .523, *MSE* = .000, η^2 = .004; and hits – difficult false alarms, *F*(1, 112) = .007, *p* = .932, *MSE* = 3.669E-006, η^2 = .000. This hypothesis was not supported.

H4: Among chronic smartphone users, anxiety will be found to best explain the effects of high vs. low distractions that influence spatial memory, followed by depression, sleep, fear of missing out, & task-unrelated thoughts (mind wandering).

A hierarchical linear regression analyses was conducted to explore if the main predictors (distractions, anxiety, depression, sleep, fear of missing out, and mind wandering) would account for variability in hits – easy false alarms. Only chronic smartphone users were included in these analyses. The first stage of the analysis was applied to evaluate the prediction of hits – easy false alarms by level of distractors (Model 1). Model 1 was not significant $F(1, 60) = .01$, $p = .90$. In Model 2 we added anxiety. Model 2 was also non-significant $F(2, 59) = .04$, $p = .96$, and did not add predictive power compared to Model 1, $F(1, 59) = .79$. Finally, in Model 3 we added mind wandering, sleep, fear of missing out, and depression. Model 3 was non-significant, $F(6, 55) = .34$, $p = .91$. The overall regression model (Model 3) predicted 3.6% of variance in hits – easy false alarms.

Table 21.

Model Summary for Hypothesis 4: Target Recollection Hits – Easy False Alarms

	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
						R Square Change	F Change	df1	df2	Sig. F Change
Chronic Smartphone Users	1[b]	.016	.000	-.016	.01803	.000	.015	1	60	.904
	2[c]	.038	.001	-.032	.01817	.001	.070	1	59	.792
	3[d]	.191[d]	.036	-.069	.01849	.035	.499	4	55	.737

a. Dependent Variable: Hits – Easy False Alarms

b. Predictors: (Constant), Distractions

c. Predictors: (Constant), Distractions, Anxiety

d. Predictors: (Constant), Distractions, Anxiety, Mind Wandering, Sleep, Fear of Missing Out, Depression

Table 22.

ANOVA for Hypothesis 4: Target Recollection Hits – Easy False Alarms[a]

Chronic Smartphone Users			Sum of Squares	df	Mean Square	F	Sig.
Model	1[b]	Regression	.000	1	.000	.015	.904[b]
		Residual	.020	60	.000		
		Total	.020	61			
	2[c]	Regression	.000	2	.000	.042	.959[c]
		Residual	.019	59	.000		
		Total	.020	61			
	3[d]	Regression	.001	6	.000	.346	.909[e]
		Residual	.019	55	.000		
		Total	.020	61			

a. Dependent Variable: Hits – Easy False Alarms

b. Predictors: (Constant), Distractions

c. Predictors: (Constant), Distractions, Anxiety

d. Predictors: (Constant), Distractions, Anxiety, Sleep, Fear of Missing Out, Mind Wandering, Depression

Table 23.

Beta Coefficients for Target Recollection Hits – Easy False Alarms

			Unstandardized Coefficients		Standardized Coefficients		
Chronic Smartphone Users			B	Std. Error	Beta	t	Sig.
	1	Distractions	.001	.005	.016	.121	.904
	2	Distractions	.001	.005	.015	.118	.907
		Anxiety	-5.854E-05	.000	-.035	-.265	.792
	3	Distractions	-9.755E-05	.005	-.003	-.020	.984
		Anxiety	.000	.000	-.138	-.717	.476
		Depression	.001	.000	.236	1.200	.235
		Sleep	.001	.001	.079	.511	.612
		Fear of Missing Out	-.003	.004	-.136	-.792	.432
		Mind Wandering	.000	.001	-.036	-.247	.805

a. Dependent Variable: Hits – Easy False Alarms

A second hierarchical linear regression analysis was conducted to explore if the main predictors (distractions, anxiety, depression, sleep, fear of missing out, and mind wandering) would account for variability of hits – difficult false alarms. Only chronic smart phone users were included in this analysis. The first stage of the analysis was applied to evaluate the prediction of hits – difficult false alarms from distractions (Model 1). Model 1 was not significant $F(1, 60) = .21$, $p = .65$. In Model 2 we added anxiety. Model 2 was also non-significant $F(2, 59) = .52$, $p = .59$, and did not add predictive power compared to Model 1, $\Delta F(1, 59) = .84$, $p = .36$. Finally, in Model 3 we added mind wandering, sleep, fear of missing out, and depression. Model 3 was non-significant, $F(6, 55) = .85$, $p = .54$. The overall regression model (Model 3) predicted approximately 8.5% of variance in hits – difficult false alarms.

Table 24.

Model Summary for Hypothesis 4: Target Recollection Hits – Difficult False Alarms[a]

	Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
						R Square Change	F Change	df1	df2	Sig. F Change
Chronic Smartphone Users	1[b]	.060	.004	-.013	.02259	.004	.215	1	60	.645
	2[c]	.132	.017	-.016	.02262	.014	.835	1	59	.364
	3[d]	.291[d]	.085	-.015	.02261	.067	1.009	4	55	.411

a. Dependent Variable: Hits – Difficult FAs

b. Predictors: (Constant), Distractions

c. Predictors: (Constant), Distractions, Anxiety

d. Predictors: (Constant), Distractions, Anxiety, Sleep, Fear of Missing Out, Mind Wandering, Depression

Table 25.

ANOVA for Hypothesis 4: Target Recollection Hits – Difficult False Alarms[a]

Chronic Smartphone Use			Sum of Squares	df	Mean Square	F	Sig.
Model	1[b]	Regression	.000	1	.000	.215	.645[b]
		Residual	.031	60	.001		
		Total	.031	61			
	2[c]	Regression	.001	2	.000	.525	.594[c]
		Residual	.030	59	.001		
		Total	.031	61			
	3[d]	Regression	.003	6	.000	.848	.539[e]
		Residual	.028	55	.001		
		Total	.031	61			

a. Dependent Variable: Hits – Difficult FAs

b. Predictors: (Constant), Distractions

c. Predictors: (Constant), Distractions, Anxiety

d. Predictors: (Constant), Distractions, Anxiety, Sleep, Fear of Missing Out, Mind Wandering, Depression

Table 26.

Beta Coefficients for Hypothesis 4: Target Recollection Hits – Difficult False Alarms[a]

			Unstandardized Coefficients		Standardized Coefficients		
Chronic Smartphone Users			B	Std. Error	Beta	t	Sig.
Model	1	Distractions	-.003	.006	-.060	-.463	.645
	2	Distractions	-.003	.006	-.059	-.456	.650
		Anxiety	.000	.000	.118	.914	.364
	3	Distractions	-.004	.006	-.080	-.615	.541
		Anxiety	7.719E-05	.000	.036	.193	.848
		Depression	.000	.001	.067	.349	.728
		Sleep	-.002	.001	-.192	-1.275	.208
		Fear of Missing Out	.006	.005	.221	1.325	.191
		Mind Wandering	-.001	.001	-.101	-.715	.478

a. Dependent Variable: Hits – Difficult FAs

H5: Regarding the short-term effects of distractions (high vs. low frequency of notification), time spent on phone will be found to best explain effects of high vs. low distractions that influence spatial and landmark memory, followed by fear of missing out and task-unrelated thoughts (mind wandering).

To explore this hypothesis, two hierarchical linear regressions were applied. All participants were included in these analyses. In the first hierarchical linear regression, 'easy false hit' was applied as the dependent variable. Distractions were entered at the first stage (Model 1) and time spent on phone (from the MTUAS) was entered at the second stage (Model 2); in the third stage, fear of missing out and mind wandering were entered (Model 3). None of the models predicted hits – easy false alarms. The overall regression model (Model 3) predicted approximately 1.5 % of variance in hits – easy false alarms $F(4, 111) = 0.43$, $p = .786$.

Table 27.

Model Summary for Hypothesis 5: Target Recollection Hits – Easy False Alarms[a]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1[b]	.034[a]	.001	-.008	.01834	.001	.133	1	114	.716
2[c]	.046[b]	.002	-.016	.01841	.001	.104	1	113	.747
3[d]	.124[c]	.015	-.020	.01845	.013	.745	2	111	.477

a. Dependent Variable: Hits – Easy FAs

b. Predictors: (Constant), Distractions

c. Predictors: (Constant), Distractions, Smartphone Use (Time on Smartphone)

d. Predictors: (Constant), Distractions, Smartphone Use (Time on Smartphone), Fear of Missing Out, Mind Wandering

Table 28.

ANOVAs for Hypothesis 5: Target Recollection Hits – Easy False Alarms[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1[a]	Regression	.000	1	.000	.133	.716[b]
	Residual	.038	114	.000		
	Total	.038	115			
2[b]	Regression	.000	2	.000	.118	.889[c]
	Residual	.038	113	.000		
	Total	.038	115			
3[c]	Regression	.001	4	.000	.431	.786[d]
	Residual	.038	111	.000		
	Total	.038	115			

a. Dependent Variable: Hits – Easy FAs

b. Predictors: (Constant), Distractions

c. Predictors: (Constant), Distractions, Smartphone Use (Time on Smartphone)

d. Predictors: (Constant), Distractions, Smartphone Use (Time on Smartphone), Fear of Missing Out, Mind Wandering

Table 29.

Coefficients for Hypothesis 5: Target Recollection Hits – Easy False Alarms[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	Distractions	-.001	.003	-.034	-.365	.716
2	Distractions	-.001	.003	-.030	-.321	.749
	Smartphone Use (Time on Smartphone)	-.001	.002	-.031	-.323	.747
3	Distractions	-.001	.003	-.035	-.366	.715
	Smartphone Use (Time on Smartphone)	-.001	.002	-.044	-.459	.647
	Fear of Missing Out	-.002	.002	-.082	-.835	.405
	Mind Wandering	.000	.000	-.063	-.632	.528

a. Dependent Variable: Hits – Easy FAs

In the second hierarchical linear regression, Hits – Difficult FAs was applied as the dependent variable. Distractions were entered at the first stage (Model 1) and time spent on phone was entered at the second stage (Model 2); in the third stage, fear of missing out and mind wandering were entered (Model 3). None of the models predicted hits – difficult false alarms.

The overall regression model (Model 3) predicted approximately 3.6 % of variance in difficult fast hits $F(4, 11) = 1.03$, $p = .391$.

Table 30.

Model Summary for Hypothesis 5: Target Recollection Hits – Difficult False Alarms[a]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1[b]	.047[a]	.002	-.007	.02239	.002	.256	1	114	.614
2[c]	.094[b]	.009	-.009	.02241	.007	.742	1	113	.391
3[d]	.190[c]	.036	.001	.02230	.027	1.572	2	111	.212

a. Dependent Variable: Hits – Difficult FAs

b. Predictors: (Constant), Distractions

c. Predictors: (Constant), Distractions, Smartphone Use (Time on Smartphone)

d. Predictors: (Constant), Distractions, Smartphone Use (Time on Smartphone), Fear of Missing Out, Mind Wandering

Table 31.

ANOVAs for Hypothesis 5: Target Recollection Hits – Difficult False Alarms[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.000	1	.000	.256	.614[b]
	Residual	.057	114	.001		
	Total	.057	115			
2	Regression	.001	2	.000	.499	.609[c]
	Residual	.057	113	.001		
	Total	.057	115			
3	Regression	.002	4	.001	1.038	.391[d]
	Residual	.055	111	.000		
	Total	.057	115			

a. Dependent Variable: Hits – Difficult FAs

b. Predictors: (Constant), Distractions

c. Predictors: (Constant), Distractions, Smartphone Use (Time on Smartphone)

d. Predictors: (Constant), Distractions, Smartphone Use (Time on Smartphone) Fear of Missing Out, Mind Wandering

Table 32.

Beta Coefficients for Hypothesis 5: Target Recollection Hits – Difficult False Alarms[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	Distractions	-.002	.004	-.047	-.506	.614
2	Distractions	-.003	.004	-.057	-.608	.544
	Smartphone Use (Time on Smartphone)	.002	.002	.081	.861	.391
3	Distractions	-.003	.004	-.069	-.732	.466
	Smartphone Use (Time on Smartphone)	.001	.002	.060	.630	.530
	Fear of Missing Out	.004	.003	.147	1.516	.132
	Mind Wandering	-.001	.001	-.128	-1.294	.198

a. Dependent Variable: Hits – Difficult FAs

DISCUSSION

Smartphone use has become pervasive in the recent decade and a large body of research has suggested that frequent smartphone may play a negative role in attention, learning, memory, driving, and emotional regulation (Lee et al., 2017; Mendoza et al.; 2018, Nasar & Troyer, 2013; Strayer, Drews, & Johnston, 2003). While many studies have examined smartphone use and cognition, this is the first study to examine the role of chronic smartphone use and spatial memory. The primary objective of this study was to investigate the effects of chronic vs. normative smartphone use, low vs. high distraction, and interaction effects on the recollection of landmarks (i.e., target images that were correctly remembered) and canonical accuracy of landmarks (i.e., placement of target images onto a map of the campus environment). A secondary goal of the study was to test for underlying mechanisms that may best explain why the level of distractions may influence spatial memory for environmental landmarks for chronic vs. normative smartphone users.

Normative vs. Chronic Smartphone Users and Memory

Surprisingly, chronic smartphone use did not show a main effect on memory. Specifically, it did not show an effect on total recollection of target images and hits minus false alarms (episodic memory) nor did it show a main effect on canonical accuracy (spatial memory). In this study, chronic smartphone use was measured using the SAS-SV (Kwon et al., 2013) and memory was measured in two ways: total recollection of target images and canonical accuracy.

One possible explanation for this null finding may be that individuals tried harder to remember the route and environment of which they traveled through and encoded the

information on a deeper level. This is aligned with the theory of transactive memory which posits that information declines when individuals rely on an external source (Sparrow, Liu, & Wegner, 2011; Wegner, 1987; Wegner, 1995). In this study, participants were asked not to use their smartphones to take a picture of the map or use any sort of GPS for guidance, thus individuals did not rely on an external source to get through the route. Therefore, it could be that individuals retained more information of their environment as they were not engaged in cognitive offloading.

This null finding however is still surprising in that the hypothesis predicted that chronic smartphone use would have a main effect on memory due to findings of previous studies that demonstrated how the mere presence of a phone can decrease attention when performing a complex task (Thornton et al., 2014). This may suggest that the task of navigating a route in this study may have lacked complexity. However, even during simple tasks, chronic smartphone use has been found to play a role in inducing anxiety which is known to decrease task performance (Agbo-Egwu, Abah, & Anyagh, 2018; Cheever, et a., 2014).

Distraction via Smartphone Notifications and Memory

The study found partial supporting evidence for Hypothesis 2, which claimed that there would be significant differences in memory between groups who received high or low amounts of distracting texts. The analysis showed that there was a significant effect of distraction on canonical accuracy. This finding suggests that distracting texts received during the study played a significant role in scores of canonical accuracy. Canonical accuracy is defined as knowing where to place a target image that was part of the route that the participant traveled. This is consistent with other studies that have found that the mere presence of a phone produced decrements in performance, specifically when engaging in a task that heavily involves attention (Cheever, et al., 2000; Thornton et al., 2014). Another explanation for this finding may be

explained by the theory of divided attention. According to Gardony et al. (2013), cognitive functions that are essential to supporting navigation, such as attention to visual cues, are impaired by technology such that navigational aides may decrease attention from the environment being navigated in. Although navigational aides were not in use during the study, the distractions coming from the manipulation contributed to a decrement in attentional resources that may have helped participants in canonical accuracy.

A third possibility is that, since the sample primarily consisted of freshman and sophomore students at the University of Alabama, it is very likely that they used GPS when first becoming acquainted with the environment. According to research, using GPS may help individuals learn more about their environment in general, but may not help them with effectively navigating their environment, (i.e., where to make turns at intersections) (Münzer, Zimmer, & Baus, 2012). Thus, they may be solidifying their episodic memory for the environment but not the configural knowledge or accuracy of where buildings and landmarks are located. Further, evidence suggests that smartphone use in general decreases the likelihood of encoding information related to memory of environmental knowledge (Hejtmánek, Oravcová, Motýl, Horáček, & Fajnerová, 2018; Münzer, Zimmer, & Baus, 2012).

A final possible explanation for the null finding is that individuals may have been more familiar with the environment than expected. There were positive correlations between the variable *familiarity* and total recollection. Therefore, it may be that being familiar with the environment acted as a buffer between the level of distractions induced and recollection of target images. Familiarity was not high enough to overcome the effects of distractions on location memory.

Memory, Distraction, and Chronic Smartphone Use

Hypothesis 3 suggested that there would be an interaction between chronic vs. normative smartphone use and high vs. low distractions. We expected bigger differences when chronic smartphone participants received high vs. low levels of distraction compared to normative smartphone users. The analysis showed that there was no interaction present and thus, the data failed to reject the null hypothesis. This finding may primarily be explained by low power due to the data sample size. However, studies with smaller sample sizes have found supporting evidence for technology's negative role in attention when navigating (Brügger, Ritcher, Fabrikant, 2019). Another probable explanation for this null result may be that chronic smartphone users may feel a sense of stress relief in being able to engage with their phones (Melumad & Pham, 2020). In the study, participants were encouraged to engage in smartphone use as it was a main manipulation. Although participants were only permitted to engage with notifications involving the study, they still received notifications from outside of the study such as messages from friends, family and/or work. Therefore, these outside messages may have brought a sense of relief despite not being allowed to interact with them.

Chronic Smartphone Use, Psychological Factors, and Spatial Memory

Hypotheses 4 aimed to test the underlying mechanisms that may best explain the impact of the amount of distractions on spatial memory among *chronic* smartphone users. Hypothesis 4 anticipated that, among chronic smartphone users, the high distraction condition would induce higher levels of anxiety than the lower distractor condition. Specifically, we predicted that anxiety levels would better predict spatial memory than high or low distractions; however, this expectation was not supported for either location accuracy or target recollection. We also tested whether any of the predictor variables (i.e., distraction, anxiety, depression, sleep, fear of missing

out, and mind wandering) would account for the variability in a more sensitive measure of target recollection (i.e., hits – false alarms). None of the predictors accounted for variability in this measure either.

A possible explanation for this null result might be that chronic smartphone use is a trait that worsens in situations where individuals do not have an activity at hand. Some studies show that when individuals who fall under smartphone addiction tend to use their phones as it alleviates feelings of loneliness compared to individuals who are not smartphone addicts (Enez Darcin, Kose, Noyan, Nurmedoy, Yilmaz & Dilbaz, 2016; Peper & Harvey, 2018). However, in the current study, participants were in a campus setting and were not alone when engaging in the wayfinding task. Moreover, the experiment took place in an outdoor setting which may have influenced their levels of anxiety and depression. Evidence shows that being outdoors may decrease levels of depression (Bayer, Sbazo, & Nattinger, 2016).

Time Spent on Phone, Psychological Factors, and Spatial Memory

Hypothesis 5 predicted that the amount of time typically spent on their phone would explain more of the variance in spatial memory than low vs. high numbers of distractions, followed by fear of missing out and mind wandering. This prediction was based on previous research which found that more time spent on one's phone would negatively impair daily activities, one of which we predicted would be wayfinding (Duke & Montag, 2017). We argued that this variable would outweigh the effects of short-term distractions on spatial memory. We found that levels of distractions contributed to the variance in location memory, specifically canonical accuracy, more than time spent on smartphone and thus, Hypotheses 5 was not supported. None of the variables predicted target recollection. One possibility for this null result may be that it was difficult for participants to remain engaged in normal smartphone use during

the wayfinding task and thus, were distracted most by notifications than their general time spent on smartphones.

Other Correlations Among the Study Variables

We looked at correlations among all of the individual-differences measures, as well as the measures of memory, to determine whether similar measures were related to one another. In general, they did. For example, sense of direction and familiarity were correlated with canonical accuracy and target recollection of images. This indicates that the spatial measures were closely aligned with validated constructs that other studies use in spatial memory research. Furthermore, smartphone addiction shared a positive relationship with anxiety and depression, which suggests that the SAS-SV was a valid construct to use when measuring levels of smartphone addiction. Finally, sleep and fear of missing out correlated with anxiety and depression, and smartphone usage correlated with anxiety and mind wandering. Thus, our measures seemed to measure what we thought they were measuring but it appears that none were related to spatial memory, except for the negative relation between smartphone use (time spent on smartphone) and location accuracy. This relation may be spurious, however, because the correlation was relatively weak and in the opposite direction.

Limitations

As with all studies, there are limitations for this study that should be noted. First, the full sample size was not able to be collected, which means that there is a chance of a Type II error. We were close to the suggested sample size for a 2 X 2 between-subjects design, but we did not exceed it. Further, the effect sizes in the current study were smaller than anticipated. In fact, they were so small that this study would have needed nearly 2500 participants to reach 80% power. This is an extraordinarily large number for spatial cognition research, where a sample

size of 30-50 is sufficient to find differences. Another limitation of the study was that the task may not have been complex enough to create enough variability in the dependent measures. Most studies that involve spatial research use a number of complex tasks that usually take place in a virtual environment. The route may have not been complex enough for participants to have found it challenging and, in addition, there was a researcher nearby for help if absolutely needed. Thus, the navigation task may not have induced the higher levels of anxiety that we expected. Finally, since most students were enrolled at the university from which the study took place, familiarity may of the campus may have made the wayfinding task easier. This may be the reason that target recollection rates were relatively low. Most often, students indicated that they both recollected and knew that the target images were on the route taken.

Another limitation of the study was that in hypothesis 4, we only included chronic smartphone users as the primary interest when looking into what variables would best explain the effects of high vs. low distractions on influence spatial memory. This is a limitation because when using half the sample size to examine the hypothesis, there is a loss of power needed to detect any existing effect.

Conclusions and Implications

Overall, level of distractions when navigating a route seems to interrupt configural knowledge of where landmarks are located, but not episodic memory for the landmarks. Perhaps more important, the effects of chronic smartphone use on spatial memory did not manifest in the current study. The results add to a growing body of research that has not found associations for chronic smartphone use and spatial memory, suggesting that chronic smartphone use may not have the dire impact on spatial memory that some predict. These findings have implications in research settings. The results suggest that chronic smartphone use may not be enough to capture

smartphone addiction in settings outside of laboratory settings. Therefore, future research should more closely examine the relationship between chronic smartphone use and anxiety is measured. Future research may also consider applying a more complex task to capture an effect for episodic memory.

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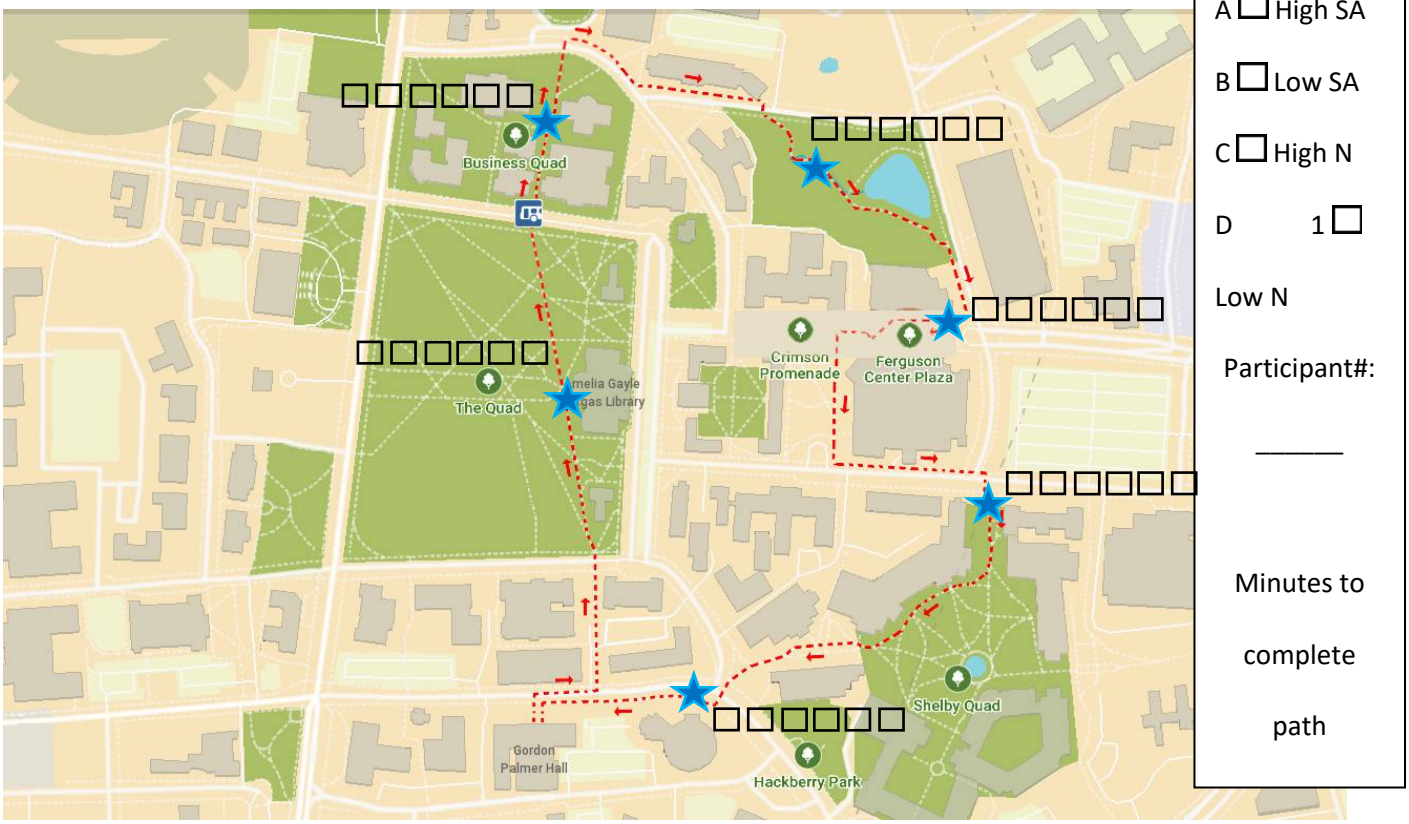
APPENDIX A

RA Instructions for Texting

Instructions: Take a copy of this sheet with you each time you run a participant.



Condition:

A ☐ High SA

B ☐ Low SA

C ☐ High N

D 1 ☐ Low N

Participant#: _____

Minutes to complete path

Please indicate if the text messages were sent out at the designated locations for HIGH distraction groups (also indicate how many texts were sent out):

- Did the participant follow the instructions to each text message? Y/N

Please indicate if the text messages were sent out at the designated locations for LOW distraction groups:

- Did the participant follow the instructions to each text message? Y/N

Was there anything that stood out during this participant run?

Did they deviate from the path? If so, please mark where on the map above:

On a scale of 1 – 6 – how much did the participant deviate from the path? (1 is not at all, 6 = deviated severely): _____

APPENDIX B

FULL SURVEY

FINAL Survey Psychological Well-Being and Campus Atmosphere

Survey Flow

Standard: Block Informed Consent (2 Questions)
Standard: Block Demographics (7 Questions)
Block: Default Question Block - Instructions for Wayfinding Task (7 Questions)
Standard: Block practice GP1 - difficult lure (3 Questions)
Standard: Block practice GP - easy lure (3 Questions)
Standard: Block Practice GP Target (3 Questions)

BlockRandomizer: 30 - Evenly Present Elements

Block: Block Computer Sci Easy Lure (3 Questions)
Block: Block Computer Sci Difficult Lure (3 Questions)
Block: Block Computer Sci Target (3 Questions)
Block: Block Shelby Easy Lure (3 Questions)
Block: Block Shelby Difficult Lure (3 Questions)
Block: Block Shelby Target (3 Questions)
Block: Block Student Center Difficult (3 Questions)
Block: Block Student Center Easy (3 Questions)
Block: Block Student Center Target (3 Questions)
Block: Block Gorgas Difficult (3 Questions)
Block: Block Gorgas Easy (3 Questions)
Block: Block Gorgas Target (3 Questions)
Block: Block SERC Difficult (3 Questions)
Block: Block SERC Easy (3 Questions)
Block: Block SERC Target (3 Questions)
Block: Block Ten Hoor Difficult (3 Questions)
Block: Block Ten Hoor Easy (3 Questions)
Block: Block Ten Hoor Target (3 Questions)
Block: Block Marrs Spring Difficult (3 Questions)
Block: Block Marrs Spring Easy (3 Questions)
Block: Block Marrs Spring Target (3 Questions)
Block: Block Ferg Easy (3 Questions)
Block: Block Ferg Difficult (3 Questions)
Block: Block Ferg Target (3 Questions)
Block: Block Block Bio Difficult (3 Questions)
Block: Block Bio Easy (3 Questions)
Block: Block Bio Target (3 Questions)
Block: Block Smith Hall Difficult (3 Questions)
Block: Block Smith Hall Easy (3 Questions)
Block: Block Smith Hall Target (3 Questions)

Block: Block Familiarity with UA (8 Questions)
Standard: Block 48 - Check for Outside Texts (3 Questions)
Standard: Block SAS-SV (12 Questions)

Standard: Block Mind Wandering (6 Questions)
Standard: Block Sense of Direction (1 Question)
Standard: Block Pittsburgh Sleep Quality Inventory (17 Questions)
Standard: Block FoMo (11 Questions)
Standard: Block BAI (22 Questions)
Standard: Block BDI (22 Questions)
Standard: Block Outdoors_physActivity (36 Questions)
Standard: Block MTUA - (45 Questions)
Standard: Block MTUA FB (4 Questions)
Standard: Block MTUA attitudes (17 Questions)
Standard: Block Discomfort about research assistant nearby (2 Questions)
Standard: Block Thank You (1 Question)
Standard: Block GMDA for Researchers ONLY (51 Questions)

Page Break

Start of Block: Block Informed Consent

Q1.1 **Study Information Sheet Please read this study information sheet carefully before you decide to participate in the study. Key Information:** · Participate in a 1 to 2 hours study about campus environment and psychological well-being · Walk around campus at your own pace · Check in with a researcher via text messages about study · Take a survey after walking around campus · Potential for you to be slightly fatigued after walking around campus but there are water fountains inside Gordon Palmer so that you may refresh yourself · No information collected that will connect identity with responses **Purpose of the research study:** The purpose of this research study is to learn about how students feel about the atmosphere of their campus environment when navigating outdoors and how this plays a role in their psychological well-being. **What you will do in the study:** You will walk on an assigned path on campus and then you will complete a survey that asks a series of questions about your experiences on campus (i.e., campus events that you may attend and outdoor activity) and other questions about your psychological well-being. The assigned path takes about 30 minutes to complete. A researcher will be nearby as you walk on the assigned path, but they will solely be there to take notes (i.e., time taken to complete path). Additionally, another researcher will contact you via text as you are walking on this path. Please put your ringer on the highest setting possible and reply as soon as you get this message as it will help keep the researcher informed on the progress of the study. **Time required:** The study will require about 60 - 120 minutes of your time. **Risks:** There should be no risks, discomforts, or other costs associated with participation, except for the time you will spend completing it. You might experience fatigue, but no more than what you already experience when walking around campus.

Benefits: Individuals who participate in this study will receive 3 credits that count towards research

requirements for students enrolled in PY 101. The study may help you understand research practices in behavioral sciences. Otherwise, there are no direct benefits to you for participating in this research study. **Confidentiality:** Participants will not be identified in any report or publication about this study. All data will be separated from any personal identifying information used to compensate the 300 respondents. The information that you give in the study will be handled confidentially. Your information will be assigned a code number. The list connecting your name will be saved via the webpage that you used to sign up for this study. The personal information that you provided on the webpage for signing up will only be used to assign you with credits. Data responses to the survey materials will be recorded using Qualtrics; this system provides an anonymous ID and is not associated with the sign-up webpage. Therefore, there is no way to link your data responses to your personal information. Your name will not be used in any report. **Data not linked to identifying information:** Researchers will destroy all text message correspondence from the study immediately once the study is over. The information that you give in the study will be handled confidentially. Your name and other information that could be used to identify you will not be collected or linked to the data. **Voluntary participation:** Your participation in the study is completely voluntary. **Right to withdraw from the study:** You have the right to withdraw from the study at any time without penalty. Full credit is only awarded when completing the study. **How to withdraw from the study:** To withdraw from the study, please inform the researcher so that they may take the proper actions to remove you from the study. If you want to withdraw from the study, tell the researcher that you'd like to withdraw and they will remove your data from the study. There is no penalty for withdrawing from the study. However, you will not receive credit if you choose not to participate in the study. If you would like to withdraw after your materials have been submitted, please contact Jessica Mendoza at: jsmendoza@crimson.ua.edu you will then be informed of how your data will be destroyed. **Compensation/Reimbursement:** You will receive no payment for participating in the study. However, by participating in the study, you may earn 3 credits towards the research

requirements for PY 101. If you choose not to participate after reading the study information sheet, you will not receive credit. **If you have questions about the study or need to report a study related issue please contact:**

Name of Principal Investigator: Jessica Mendoza Department Name: Psychology

Telephone: (562) 833-0633

Email address: jsmendoza@crimson.ua.edu Faculty Advisor's Name: Dr. Beverly Roskos, Dr. Ian McDonough

Department Name: Psychology

Telephone: (205) 348-5083 Email address: brokos@ua.edu, immcdonough@ua.edu **If you have questions about your rights as a participant in a research study, would like to make suggestions or file complaints and concerns about the research study, please contact:**

Ms. Tanta Myles, the University of Alabama Research Compliance Officer at (205)-348-8461 or toll-free at 1-877-820-3066. You may also ask questions, make suggestions, or file complaints and concerns through the IRB Outreach Website at http://ovpred.ua.edu/research-compliance/prco/. You may email the Office for Research Compliance at rscompliance@research.ua.edu.

Q1.2 **Participant's Agreement:**

I have read the information provided above, and voluntarily agree to participate in this research study

- ○ I agree to participate in the research study described above. (1)
- ○ I do not agree to participate in the research described above. (2)

End of Block: Block Informed Consent

Start of Block: Block Demographics

Q2.1 Are you currently an undergraduate student enrolled at UA?

- Yes (1)
- No (2)

Q2.2 Participant ID (**provided by the researcher**, NOT your CWID)

_____

Q2.3 Please enter your age:

_____

Q2.4 Please select your year in school:

- ○ Freshman (1)
- ○ Sophomore (2)
- ○ Junior (3)
- ○ Senior (4)

Q2.5 Please select the option that you best identify with:

- ○ Male (2)
- ○ Female (3)
- ○ Nonbinary (4)
- ○ Transgender Male (7)
- ○ Transgender Female (8)
- ○ Prefer not to respond (5)
- ○ Other (6)

Q2.6 Please select your biological sex:

- ○ Male (1)
- ○ Female (2)

Q2.7 Please select the option(s) that best describe your ethnic background.

- ☐ African American / Black (1)
- ☐ Asian / Pacific Islander (2)
- ☐ Native American (3)
- ☐ Latino /Hispanic (4)
- ☐ White / Caucasian (5)
- ☐ Other (6)

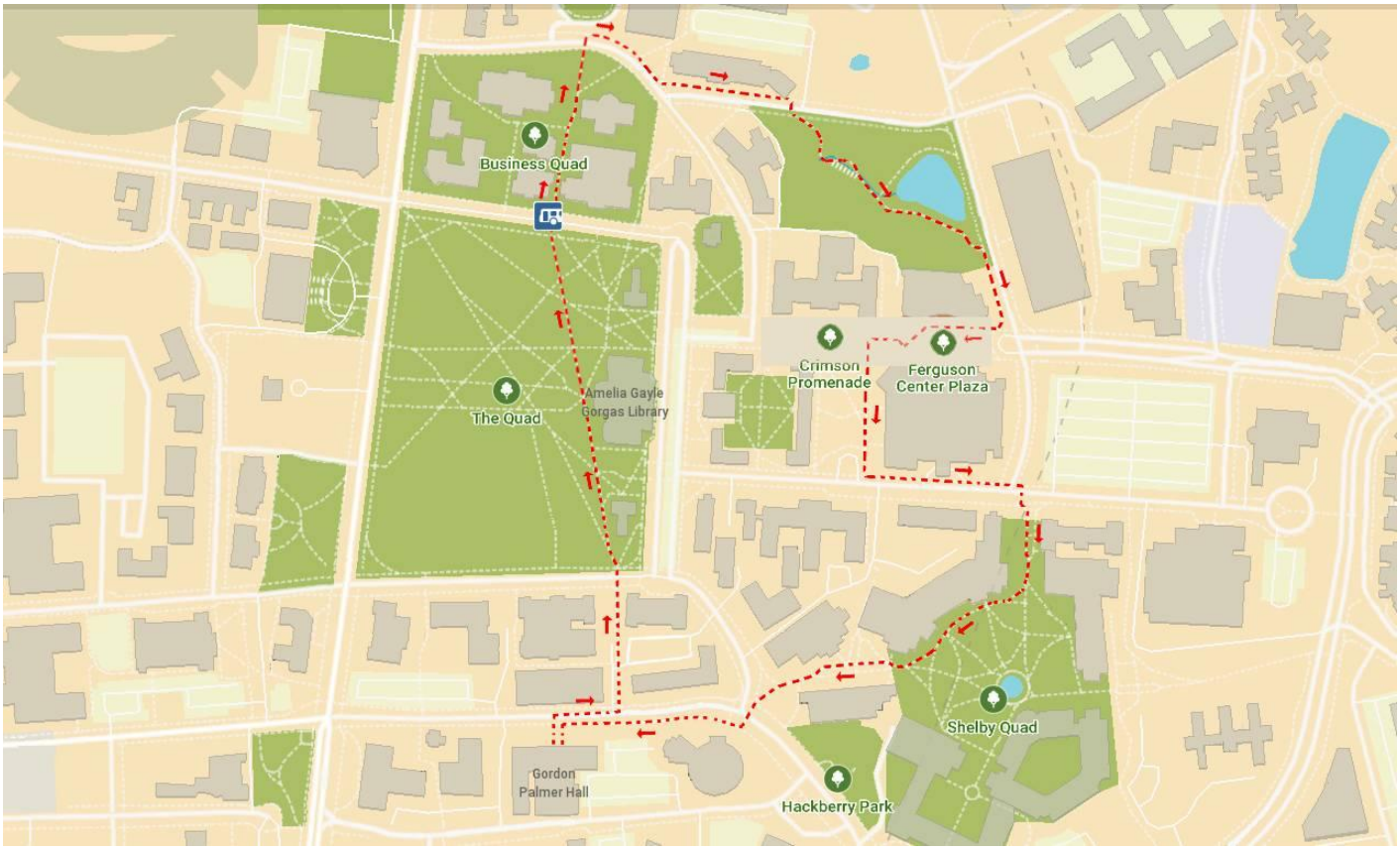
End of Block: Block Demographics

Start of Block: Default Question Block - Instructions for Wayfinding Task

Q3.1 Instructions for Part 1 Please take the next 5 minutes to study the path depicted in the image below. You will be walking on this path for part of the study. A researcher will be nearby so that they

may record the time and distance traveled. Please refrain from interacting with the researcher as they are only there for the purpose of taking notes on the time and distance traveled. The assigned path takes about 30 minutes to complete. A researcher will be nearby as you walk on the assigned path, but they will solely be there to take notes (i.e., time taken to complete path). Additionally, another researcher will contact you via text as you are walking on this path. Please keep you ringer on its highest setting and reply as soon as you get this message as it will help keep the researcher informed on the progress of the study. **Note: Your safety is always important to us so please be cautious and follow all traffic rules (i.e., look both ways before crossing any streets). When you are walking this path, please be sure to pay attention to everything within your 180 view. While you're on the path, be sure to follow the arrows, stay on the sidewalks, and pay attention to what side of the sidewalk you should be on when following the task.**

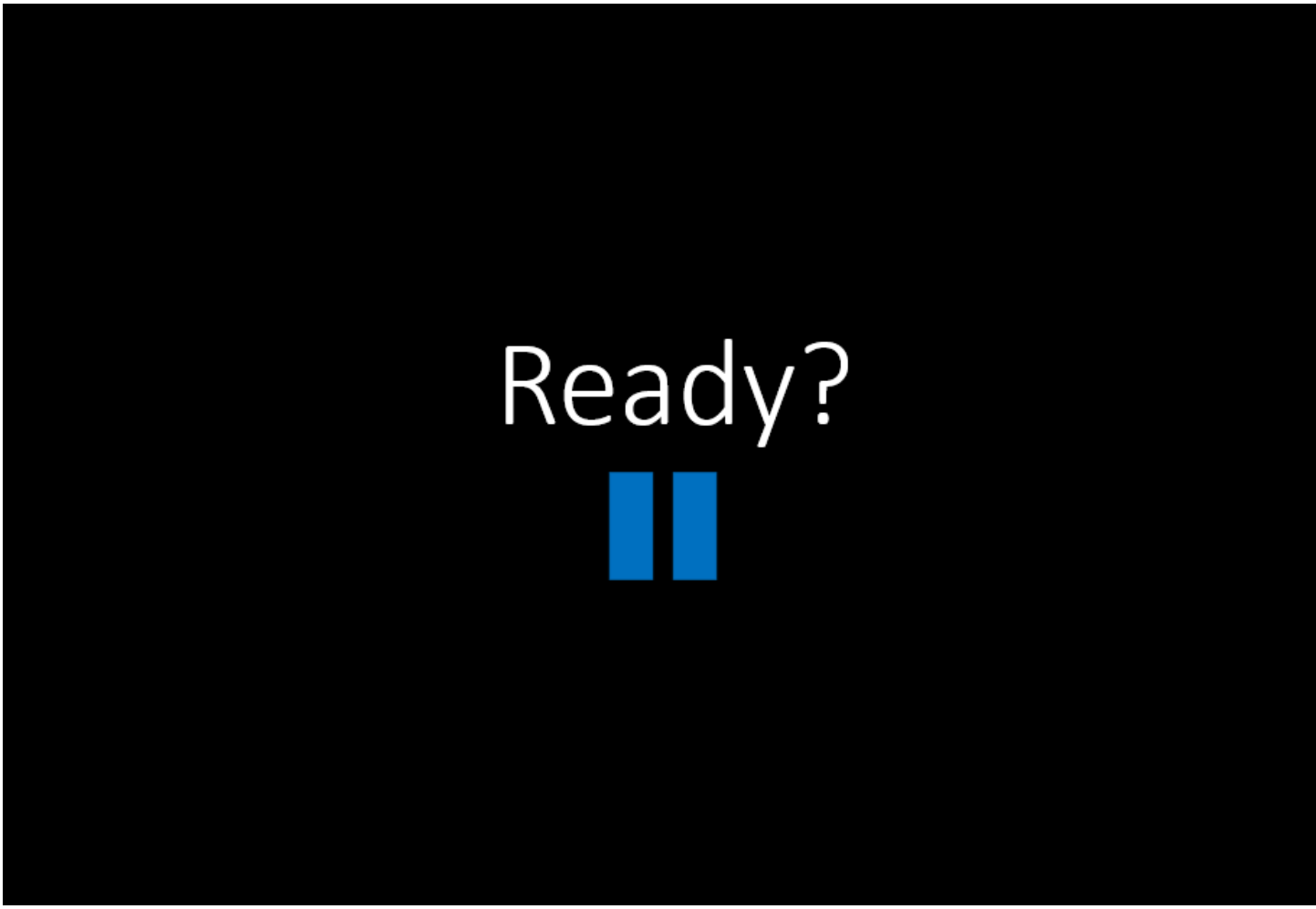
Q3.2



Q3.3 **Please inform the researcher once you are ready to proceed with the navigation task. You may continue with the rest of the survey once you return to the laboratory.**

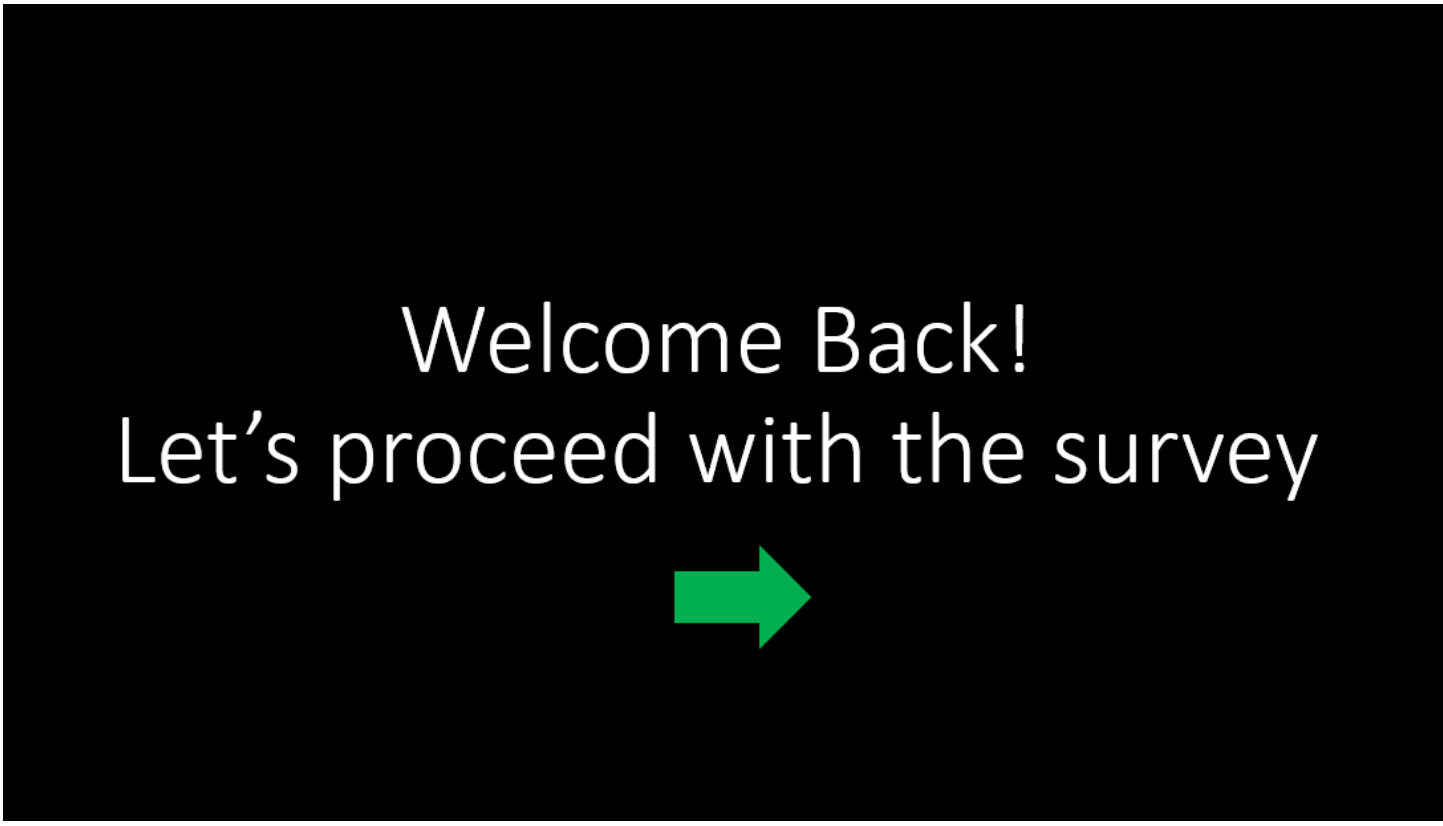
Page Break

Q3.4



Page Break

Q3.5



Page Break

Q3.7

You may have seen these images while walking on campus, but you will only need to drag and drop the image that *best* corresponds with what you saw while you were walking outside. You will do this by using a separate screen.

Some of the images will not correspond with what you saw on the path that you walked today, in that instance, you will not need to place those images anywhere onto the map. Instead, you will double click on the image number and move onto the next image. In total, you should have at least 11 items placed onto the map which correspond with what you saw during the walk from this study (including the practice item).

Make sure you are placing the corresponding box on *where you were when you saw it* on the path that you just walked and *NOT* where the actual item is. Each set of pictures will have a number at the top of the slide that corresponds with the box that you will drag and drop onto the map.

Note that there is no "back" button. Take your time when and be careful to only drag and drop the boxes for the images that you saw on the path today.

Please let researchers know if you have any other questions! We are happy to provide you with any clarification if needed. Just ask us!

Q3.6

Practice Run!

End of Block: Default Question Block - Instructions for Wayfinding Task

Start of Block: Block practice GP1 - difficult lure

Q4.1

[redacted]

1

[redacted]

Q464 Was this image on the path?

Q4.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this image on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know that this image was NOT on the path that I walked on today. (5)

End of Block: Block practice GP1 - difficult lure

Start of Block: Block practice GP - easy lure

Page Break

Q5.1

[redacted]

2

[redacted]

Q465 Was this image on the path?

Q5.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this image on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know that this image was NOT on the path that I walked on today. (5)

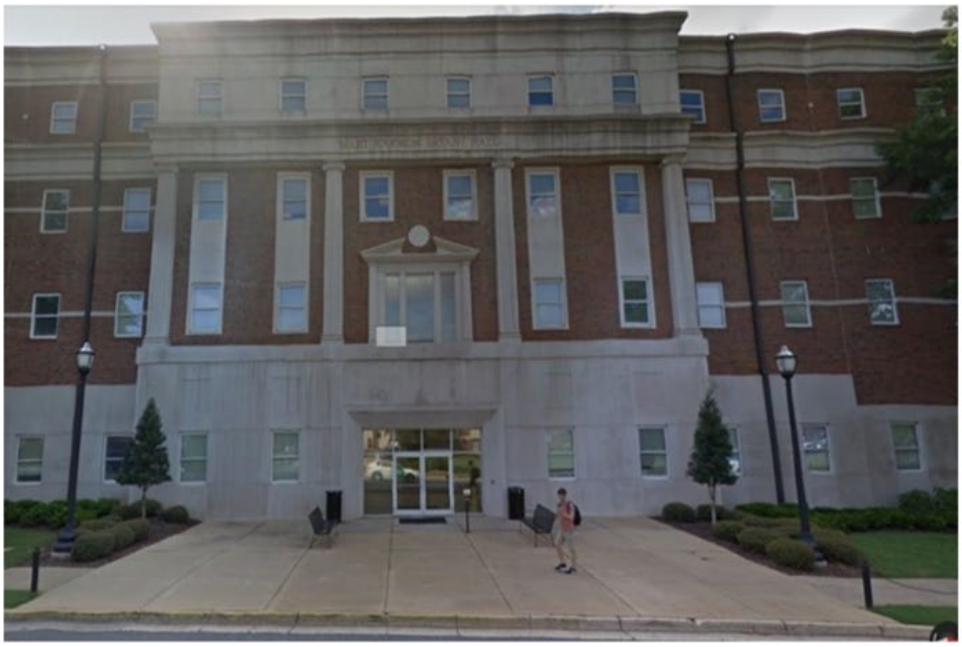
End of Block: Block practice GP - easy lure

Start of Block: Block Practice GP Target

Q6.1

[redacted]

3



[redacted]

Q466 Was this image on the path?

Q6.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this image on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know that this image was NOT on the path that I walked on today. (5)

End of Block: Block Practice GP Target

Start of Block: Block Computer Sci Easy Lure

Q7.1

[redacted]

4

[redacted]

Q467 Was this image on the path?

Q7.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this image on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Computer Sci Easy Lure

Start of Block: Block Computer Sci Difficult Lure

Q8.1

[redacted]

5

[redacted]

Q468 Was this image on the path?

Q8.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this image on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Computer Sci Difficult Lure

Start of Block: Block Computer Sci Target

Q9.1

[redacted]

18

[redacted]

Q469 Was this image on the path?

Q9.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this image on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Computer Sci Target

Start of Block: Block Shelby Easy Lure

Q10.1

[redacted]

7

[redacted]

Q470 Was this image on the path?

Q10.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this image on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Shelby Easy Lure

Start of Block: Block Shelby Difficult Lure

Q11.1

[redacted]

8

[redacted]

Q471 Was this image on the path?

Q11.2 Please choose the best option that describes how you made the most recent selection:

- [ ] I remember seeing this image on the path that I walked for this study. (1)
- [ ] I know this image because I walk by here a lot in general. (2)
- [ ] Both of the above. (3)
- [ ] I don't recognize this image, this was new to me. (4)
- [ ] I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Shelby Difficult Lure

Start of Block: Block Shelby Target

Q12.1

12

Q472 Was this image on the path?

Q12.2 Please choose the best option that describes how you made the most recent selection:

- [ ] I remember seeing this on the path that I walked for this study. (1)
- [ ] I know this image because I walk by here a lot in general. (2)
- [ ] Both of the above. (3)
- [ ] I don't recognize this image, this was new to me. (4)
- [ ] I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Shelby Target

Start of Block: Block Student Center Difficult

Q13.1

[redacted]

10

[redacted]

Q473 Was this image on the path?

Q13.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this on the path that I walked for this study. (1)
- ☐ I know that this is the image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Student Center Difficult

Start of Block: Block Student Center Easy

Q14.1

[redacted]

11

[redacted]

Q474 Was this image on the path?

Q14.2 Please choose the best option that describes how you made the most recent selection:

- [ ] I remember seeing this on the path that I walked for this study. (1)
- [ ] I know this image because I walk by here a lot in general. (2)
- [ ] Both of the above. (3)
- [ ] I don't recognize this image, this was new to me. (4)
- [ ] I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Student Center Easy

Start of Block: Block Student Center Target

Q15.1

[redacted]

6

[redacted]

Q475 Was this image on the path?

Q15.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Student Center Target

Start of Block: Block Gorgas Difficult

Q16.1

[redacted]

13

[redacted]

Q476 Was this image on the path?

Q16.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this image on the path that I walked for this study. (1)
- ☐ I know that this is the image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Gorgas Difficult

Start of Block: Block Gorgas Easy

Q17.1

[redacted]

14

[redacted]

Q477 Was this image on the path?

Q17.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Gorgas Easy

Start of Block: Block Gorgas Target

Q18.1

[redacted]

15

[redacted]

Q478 Was this image on the path?

Q18.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Gorgas Target

Start of Block: Block SERC Difficult

Q19.1

[redacted]

16

[redacted]

Q479 Was this image on the path?

Q19.2 Please choose the best option that describes how you made the most recent selection:

- [ ] I remember seeing this on the path that I walked for this study. (1)
- [ ] I know this image because I walk by here a lot in general. (2)
- [ ] Both of the above. (3)
- [ ] I don't recognize this image, this was new to me. (4)
- [ ] I know this image and I know that it was NOT on the path that I walked on today. (6)

End of Block: Block SERC Difficult

Start of Block: Block SERC Easy

Q20.1

[redacted]

17

[redacted]

Q480 Was this image on the path?

Q20.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block SERC Easy

Start of Block: Block SERC Target

Q21.1

[redacted]

24

[redacted]

Q481 Was this image on the path?

Q21.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I know this image because I walk by here a lot in general. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block SERC Target

Start of Block: Block Ten Hoor Difficult

Q22.1

[redacted]

19

[redacted]

Q482 Was this image on the path?

Q22.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Ten Hoor Difficult

Start of Block: Block Ten Hoor Easy

Q23.1

[redacted]

20

[redacted]

Q483 Was this image on the path?

Q23.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Ten Hoor Easy

Start of Block: Block Ten Hoor Target

Q24.1

[redacted]

30

[redacted]

Q484 Was this image on the path?

Q24.2 Please choose the best option that describes how you made the most recent selection:

- [ ] I remember seeing this on the path that I walked for this study. (1)
- [ ] I know this image because I walk by here a lot in general. (2)
- [ ] Both of the above. (3)
- [ ] I don't recognize this image, this was new to me. (4)
- [ ] I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Ten Hoor Target

Start of Block: Block Marrs Spring Difficult

Q25.1

[redacted]

22

[redacted]

Q485 Was this image on the path?

Q25.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

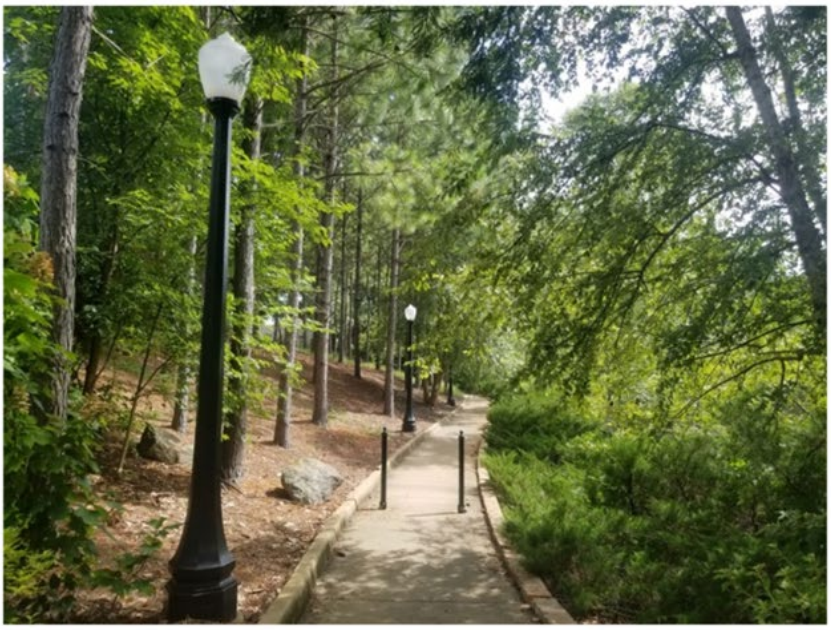
End of Block: Block Marrs Spring Difficult

Start of Block: Block Marrs Spring Easy

Q26.1

[redacted]

23



[redacted]

Q486 Was this image on the path?

Q26.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Marrs Spring Easy

Start of Block: Block Marrs Spring Target

Q27.1

[redacted]

9

[redacted]

Q487 Was this image on the path?

Q27.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Marrs Spring Target

Start of Block: Block Ferg Easy

Q28.1

[redacted]

25

[redacted]

Q488 Was this image on the path?

Q28.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Ferg Easy

Start of Block: Block Ferg Difficult

Q29.1

[redacted]

26

[redacted]

Q489 Was this image on the path?

Q29.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Ferg Difficult

Start of Block: Block Ferg Target

Q30.1

[redacted]

27

[redacted]

Q490 Was this image on the path?

Q30.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Ferg Target

Start of Block: Block Block Bio Difficult

Q31.1

[redacted]

28

[redacted]

Q491 Was this image on the path?

Q31.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Block Bio Difficult

Start of Block: Block Bio Easy

Q32.1

[redacted]

29

[redacted]

Q492 Was this image on the path?

Q32.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Bio Easy

Start of Block: Block Bio Target

Q33.1

[redacted]

21

[redacted]

Q493 Was this image on the path?

Q33.2 Please choose the best option that describes how you made the most recent selection:

- [ ] I remember seeing this on the path that I walked for this study. (1)
- [ ] I know this image because I walk by here a lot in general. (2)
- [ ] Both of the above. (3)
- [ ] I don't recognize this image, this was new to me. (4)
- [ ] I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Bio Target

Start of Block: Block Smith Hall Difficult

Q34.1

[redacted]

31

[redacted]

Q494 Was this image on the path?

Q34.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Smith Hall Difficult

Start of Block: Block Smith Hall Easy

Q35.1

[redacted]

32

[redacted]

Q495 Was this image on the path?

Q35.2 Please choose the best option that describes how you made the most recent selection:

- ☐ I remember seeing this on the path that I walked for this study. (1)
- ☐ I know this image because I walk by here a lot in general. (2)
- ☐ Both of the above. (3)
- ☐ I don't recognize this image, this was new to me. (4)
- ☐ I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Smith Hall Easy

Start of Block: Block Smith Hall Target

Q36.1

[redacted]

33

[redacted]

Q496 Was this image on the path?

Q36.2 Please choose the best option that describes how you made the most recent selection:

- [ ] I remember seeing this on the path that I walked for this study. (1)
- [ ] I know this image because I walk by here a lot in general. (2)
- [ ] Both of the above. (3)
- [ ] I don't recognize this image, this was new to me. (4)
- [ ] I know this image and I know that it was NOT on the path that I walked on today. (5)

End of Block: Block Smith Hall Target

Start of Block: Block Familiarity with UA

Q37.1 The following set of questions are to let researchers know how **familiar** you are with the UA campus. Please answer all questions to the best of your ability.

Q37.2 How many semesters have you completed at UA? (not including this semester)

- ○ 1-2 (2)
- ○ 3-4 (3)
- ○ 5-6 (4)
- ○ 7-8 (5)

Q37.3 How many times per week do you attend a class that is on campus?

- [ ] none (1)
- [ ] 1-2 (2)
- [ ] 3-4 (3)
- [ ] 5-6 (4)
- [ ] 6-7 (5)
- [ ] more than 7 (6)

Q37.4 How frequently do you walk around campus?

- ○ Never (1)
- ○ Sometimes (2)
- ○ About half the time (3)
- ○ Most of the time (4)
- ○ Always (5)

Q37.5 How familiar are you with the campus layout?

- ○ Not familiar at all (1)
- ○ Moderately Familiar (2)
- ○ Slightly Familiar (3)
- ○ Very Familiar (4)
- ○ Extremely Familiar (5)

Q37.6 How familiar are you with the campus building locations?

- ○ Not familiar at all (1)
- ○ Moderately Familiar (2)
- ○ Slightly Familiar (3)
- ○ Very Familiar (4)
- ○ Extremely Familiar (5)

Q37.7 How familiar are you with the campus building names?

- ○ Not familiar at all (1)
- ○ Moderately Familiar (2)
- ○ Slightly Familiar (3)
- ○ Very Familiar (4)
- ○ Extremely Familiar (5)

Q37.8 How familiar are you recognizing the campus buildings?

- ○ Not familiar at all (1)
- ○ Moderately Familiar (2)
- ○ Slightly Familiar (3)
- ○ Very Familiar (4)
- ○ Extremely Familiar (5)

End of Block: Block Familiarity with UA

Start of Block: Block 48 - Check for Outside Texts

Q38.1 Did you receive any text messages that were *NOT* a part of the study during the session?

- ○ Yes (1)
- ○ No (2)

Q38.2 If yes, please indicate how many:

_____

Q431 If you received any texts that were outside of this study, mark all categories from which the texts were from:

- ☐ Work related notification (1)
- ☐ School related notification (Professor Email) (6)
- ☐ School related notification (Peer contacted you regarding coursework) (8)
- ☐ School related notification (Blackboard notification) (7)
- ☐ Social Media notification - Direct message (DM) (2)
- ☐ Social Media notification - Liked photo or status update (4)
- ☐ Social Media notification - You were tagged in a post (5)
- ☐ Other (9) _____

End of Block: Block 48 - Check for Outside Texts

Start of Block: Block SAS-SV

Q39.1 Please choose the response that best describes your behavior(s) with your smartphone:

Q39.2 Missing planned work due to smartphone use.

- Strongly Disagree (1)
- Disagree (2)
- Slightly Disagree (3)
- Slightly Agree (4)
- Agree (5)
- Strongly Agree (6)

Q39.3 Having a hard time concentrating in class, while doing assignments, or while working due to smartphone use.

- Strongly Disagree (1)
- Disagree (2)
- Slightly Disagree (3)
- Slightly Agree (4)
- Agree (5)
- Strongly Agree (6)

Q39.4

Feeling pain in the wrists or at the back of the neck while using a smartphone.

- Strongly Disagree (1)
- Disagree (2)
- Slightly Disagree (3)
- Slightly Agree (4)
- Agree (5)
- Strongly Agree (6)

Q39.5 Won't be able to not stand not having a smartphone

- Strongly Disagree (1)
- Disagree (2)
- Slightly Disagree (3)
- Slightly Agree (4)
- Agree (5)
- Strongly Agree (6)

Q39.6 Feeling impatient and fretful when I am not holding my smartphone.

- Strongly Disagree (1)
- Disagree (2)
- Slightly Disagree (3)
- Slightly Agree (4)
- Agree (5)
- Strongly Agree (6)

Page Break

Q39.7 Please choose the response that best describes your behavior(s) with your smartphone:

Q39.8 Having my smartphone in my mind even when I am not using it.

- ○ Strongly Disagree (1)
- ○ Disagree (2)
- ○ Slightly Disagree (3)
- ○ Slightly Agree (4)
- ○ Agree (5)
- ○ Strongly Agree (6)

Q39.9 I will never give up using my smartphone even when my daily life is already greatly affected by it.

- Strongly Disagree (1)
- Disagree (2)
- Slightly Disagree (3)
- Slightly Agree (4)
- Agree (5)
- Strongly Agree (6)

Q39.10 Constantly checking my smartphone so as not to miss conversations between other people on Twitter or Facebook

- Strongly Disagree (1)
- Disagree (2)
- Slightly Disagree (3)
- Slightly Agree (4)
- Agree (5)
- Strongly Agree (6)

Q39.11 Using my smartphone longer than I had intended.

- Strongly Disagree (1)
- Disagree (2)
- Slightly Disagree (3)
- Slightly Agree (4)
- Agree (5)
- Strongly Agree (6)

Q39.12 The people around me tell me that I use my smartphone too much.

- Strongly Disagree (1)
- Disagree (2)
- Slightly Disagree (3)
- Slightly Agree (4)
- Agree (5)
- Strongly Agree (6)

End of Block: Block SAS-SV

Start of Block: Block Mind Wandering

Q40.1 Select the option that corresponds best to each statement:

Q40.2 I have difficulty maintaining focus on simple or repetitive work.

- ○ Almost Never (4)
- ○ Very Infrequently (7)
- ○ Somewhat Infrequently (8)
- ○ Somewhat Frequently (9)
- ○ Very Frequently (10)
- ○ Almost Always (11)

Q40.3 While reading, I find I haven't been thinking about the text and must therefore read it again.

- Almost Never (1)
- Very Infrequently (2)
- Somewhat Infrequently (3)
- Somewhat Frequently (4)
- Very Frequently (5)
- Almost Always (6)

Q40.4 I do things without paying full attention.

- Almost Never (1)
- Very Infrequently (2)
- Somewhat Infrequently (3)
- Somewhat Frequently (4)
- Very Frequently (5)
- Almost Always (6)

Q40.5 I find myself listening with one ear, thinking about something else at the same time

- Almost Never (1)
- Very Infrequently (2)
- Somewhat Infrequently (3)
- Somewhat Frequently (4)
- Very Frequently (5)
- Almost Always (6)

Q40.6 I mind-wander during lecture presentations

- Almost Never (1)
- Very Infrequently (2)
- Somewhat Infrequently (3)
- Somewhat Frequently (4)
- Very Frequently (5)
- Almost Always (6)

End of Block: Block Mind Wandering

Start of Block: Block Sense of Direction

Q41.1 How good is your sense of direction?

	Poor					Good
	1	2	3	4	5	6	7
()							

End of Block: Block Sense of Direction

Start of Block: Block Pittsburgh Sleep Quality Inventory

Q42.1

The following questions relate to your usual sleep habits during the past month *only*. Your answers should indicate the most accurate reply for the *majority* of days and nights in the past month.

Please answer all questions.

Q42.2 During the past month, when have you gone to bed at night?

_____

Q42.3 During the past month, how long **(in minutes)** does it usually take you to fall asleep each night?

Please enter number of **minutes** below:

_____

Q42.4 During the past month, when have you usually gotten up in the morning?

Please enter your usual getting up time:

_____

Q42.5 During the past month, how many hours of *actual sleep* did you get at night? (This may be different than the number of hours that you spend in bed.)

Please enter **hours of sleep** per night:

_____

Q42.6 **For each of the remaining questions, check the one best response. Please answer *all* questions.**

Q42.7 During the past month, how often have you had trouble sleeping because you...

	Not during the Past Month (0)	Less than once a week (1)	Once or twice a week (2)	Three or more times a week (3)
(a) Cannot sleep within 30 minutes (1)	○	○	○	○
(b) Wake up in the middle of the night or early morning (2)	○	○	○	○
(c) Have to get up to use the bathroom (3)	○	○	○	○
(d) Cannot breathe comfortably (4)	○	○	○	○
(e) Cough or snore loudly (5)	○	○	○	○
(f) Feel too cold (6)	○	○	○	○
(g) Feel too hot (7)	○	○	○	○
(h) Had bad dreams (8)	○	○	○	○
(i) Have pain (9)	○	○	○	○

Q42.8 (j) Other reason(s), please describe:

_____

_____

_____

_____

_____

Q42.9 How often during the past month have you had trouble sleeping because of this? (reason mentioned above?

Note: If you did **not** provide a reason for the text box entry for "other", please check appropriate box:

- ○ Not during the past month (1)
- ○ Less than once a week (2)
- ○ Once or twice a week (3)
- ○ Three or more times a week (4)
- ○ Not Applicable (6)

Q42.10 During the past month, how would you rate your overall sleep quality?

- Very good (1)
- Fairly good (2)
- Fairly bad (3)
- Very bad (4)

Q42.11 During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?

- Not during the past month (1)
- Less than once a week (2)
- Once or twice a week (3)
- Three or more times a week (4)

Q42.12 During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity?

- ○ Not during the past month (1)
- ○ Less than once a week (2)
- ○ Once or twice a week (3)
- ○ Three or more times a week (4)

Q42.13 During the past month, how much of a problem has it been for you to keep enough enthusiasm to get things done?

- ○ No problem at all (1)
- ○ Only a very slight problem (2)
- ○ Somewhat of a problem (3)
- ○ A very big problem (4)

Q42.14 Do you have a bed partner or roommate?

- ○ No bed partner or roommate (1)
- ○ Partner/roommate in other room (2)
- ○ Partner in the same room, but not same bed (3)
- ○ Partner in same bed (4)

Q42.15 If you have a roommate or bed partner, how often in the past month have they mentioned:

	Not during the past month (1)	Less than once a week (2)	Once or twice a week (3)	Three or more times a week (4)
(a) Loud Snoring (1)	○	○	○	○
(b) Long pauses between breaths while asleep (2)	○	○	○	○
(c) Legs twitching or jerking while you sleep (3)	○	○	○	○
(d) Episodes of disorientation or confusion during sleep (4)	○	○	○	○

Q42.16 (e) Other restlessness while you sleep; please describe:

_____

_____

_____

_____

_____

Q42.17 Please select the response that best describes how often your description for "other" has occurred in the past month:

Note: If you did not write anything for other, please select the appropriate response:

- Not during the past month (1)
- Less than once a week (2)
- Once or twice a week (3)
- Three or more times a week (4)
- Not applicable (5)

End of Block: Block Pittsburgh Sleep Quality Inventory

Start of Block: Block FoMo

Q43.1 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.

Q43.2 I fear others have more rewarding experiences than me.

- ○ Not at all true of me (1)
- ○ Slightly true of me (4)
- ○ Moderately true of me (5)
- ○ Very true of me (6)
- ○ Extremely true of me (7)

Q43.3 I fear my friends have more rewarding experiences than me.

- ○ Not at all true of me (1)
- ○ Slightly true of me (4)
- ○ Moderately true of me (5)
- ○ Very true of me (6)
- ○ Extremely true of me (7)

Q43.4 I get worried when I find out my friends are having fun without me.

- Not at all true of me (1)
- Slightly true of me (4)
- Moderately true of me (5)
- Very true of me (6)
- Extremely true of me (7)

Q43.5 I get anxious when I don't know what my friends are up to.

- Not at all true of me (1)
- Slightly true of me (4)
- Moderately true of me (5)
- Very true of me (6)
- Extremely true of me (7)

Q43.6 It is important that I understand my friends ‘‘inside jokes’’.

- Not at all true of me (1)
- Slightly true of me (4)
- Moderately true of me (5)
- Very true of me (6)
- Extremely true of me (7)

Q43.7 Sometimes, I wonder if I spend too much time keeping up with what is going on.

- Not at all true of me (1)
- Slightly true of me (4)
- Moderately true of me (5)
- Very true of me (6)
- Extremely true of me (7)

Q43.8 It bothers me when I miss an opportunity to meet up with friends.

- Not at all true of me (1)
- Slightly true of me (4)
- Moderately true of me (5)
- Very true of me (6)
- Extremely true of me (7)

Q43.9 When I have a good time it is important for me to share the details online (e.g. updating status).

- Not at all true of me (1)
- Slightly true of me (4)
- Moderately true of me (5)
- Very true of me (6)
- Extremely true of me (7)

Q43.10 When I miss out on a planned get-together it bothers me.

- Not at all true of me (1)
- Slightly true of me (4)
- Moderately true of me (5)
- Very true of me (6)
- Extremely true of me (7)

Q43.11 When I go on vacation, I continue to keep tabs on what my friends are doing.

- Not at all true of me (1)
- Slightly true of me (4)
- Moderately true of me (5)
- Very true of me (6)
- Extremely true of me (7)

End of Block: Block FoMo

Start of Block: Block BAI

Q44.1 Below is a list of common symptoms of anxiety. Please carefully read each item in the list. Indicate how much you have been bothered by that symptom during the past month, including today, by circling the number in the corresponding space in the column next to each symptom.

Q44.2 Numbness or tingling

- Not at all (5)
- Mildly, but it didn't bother me much (6)
- Moderately -- it wasn't pleasant at times (7)
- Severely -- it bothered me a lot (8)

Q44.3 Feeling hot

- Not at all (1)
- Mildly, but it didn't bother me much (2)
- Moderately -- it wasn't pleasant at times (3)
- Severely -- it bothered me a lot (4)

Q44.4 Wobbliness in legs

- Not at all (1)
- Mildly, but it didn't bother me much (2)
- Moderately -- it wasn't pleasant at times (3)
- Severely -- it bothered me a lot (4)

Q44.5 Unable to relax

- Not at all (1)
- Mildly, but it didn't bother me much (2)
- Moderately -- it wasn't pleasant at times (3)
- Severely -- it bothered me a lot (4)

Q44.6 Fear of worst happening

- Not at all (1)
- Mildly, but it didn't bother me much (2)
- Moderately -- it wasn't pleasant at times (3)
- Severely -- it bothered me a lot (4)

Q44.7 Dizzy or lightheaded

- Not at all (1)
- Mildly, but it didn't bother me much (2)
- Moderately -- it wasn't pleasant at times (3)
- Severely -- it bothered me a lot (4)

Q44.8 Heart pounding/racing

- Not at all (1)
- Mildly, but it didn't bother me much (2)
- Moderately -- it wasn't pleasant at times (3)
- Severely -- it bothered me a lot (4)

Q44.9 Unsteady

- Not at all (1)
- Mildly, but it didn't bother me much (2)
- Moderately -- it wasn't pleasant at times (3)
- Severely -- it bothered me a lot (4)

Q44.10 Terrified or afraid

- Not at all (1)
- Mildly, but it didn't bother me much (2)
- Moderately -- it wasn't pleasant at times (3)
- Severely -- it bothered me a lot (4)

Q44.11 Nervous

- Not at all (1)
- Mildly, but it didn't bother me much (2)
- Moderately -- it wasn't pleasant at times (3)
- Severely -- it bothered me a lot (4)

Q44.12 Feeling of choking

- Not at all (1)
- Mildly, but it didn't bother me much (2)
- Moderately -- it wasn't pleasant at times (3)
- Severely -- it bothered me a lot (4)

Q44.13 Hands trembling

- Not at all (1)
- Mildly, but it didn't bother me much (2)
- Moderately -- it wasn't pleasant at times (3)
- Severely -- it bothered me a lot (4)

Q44.14 Shaky/unsteady

- Not at all (1)
- Mildly, but it didn't bother me much (2)
- Moderately -- it wasn't pleasant at times (3)
- Severely -- it bothered me a lot (4)

Q44.15 Fear of losing control

- Not at all (1)
- Mildly, but it didn't bother me much (2)
- Moderately -- it wasn't pleasant at times (3)
- Severely -- it bothered me a lot (4)

Q44.16 Difficulty in breathing

- Not at all (1)
- Mildly, but it didn't bother me much (2)
- Moderately -- it wasn't pleasant at times (3)
- Severely -- it bothered me a lot (4)

Q44.17 Fear of dying

- Not at all (1)
- Mildly, but it didn't bother me much (2)
- Moderately -- it wasn't pleasant at times (3)
- Severely -- it bothered me a lot (4)

Q44.18 Scared

- Not at all (1)
- Mildly, but it didn't bother me much (2)
- Moderately -- it wasn't pleasant at times (3)
- Severely -- it bothered me a lot (4)

Q44.19 Indigestion

- Not at all (1)
- Mildly, but it didn't bother me much (2)
- Moderately -- it wasn't pleasant at times (3)
- Severely -- it bothered me a lot (4)

Q44.20 Faint/ lightheaded

- Not at all (1)
- Mildly, but it didn't bother me much (2)
- Moderately -- it wasn't pleasant at times (3)
- Severely -- it bothered me a lot (4)

Q44.21 Face flushed

- Not at all (1)
- Mildly, but it didn't bother me much (2)
- Moderately -- it wasn't pleasant at times (3)
- Severely -- it bothered me a lot (4)

Q44.22 Hot/ cold sweats

- ○ Not at all (1)
- ○ Mildly, but it didn't bother me much (2)
- ○ Moderately -- it wasn't pleasant at times (3)
- ○ Severely -- it bothered me a lot (4)

End of Block: Block BAI

Start of Block: Block BDI

Q45.1 Instructions: This questionnaire consists of 21 groups of statements. Please read each group of statements carefully. And then pick out the ***one*** statement in each group that best describes the way you have been feeling during the past two weeks, including today.

Select the number beside the statement you have picked. If several statements in the group seem to apply equally well, select the highest number for that group. Be sure that you do not choose more than one statement for any group, including Item 16 (Changes in Sleeping Pattern) or Item 18 (Changes in Appetite).

Q45.2 Sadness

- I do not feel sad (1)
- I feel sad (2)
- I am sad all the time and I can't snap out of it. (3)
- I am so sad and unhappy that I can't stand it. (4)

Q45.3 Pessimism

- I am not particularly discouraged about the future. (1)
- I feel more discouraged about my future than I used to. (2)
- I do not expect things to work out for me. (3)
- I feel my future is hopeless and will only get worse. (4)

Q45.4 Past Failure

- I do not feel like a failure. (1)
- I have failed more than I should have. (2)
- As I look back on my life, all I can see is a lot of failures. (3)
- I feel I am a complete failure as a person. (4)

Q45.5 Loss of Pleasure

- I get as much pleasure as I ever did from the things I enjoy. (1)
- I don't enjoy things as much as I used to. (2)
- I get very little pleasure from the things I used to enjoy. (5)
- I can't get any pleasure from the things I used to enjoy. (6)

Q45.6 Guilty Feelings

- I don't feel particularly guilty. (1)
- I feel guilty over many things I have done or should have done. (2)
- I feel quite guilty most of the time. (3)
- I feel guilty all of the time. (4)

Q45.7 Punishment Feelings

- I don't feel I am being punished. (1)
- I feel I may be punished. (2)
- I expect to be punished. (3)
- I feel I am being punished. (4)

Q45.8 Self-Dislike

- I feel the same about myself as ever. (1)
- I have lost confidence in myself. (2)
- I am disappointed in myself. (3)
- I dislike myself. (4)

Q45.9 Self-Criticalness

- I don't criticize or blame myself more than usual. (1)
- I am more critical of myself than I used to be. (2)
- I criticize myself for all my of my faults. (4)
- I blame myself for everything bad that happens. (3)

Q45.10 Suicidal Thoughts or Wishes

- I don't have any thoughts of killing myself. (1)
- I have thoughts of killing myself, but I would not carry them out. (2)
- I would like to kill myself. (3)
- I would kill myself if I had the chance. (4)

Q45.11 Crying

- I don't cry any more than usual. (1)
- I cry more than I used to. (2)
- I cry over every little thing. (4)
- I feel like crying but I can't. (5)

Q45.12 Agitation

- I am no more restless or wound up than usual. (1)
- I feel more restless or wound up than usual. (2)
- I am so restless or agitated, it's hard to stay still. (3)
- I am so restless or agitated that I have to keep moving or doing something. (4)

Q45.13 Loss of Interest

- I have not lost interest in other people or activities. (1)
- I am less interested in other people or things than before. (2)
- I have lost most of my interest in other people or things. (3)
- It's hard to get interested in anything. (4)

Q45.14 Indecisiveness

- I make decisions about as well as ever. (1)
- I find it more difficult to make decisions than usual. (2)
- I have much greater difficulty in making decisions than I used to. (3)
- I have trouble making any decisions. (4)

Q45.15 Worthlessness

- I do not feel I am worthless. (1)
- I don't consider myself as worthwhile and useful as I used to. (2)
- I feel more worthless as compared to others. (3)
- I feel utterly worthless. (4)

Q45.16 Loss of Energy

- I have as much energy as ever. (1)
- I have less energy than I used to have. (2)
- I don't have enough energy to do very much. (3)
- I do not have enough energy to do anything. (4)

Q45.17 Changes in Sleeping Pattern

- ○ I have not experienced any change in my sleeping. (1)
- ○ I sleep somewhat more than usual. (2)
- ○ I sleep somewhat less than usual. (3)
- ○ I sleep a lot more than usual. (4)
- ○ I sleep a lot less than usual. (5)
- ○ I sleep most of the day. (6)
- ○ I wake up 1-2 hours early and can't get back to sleep. (7)

Q45.18 Irritability

- ○ I am not more irritable than usual. (1)
- ○ I am more irritable than usual. (2)
- ○ I am much more irritable than usual. (3)
- ○ I am irritable all the time. (4)

Q45.19 Changes in Appetite

- ○ I have not experienced any change in my appetite. (1)
- ○ My appetite is somewhat less than usual. (2)
- ○ My appetite is somewhat greater than usual. (3)
- ○ My appetite is much less than before. (4)
- ○ My appetite is much greater than usual. (5)
- ○ I have no appetite at all. (6)
- ○ I crave food all the time. (7)

Q45.20 Concentration Difficulty

- ○ I can concentrate as well as ever. (1)
- ○ I can't concentrate as well as usual. (2)
- ○ It's hard to keep my mind on anything for very long. (3)
- ○ I find it hard to concentrate on anything. (5)

Q45.21 Tiredness or Fatigue

- I am no more tired or fatigued than usual. (1)
- I get more tired or fatigues more easily than usual. (2)
- I am too tired or fatigued to do a lot of the things I used to do. (5)
- I am too tired or fatigued to do most of the things I used to do. (6)

Q45.22 Loss of Interest in Sex

- I have not noticed any recent change in my interest in sex. (1)
- I am less interested in sex than I used to be. (2)
- I am much less interested in sex now. (3)
- I have lost interest in sex completely. (4)

End of Block: Block BDI

Start of Block: Block Outdoors_physActivity

Q46.1 For each of the following statements, please indicate to what extent you agree or disagree to the statement:

Q46.2 I walk for transportation (i.e., work, the store) which causes some increased breathing and heart-rate.

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.3 In the past week, I participated in work activities that involved walking, lifting, or carrying objects that caused some increase in breathing and heart-rate.

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.4 I prefer to bike or walk whenever I can.

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.5 I drive to get to wherever I need to go whenever possible.

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.6 My work requires me to spend a lot of time indoors.

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.7 I do not engage in a lot of walking activities because I have an injury (i.e., knees or ankles hurt).

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.8 I look for opportunities to spend time outdoors whenever possible.

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.9 In my childhood, I spent time engaging in outdoor activities:

- ○ Never (1)
- ○ Rarely, less than 10% of the time (2)
- ○ Occasionally, about 30% of the time (3)
- ○ Sometimes, about 50% of the time (4)
- ○ Frequently, about 70% of the time (5)
- ○ Usually, about 90% of the time (6)
- ○ All the time, 100% of the time (7)

Q46.10 As an adult, I look for opportunities to spend my time indoors whenever possible.

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.11 My social group likes to spend time engaging in outdoor activities.

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.12 Even if my social group likes to spend time engaging in outdoor activities, I would prefer an alternative activity that we could do indoors.

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.13 My social group likes to spend time engaging in indoor activities.

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.14 I prefer to drive to get around whenever possible.

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.15 Walking is dangerous because of the traffic in my neighborhood.

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.16 Even if my social group likes to spend time engaging in an indoor activity, I would prefer an alternative activity that we could do outdoors.

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.17 Most of the activities I choose do for fun can be done indoors (i.e., watching movies, video gaming, web browsing etc.).

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.18 I enjoy shopping online.

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.19 I prefer shopping for things in person at the store.

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.20 I experience pain when I am doing any form of physical activity, therefore I limit my amounts of physical activity.

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.21 Most of the activities I choose do for fun can be done outdoors (i.e., hiking, going for a walk, running, fishing etc.).

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.22 I like spending time outdoors.

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.23 I prefer to spend my time indoors.

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.24 I prefer to socialize online from the comfort of being indoors.

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.25 I prefer to socialize by going to do some outdoor activity that requires meeting people in person.

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.26 In my adult life, I spend time indoors

- Never (1)
- Rarely, less than 10% of the time (2)
- Occasionally, about 30% of the time (3)
- Sometimes, about 50% of the time (4)
- Frequently, about 70% of the time (5)
- Usually, about 90% of the time (6)
- All the time, 100% of the time (7)

Q46.27 In my adult life, I spend time outdoors

- Never (1)
- Rarely, less than 10% of the time (2)
- Occasionally, about 30% of the time (3)
- Sometimes, about 50% of the time (4)
- Frequently, about 70% of the time (5)
- Usually, about 90% of the time (6)
- All the time, 100% of the time (7)

Q46.28 I spend at least 30 consecutive minutes outside at least once a week:

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.29 I spend at least 30 consecutive minutes outside at least twice a week:

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.30 I spend at least 30 consecutive minutes outside three or more times a week:

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.31 When I find that I am bored, I usually go outside and take a walk somewhere:

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.32 When I find that I am bored, I usually find something to indoors which usually involves the use of some type of media (i.e., Watching TV, watching YouTube videos, playing video games, scrolling through Instagram or Facebook etc.)

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.33 Most of the activities I choose do for fun can be done outdoors (i.e., hiking, running, camping etc.).

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.34 I have lots of friends that like to spend time outside (i.e., going out to the park, beach, camping).

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.35 I have lots of friends that like to spend time indoors (i.e., cocktail parties, going to bars, house parties, movie marathons, etc.).

- ○ Strongly disagree (9)
- ○ Disagree (10)
- ○ Somewhat disagree (11)
- ○ Somewhat Agree (12)
- ○ Agree (13)
- ○ Strongly agree (14)

Q46.36 I have the motivation to go outside for fun but this motivation rarely becomes a reality.

- Strongly disagree (9)
- Disagree (10)
- Somewhat disagree (11)
- Somewhat Agree (12)
- Agree (13)
- Strongly agree (14)

End of Block: Block Outdoors_physActivity

Start of Block: Block MTUA -

Q47.1 Please indicate how often you do each of the following e-mail activities on any device (mobile phone, laptop, desktop, etc.)

Q47.2 Send, receive and read e-mails (not including spam or junk mail).

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.3 Check your personal e-mail

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.4 Check your work or school e-mail.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.5 Send or receive files via e-mail.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.6 Please indicate how often you do each of the following activities on your mobile phone.

Q47.7 Send and receive text messages on a mobile phone.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.8 Make and receive mobile phone calls.

- Never (1)
- Once a month (2)
- Several times a month (6)
- Once a week (7)
- Several times a week (8)
- Once a day (9)
- Several times a day (10)
- Once an hour (11)
- Several times an hour (12)
- All the time (3)

Q47.9 Check for text messages on a mobile phone.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.10 Check for voice calls on a mobile phone.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.11 Read e-mail on a mobile phone.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.12 Get directions or use GPS on a mobile phone.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.13 Browse the web on a mobile phone.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.14 Listen to music on a mobile phone.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.15 Take pictures using a mobile phone.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.16 Check the news on a mobile phone.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.17 Record video on a mobile phone.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.18 Use apps (for any purpose) on a mobile phone.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.19 Search for information with a mobile phone.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.20 Use your mobile phone during class or work time.

- Never (1)
- Once a month (2)
- Several times a month (6)
- Once a week (7)
- Several times a week (8)
- Once a day (9)
- Several times a day (10)
- Once an hour (11)
- Several times an hour (12)
- All the time (3)

Q47.21 How often do you do each of the following activities?

Q47.22 Watch TV shows, movies, etc. on a TV set.

- Never (1)
- Once a month (2)
- Several times a month (6)
- Once a week (7)
- Several times a week (8)
- Once a day (9)
- Several times a day (10)
- Once an hour (11)
- Several times an hour (12)
- All the time (3)

Q47.23 Watch video clips on a TV set.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.24 Watch TV shows, movies, etc. on a computer.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.25 Watch video clips on a computer.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.26 Download media files from other people on a computer.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.27 Share your own media files on a computer.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.28 Search the Internet for news on any device.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.29 Search the Internet for information on any device.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.30 Search the Internet for videos on any device.

- Never (1)
- Once a month (2)
- Several times a month (6)
- Once a week (7)
- Several times a week (8)
- Once a day (9)
- Several times a day (10)
- Once an hour (11)
- Several times an hour (12)
- All the time (3)

Q47.31 Search the Internet for images or photos on any device.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.32 Play games on a computer, video game console or smartphone BY YOURSELF.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.33 Play games on a computer, video game console or smartphone WITH OTHER PEOPLE IN THE SAME ROOM.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.34 Play games on a computer, video game console or smartphone WITH OTHER PEOPLE ONLINE.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.35 Do you have a social media account that you use often?

- ○ Yes (1)
- ○ No (2)

Q47.36 How often do you do each of the following activities on social networking sites such as Facebook, Instagram, Twitter?

Q47.37 Check your social page or other social networks.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.38 Check your social media page from your smartphone.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.39 Check social media at work or school.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.40 Post status updates.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.41 Post photos.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.42 Browse profiles and photos.

- Never (1)
- Once a month (2)
- Several times a month (6)
- Once a week (7)
- Several times a week (8)
- Once a day (9)
- Several times a day (10)
- Once an hour (11)
- Several times an hour (12)
- All the time (3)

Q47.43 Read postings.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.44 Comment on postings, status updates, photos, etc.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

Q47.45 Click “Like” to a posting, photo, etc.

- ○ Never (1)
- ○ Once a month (2)
- ○ Several times a month (6)
- ○ Once a week (7)
- ○ Several times a week (8)
- ○ Once a day (9)
- ○ Several times a day (10)
- ○ Once an hour (11)
- ○ Several times an hour (12)
- ○ All the time (3)

End of Block: Block MTUA -

Start of Block: Block MTUA FB

Q48.1 How many friends do you have on your social media page?

	(0)	(1-50)	(51-100)	(101-175)	(176-250)	(251-375)	(376-500)	(501-750)	(751 or more)
	1	2	3	4	5	6	7	8	9
1 ()									

Q48.2 How many of friends from your social media page do you know in person?

	(0)	(1-50)	(51-100)	(101-175)	(176-250)	(251-375)	(376-500)	(501-750)	(751 or more)
	1	2	3	4	5	6	7	8	9
Answer to the best to your ability ()									

Q48.3 How many people have you met online that you have never met in person?

	(0)	(1-50)	(51-100)	(101-175)	(176-250)	(251-375)	(376-500)	(501-750)	(751 or more)
	1	2	3	4	5	6	7	8	9
Answer to the best to your ability ()									

Q48.4 How many people do you regularly interact with online that you have never met in person?

	(0)	(1-50)	(51-100)	(101-175)	(176-250)	(251-375)	(376-500)	(501-750)	(751 or more)
	1	2	3	4	5	6	7	8	9
Answer to the best to your ability ()									

End of Block: Block MTUA FB

Start of Block: Block MTUA attitudes

Q49.1 The following questions are regarding your attitudes and beliefs towards technology:

Q49.2 I feel it is important to be able to find any information whenever I want online.

- Strongly agree (1)
- Agree (2)
- Neither agree nor disagree (3)
- Disagree (4)
- Strongly Disagree (5)

Q49.3 I feel it is important to be able to access the Internet any time I want.

- Strongly agree (1)
- Agree (2)
- Neither agree nor disagree (3)
- Disagree (4)
- Strongly Disagree (5)

Q49.4 I think it is important to keep up with the latest trends in technology.

- Strongly agree (1)
- Agree (2)
- Neither agree nor disagree (3)
- Disagree (4)
- Strongly Disagree (5)

Q49.5 I get anxious when I don't have my cell phone.

- Strongly agree (1)
- Agree (2)
- Neither agree nor disagree (3)
- Disagree (4)
- Strongly Disagree (5)

Q49.6 I get anxious when I don't have the Internet available to me.

- Strongly agree (1)
- Agree (2)
- Neither agree nor disagree (3)
- Disagree (4)
- Strongly Disagree (5)

Q49.7 I am dependent on my technology.

- ○ Strongly agree (1)
- ○ Agree (2)
- ○ Neither agree nor disagree (3)
- ○ Disagree (4)
- ○ Strongly Disagree (5)

Q49.8 Technology will provide solutions to many of our problems.

- ○ Strongly agree (1)
- ○ Agree (2)
- ○ Neither agree nor disagree (3)
- ○ Disagree (4)
- ○ Strongly Disagree (5)

Q49.9 With technology anything is possible.

- Strongly agree (1)
- Agree (2)
- Neither agree nor disagree (3)
- Disagree (4)
- Strongly Disagree (5)

Q49.10 I feel that I get more accomplished because of technology.

- Strongly agree (1)
- Agree (2)
- Neither agree nor disagree (3)
- Disagree (4)
- Strongly Disagree (5)

Q49.11 New technology makes people waste too much time.

- ○ Strongly agree (1)
- ○ Agree (2)
- ○ Neither agree nor disagree (3)
- ○ Disagree (4)
- ○ Strongly Disagree (5)

Q49.12 New technology makes life more complicated.

- ○ Strongly agree (1)
- ○ Agree (2)
- ○ Neither agree nor disagree (3)
- ○ Disagree (4)
- ○ Strongly Disagree (5)

Q49.13 New technology makes people more isolated.

- Strongly agree (1)
- Agree (2)
- Neither agree nor disagree (3)
- Disagree (4)
- Strongly Disagree (5)

Q49.14 I prefer to work on several projects in a day, rather than completing one project and then switching to another.

- Strongly agree (1)
- Agree (2)
- Neither agree nor disagree (3)
- Disagree (4)
- Strongly Disagree (5)

Q49.15 When doing a number of assignments, I like to switch back and forth between them rather than do one at a time.

- ○ Strongly agree (1)
- ○ Agree (2)
- ○ Neither agree nor disagree (3)
- ○ Disagree (4)
- ○ Strongly Disagree (5)

Q49.16 I like to finish one task completely before focusing on anything else.

- ○ Strongly agree (1)
- ○ Agree (2)
- ○ Neither agree nor disagree (3)
- ○ Disagree (4)
- ○ Strongly Disagree (5)

Q49.17 When I have a task to complete, I like to break it up by switching to other tasks intermittently.

- Strongly agree (1)
- Agree (2)
- Neither agree nor disagree (3)
- Disagree (4)
- Strongly Disagree (5)

End of Block: Block MTUA attitudes

Start of Block: Block Discomfort about research assistant nearby

Q50.1 At any point during the study, did you feel uncomfortable with the researcher nearby?

- Not at all (1)
- Slightly (2)
- Moderately (3)
- Very (4)
- Extremely (5)

Q50.2 Do you have any suspicions on what the true nature of the study is on?

- Not at all (1)
- Slightly (2)
- Moderately (3)
- Very (4)
- Extremely (5)

End of Block: Block Discomfort about research assistant nearby

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Start of Block: Block Thank You

Q51.1

Thank You for Your Support!

At this moment, please contact the experimenter so that they may debrief you and ensure that your information is saved. ☺

End of Block: Block Thank You

Start of Block: Block GMDA for Researchers ONLY

Q52.1 Participant ID

_____

Q52.2 Please select all that apply according the condition that the current participant was in:

- [ ] High Text Condition (1)
- [ ] Low Text Condition (7)
- [ ] Chronic Smartphone User (8)
- [ ] Normative Smartphone User (9)

Q462 Did you experience any problems with sending/receiving texts? If so, please indicate at which set of texts?

If so, indicate where:

	Problems Sending/Receiving Texts (8)	NA (9)
Gorgas (1)	☐	☐
Business Quad (2)	☐	☐
Marr's Spring (3)	☐	☐
Student Center (4)	☐	☐
Shelby Scene (5)	☐	☐
Bio Building (6)	☐	☐

Q463 For the question above -- do you think that this was an issue due to poor network service?

- ○ Yes (1)
- ○ No (2)
- ○ Not applicable (4)
- ○ Other (3) _____

Q52.3 Total time to complete **WF task** (Enter in mm:ss)

_____

Q457 Total time for overall study (Enter in hh:mm)

_____

Q52.26 **In this section, please respond to the questions and write out any notes/observations from running the current participant:**

Q52.27 Did it rain during the study?

- ○ Yes (1)
- ○ No (2)

Q52.28 Did it appear that the participant received any text messages that were *not* part of the study?

- ○ Yes (1)
- ○ No (2)

Q52.29 Were you able to send out the appropriate amounts of text for this participant's condition?

Indicate how many texts were sent:

- ○ Yes (1) _____
- ○ No (2) _____

Q52.30 Did the participant reply appropriately to the instructions for each text message? Indicate how many texts you received as the researcher:

- ○ Yes (1) _____
- ○ No (2) _____

Q52.31 Did the participant complete the entire study?

- Yes (1)
- No (2)

Q52.32 How much did the participant stray from the path during the study?

- Not at all (1)
- Very little (2)
- Somewhat (3)
- To a great extent (4)

Q52.33 How often did you need to step in to correct the participant during the study?

- Not at all (1)
- Very little (2)
- Somewhat (3)
- To a great extent (4)

Q52.34 Was there anything that stood out during this session?

_____

Q52.35 Use this section for any other notes you'd like to add:

_____

Page Break

Q52.4 Record the response to **Canonical Accuracy** for only the practice and Target landmarks in GMDA's summary score spreadsheet.

Q433 Landmark 1

_____

Q434 Landmark 2

_____

Q52.5 Landmark 3

_____

Q436 Landmark 4

_____

Q435 Landmark 5

_____

Q52.7 Landmark 6

_____

Q438 Landmark 7

_____

Q437 Landmark 8

_____

Q52.9 Landmark 9

_____

Q440 Landmark 10

_____

Q439 Landmark 11

_____

Q52.11 Landmark 12

_____

Q442 Landmark 13

_____

Q441 Landmark 14

_____

Q52.13 Landmark 15

____

Page Break

Q52.14 Record the response to **Canonical Accuracy** for only the practice and Target landmarks in GMDA's summary score spreadsheet.

Q444 Landmark 16

_____

Q443 Landmark 17

_____

Q52.15 Landmark 18

_____

Q446 Landmark 19

_____

Q445 Landmark 20

_____

Q52.17 Landmark 21

_____

Q448 Landmark 22

_____

Q447 Landmark 23

_____

Q52.19 Landmark 24

_____

Q451 Landmark 25

_____

Q450 Landmark 26

_____

Q52.21 Landmark 27

_____

Q453 Landmark 28

_____

Q452 Landmark 29

_____

Q52.23 Landmark 30

_____

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Q455 Landmark 31

_____

Q454 Landmark 32

_____

Q52.25 Landmark 33

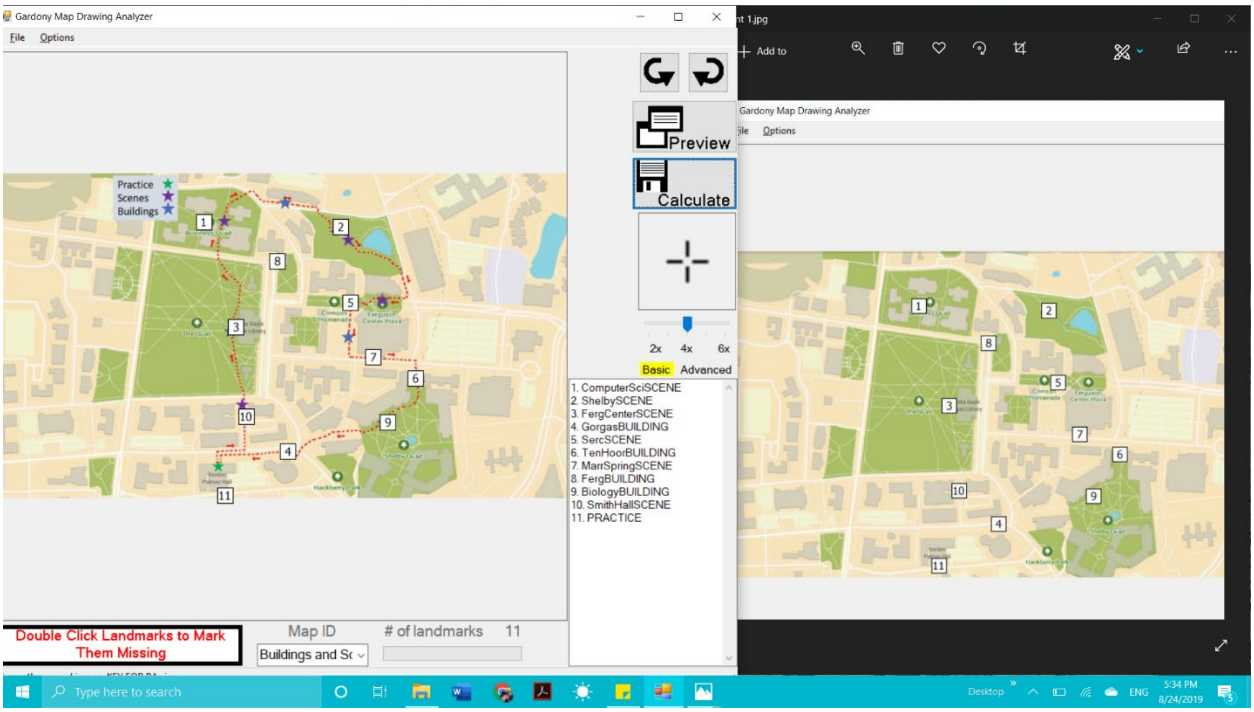
_____

Page Break

End of Block: Block GMDA for Researchers ONLY

APPENDIX C

GMDA, Target Environment ("key", on left) and Example of Participant Data (pilot, right) (Gardony, Taylor, & Brunyé, 2016)



THE UNIVERSITY OF ALABAMA | Office of the Vice President for Research & Economic Development
Office for Research Compliance

February 20, 2020

Jessica Mendoza, M.A.
Department of Psychology
College of Arts & Sciences
The University of Alabama
Box 870348

Re: IRB # 19-OR-235-A "Differences in Spatial Memory between Chronic versus Normative Smartphone Users and Texting Distractions"

Dear Ms. Mendoza:

The University of Alabama Institutional Review Board has reviewed the revision to your previously approved expedited protocol. The board has approved the change in your protocol.

Please remember that your protocol will expire on November 6, 2020.

Should you need to submit any further correspondence regarding this proposal, please include the assigned IRB application number. Changes in this study cannot be initiated without IRB approval, except when necessary to eliminate apparent immediate hazards to participants.

Good luck with your research.

Sincerely,

[redacted]
Director & Research Compliance Officer

Jessup Building | Box 870127 | Tuscaloosa, AL 35487-0127
205-348-8461 | Fax 205-348-7189 | Toll Free 1-877-820-3066