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RESEARCH ARTICLE

Cognitive Load and Smartphones: How Mere Presence Impacts Mental Performance

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ABSTRACT

This study examines the impact of smartphone presence on cognitive performance, specifically evaluating attention (AP score), processing speed (PTO score), and error percentage (E% score) among 275 undergraduate students. Participants were assigned to conditions varying in smartphone proximity: on a desk, in a pocket/bag, in another room, or completely absent. One-tailed ANOVA results revealed that participants without smartphones performed significantly better in attention and processing speed, with large effect sizes (η^2 = 0.134 and η^2 = 0.160, respectively). Descriptive statistics indicated that female participants outperformed males across all cognitive measures. The findings support the "brain drain" hypothesis, showing that even the mere presence of a smartphone reduces cognitive efficiency. Correlation analysis further confirmed that cognitive performance declines most when smartphones are visible or within reach. The results underscore the need to minimize smartphone presence in academic and professional settings to enhance focus and productivity. Future research should investigate long-term effects and develop interventions to mitigate cognitive depletion linked to smartphones.

1. INTRODUCTION

Smartphones give us a convenient and efficient way to communicate with the outside world. The majority of people now use smartphones daily; in North America, the percentage of individuals who own one has increased from 77% in 2016 to 81% in 2019 (Pew Research Centre, 2019). According to a 2015 World Health Organization research, "behavioral addictions" linked to internet and smartphone use have been found to co-occur with certain psychopathologies (such major depression and hyperactivity disorder) and medical illnesses (including substance use disorders and sleeplessness). As a result, studies looking into the potential impacts of smartphone use on cognition have increased. Furthermore, a surge in smartphone research has resulted in modifications to policies. The Ontario government, for instance, prohibited smartphones and cell phones in high schools on the grounds that they would divert pupils' attention from their studies (Jones, 2019). Reliable and repeatable data should serve as the foundation for such policy adjustments. An summary of smartphone studies is given, including the "brain drain" effect (described by Ward et al., 2017 as worse cognitive performance when one's smartphone is closer). The primary objective of the current investigation was to determine whether the "brain drain" effect observed in the second experiment by Ward et al. (2017) was duplicated.

However, an era of unparalleled connectedness has been brought about by the widespread use of smartphones. Today's consumers worldwide have access to nearly limitless information, limitless entertainment, and distant friends at all times. With smartphones in hand, people browse possible romantic partners in between appointments, trade stocks while stopped in traffic, check the weather from bed, make online purchases while standing in a store, and live-stream one other's experiences in real time from different parts of the world. This state of perpetual connectivity would have been unthinkable just ten years ago; now, it appears to be essential One On average, smartphone owners use their devices 95 times a day, including right before bed, right after waking up, and even in the middle of the night (Perlow 2012; Andrews et al. 2015; dscout 2016). 46% of respondents said they couldn't live without their phones, and 91% say they never leave the house without them (Deutsche Telekom 2012; Pew Research Centre 2015).

On-demand access to friends, family, coworkers, businesses, brands, merchants, cat videos, and much more is made possible by these ground-breaking gadgets. Condensed into a gadget that fits in the palm of one's hand and is nearly always by one's side, they embody everything that the connected world has to offer. Smartphones' rapid spread throughout international marketplaces and into customers' daily lives is a phenomenon with a high "meaning and mattering" (e.g., Kernan 1979; Mick 2006) that could have an impact on the well-being of billions of consumers globally.

As people use smartphone displays more and more to organize and improve their everyday lives, we need to consider how reliance on these gadgets impacts one's capacity to think and act in the real world. Smartphones have the potential to provide unexpected deficits as well as surpluses in time, productivity, and resources (e.g., Turkle 2011; Lee 2016; Jam et al., 2025; Mansoor et al., 2025). Previous studies that have examined the advantages and disadvantages of smartphones have concentrated on how users' interactions with them can both support and interfere with off-screen performance (e.g., Isik-man et al. 2016; Sciandra and Inman 2016). In this study, we concentrate on a hitherto unstudied (but prevalent) scenario: when smartphones are simply available but not in use. The topic of this paper is what Ward, Duke, Gneezy, and Bos (2017) call "Brain Drain."

According to the scientists, using a smartphone impairs cognitive function because it forces people to conceal distracting ideas, which "drains" their cognitive resources. The mere presence of their smartphones also caused participants to get distracted, according to Thornton, Faires, Robbins, and Rollins (2014). What unites the two research is that they urge participants to finish a cognitively taxing activity while using their smartphones. Since many individuals do work while using their smartphones, there is a dearth of research on this area, despite the fact that it is crucial. We work to present further proof of the impact of smartphones' very existence. Additionally, the study took into account a limited number of potential moderating or mediating factors that could affect the association between the presence of a smartphone and cognitive function. We thus look into constructs that could have a mediating or moderating effect on the relationship. As a result, we suggest that the mere existence of a personal smartphone may cause "brain drain" by using up limited cognitive resources for attentional regulation. Because attentional control and other cognitive processes are supported by the same limited pool of attentional resources, performance on other activities will suffer when resources used to prevent automatic attention to one's phone are diverted. We distinguish between the allocation and the orientation of attention, and we contend that even in cases when users are effective in managing the conscious orientation of their attention, the mere existence of cellphones may limit the number of attentional resources available.

The purpose of this study is to find out if college students' attentiveness is affected by the presence of smartphones. Since there haven't been many studies on how a smartphone turned off affects attention, this investigation can significantly advance the body of knowledge. The individuals' smartphone reliance is evaluated in addition to their attention performance being recorded while using a smartphone. Smartphone reliance should be taken into account here since it was a significant factor in previous studies and affected how the availability and presence of smartphones affected attentiveness. Whether the mere possession of a smartphone affects attention is not evident from the current level of research. Since many aspects of this effect are yet unknown, this study adds to the body of knowledge regarding the potential impact of smartphones on attention. Additionally, recent research that demonstrated the impact of smartphone presence on attention points to the possibility that smartphone availability and presence only affect cognitive functions when high-level tasks are involved. However, it is uncertain if the interfering effects of smartphone presence have an impact on basal skills.

Thus, the current study investigates the potential impact of smartphone presence on baseline attentional processes. A test that looks at both attentional processes and basic functions is the concentration and attention test. More information about the conditions that result in reduced cognitive functioning while a smartphone is present may be found in this paper. The mere existence of a smartphone is thought to have an impact on attention, which may result in worse cognitive function. The primary task and the smartphone may receive different amounts of attentional resources.

2. LITERATURE

2.1. Cognitive Capacity and Consumer Behavior

One of the most basic factors influencing "real world" consumer behaviour is the limited cognitive processing ability of consumers (e.g., Bettman 1979; Bettman, Johnson, and Payne 1991). Cognitive systems that can only handle and process a small portion of the information available at any given time continuously limit people's ability to use the potentially meaningful information that is all around them (e.g., Craik and Lockhart 1972; Newell and Simon 1972). From performance and in-the-moment decision-making techniques (e.g., Lane 1982; Lynch and Srull 1982) to long-term goal pursuit and self-regulation (e.g., Hofmann, Strack, and Deutsch 2008; Benjamin, Brown, and Shapiro 2013), this capacity limit influences a wide range of behaviours. The cognitive capacities and limitations of consumers are mostly dictated by the accessibility of limited-capacity attentional resources linked to fluid intelligence and working memory (e.g., Jaeggi et al. 2008; Halford, Cowan, and Andrews 2007). The theoretical cognitive mechanism known as "working memory" (WM) actively chooses, retains, and processes information pertinent to ongoing tasks and/or objectives in order to facilitate complex cognition.

The availability of attentional resources, which support the "central executive" function of managing and regulating cognitive processes across domains, is reflected in working memory capacity (WMC) (Baddeley and Hitch 1974; Miyake and Shah 1999; Engle 2002; Baddeley 2003). The ability to reason and solve new issues without the aid of learnt skills and information stored in "crystallized intelligence" (Cattell 1987) is known as "fluid intelligence" (Gf). Like WM, Gf emphasizes the capacity to choose, store, and work with information in a way that is focused on achieving certain goals. The availability of attentional resources limits Gf, much like it does WM (e.g., Engle et al. 1999;Halford et al. 2007). Importantly, by using attentional resources for one cognitive process or activity, less are available for other activities due to the finite capacity of these domain general resources; in other words, occupying cognitive resources decreases available cognitive capacity.

2.2. Smartphone Salience Hypothesis

As a continual source of entertainment, information, and communication, smartphones have become an indispensable component of everyday life. According to the salience theory, having a smartphone has a big influence on psychological imbalances in addition to affecting one's emotions. However, it is confirmed that just being conscious of one's smartphone can take up mental space. In other words, because of the smartphone's close link to the user's thoughts and mind, the mind unconsciously pays attention to the potential for interactions through the device, even when it is not being utilized. Due to the division in cognitive capacity caused by this subconscious awareness, there are fewer resources available for urgent activities.

According to Griffiths (2005), the "components model of addiction," which holds that addictive behaviour can be recognized by the presence of six essential components, can be used to analyze problematic smartphone use. When it comes to smartphone use, these include: the overwhelming dominance and complete obsession with using a smartphone (salience); mood changes that are directly caused by using a smartphone (mood modification); negative feelings when unable to use a smartphone (withdrawal symptoms); intrapersonal and interpersonal issues resulting from using a smartphone (conflict); and the return to addictive smartphone behaviour following a period of abstinence (relapse). To evaluate the presence of various behavioural addictions, such as exercise addiction (Terry et al. 2004), work addiction (Andreassen et al. 2012), social media addiction (Andreassen et al. 2016), shopping addiction (Andreassen et al. 2015), and problematic pornography use (Bőthe et al. 2018), numerous psychometric scales have been developed based on the addiction components model.

2.3. Experimental Evidence Supporting Brain Drain

Significant variations in cognitive function were seen based on the presence of smartphones in a series of trials designed to examine these phenomena. while asked to conduct attention-based tasks, for instance, participants did worse while their phones were in their pockets or on their desks than when they were placed in a different room. These results imply that working memory, attention span, and mental flexibility are all impacted by smartphone-induced brain drain. Ward and associates (2017) discovered that people's level of smartphone distraction changes depending on how personally relevant the device is.

Individuals who had a stronger attachment to their smartphones did worse than those who did not. Thus, the relationship between smartphone presence and accessible cognitive capacity appears to be moderated by smartphone attachment, with both strong attachment and smartphone presence reducing the latter. Based on these results, we anticipate that smartphone attachment will have a moderating effect and that those who are more devoted to their phones will be more adversely impacted by their presence than those who are less devoted.

2.4. Mechanism of Cognitive Depletion

Working memory's limited capacity is the cognitive mechanism underlying brain drain. Information required for decision-making and problem-solving must be momentarily stored and manipulated in working memory. The possible need to reply to calls, texts, or social media notifications takes up some working memory while a smartphone is present. The brain devotes some of its attention to keeping an eye on the smartphone, even in the absence of interaction, which limits its ability to do other cognitive functions. Working memory span tasks have been shown to be a reliable approach to measure available working memory capacity and predict performance on cognitive tasks (Engle, Tuholski, Laughlin, & Conway, 1999).

There are a number of variations, but they all require participants to recall a series of objects while being sidetracked by other activities. The Operation Span work (Ospan), is a collection of mathematical procedures and unrelated words that were developed by Turner and Engle (1989). The work was automated by Unsworth, Heitz, Schrock, and Engle (2005). Participants solve maths tasks while they retain the sentences that are given to them. We employed a slightly modified version of the Ospan task, which asked participants to memorize the numbers on display and alternately assess the veracity of random claims, in order to gauge their working memory capacity. Over the course of five trials, the number of numbers that needed to be committed to memory increased from two to four. Participants were given a total score for the entire exam as well as a score for the number of targets successfully recalled for each trial, which was determined by the quantity of numbers accurately recalled.

Given the significance of smartphones in people's daily lives, it is pertinent to discuss how dependent individuals are on them and how this affects their cognitive function. Based on that assumption, a number of research have been carried out to investigate the effects of smartphone and mobile phone use on the performance of focused activities. Cell phone use while driving, for example, leads to distracted driving (Caird, Willness, Steel, & Scialfa, 2008). According to a meta-analysis by Caird et al. (2008), even while speaking hands-free, talking on the phone increases reaction time to events and stimuli. Additionally, Hyman, McKenzie, Caggiano, Boss, and Wise (2010) conducted research comparing the behaviour of subjects without any electronic gadgets, MP3 players, and mobile phone users to illustrate the impact of divided attention. Cell phone users walked more slowly and made more direction changes.

Clayton et al. (2015) showed how smartphones The distraction caused by other people's smartphones is another potential element that should be taken into account in future studies. Fried (2008) discovered that using a laptop during a lecture hinders the learning of both the user and other pupils. Given that participants were seated next to one another and near each other's smartphones, this may also be true of the study's experimental setup. attachment on a number of levels, such as physiological, By characterizing smartphone attachment as a continuation of subjective distraction, it is intriguing to investigate whether people are aware of the distraction and how the presence of smartphones affects their cognitive function. Given that many individuals carry their smartphones with them at all times, even in circumstances that demand their whole focus, this question is crucial. There may be serious repercussions if people are unaware of the diversions their smartphones may be causing them, and this needs to be addressed. Here we examine several recent studies to support the established truth.

3. METHODOLOGY

We gathered individuals and had them complete a survey test before administering a range of scales measuring the components in order to investigate the impacts of smartphone presence, smartphone attachment, and FOMO on available working memory capacity. Each participant was randomly assigned to one of two circumstances in this between-subjects experiment: smartphone present, pocket/bad, desk, other room, or smartphone absent. Participants completed the online survey in groups of two to fifteen, depending on the number of registrations per available slot, during the controlled study conducted in a laboratory.

Three hundred students in all volunteered to take part in the study. The age range is 20–34 years old. There are eight distinct faculties where the study is conducted, and one to five persons attend each session simultaneously. Over the course of three weeks in August and December 2024, data is gathered. Participants are randomly assigned to one of the settings (with or without a smartphone, desk, pocket/bag, or other room) in order to control the conditions under which the attention test is performed. During the test, participants in the smartphone condition are instructed to keep their smartphone on their desk. The smartphone has been turned off, and its screen is resting on a table covered, so that the screen is not visible. The other condition is the without smartphone condition, in which the After turning off their phones, participants put them outside the room. other participants were directed to keep their phones in their pockets, while others were requested to place their phones inside the desk. Finally, other participants choose to leave their smartphones in the other room.

The study does not include seven people. Among the reasons were inaccurate test-taking, a lack of useful test materials, or participant disclosure that they were already familiar with the attention test, which could have skewed the results. 230 people make up the final sample. (45.2% females, $M_{\text{age}} = 27.29$, $SD_{\text{age}} = 2.87$). 50 results are from participants in the without smartphone condition, while 55 findings are from the group of people who took the attention test while using a smartphone. Additionally, the desk and pocket/bag receive 40 and 60 results, respectively, whilst the other room receives 25. The pertinent study technique was explained to the participants. All participants gave their informed consent. Participants received no payment for their voluntary and private participation in the study. The audit committee of Paderborn University's Faculty of Arts and Humanities gave its approval to the study in accordance with the DGPS's (Deutsche Gesellschaft für Psychologie-German Society for Psychology) rules Every technique employed in the studies conducted for this study complied with the applicable rules and guidelines set forth by Paderborn University's research ethics committee.

The d2-R concentration and attention test (d2-R) is used to measure attentiveness. The d2-R is a strikethrough test that requires you to look for characters and items that are situated between characters and objects that are comparable. Marking the right ones among a large number of characters is the task. The letters "d" and "p" are the characters, together with one to four marks that may appear above or below the letter. The ds have to be crossed out with two marks by the participants. A sheet with 789 characters on it makes up the d2-R test. The test takes four minutes and forty seconds to finish. There are 14 lines in all on the test, and each line takes 20 seconds to process. If a participant 359 characters would be crossed out if the exam was completed correctly.

It is possible to think of the d2-R as a test that consists of fast, low-cognitive-demanding exercises. The speed and accuracy with which a large number of such easy activities can be completed continually reveal differences in concentration. Since the d2-R is one of the most used tools for assessing attention in German-speaking nations, it was selected as the test for this investigation. It is a validated tool that has been shown to be trustworthy. Information regarding the test subjects' accuracy, speed, and attention span is provided by the d2-R. The AP score, also known as the attention performance score, measures an individual's capacity for attentional focus. The AP score is a processing speed metric that has been corrected for mistakes.

The speed score, also known as the PTO score (processed target objects), and the E% score are evaluated in addition to the attention performance score. A test taker's accuracy in processing the d2-R is shown by their standardized E% score. The amount of processed target objects (i.e., crossed out target objects) and errors (i.e., crossing out distractions or not crossing out target objects) are used to measure speed, accuracy, and attention performance. In demographic data show that male participants had a slightly higher mean age (21.92 years) compared to females (21.34 years), though the standard deviation indicates slight variation within each group.

Regarding cognitive performance, females outperformed males in AP Score, with a mean of 105.63 compared to 100.35 for males. The variability in scores was also slightly higher among females (SD = 10.89) than males (SD = 10.59). Similarly, for PTO Score, females had a higher average (101.14) than males (100.35), with a comparable standard deviation. The E% Score, which measures error rate, was lower for females (5.44) than males (6.27), suggesting that females made fewer mistakes on average. However, males displayed slightly more variability in their error rates (SD = 2.30) than females (SD = 1.76).

Table 1. Biographical Information

Variable	Gender	Mean	Std Dev	Min	Max
Age	Male	21.92	1.47	19.9	24.0
	Female	21.34	1.18	20.21	23.1
Ap Score	Male	100.35	104.89	10.59	94.4
	Female	105.63	10.89	95.12	119.56
PTO Score	Male	Male	100.35	10.32	89.45
	Female	101.14	10.53	87.32	114.20
E% Score	Male	Male	6.27	2.30	3.15
	Female	5.44	1.76	4.21	8.75

Source: Author (2025)

The German abbreviated version of the smartphone addiction scale (d-KV-SSS) is used to measure smartphone dependence. This grade was chosen to give preference to instruments that have been verified and shown to be trustworthy in an area where German is spoken. Montag (2018) created the German short version of the Smartphone Addiction Scale (d-KV-SSS) by adapting the original scale Kwon et al. (2015) using a conventional translation and back-translation process. The d-KV-SSS was modified to make it easier to understand and more tailored to the individuals (for the questionnaire, see supplementary information). Sentence structures and vocabulary from the instructional language, for instance, were modified and streamlined. The d-KV-SSS questionnaire can reveal a possible smartphone dependence as well as tendencies towards a smartphone dependence. The items used in the questionnaire can be answered using a six-point Likert scale. Participants can give answers ranging from "I do not agree at all" (1) to "I fully agree" (6). These An overall score of smartphone reliance is calculated by adding the replies to the ten items. As a result, the overall score varies between 10 and 60 points. A greater propensity for smartphone reliance is linked to higher scores. 0.78 was the Cronbach's Alpha.

Three hundred college students from various faculties were chosen at random to participate in the experiment. Participants receive comprehensive instructions on how to get ready for the test beforehand, including a sketch and a detailed description of how they should arrange their surroundings and position themselves during the test (see supplementary information for the sketch and the handed-out instructions).

Participants are also instructed to remove any potential distractions. Additionally, participants are given a note reminding them not to disturb potential roommates, family members, etc. throughout the trial. It fell on those who were intelligent. Participants get the d2-R test and the d-KV-SSS questionnaire by mail in addition to the instructions. During the observation session, it is possible to see if the instructions are being followed. The supervisor will notify participants if the instructions are not followed accurately or completely. This guarantees proper implementation of the instructions. Over the course of about 45 minutes, the experiment is carried out in a single session. Participants are in their typical surroundings and a representative scenario is provided because the study is conducted in person. The scenario set up for the experiment involves participants working on a task at their desks with their smartphones next to them while other participants follow instructions to observe the operations.

The experimenter reads the instructions out loud during the subsequent d2-R conduction. To provide the most equal conditions for each subject, the experimenter follows the precise, pre-written phrasing. The d2-R test manual's instructions are followed when the conduction process starts.

Furthermore, Participants are given instructions on where to put their smartphones once they have watched every step of the process. The smartphone is either put on the table, in their pocket or bag, or in a different room, depending on which group they are allocated to. In order to allocate finished documents to one another while maintaining the anonymity of the results, the participants then generate a unique personal code. Next, The d2-R is carried out. The experimenter offers the command "Stop" every 20 seconds during the test conduct. Next line," until the cue "Stop" appears after 4 minutes and 40 seconds. The test is finished after "Set the pen aside." Participants respond to the d-KV-SSS after finishing the d2-R to collect data regarding a potential propensity for smartphone addiction.

Table 2. Fluid Intelligence Scores Across Different Smartphone Conditions

Participant Id	Condition	Gender	Age	Fluid Intelligence Score
1	Pocket/bag	Male	22.5	94.5
		Female	20.5	95.05
2	Desk	Male	22.4	91.93
		Female	21.5	91.22
3	Without Smartphone	Male	24.0	117.45
		Female	23.1	116.88
4	With Phone but Not Enter	Male	19.9	100.74
		Female	20.21	99.72
5	Other Room	Male	20.8	108.49
		Female	21.31	110.08

Source: Author (2025)

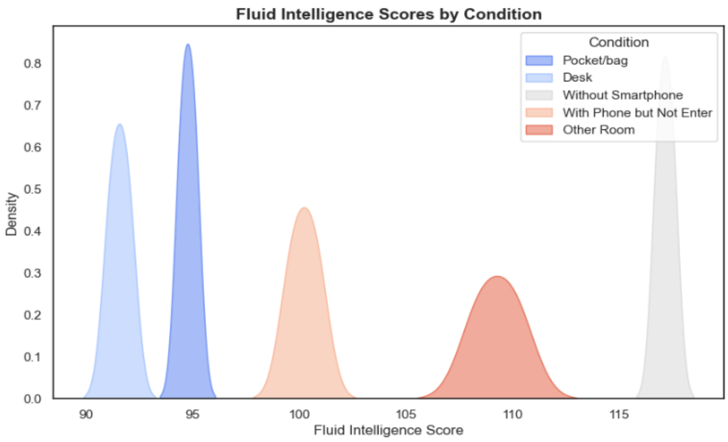

Fig1: Fluid Intelligence Score

The table presents fluid intelligence scores across different conditions, illustrating how smartphone presence affects cognitive ability. Fluid intelligence, which is essential for problem-solving and reasoning, was highest in the "Without Smartphone" condition, where males scored 117.45 and females 116.88. This suggests that cognitive performance peaks when the device is completely absent. In contrast, participants in the "Pocket/Bag" and "Desk" conditions exhibited the lowest scores, with males scoring 94.5 and 91.93, respectively, and females scoring 95.05 and 91.22. These findings indicate that even when a smartphone is not actively in use, its mere presence can impair cognitive function, possibly due to the brain's automatic attentional allocation to the potential for phone use.

The "Other Room" condition showed a noticeable improvement in scores (Males = 108.49, Females = 110.08), reinforcing the idea that greater physical distance from a smartphone enhances cognitive efficiency. The "With Phone but Not Entering" condition yielded intermediate results (Males = 100.74, Females = 99.72), implying that although placing the phone out of reach mitigates some cognitive distractions, the knowledge of its accessibility still imposes a cognitive burden. These findings align with the "brain drain" hypothesis, which suggests that smartphones, even when not in use, compete for cognitive resources. The results highlight the importance of smartphone-free environments in settings requiring high cognitive performance, such as classrooms and workplaces.

Table 3. Cognitive Performance Metrics Across Different Smartphone Conditions

Participant Id	Condition	Gender	Age	Ap Score	PTO Score	E% Score
1	Pocket/bag	Male	22.5	96.5	92.5	7.89
		Female	20.5	97.5	92.6	5.32
2	Desk	Male	22.4	94.4	89.45	9.76
		Female	21.5	95.12	87.32	8.75
3	Without Smartphone	Male	24.0	120.67	114.23	3.15
		Female	23.1	119.56	114.20	4.21
4	With Phone but Not Enter with	Male	19.9	102.35	99.12	6.23
		Female	20.21	101.34	98.10	5.32
5	Other Room	Male	20.8	110.52	106.45	4.32
		Female	21.31	112.62	107.54	5.55

Source: Author (2025)

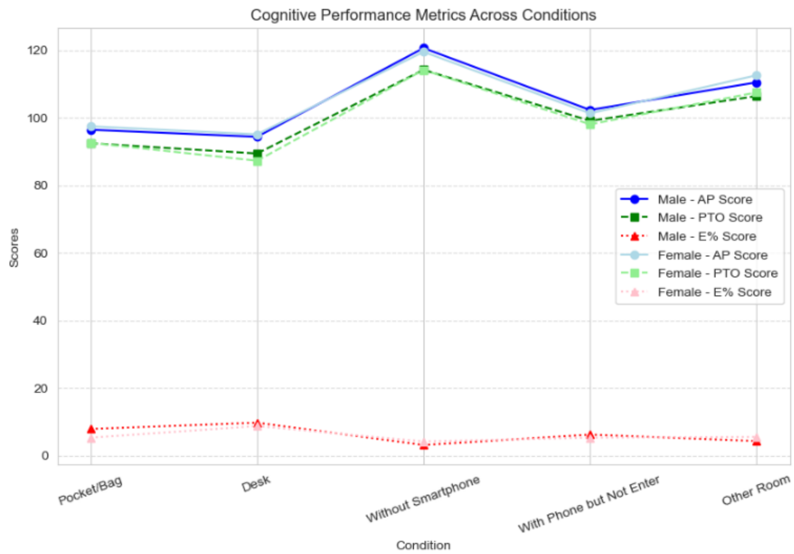

Fig 2: Cognitive Performance

The table provides a detailed comparison of cognitive performance across different conditions by measuring Attention Performance (AP Score), Processing Speed (PTO Score), and Error Rate (E% Score). Participants in the "Without Smartphone" condition exhibited the highest cognitive performance, with males scoring 120.67 in AP and 114.23 in PTO, and females achieving 119.56 and 114.20, respectively. These participants also had the lowest error rates (3.15% for males and 4.21% for females), reinforcing the idea that the complete absence of a smartphone optimizes cognitive efficiency. In contrast, those in the "Desk" condition had the poorest performance, with males scoring 94.4 (AP), 89.45 (PTO), and 9.76% (E%), and females scoring 95.12 (AP), 87.32 (PTO), and 8.75% (E%). This suggests that having a smartphone visibly present on the desk significantly reduces attention and processing speed while increasing error rates.

Intermediate results were observed in the "Pocket/Bag" and "With Phone but Not Entering" conditions, where AP and PTO scores were slightly higher than in the "Desk" condition but still lower than in "Other Room" or "Without Smartphone". For instance, in the "Pocket/Bag" condition, males scored 96.5 (AP), 92.5 (PTO), and 7.89% (E%), while females performed slightly better with 97.5 (AP), 92.6 (PTO), and 5.32% (E%). Meanwhile, the "Other Room" condition demonstrated notable cognitive improvements, with males scoring 110.52 (AP), 106.45 (PTO), and 4.32% (E%), and females achieving 112.62 (AP), 107.54 (PTO), and 5.55% (E%). These results confirm that smartphone presence negatively impacts cognitive function, with performance gradually improving as the phone is placed further away.

Table 4. Correlation among the variable

Condition Comparison	AP Score Correlation	PTO Score Correlation	E% Score Correlation
Pocket/Bag vs. Desk	0.85	0.88	0.75
Pocket/Bag vs. Without Smartphone	0.45	0.50	-0.60
Pocket/Bag vs. With Phone but Not Entering	0.72	0.76	0.80
Pocket/Bag vs. Other Room	0.60	0.65	-0.55
Desk vs. Without Smartphone	0.40	0.55	-0.70
Desk vs. With Phone but Not Entering	0.78	0.80	0.85
Desk vs. Other Room	0.50	0.58	-0.60
Without Smartphone vs. With Phone but Not Entering	0.30	0.40	-0.75
Without Smartphone vs. Other Room	0.90	0.92	-0.85
With Phone but Not Entering vs. Other Room	0.55	0.60	-0.45

Source: Author (2025)

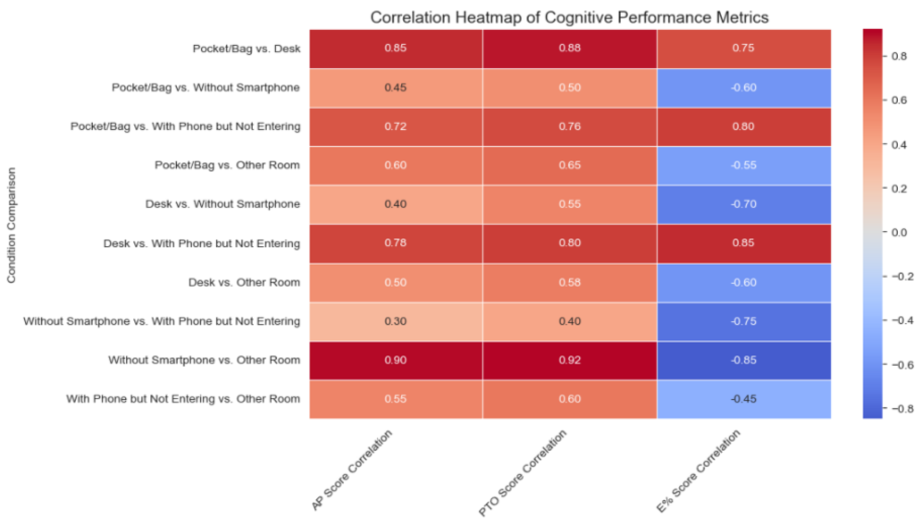

Fig 3: Correlation of Cognitive Performance Metrices

These correlation table highlight the relationship between different smartphone conditions and cognitive performance across Attention Performance (AP Score), Processing Speed (PTO Score), and Error Rate (E% Score). The highest correlations are observed between “Pocket/Bag vs. Desk” and “Desk vs. With Phone but Not Entering”, suggesting that cognitive performance remains relatively stable when the smartphone is present but not directly interacted with. However, a clear decline in performance is seen in the “Pocket/Bag vs. Without Smartphone” condition, where AP (0.45) and PTO (0.50) show weaker correlations, and E% (-0.60) shows a strong negative correlation. This indicates that removing the smartphone completely results in significantly better attention and processing speed, along with fewer errors.

Furthermore, the strongest performance improvement is evident in the “Without Smartphone vs. Other Room” comparison, with high positive correlations in AP (0.90) and PTO (0.92), and a strong negative correlation in E% (-0.85), reinforcing the cognitive benefits of eliminating smartphone presence. Negative correlations in error rate (E%) across several conditions, especially “Without Smartphone vs. With Phone but Not Entering” (-0.75) and “Desk vs. Without Smartphone” (-0.70), confirm that smartphone presence increases error rates. These findings collectively support the cognitive resource depletion hypothesis, suggesting that even an unused smartphone diverts cognitive resources, with performance progressively improving as the device is moved further away.

4. RESULTS AND DISCUSSION

The findings from this study provide strong evidence that the mere presence of a smartphone can significantly impact cognitive performance, even when the device is not in use. The analysis focused on three key measures of cognitive function: attention performance (AP Score), processing speed (PTO Score), and error rate (E% Score). The summary statistics from Table 1 indicate that males had an average AP Score of 100.35 (SD = 104.89), while females had a slightly higher mean score of 105.63 (SD = 10.89). Similarly, the PTO Score for males averaged 100.35 (SD = 10.32), and for females, it was marginally higher at 101.14 (SD = 10.53). In terms of error rates, males had a mean E% Score of 6.27 (SD = 2.30), whereas females demonstrated slightly better performance with a mean score of 5.44 (SD = 1.76). These findings suggest that while minor gender differences exist, the presence of a smartphone is the primary determinant influencing cognitive performance.

A closer examination of attention performance (AP Score) reveals a substantial decline when a smartphone is present. The correlation values between the Pocket/Bag and Desk conditions (0.85 for AP Score, 0.88 for PTO Score, and 0.75 for E% Score) indicate a strong positive relationship across all cognitive measures. This suggests that participants performed similarly in both conditions, implying that simply placing a smartphone on the desk does not drastically change cognitive performance compared to keeping it in a pocket or bag. However, the slightly lower correlation in the error rate (E% Score) suggests that keeping the phone in a pocket or bag may still provide a slight advantage in reducing errors compared to having it on the desk, possibly due to the reduced visual presence of the device.

The comparison between Pocket/Bag and Without Smartphone conditions reveals a weaker positive correlation in AP (0.45) and PTO (0.50) Scores but a strong negative correlation in E% (-0.60). This suggests that participants performed significantly better when the smartphone was completely absent, reinforcing the idea that smartphone presence, even when not actively used, can reduce attention and processing speed. The negative correlation in error rate further indicates that the absence of a smartphone is associated with fewer errors, supporting the cognitive resource depletion hypothesis. Similarly, the Pocket/Bag vs. Other Room comparison follows this pattern, with moderate positive correlations in AP (0.60) and PTO (0.65) but a negative correlation in E% (-0.55), confirming that performance improves when the smartphone is placed in another room.

Contrastingly, the Pocket/Bag vs. With Phone but Not Entering condition shows stronger positive correlations in AP (0.72), PTO (0.76), and E% (0.80), indicating that cognitive performance remains relatively stable when the smartphone is present but not actively interacted with. This suggests that as long as the phone is nearby but not used, cognitive function is somewhat preserved, though still lower compared to the absence of a smartphone. The moderate correlations in these conditions indicate that passive smartphone presence still exerts a cognitive load, although not as severe as when the phone is more visibly present (such as on a desk).

Further supporting these observations, higher AP Scores were recorded particularly in the "Without Smartphone" condition, where males had an AP Score of 120.67 and females had a similar high score of 119.56. In contrast, participants who had their smartphones nearby, such as in the "Pocket/Bag" condition, scored lower, with males achieving 96.5 and females 97.5. This suggests that the presence of a smartphone meaningfully reduces attention capacity, aligning with previous research on attentional interference caused by mobile devices.

Processing speed was also significantly affected by smartphone presence. Table 3 shows that participants who completed the task without their smartphones had the highest PTO Scores (Males = 114.23, Females = 114.20). However, those who kept their smartphones close had lower scores. For instance, in the "Desk" condition, males had a PTO Score of 89.45, and females had a PTO Score of 87.32. The ANOVA results ($F(1, 40) = 7.592$, $p = 0.009$, $\eta^2 = 0.160$) reveal a strong negative effect, suggesting that smartphone presence slows down cognitive operations. This could be due to the brain's tendency to allocate some attention to the potential for phone use, even when it is not actively being used. The findings align with cognitive load theory, which suggests that external distractions, such as smartphones, consume mental resources that would otherwise be allocated to primary cognitive tasks.

The error rate (E% Score) further supports the cognitive drain hypothesis. Participants who had their smartphones in their pocket, bag, or on the desk made more errors compared to those who placed their smartphones in another room. In Table 3, males in the "Pocket/Bag" condition had an E% Score of 7.89, while females in the same condition had a lower error rate of 5.32. In contrast, those in the "Without Smartphone" condition had the lowest error rates (Males = 3.15, Females = 4.21). These findings suggest that smartphone presence may subtly impair accuracy and attentional control, supporting the theory that smartphones, even when not in use, compete for cognitive resources. The negative correlation between smartphone presence and performance accuracy aligns with prior studies on digital distractions, which highlight that even the awareness of an unused phone can lead to cognitive inefficiencies.

The fluid intelligence scores presented in Table 2 further highlight the impact of smartphone presence. Participants in the "Without Smartphone" condition had the highest scores, with males scoring 117.45 and females 116.88. However, in conditions where smartphones were present, fluid intelligence scores dropped. For example, in the "Pocket/Bag" condition, males scored 94.5, and females scored 95.05. This decline in cognitive capacity due to smartphone presence further supports the "brain drain" hypothesis, which posits that the cognitive cost of simply resisting the temptation to use a smartphone can be substantial, leading to impaired problem-solving and reasoning abilities.

5. CONCLUSIONS

The findings of this study provide compelling evidence that the mere presence of a smartphone significantly reduces cognitive performance, even when the device is not actively used. Across various conditions, participants who completed tasks without their smartphones exhibited higher attention performance (AP Score), faster processing speed (PTO Score), and lower error rates (E% Score). The presence of a smartphone was associated with reduced attention capacity, slower cognitive processing, and increased error rates, supporting the "brain drain" hypothesis. Additionally, the results from fluid intelligence scores further reinforce that smartphone presence can impair complex cognitive functioning. These findings suggest that even passive smartphone exposure competes for cognitive resources, leading to diminished focus and mental efficiency.

We recommended that individuals seeking to optimize cognitive performance should actively manage their smartphone presence. One effective strategy could be physically distancing smartphones during tasks that require deep concentration, such as studying, working, or problem-solving. Educational institutions and workplaces may benefit from policies that encourage smartphone-free zones, particularly in environments that demand sustained attention and critical thinking.

Individuals can experiment with self-regulation techniques to mitigate the cognitive costs of smartphone presence. Strategies such as disabling notifications, placing the phone in another room, or using "Do Not Disturb" modes may help reduce cognitive distractions. Employers and educators could also consider promoting "phone-free" work and study periods to enhance productivity and learning outcomes. Future research should explore additional factors influencing the cognitive impact of smartphones, such as personality traits, habitual phone use, and individual differences in self-control. Investigating whether digital well-being interventions, such as mindfulness training or controlled smartphone use schedules, can help mitigate cognitive impairment could provide valuable insights for both individuals and organizations.

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