

Does Cell Phone Usage Have an Effect on Cognitive Flexibility?

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ABSTRACT

The usage of cell phones is intermittent with the daily activities thereby having a great impact on individual's life, thus it also has an impact on our cognitive functioning, such as cognitive flexibility. The purpose of the present study was to examine how the usage of cell phones impacted the cognitive flexibility of individuals. Thirty female graduate students, the age ranging from 20-25 years (mean age 22.22 years) participated in the study. Cell phone usage of the participants was assessed using the Mobile Phone Addiction Scale (Velayudhan & Srividya, 2012). Cognitive flexibility was measured using Stroop task and Switcher task available on an open source software known as PEBL (Mueller & Piper, 2014). One-way analysis of variance was used to find the effect of cell phone usage on the cognitive flexibility of the participants. The result indicated non-significant effect of cell phone usage on the cognitive flexibility of the participants. However, mean scores indicated that low cell phone users performed better on the measures of cognitive flexibility in comparison to high and moderate user groups.

1. Introduction

Cell phones are an integral part and platform of telecommunication; however, they are the greatly used amongst all the other forms of telecommunication. As it allows individuals to be in touch with each other irrespective of their distance and time limitations and there is no fear of interruption that may be caused due to movements such as walking and doing other activities. Because people can use it anywhere and at any time, it has also helped in making cell-phones a popular choice of communication. Due to the mobility of the device, it is also called 'mobile phone'. Cell phones are something that a person sees first thing in the morning after waking up and the last thing a person sees right before going off to sleep. A survey conducted on the average smartphone influx showed a rate of 44.6% in 47 countries, this rate is expected to have an increase over time at a greater pace (International Data Corporation, 2013; Our Mobile Planet, 2013).

There are many advantages of using cell-phones, such as an improvement in the social networking, an ascend in productivity, and a more dynamic and instant way of living and working. There are evidences suggesting that higher use of cell-phone leads to interference with daily lives of people (Clayton, Leshner, & Almond, 2015; Demirci, Akgonul, & Akpinar, 2015), and greatly with their safety (Cazzulino, Burke, Muller, Arbogast, & Upperman, 2014).

Excessive usage of cell-phone which can often lead to smartphone/cell phone dependency or "addiction" is a matter of great concern among behavioural scientists. It is also known as problematic cell-phone usage, if it is considered a type of addiction; it would fall under the category of behavioural addiction which has to do more with non-substance abuse rather than substance abuse. A recent study reported that the participants checked their phones over 34 times a day not necessarily because they really needed to check their cell phones that many times but rather it had simply become a

habit (Oulasvirta, Rattenbury, Ma, & Raita, 2012). excessive usage and habitual checking of their phones may gradually lead in compulsive usage and may even lead to mobile phone addiction for its users. (Bianchi & Phillips, 2005; Oulasvirta et al., 2012; Takao, Takahashi, & Kitamura, 2009). For a better understanding, it is important to understand addiction and its various processes. Addiction may be referred to as, being engaged in a behaviour repeatedly (Alexander & Schweighofer, 1988) or being 'highly devoted' to some activity or an individual (Levine, 2018).

Certain behaviours are performed that might have some impact on an individual's life, as several forms of addictive like behaviour exist those are on the verge of being diagnosed as a type of addiction, such high usage or problematic usage is a similar kind of problem that is seen with the usage of cell phones/ smartphones. For both substance and non-substance/behavioural addiction there are certain neuro-cognitive decline such as in the executive functioning. (Goudriaan, Oosterlaan, Beurs & Van Den Brink, 2006). Cognitive flexibility is a type of Executive functioning (Hughes et al., 2005).

Executive function is rather a broader term that integrates several higher order cognitive functioning. These higher order functions include functions like inhibitory control, working memory and also cognitive flexibility. Executive function is a type of top-down processing which is required for concentrating or paying attention in place of just relying on automatic, instinctual responses which will be insufficient or impossible. (Burgess & Simons, 2005; Espy, 2004; Miller & Cohen, 2000). Studies have shown that there are three major executive functioning (e.g., Lehto et al. 2003, Miyale et al. 2000) one of them being cognitive flexibility.

Cognitive flexibility is the capability of having alternative perspective or approaches to a problem, flexibly adjusting to

new demands, rules or priorities (as in switching between tasks) (Diamond, 2018). The neuropsychological basis of cognitive flexibility is very similar to the neurological underpinning of the executive functioning, that involves the prefrontal cortex in general and its related circuitry. Cognitive flexibility is believed to have an adaptive feature (Payne, Bettman and Johnson, 1993), for example in any given situation an individual may be expected to adapt and adjust to their environment. Thus, failure to attain such form of adaptability may be introduced using a different concept, cognitive inflexibility, where the individual is unable to adapt to the change and sustains to a previous idea, behaviour or situation. The lack of formal research on the usage of cell phone necessitates the study of research in other areas of cognition such as executive functioning. Excessive use of cell phones may be responsible for cell phone/Smart phone addiction. This in turn can affect cognitive flexibility of an individual

2. Methods

Participants

Participants who were willing to participate were recruited and were given a standardised test known as the MPAS used to find out the usage of cell phone. A participant pool of 67 females was obtained who were all between the age ranges 20-25 and enrolled in a post-graduate programme in Banaras Hindu University and did not have any physical illness or any psychiatric disorder or were suffering from any disability, any major developmental disorder, and history of substance abuse or use of any psychotropic drugs. Further, it is safe to say that convenient sampling was applied where the score on the MPAS divided the pool of participants into 3 stratus, high, moderate and low. Through the method of random selection 10 participants were further selected from each of the clusters.

Measures

Mobile Phone Addiction Scale. This scale is used to examine the usage of cell phone. This scale was developed by Velayudhan & Srividya (2012). The scale consists of thirty-seven items rated on a five-point Likert scale. The scale consists of six factors (sub-domains). The six domains being: Maladaptive usage, Self-expression, Peer relationship and mobile phone, Interpersonal relations, Impulsivity, Usage time. There are 34 positive items and three negative items. Scoring of positive items are done 5-1, where 5 is allocated to strongly agree and 1 to strongly disagree. The negative items are scored as 1-5, where 1 is strongly disagree and 5 is strongly agree. The scale score ranges from 37, indicative of low cell phone usage to 185, indicative of very high usage of cell phone usage. The alpha (test retest) reliability of the scale was found to 0.79 and the split half reliability index was found to be 0.75. The internal consistency reliability was found to be 0.89. Also, the validity that is, content and concurrent of the test is found to be high.

Psychology Experiment Building Language. The Psychology Experiment Building Language (PEBL) is a free, open-source software system developed by Mueller & Piper, (2014) that allows researchers and clinicians to design, run and share behavioural tests.

1. Stroop Task

In PEBL, there is implementation of Victoria Stroop Task developed by Regard (1981) which is described as “a very brief test that involves responding to many targets (either color or word) on a single screen” as is mentioned in the description box which appears when Stroop task is selected, on the top right-hand side corner of the Software window.

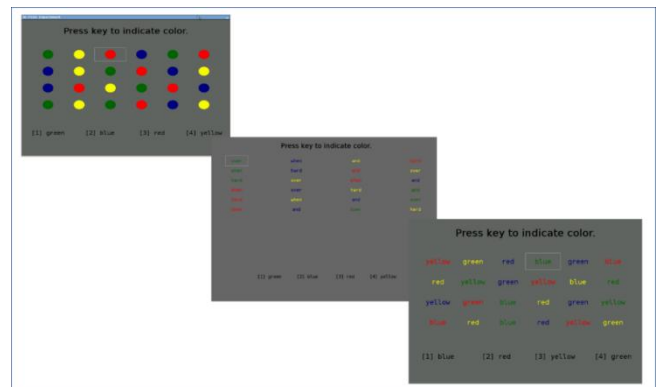


Figure 1. Visual representation of the sample trials in order of successive appearance on the stroop task.

2. Switcher task

The goal of this task is to compare the ability to flexibly switch between decision rules. This was developed by Anderson, Deane, Lindley, Loucks, & Veach, (2012). Participants must choose the next stimulus based on a rule that either rotates consistently between two rules, consistently between three rules, or inconsistently between three rules.

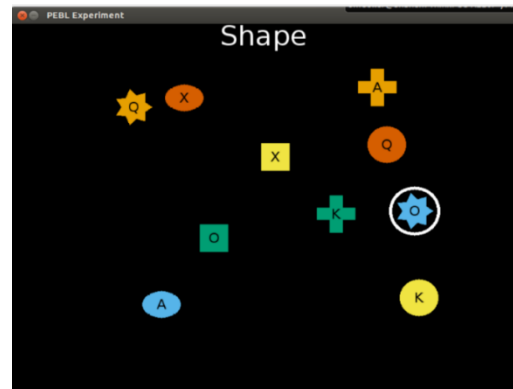


Figure 2: Visual representation of sample trial task of the switcher task.

Design

The present study used single-factor between group design. The scale was regarding cell phone usage (Mobile Phone Addiction Scale) and this scale is used to screen people and put them under different categories. Individuals in each category were then administered tasks on cognitive flexibility. Demographic variables were also noted.

3. Results

The data was analysed using Statistical Package for Social Science Version 20.0 (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0 Armonk, New York: IBM Corp, United States of America). One-way Analysis of Variance across the groups (High, Moderate, Low usage of cell phone) and the measures of cognitive flexibility (Stroop accuracy, Stroop RT, Switcher Accuracy, Switcher RT).

Table 1: Mean scores and SDs for the measures of Stroop accuracy and Stroop RT along with analysis of variance.

Variables	N	Mean	SD	F (2,29)	P
Stroop Accuracy					
Low Usage	10	97.45	1.57	0.28	0.757
Moderate Usage	10	96.15	6.18		
High Usage	10	96.57	2.57		
Stroop RT					
Low Usage	10	1682.57	342.22	0.97	0.391
Moderate Usage	10	1867.18	419.11		
High Usage	10	1877.24	278.27		

The results show that the groups did not differ significantly in accuracy analysis on Stroop task, $F(2, 29) = 0.28, p = 0.757$. Additionally, low cell phone usage group ($M = 97.45\%$, $SD = 1.57$) performed more accurately than moderate ($M = 96.15\%$, $SD = 6.18$) and high ($M = 96.57\%$, $SD = 2.57$) cell phone usage groups. The performance of participants in terms of response time on the Stroop task was measured for each

condition separately. The groups did not differ significantly in response time measure, $F(2, 29) = 0.97, p = 0.391$. Further, the low cell phone usage group ($M = 1682.57$ ms, $SD = 342.22$) showed a better performance than moderate cell phone usage ($M = 1867.18$ ms, $SD = 419.11$) and high cell phone usage group ($M = 1877.24$ ms, $SD = 278.27$).

Table 2: Mean scores and SDs for the measures of switcher accuracy and switcher RT along with analysis of variance

Variables	N	Mean	SD	F (2,29)	p
Switcher Accuracy					
Low Usage	10	98.75	1.33	2.71	0.084
Moderate Usage	10	96.24	3.57		
High Usage	10	97.63	1.71		
Switcher RT					
Low Usage	10	2755.07	514.16	0.69	0.508
Moderate Usage	10	2779.53	553.01		
High Usage	10	3019.39	592.09		

The performance of participants on the Switcher task was measured for each condition. The accuracy data analysis revealed that groups did not differ significantly on Switcher task, $F(2, 29) = 2.71, p = 0.084$, comparatively, the low cell phone usage group ($M = 98.75\%$, $SD = 1.33$) had greater accuracy than moderate ($M = 96.24\%$, $SD = 3.57$) and high ($M = 97.63\%$, $SD = 1.71$) cell phone usage groups. The performance of participants in terms of response time measure revealed that the groups did not differ significantly on switcher reaction time, $F(2,29) = 0.69, p = 0.508$. Furthermore, the low cell phone usage group ($M = 2755.07$ ms, $SD = 514.16$) had better performance in comparison to moderate cell phone usage ($M = 2779.53$ ms, $SD = 553.01$) and high cell phone usage groups ($M = 3019.39$ ms, $SD = 592.09$).

4. Discussion

The main objective of this study was to assess the degree of cell phone usage on cognitive flexibility of the participants. A scale was administered for categorizing participants into different groups of cell phone usage. The impact of the six sub-domains of the scale was examined on the different groups or conditions. The main findings include no significant difference existing in the cognitive flexibility of individuals with high, moderate and low usage of cell phone. Additional analysis on Stroop accuracy showed no significant difference among the three groups of cell phone usage. Further, the performance in

terms of reaction time measure on Stroop task revealed a non-significant difference among the three groups of cell phone usage. Similar findings were obtained from the analysis of Switcher task, which demonstrated no significant difference among the three groups of cell phone usage (low, moderate, high) on both accuracy and reaction time measure. Also, a further analysis of the descriptive of the present data, showed that participants in low cell phone usage group performed better on cognitive flexibility tasks in comparison to moderate and high groups of cell phone usage. Although much work hasn't been reported in this area, certain studies have found a fair share of link between cell phone usage and cognition. A recent study showed negative impact on cognitive flexibility regardless of the participants' degree of cell phone usage (Hartanto & Yang, 2016). However, the findings of the present study is not in the favour of the previous findings acquired from the research study, showing no significant difference in cognitive flexibility among the degree of cell phone usage, therefore the current findings do not fully support the finding of previous study.

Further research may possibly more beneficial by adding males as part of the research study. Also extending the study to other walks of life and not just to university students. In the present study there was no significant difference was found between the cognitive flexibility of low, moderate and high

users of cell phone which may be owing to a smaller sample. Therefore, a larger sample size might yield better results. Also, age is another factor which could be altered in the age group; rather than focusing on twenty to twenty-five year olds a wider age could be utilised or used to compare with other age groups.

Further study in this area could be beneficial in examining these measures, if any changes, occur that would reflect if there is any effect of cell phone usage on cognitive flexibility. It would also help in the understanding which usage condition, low, moderate, or high has the greater cognitive flexibility. The study can be extended to other age groups such as, it can be extended to children who are exposed to cell phones and how

its usage has an impact on the cognitive flexibility. Individuals with disorders like ADHD, anxiety, social anxiety and stress related disorders can also be screened for cell phone usage and its impact on cognitive flexibility.

5. Conclusion

The main findings of this research show that there is no significant difference in the usage of cell phone (that is, among low, moderate and high users) on cognitive flexibility of individuals. Further, longitudinal research as well as cross sectional studies are needed to be done in this area to investigate the impact the usage of cell phone has on cognitive flexibility.

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