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Evaluation of the Effects of Mobile Phone Usage on Selected Executive Functions, Age and Gender in Healthy Young Adults

Victoria O. Dimkpa[1] and Lekpa K. David[2*]

[1]Department of Biomedical Technology, School of Science Laboratory Technology, University of Port-Harcourt, Port-Harcourt, Rivers State, Nigeria.
[2]Department of Anatomy, Faculty of Basic Medical Sciences, University of Port-Harcourt, Port-Harcourt, Rivers State, Nigeria.

Authors' contributions

This work was carried out in collaboration between both authors. Author LKD designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Author VOD managed the analysis and the literature searches. Both authors read and approved the final manuscript

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ABSTRACT

Introduction: Despite a huge spike in smartphone usage, little is understood about whether increased usage affects executive functioning (EF) and the range of mental processes that aid goal attainment.
Aim: Evaluation of the effects of mobile phone usage on selected executive functions, age and gender in healthy young adults.
Methodology: A total of 500 students randomly selected from the University of Port-Harcourt were recruited into the study. Different ages specified by the respondents through structural.
Questionnaires were used. Data obtained from the retrieved questionnaire were analyzed using multiple STATGRAPHICS for the descriptive statistics. While SPSS was used for the inferential statistics.

**Corresponding author: E-mail: lekpa.david@uniport.edu.ng;*

Results: There was no significant association between phone usage/ownership and working memory, attention capacity, time management, flexibility and stress tolerance. The result however showed that, smart phone users showed less working memory, higher attention capacity, higher time management ability, more flexibility, less stress tolerance than non-smart phone users. Male respondents showed better attention capacity, time management ability and stress tolerance than the female while respondents above 18years showed better working memory, more attention capacity, time management ability and more flexibility than those ≤18years.
Conclusion: Smart phone users were found to have challenges with some executive functions, particularly, stress tolerance and working memory.

Keywords: Mobile phone; flexibility; executive; questionnaires; memory.

1. INTRODUCTION

A mobile phone is a device that make and receive telephone calls over a radio link while moving around a wide geographic area [1]. Mobile devices have become very necessary to people's lives by offering a myriad of functions [1-2]. Smartphone technology, is taking on an increasingly larger role in our daily mental activities [3]. The Pew Center also indicated that, in 2018, 94% of people from age 18 to 29 owned a smartphone. To date, a possible attempt to determine the relationship between mobile device and executive functioning has not been successfully achieved. Some studies however, suggested a benefit of exposure, including improved task switching [4] and attentional control [5]. Conversely, research has also demonstrated a negative relationship, including reduced task switching ability [6] decreased attentional capacity [7-8] and working memory deficits [9-14]. Moreover, smartphone use has been found to impair working memory through inducing separation anxiety [15]. Excessive smartphone use may also be related to reduced brain functional connectivity in regions associated with cognitive control: the orbitofrontal cortex (OFC), nucleus accumbens (NAcc) and midcingulate cortex (MCC) [16]. Despite evidence of interesting and complex associations, there is a shortage of experimental research in this area. While access to smartphone technology has grown, so too has the body of literature investigating the concurrent and immediate residual inhibitory effects of these devices on certain forms of cognition [17-18]. Given the saturation of screen-based and mobile devices in society, objective scientific research into the effects of exposure on a variety of populations is needed to inform public policy. Our study, however, focused on the evaluation of the effects of mobile phone usage on selected executive functions, age and gender in healthy young adults.

2. MATERIALS AND METHODS

This study is a descriptive survey research. A sample size of five hundred (500) respondents randomly selected from the University of Port-Harcourt, School of Basic Studies who met the criteria for the study were used. Every member of the population had an equal Probability of Selection (EPS). The samples included male of different ethnic and religious background. All participants were students receiving education in the University of Port-Harcourt. The students and their lecturers were reached as a result of repeated visits by researchers.

2.1 Study Protocols

The major instrument for data collection was the questionnaire; the questionnaires were adequately evaluated and edited in order to guarantee its suitability for the study. The questionnaire was divided into three (3) sections; section A, B and C. Section A is concerned with demographic data of the respondents, section B contains the research question on assessment of cognitive skills of the students while section C assessed how mobile phone has affected academic performance of student. A detailed explanation of the aim and importance of the study was done to the respondents, to enable us meet the target of the research. They were also assured that every information given would be handled confidentially. As soon as consent was obtained, the respondents were requested to manually fill the questionnaire. The questionnaires were administered by the author, who resides in the neighborhood of the University. The data collected were assessed for completeness and responses failing to meet the 75% cut-off (on all valid questions) were excluded. The questionnaire was adopted from Peg Dawson and Richard Guare.

2.2 Inclusion Criteria

2.2.1 The inclusion criteria for the study include

- ✓ Human subjects
- ✓ Students from same institution (University of Port-Harcourt)
- ✓ Consenting teenagers and adults using a mobile phone.
- ✓ Young adults that does not have any visual or auditory deficiencies.
- ✓ Physically and mentally healthy

2.3 The exclusion criteria include

- ✓ Non-human subjects
- ✓ Students from a different institution
- ✓ Young adults that have any visual or auditory deficiencies.
- ✓ Mentally unhealthy

2.4 Research Questions

1. What effects does mobile phone use by students affects working memory, cognitive flexibility, attentional capacity, time management, stress tolerance?
2. What effects does mobile phone usage have on age and gender?
3. What is the association between sex and age on selected executive functions (working memory, cognitive flexibility, attentional capacity, time management, stress tolerance)?
4. What is the extent of the relationship between the different executive functions?

2.5 Statistical Analysis

The statistical tools used for this study were STATGRAPHICS centurion CVI version 16.1.11 (StatPoint Tech., Inc.) and Statistics Package for Social Science (SPSS IBM® Amos V21.0.0, USA).

3. RESULTS AND DISCUSSION

Multifactor ANOVA map for demographic differences in working memory: Fig. 1 shows no significant association between age, sex, smart phone usage and working memory. The result however showed that, smart phone users showed less working memory than non-smart phone users. Female respondents showed better working memory than males while respondents above 18years showed better working memory than those ≤18years.

Multifactor ANOVA map for demographic differences in attention capacity: Fig. 2 revealed no significant association between age, sex, smart phone usage/ownership and attention capacity. However, smart phone users showed higher attention capacity than non-smart phone users. Male respondents showed more attention capacity than female respondents while those greater than 18year showed more attention capacity than those ≤18years.

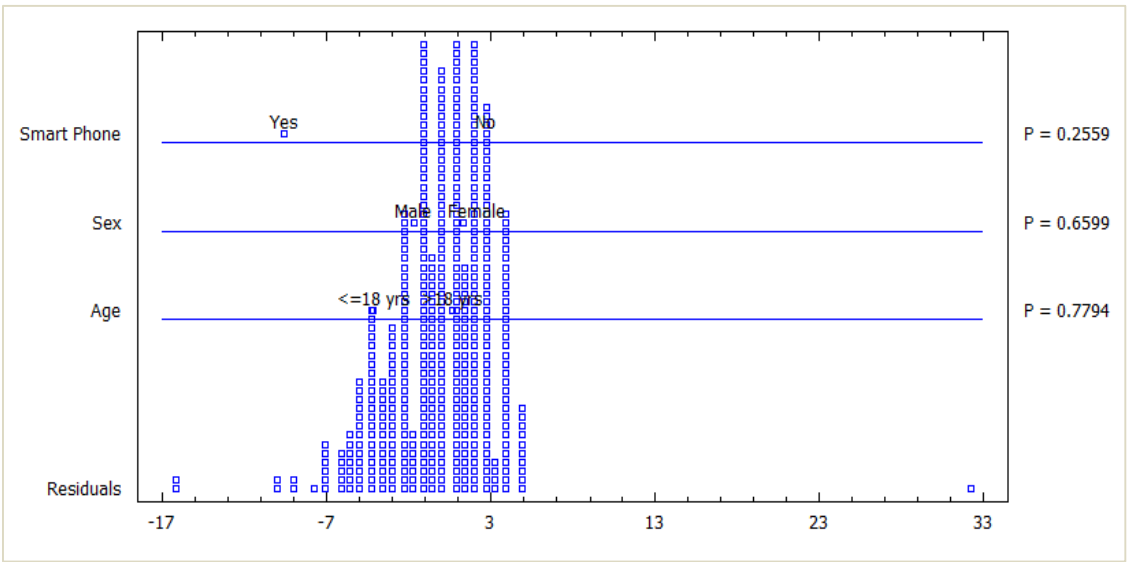

Fig. 1. Multifactor ANOVA map for demographic differences in working memory

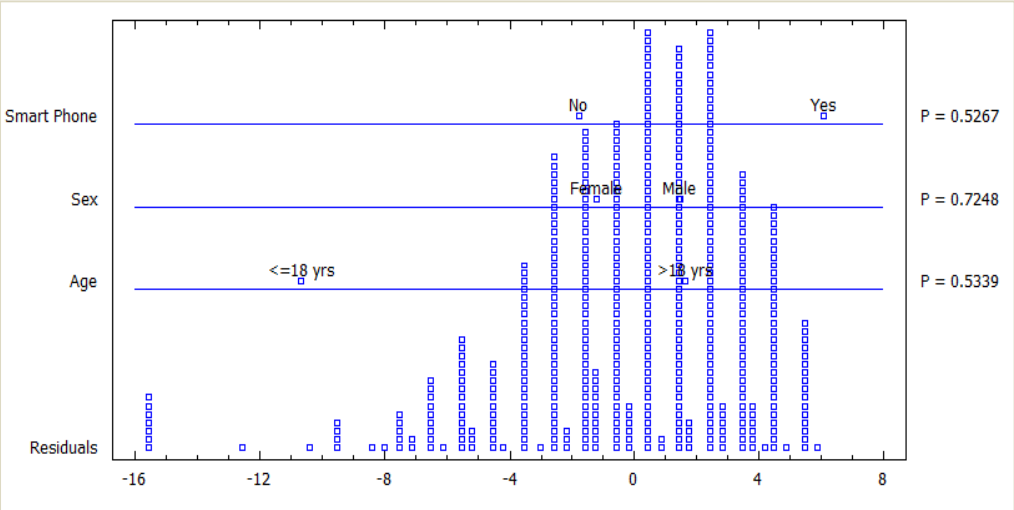

Fig. 2. Multifactor ANOVA map for demographic differences in attention capacity

Multifactor ANOVA map for demographic differences in time management: Fig. 3 shows no significant association between age, sex and smart phone ownership and time management. The result revealed that smart phone users showed higher time management ability than non-smart phone users. Male respondents showed more time management ability than female respondents while those greater than 18year showed more time management ability than those ≤18years.

Multifactor ANOVA map for demographic differences in flexibility: Fig. 4 clearly reveals no significant association between age, sex, smart phone ownership and flexibility. The result revealed that smart phone users showed more flexibility than non-smart phone users. Female respondents showed more flexibility than male respondents while those greater than 18year showed more flexibility than those ≤18years.

Multifactor ANOVA map for demographic differences in stress tolerance: Fig. 5 does not show any significant association between age, smart phone ownership and stress tolerance. However, except for males that had significant higher stress tolerance compared to females (P=0.013). The result revealed that smart phone users show less stress tolerance than non-smart phone users. Female respondents showed less stress tolerance than male respondents while those greater than 18year showed less stress tolerance than those ≤18years.

The study aims to evaluate the effects of mobile phone usage on selected executive functions, age and gender in healthy young adults. The results shows that, smart phone users show less working memory which validates [15], who links smartphone use to impair inhibition and working memory through separation anxiety.

Furthermore, smart phone users showed higher attention capacity than non-smart phone users, this varies with [19] who suggested that regular engagement with phone devices can lead to diminished attentional capacity, producing shorter attention spans and “scatter-brained” tendencies among those who are most invested with the devices. Male respondents showed more attention capacity than female respondents while those greater than 18years showed more attention capacity than those ≤18years; this is in line with [20] who stated that the current generation of adolescents is developing increasingly shorter attention spans due to their increased contact with mobile phone technology.

The study further posited that smart phone users show higher time management ability than non-smart phone users. Male respondents showed more time management ability than female respondents while those greater than 18years showed more time management ability than those ≤18years.

Furthermore, smart phone users showed more flexibility than non-smart phone users. Female respondents showed more flexibility than male respondents while those greater than 18years showed more flexibility than those ≤18 years.

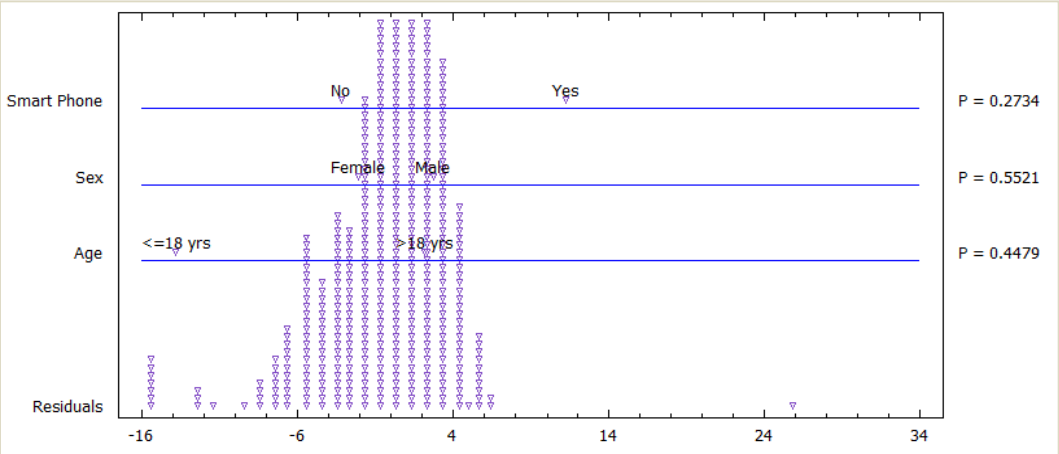

Fig. 3. Multifactor ANOVA map for demographic differences in time management

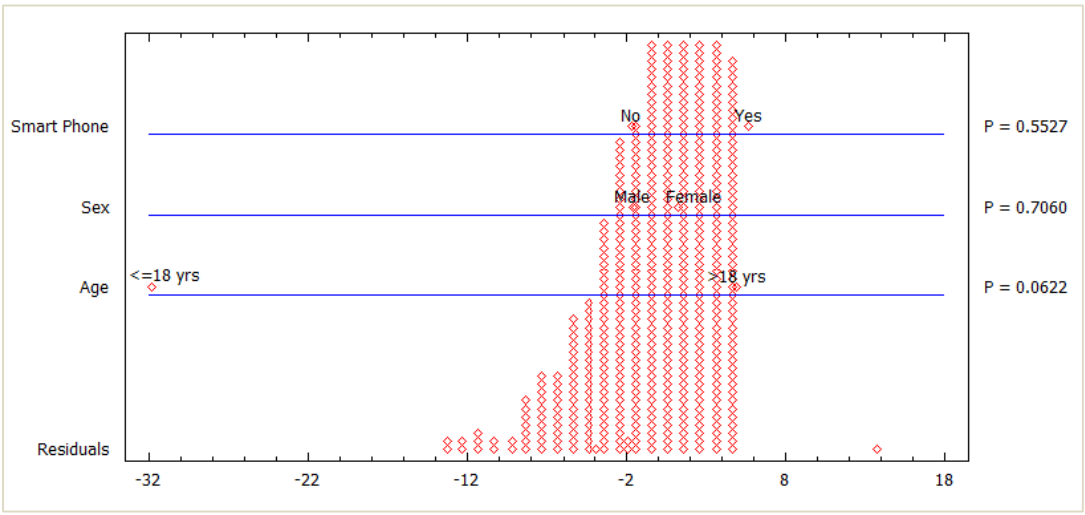

Fig. 4. Multifactor ANOVA map for demographic differences in flexibility

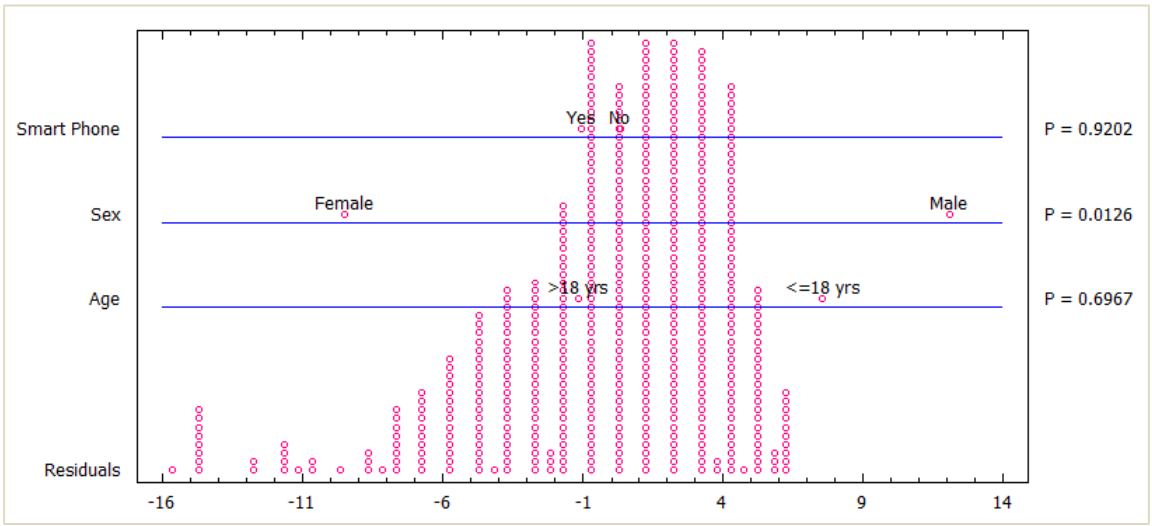

Fig. 5. Multifactor ANOVA map for demographic differences in stress tolerance

More so, males had significant higher stress tolerance compared to females (P=0.013). The results revealed that smart phone users exhibit less stress tolerance ability than non-smart phone users. Female respondents showed less stress tolerance than male respondents while those greater than 18years showed less stress tolerance than those ≤18years.

Distraction was found to have a significant relationship with stress (P=0.033). In addition time management and flexibility showed a strong significant relationship **(**r=0.512**),** followed by flexibility and stress tolerance (r=0.461) as well as time management and stress tolerance (r=0.453).

4. CONCLUSION

The results from the current study established that advanced mobile technology is a double-edged sword because smartphones are useful and convenient; but higher usage could negatively affect individuals' executive function depending on age and gender. The study established that stress and distraction were strongly associated with the use of mobile phone. Also, smart phone users were found to have stress tolerance ability.

DISCLAIMER

The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

CONSENT

Also, informed consent was obtained from respondents after explaining to them the objectives of the study in the language they understood. Only those who met the inclusion criteria were recruited for data collection. They were equally told that they are free to withdraw from the study at any time. They were assured of confidentiality and their right to privacy was assured and maintained.

ETHICAL APPROVAL

The present study was approved by the relevant ethical committee of our institution, and has therefore been performed in accordance with the ethical standards laid down by the University.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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