Journal of Research in Medical and Dental Science
2020, Volume 8, Issue 3, Page No: 1-5

Available Online at: www.jrmds.in
eISSN No.2347-2367: pISSN No.2347-2545

Correlations Among IQ, Visual Memory Assessed by ROCF Test and GPA in University Students

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ABSTRACT

Introduction: It is well known that cognitive ability tests predict academic performance. This study was conducted to reinvestigate the effects of IQ assessed by Wonderlic Cognitive Ability Test and Immediate recall (short-term visual memory) and Delayed recall (long-term visual memory) subtests of the ROCF on GPA in university students.

Methods: A total of 125 Nigerian university students were involved in the study. Participants were 63 men and 62 women who were 16-18 years of age. The Rey-Osterrieth Complex Figure (ROCF) test developed by Rey and standardized by Osterrieth used to screen for visual memory. To get their full-scale IQ scores were used the Wonderlic Personnel Test Quicktest.

Results: There were a strong positive correlation between GPA and IQ and short-term and long-term visual memories in total sample as well as men and women. GPA was not correlated with IQ in medicine students. But short-term and long-term visual memories were highly correlated with GPA.

Conclusion: Because visual memory tests are culture and language free international tests, the universities can use visual memory tests firstly and IQ tests secondarily to predict their academic performance.

Key words: IQ, GPA, Visual memory, Academic performance

HOW TO CITE THIS ARTICLE: Ochilbek Rakhmanov, Senol Dane,Correlations Among IQ, Visual Memory Assessed by ROCF Test and GPA in University Students, J Res Med Dent Sci, 2020, 8(3): 1-5

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Received: 28/03/2020
Accepted: 14/04/2020

INTRODUCTION

It has been well documented that cognitive ability tests predict academic performance [1]. Academic performance is a criterion for validating IQ tests. However, IQ tests rarely account for more than 50% of the variance in academic performance [2,3], suggesting that factors other than ability contribute to individual differences in academic performance.

General mental abilities or general cognitive ability and general intelligence is a well-researched construct with impressive supporting evidence for its capacity to predict important outcomes such as job performance and career success [4,5]. There is also relatively strong evidence of predictive power of general mental ability on students' academic performance [6].

Emotional intelligence may be an important factor in predicting performance over and above general mental ability. In addition to analytic and reasoning abilities and specific knowledge, abilities that are related to social interactions are important determinants of performance [7,8]. However, general mental ability predicts job performance across jobs and settings primarily by predicting learning and the acquisition of job knowledge, rather than by predicting the quality of social interactions [9,10]. Like other forms of human performance, students may need both cognitive abilities, such as language and reasoning, and emotional abilities, such as being able to stay calm before and during examinations in order to perform well academically [11].

An intelligence quotient (IQ) is a total score derived from a set of standardized tests or subtests designed to assess human intelligence. Children with high IQ test scores, for example, tend to do better at school than those with lower test scores. Up to university level, indeed, educational attainment is moderately well predicted by IQ [12]. The Wonderlic Personnel Test, also called the Wonderlic Cognitive Ability Test, is designed to measure cognitive ability by assessing mathematics skills, logic skills and verbal reasoning [13]. Wonderlic stated that the test correlates very highly (r=.92) with the Wechsler adult intelligence scale-revised [14], making it an ideal option for collecting IQ data under time-constraints.

The Rey-Osterrieth Complex Figure (ROCF) test is a non-verbal neuropsychological test and is used for the evaluation of visuospatial and visual memory [15]. Immediate recall (short-term visual memory) and delayed recall (long-term visual memory) can be assessed using the ROCF test. Immediate recall and delayed recall are closely related to the accuracy in visual memory [16]. In a recent study, there were negative correlations between depression score and short-term and long-term visual memories assessed by this test and positive correlations between GPA and short-term and long-term visual memories [17].

This study was conducted to explore the effects of Intelligence (full scale intelligence) (IQ) assessed by Wonderlic Cognitive Ability Test and Immediate recall (short-term visual memory) and Delayed recall (long-term visual memory) subtests of the ROCF on GPA in university students. In addition, we aimed to investigate if GPA can be predicted by using IQ and visual memory tests.

METHODS

Participants

Students (One hundred twenty-five) who had classes at the time of the study were approached and requested to participate in the study. All of them accepted to participate in this study (63 men, average age=18.444 years, standard deviation, SD=2.428: 62 women, average age=17.307, SD=1.196). They were the first-year students of the four different departments (Computer Science (N=56), Information Technology (N=7), Medicine (N=51) and Software Engineering (N=11)) at Nile University of Nigeria, private tertiary institution in Abuja, Nigeria. The age of the participants was not different statistically by sex and department.

Inclusion criteria

Willingness to participate.

Only university students could participate.

Only undergraduate students studying were included in the study.

Exclusion criteria

The study excluded participants that were not willing to be involved.

Students with respiratory, metabolic, cardiac, psychiatric or central and autonomic nervous system disease that might change the IQ and visual memory scores were not involved.

Procedure

The experimental protocol was by following international ethical standards. The study was performed per under the Helsinki Declaration (1975, revised in 1996-2013). It was a descriptive cross-sectional study. The aims and objectives of the study were explicitly explained to the participants before the commencement of the study. All participants voluntarily gave written informed consent to participate in the study. The study was anonymous. A paper-and-pencil based method of filling questionnaires was utilized. All questionnaires were distributed only among first-year students of medicine and computer science departments. The study was made between December 2019 and January 2020. Only one examiner (Ochilbek Rakhmanov) has collected and validated all the data to avoid the possible errors.

Procedure for full-scale IQ test (The Wonderlic Personnel Test Quicktest)

The Wonderlic Personnel Test Quicktest, or The Wonderlic Cognitive Ability Test is a timed 8-minute test made up of 30 questions worth one point each. Scores can range from 0 to 30. Items include number comparisons, serial analysis of geometric figures, mathematical and logical problems [13]. Students were given the test and were requested to finish in 8-minute period. No time extension was given.

Procedure for Rey–Osterrieth Complex Figure Test (ROCF)

The following instructions to conduct the ROCF test were followed [18].

All students were given 2 pieces of a blank sheet and were told they would be given a figure which they need to copy to blank paper in front of them. They were also informed that details are important rather than beauty and colorfulness of the picture. Finally, a copy of ROCF is given to everyone at the same time. The time limit was given as 3 minutes, but nearly everyone finished in 2 minutes time period.

All sketched papers and original ROCF papers were collected by the invigilator, which took approximately 2-3 minutes. So, by the instructions of (Meyers et al.), a break of 3 minutes was given [19].

Once Step 2 is done, students were requested to sketch the figure from their memory on a 2nd blank sheet. The time limit was given as 3 minutes again, and all figures were collected back once sketches are done. These sketches served as the Immediate Recall test.

Meyers, et al. suggested using 30-45 minutes time interval between the Immediate and Delay Recall test [19]. They also suggested using conducting some verbal tasks in between this interval. So, we discussed with students about modern scientists and inventors and their impacts on modern technology. This process took between 32-37 minutes in our case.

Lastly, students were given a blank sheet and requested to draw ROCF again from their memory. These sketches were served as the Delay Recall test.

Scoring of ROCF test

A quantitative scoring system was used. In Rey's scoring system, the ROCF stimulus is divided into 18 sections/

units and each unit is scored separately in terms of both accuracy and placement. A standardized scoring system proposed by Meyers and Meyers was presented in Table 1 [19]. The total score of every sketch may range from 0.0 to 36.0. The scoring of the pictures was done by researchers personally.

Table 1. Scoring of ROCF test.

Score	Accuracy	Placement
2	Accurately drawn	Correctly placed
1	Accurately drawn	Incorrectly placed
1	Inaccurately drawn	Correctly placed
0.5	Inaccurately drawn, but recognizable	Incorrectly placed
0	Inaccurately drawn and unrecognizable, or omitted	Incorrectly placed

Statistical analyses

Measured values are given as a mean +/- standard deviation (SD). Statistical analysis was performed using SPSS for Windows version 18. The Pearson correlation test was used. A p-value of less than 0.05 was considered statistically significant.

RESULTS

In the total sample, there were significant positive Pearson Correlations between GPA and other parameters (IQ (r=0.396, p=0.00), short- (r=0.435, p=0.00) and long-term (r=0.453, p=0.00) visual memories) (Table 1).

Like total sample, in male subjects, there were significant positive Pearson Correlations between GPA and other parameters (IQ (r=0.395, p=0.001), short- (r=0.341, p=0.006) and long-term (r=0.394, p=0.001) visual memories) (Table 2).

Also, in female subjects, there were significant positive Pearson Correlations between GPA and other parameters (IQ (r=0.344, p=0.006), short- (r=0.458, p=0.00) and long-term (r=0.436, p=0.00) visual memories) (Table 2).

Table 2: Correlations between GPA and other parameters (IQ, short- and long-term visual memories) by gender.

Parameters/Gender	Total Sample (N=125)	Men (N=63)	Women (N=62)
IQ	r=0.396, p=0.00	r=0.395, p=0.001	r=0.344, p=0.006
Short-term Visual Memory	r=0.435, p=0.00	r=0.341, p=0.006	r=0.458, p=0.00
Long-term Visual Memory	r=0.453, p=0.00	r=0.394, p=0.001	r=0.436, p=0.00
r: correlation value, p: significance value			

In computer science students, there were significant positive Pearson Correlations between GPA and other parameters (IQ (r=0.381, p=0.004), short- (r=0.297, p=0.026) and long-term (r=0.314, p=0.018) visual memories) (Table 3).

Like computer science students, in medicine students, there were significant positive Pearson Correlations between GPA and short- (r=0.507, p=0.00) and long-term (r=0.515, p=0.00) visual memories, but not between IQ and GPA (Table 3).

Unlike computer science students, in information technology and software engineering students, there were no significant correlation between GPA and other parameters (IQ, short- and long-term visual memories) (Table 3).

Table 3: Correlations between GPA and other parameters (IQ, short- and long-term visual memories) by subjects' departments in university.

Parameters/Departments	Computer Science (N=56)	Information Technology (N=7)	Medicine (N=51)	Software Engineering (N=11)
IQ	r=0.381, p=0.004	r=-0.03, p=0.949	r=0.107, p=0.453	r=0.277, p=0.409
Short-term Visual Memory	r=0.297, p=0.026	r=0.006, p=0.99	r=0.507, p=0.00	r=0.278, p=0.407
Long-term Visual Memory	r=0.314, p=0.018	r=0.081, p=0.862	r=0.515, p=0.00	r=0.257, p=0.445
r: correlation value, p: significance value				

DISCUSSION

If GPA is accepted as a dependent factor and but others (IQ and short-term and long-term visual memories) are independent factors in university students, there were a strong positive correlation between GPA and other independent factors in total sample as well as men and women in the present study. The results of the present study suggest that GPA can be predicted partially from IQ and short-term and long-term visual memories. These results were supported by a previous recent study [17].

While full scale IQ is correlated with GPA in total sample as well as men and women, it was not correlated in medicine, information technology and software engineering students. The non-significance in information technology and software engineering students may be due to few numbers of subjects. Also, GPA was not correlated with IQ in medicine students. But, short-term and long-term visual memories were highly correlated with GPA. These results show that short-term and long-term visual memories are more determining factors in prediction of GPA in university students. Also, visual memory tests are culture and language free international tests. Therefore, universities can use visual memory tests firstly and IQ tests secondarily.

Openness was found to mediate the links between IQ and academic performance, suggesting that individuals with higher IQ obtain higher grades only because they are more open to new experiences. Likewise, deep learning mediated the effects of IQ on academic performance, suggesting that IQ led to higher academic performance because individuals with a higher IQ employed a deep learning approach [20].

In a study, it has been reported that both short-term memory and working memory were related in reading comprehension and mathematics performances in children and adults with learning disabilities; however, working memory is more important for children and adults without learning disabilities. In contrast to working memory, short-term memory contributed minimal variance to word recognition in both ability groups. Overall, it was concluded that short-term memory and working memory reflect different processes, both of which seem to separate the two ability groups [21]. Also, in a recent study, there was negative correlation between the Draw-A-Man Test score and classroom behavioral performance score in VADRS. Additionally, there was positive correlation between the Draw-A-Man Test score and academic performance score [22].

The "American Dream" was coined by the American writer and historian Adams, et al. in the 1930s [23] to describe the U.S. national ethos. This ethos proposes an opportunity for wealth, health, and well-being for each individual according to ability (e.g., intelligence [IQ]) and effort (e.g., as manifested in achieving a high grade point average [GPA]), regardless of social class (e.g., socioeconomic status [SES]) or circumstances of birth (e.g., gender or ethnicity). The idea of the "American Dream" is still alive. However, because the U.S. has undergone major social, political, and economic changes in recent decades [24], it seems justified to ask whether these changes affected core assumptions of the "American Dream." Studies have established that individual differences in characteristics that are central to the American Dream (e.g., IQ, GPA, SES) can significantly predict key life outcomes (e.g., educational and occupational success, health) across the life span [25,26]. However, empirical findings are still limited with respect to how individual difference variables and social environmental factors might interact in achieving these outcomes [27].

CONCLUSION

These results show that short-term and long-term visual memories are more determining factors than full scale IQ in prediction of GPA in university students. Because visual memory tests are culture and language free international tests, the universities or tertiary schools can use visual memory tests firstly and IQ tests secondarily to predict GPA or academic performance of their students.

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