Volume : 5 | Issue : 2 | February 2016 • ISSN No 2277 - 8179

Research Paper

A Study of Correlation between Alpha Appearance Time in EEG and I.Q.

Medical Science

KEYWORDS : I.Q., Alpha Appearance Time, Alpha Index, EEG

Dr. Prabhat Kumar Budholia — Associate Professor- Department of Physiology, N.S.C.B. Medical College Jabalpur MP

Dr. Ajay Kumar Mishra — Assistant Professor- Department of Physiology, N.S.C.B. Medical College Jabalpur MP

ABSTRACT

Purpose of this study is to observe correlation between IQ and alpha appearance time of EEG in young medical students. Correlation of alpha activity with intelligence is an important variable that sought a lot of attention of various investigators and has a long history. An electroencephalogram (EEG) is a neuroimaging technique that enables, using many sensors on the scalp, a measure of electrical activity from neurons in the brain. EEG recordings can measure Alpha activity because it is the largest, most easily identifiable signal in the brain. In trials, alpha index measurement involved long and cumbersome computations as compared to alpha appearance time measurement i.e. time for alpha pattern to appear after closure of eyes. Alpha appearance time is very simple to measure and involves only one time measurement. For doing the I.Q. test of students, Jalota's Group test for General Mental Ability was used.

Introduction

The intelligence of an individual has always been an intriguing subject. Why is one person more intelligent than another? Is this due to genetic influences or environmental influences? Does the personality of a person have any influence over intelligence? Are the psychological measures of intelligence adequate to gauge a person's intelligence, Can a person become more intelligent by controlling environmental influences? The understanding of biological basis of intelligence requires detailed analysis of neurophysiological processes contributing to particular aspect of mental abilities. Despite the advent of modern brain imaging techniques, the electroencephalogram still plays the main role as a tool for investigating brain functioning in normal healthy humans.

Correlation of alpha activity with intelligence is an important variable that sought a lot of attention of various investigators and has a long history. The earliest studies utilized only mentally defective subjects. Berger in 1931 compared EEG of normal people with imbeciles, but he found no significant difference in EEG of normal and imbeciles. Knott et al in 1942 reported statically significant relationship between occipital alpha frequency and intelligence in children. They found normal adult with faster alpha frequency scored higher I.Q. as compared to person with slower alpha frequency.

Mundy Castle 1958 found that normal adults with faster alpha frequencies scored higher I.Q. as compared to the person with slower alpha frequency. In1960 Netchine and Lairy found in their study that occipital alpha frequency correlated very significantly with IQ, higher frequencies corresponding with the higher IQ.

An electroencephalogram (EEG) is a neuroimaging technique that enables, using many sensors on the scalp, a measure of electrical activity from neurons in the brain. EEGs are used not only in research settings, but also clinical settings to help with the diagnosis of attentional difficulties and much more. The EEG machine can pick up where brainwaves are highest in frequency, which could be at the front part of the brain, the back, or anywhere in between. When brainwaves 'light up' in a region they show coherence, which means brain regions are operating together. EEG recordings can measure Alpha activity because it is the largest, most easily identifiable signal in the brain. In trials, alpha index measurement involved long and cumbersome computations as compared to alpha appearance time measurement i.e. time for alpha pattern to appear after closure of eyes. Alpha appearance time is very simple to measure and involves only one time measurement.

Objective of Study

Purpose of this study is to observe correlation between IQ and alpha appearance time of EEG in young medical students.

Material and Method:

The present work was undertaken in department of physiology, N.S.C.B. Medical College, Jabalpur, M.P. The subjects comprised of both male and female 120 young medical students of age group 18 to 21 years, selected randomly, studying in first M.B.B.S. classes.

EEG recording for Alpha Appearance Time:

For recording of EEG, Medicare 8-channel EEG Machine was used. Students were instructed to come with certain preparations. They were requested to wash their hair and scalp with soap or preferably shampoo and not to apply any oil to their hair or scalp on the day their EEG was to be done.

The EEG of students was recorded on Medicare 8-channel EEG Machine using 10/20 international system of electrode placement over scalp. EEG recording was done for 1 minute, with the subject's eyes open. Then the subject was asked to close his eyes. The genesis/appearance of alpha wave was studied in the posterior i.e. occipital lobes bilaterally. Calculation of alpha appearance time was done as follows:

Because EEG paper moved at a speed of 5 cm = 50 mm in 1 second i.e. 1000 milliseconds. Therefore, 1 mm distance on EEG paper represented 20 milliseconds. Distance on EEG paper from the point of closure of eyes to appearance of alpha wave was measured. This distance in mm when multiplied by 20 gave the alpha appearance time, in EEG, in milliseconds.

I.Q. Test:

For doing the I.Q. test of students, Jalota's Group test for General Mental Ability was used. The test consisted of 100 questions, covering various aspects of intelligence, based upon logical, reasoning, imaginative and numerical abilities of the candidates. While doing the I.Q. test, 20 students were taken at a time. In the first 15-20 minutes, nature of the test was explained. Students were given proper instructions about filling of the answer sheet, marking of the correct response i.e. answer. Examples of various series and types of questions with their correct answers were given to the students. The students were told that the time limit for test was 20 minutes and in these 20 minutes time only, they had to attempt all 100 multiple choice questions and write their responses i.e. answers in answer sheet. They were advised not to waste time on any one question that they found difficult, and to do as many questions as possible first, and then to attempt the difficult left over questions later, if time permitted. As the duration of time for test i.e. for answering 100 multiple choice questions was 20 minutes, at every interval of 5 minutes, students

Volume : 5 | Issue : 2 | February 2016 • ISSN No 2277 - 8179

were prompted about time. At the end of exactly 20 minutes, answer sheets were collected and evaluated.

Based upon the number of right answers, mental age of individual student was drawn and taking 192 months as chronological age of all students, [it is said that I.Q. increases up to the age of 16 years only, after that only experience adds up] and using the formula:

I.Q. = [Mental age/ Chronological age] multiplied by 100 Individual student's I.Q. was calculated.

Observation:

Table- 1

Table showing mean age of the students

Cases	Number	Mean Age (in years)	F-value	p-value
Total	120	18.90±0.95	1.94	>.05
Male	62	19.01±1.0		
Female	58	18.78±0.88		

Table- 2

Table showing mean Intelligence Quotient (I.Q.)

Cases	Number	Mean I.Q.	t-value	p-value
Total	120	118.75±18.64	0.36	>.05
Male	62	119.35±17.63		
Female	58	118.10±19.81		

P value is not significant; it is evident that IQ scores of male and female group do not differ significantly.

Table- 3

Table showing Mean Alpha Appearance Time in all cases, male and female groups

Cases	Number	Mean Alpha Appearance Time (in milliseconds)	t-value	p-value
Total	120	573.46±311.78	1.20	>.05
Male	62	606.29±318.86		
Female	58	538.36±302.83		

Table is clearly depicting that there is no significant difference in Mean Alpha Appearance Time in either sex group.

Table- 4

Table showing Correlation Coefficient between Alpha Appearance Time and (I.Q.)

Variables	Mean Value	No. of Cases	Correlation Coefficient	t-value	Significance
I.Q. Score	118.75±18.64	120	-0.4975	-6.229	p< .00001
Alpha Appearance Time	573.46±311.78				

From the above it is apparent that there is strongly negative significant correlation between alpha appearance time and I.Q.

Results and Inferences

The subjects chosen for this study (n= 120) were young medical students having a mean age of 18.90±0.95 years. Males (n= 62) among them were averaging 19.01±1 years and females (n= 58) averaged 18.78±0.88 years. There was no statistically significant age difference between male and female groups; and they formed a single age group [Table 1].

I.Q. score of the subjects (n= 120) averaged 118.75±18.64. The I.Q. score in 62 males was 119.35±17.63 and in 58 females, it was 118.10±19.81. There was no statistically significant difference in the mean I.Q. of male and female groups, and hence all subjects can be considered to be belonging to a single group [Table 2].

Alpha appearance time of whole group was 573.46±311.78 milliseconds while that of male and female groups were 606.29±318.86 millisec and 538.36±302.83 millisec, respectively. The difference in mean alpha appearance time in male and female groups at 0.05 level of probability was statistically insignificant; once again confirming that the entire group can be treated as single [Table 3].

Alpha appearance time in EEG had a statistically significant negative correlation with I.Q., [r= -0.498 and P< .0001] [Table 4].

Discussion

In the present study, I.Q. scores and alpha appearance time were found to have a statistically significant negative correlation [r= -0.4975] [Table 4]. Although studies by Berger in 1931 and 1938a, Henry in 1944, Shagass in 1946, Biesheuval and Pitt in 1955 (23) and Gastaut in 1959a and 1960 all these constituted a group that opined that there is no significant relationship between alpha wave in EEG and I.Q. On the contrary, studies by Kreezer (1936), Knott et al (1942), Mundy Castle (1958), Netshine and Lairy (1960) and Mundy Castle and Nelson (1960) fall in another group that very strongly enunciated that there is significant relationship between alpha frequency and IQ and in fact these both measured CNS excitability. Voagel and Broverman (1964) opine that findings of studies of above two groups may not be as contradictory to each other as they may appear. Human intelligence is not unitary; rather it is composed of at least fifty independent facets, which vary widely across individuals. Different intelligence tests include and measure different combinations of facets and therefore, correlations amongst various intelligence tests may appear to be low [Wechsler 1944].

Conclusion:

In this study, a negative association of IQ, with alpha appearance time in EEG was found, which means that people in whom appearance of alpha wave is delayed after closure of eyes, they tend to have a low I.Q. score and vice versa, since both I.Q. and alpha appearance time in EEG are related to cortical activity, their relationship is logical.

REFERENCE

• Berger, H Hans Berger on the electroencephalogram of man. 1931. English translation by P. Gloor in Electroenceph. Clin.Neurophysio, 1969; suppl. 28: 133-150. | | • Biesheuvel, S. and Pitt, D.R. Some tests of speed and tempo of behaviour as predictors of the primary- secondary function temperament variable. J. Nat. Inst. Personnel. Res, 1955; 6: 87-94. | | • Gastaut, H. et al Rev Neurol.- 1959a; 101: 320-390. Comparative EEG and psychometric data for 825 french naval pilots and 511 control subjects of the same age-Aerospace Med, 1960; 31: 547-552. | | • Knott, J.R. et al Some electroencephalographic correlates of intelligence in eight year and twelve year old children- J. Exp. Psychol.- 1942: 30: 380-391. | | • Kreezer, G.Electric potentials of the brain in certain types of metal deficiency-Arch. Neurol. Psychiat [Chic], 1936; 36: 1206-1214. | | • Mizuhara H, Wang LQ, Kobayashi K, Yamaguchi Y. A long-range cortical network emerging with theta oscillation in a mental task. NeuroReport 2004;15(8):1233–8. | | • Mundy Castle, A.C. Electrophysiological correlates of intelligence- J. Personality, 1958; 26: 184-199. | | • Neubauer AC, Grabner RH, Freudenthaler HH, Beckmann JF, Guthke J.,"Intelligence and individual differences in becoming neurally efficient". Acta Psychol (Amsterdam) 2004;116(1):55–74. | | • Posthuma D, Neale MC, Boomsma DI, de Geus EJ. Are smarter brains running faster? Heritability of alpha peak frequency, IQ, and their interrelation Behav Genet 2001;31(6):567–79 | | • Shagass, C.An attempt to correlate the occipital alpha frequency of theelectroencephalogram with performance on a mental ability test-J.Exp. Psychol- 1946, 36: 88-92. | | • Thatcher R.W., North D. and Biver C.(2005), "EEG and intelligence: Relations between EEG coherence, EEG phase delay and power" , International Federation of Clinical Neurophysiology -116 :p.p. 2129–2141 , Published by Elsevier Ireland Ltd. | | • Vogel, W. and Broverman, D.M. Relationship between EEG and test intelligence: a critical review. Psychol. Bull.- 1964, 62: 132-144. | | • Wechsler, D.The measurements of adult intelligence-[3rded] Williams and Wilkins, Baltimore Md, 1944; Pg. 297. | |