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Mathematical relationship among visual reaction time, age and BMI in healthy adults

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ABSTRACT Reaction is a purposeful voluntary response to an external stimulus. There is certain time period between application of external stimulus and appropriate motor response to the stimulus called the reaction time. Various factors affect reaction time like handedness, age and gender of the person, BMI, type of receptor system involved. It is well known that there exist relationship among Visual Reaction Time, age and BMI. The degree of correlation among these variables is found to be higher. We develop a multivariate regression line in the form of z = ax +by +c, where x, y are two independent variable (x=age, y=BMI) and z is the measure of visual reaction time. Key Words: Visual reaction time, BMI , Correlation and Regression line

KEYWORDS : Audiovisual reaction time, BMI ,AVRT APPARATUS

INTRODUCTION

Reaction time (RT) is a measure of the quickness with which an organism responds to some sort of stimulus. RT is defined as the interval of time between the presentation of the stimulus and appearance of appropriate voluntary response in the subject.[1] Luce[2] and Welford[3] described three types of RT. (1) Simple RT: Here there is one stimulus and one response. (2) Recognition RT: Here there is some stimulus that should be responded to and other that should not get a response. (3) Choice RT: Here there are multiple stimulus and multiple responses.

Abū Rayhān al-Bīrūnī was the first to describe the concept of RT.[4] Dutch physiologist Franciscus Cornelis Donders (1865) was among the first to systematically measure human RT using a telegraph like device invented in 1840 by Charles Wheatstone. Prior to his studies, there is no significant traceable thread in the literature about human RTs being measured.

Human RT works by having a nervous system recognize the stimulus. The neurons then relay the message to the brain. The message then travels from the brain to the spinal cord, which then reaches person's hands and fingers. The motor neurons then tell the hands and fingers how to react. The accepted figures for mean simple RTs for college-age individuals have been about 190 ms for light stimuli and about 160 ms for sound stimuli.[3] RT in response to a situation can significantly influence our lives due its practical implications. Fast RTs can produce rewards (e.g. in sports) whereas slow RT can produce grave consequences (e.g. driving and road safety matters). Factors that can affect the average human RT include age, sex, left or right hand, central versus peripheral vision, practice, fatigue, fasting, breathing cycle, personality types, exercise, and intelligence of the subject.[5]

Reaction time is defined as interval of time between presentation of stimulus and appearance of appropriate voluntary response in a subject [1, 2]. It is usually expressed in milliseconds. It reflects the speed of the flow of neurophysiological, cognitive, and information processes which are created by the action of stimulus on the person's sensory system. The receipt of information (visual or auditory), its processing, decision making, and giving the response or execution of the motor act are the processes which follow one another and make what we call the reaction time [3–5] Reaction time can be divided into three parts. The first part is perception time, the time for the application and perception of stimulus. Second part is decision time, which signifies time for giving a suitable response to the stimulus. The third part is motor time, which is the time for the compliance to the order received [6,7,8].

Many research works have been published on reaction time and it is reported that there are many factors on which the reaction time depends. Some factors are Age, BMI, Sex, Fatigue condition etc. But there are very few research works available on the development of mathematical models based on reaction time visual reaction time with respect to age, BMI, sex etc. The application of these models may be wide not only to predict or estimate the visual reaction time but also to know the contribution of these factors on reaction time [7,8].

2. Materials and Methods

This study was carried out in the Department of Physiology, Career Institute of Medical Sciences, Lucnow, India with prior approval from the Head of Department of Physiology.

2.1 Study Group

The study pattern and objectives were explained to medical undergraduate students. 122 students volunteered to be part of the study. The study group thus comprised of 122 apparently healthy medical students of the age group of 17-22 years .Written informed consent was taken from those who volunteered. Tests for hearing, vision and motor system examination including reflexes in upper limb were carried out on the subjects to rule out any auditory, visual and neuromuscular disorders, respectively.

2.2 Recording of Anthropometrical Parameters

Age and gender of each subject were noted. The height of the subjects was measured using a stadiometer whose least count was 1cm. The recording was then converted into unit of meters. Weight was measured using weighing machine whose least count was 0.5 kgs.

BMI of each subject was calculated BMI = Weight (in kg)/Height2 (in m) The very common, efficient and easy machine "IMCORP Ambala Reaction Time Instrument" was used to acquire the simple reaction time data in children. The Reaction Time tests consist of two coloured lights (red & green) and two response buttons to which a digital timer is connected.

The specifications of reaction timer machine are, 1. Inbuilt chronoscope – 4 digit chronoscope with least count of 1/1000 seconds. 2. It works on – 230 volts AC.

Subjects were present randomly with two visual stimuli i.e. red & green light. The operating process was demonstrated priory to reduce errors .Three readings of each stimulus noted after giving three practical trials and the lowest taken as the reaction time. The reaction time measured for both red and green colour. The process of pressing the buttons was explained to students to minimise the error.The study was cleared by the Institutional ethical committee. After the collection of data it was analyzed by using SPSS of version 20 to calculate descriptive statistics and regression constants.

RESULTS

The mean VRT score of green and red light was calculated. The average VRT (AVRT) is dependent variable in linear regression analysis while the age and BMI of children are independent variables. Table 1 shows the descriptive statistics. The average of average visual reaction time (AVRT) is 209.11 with standard deviation 42.50; the average age of students is 19.11 years with standard deviation 5.12 and BMI is 156.81 with standard deviation 17.48. The mathematical linear relationship among variable is calculated as AVRT= -11.6 ×Age –

0.38×BMI + 423.The coefficient of determination is 0.78.The high value shows that the high degree of the data are to the fitted regression line. The ANOVA obtained from regression analysis is found statistically significant .

DISCUSSION

In the present study we developed a mathematical linear regression model in terms of VRT=a× Age+ b× BMI + C. The importance of this equation is inevitably. The above model may be used to forecast the reaction time score if the age and BMI of subjects are known. Very few works are available regarding the development of these types of equations [8].

CONCLUSION

In this paper our finding is development of a mathematical linear model to forecast the visual reaction time for known values of BMI and age.

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