

RESEARCH ARTICLE

A correlational study of visual and auditory reaction time with their academic performance among the first year medical students

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Received: November 07, 2016; Accepted: November 28, 2016

ABSTRACT

Background: Reaction time (RT) is a measure of the response to a stimulus which plays a very important role in our lives as its practical implications may be of great consequences in the learning process and cognition. **Aims and Objectives:** To compare visual RTs (VRTs) and auditory RTs (ARTs) on the basis of gender and to correlate it with the academic performance. **Materials and Methods:** This is a cross-sectional study conducted on 100 first year medical students, out of which 50 were males and 50 were females. The RT was tested using PC1000Hz RT. Academic performance was considered as an average of the internal assessment test conducted in physiology in the academic years 2015-16. Statistical analysis was performed using SPSS software version 19. **Result:** The ART is (184 ms) faster than VRT (208 ms) in both males and females. VRT and ART were significantly different between males and females ($P < 0.05$). The VRT was $199.36 + 23.239$ in males when compared to females $217.44 + 29.151$ with $P = 0.049$, and ART was $178.20 + 29.928$ and $190.12 + 19.442$ with $P = 0.021$. No significant difference in academic performance between the two genders; however, there was a significant negative correlation of the RT with the academic performance with VRT ($r = -0.290, P = 0.003$) and ART ($r = -0.271, P = 0.006$). **Conclusion:** ART is faster than the VRT in medical students. Furthermore, male medical students have faster RTs as compared to females for both auditory and visual stimuli. Furthermore, students with higher academic performance had faster RT, suggesting that attention, concentration, arousal level and processing speed is an important for students' success in learning process and cognition.


KEY WORDS: Auditory Reaction Time; Visual Reaction Time; Academic Performance

INTRODUCTION

Reaction time (RT) is the time taken by the individual to respond to a sensory stimulus. Simple RT involves one stimulus and one response. In our study, simple

RT was measured for the visual and auditory stimulus. RT depends on several factors such as age, sex, intelligence, and exercise. It also represents the level of neuromuscular coordination and cognition level of the subject.

The previous research study shows that the auditory RT (ART) is faster than the visual RT (VRT)^[1] and has documented that the mean VRT is 180-200 ms, whereas that of auditory is 140-160 ms.^[2] However, some other studies have proven the opposite wherein the visual is faster than ART.^[3,4] Furthermore, studies have proven that the RT is faster in males when compared to females.^[5]

Access this article online	
Website: www.njppp.com	Quick Response code
DOI: 10.5455/njppp.2017.7.1131828112016	

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Further education and affective learning has an important role in individual achievements. For learning any information, state of arousal, wakefulness, processing speed,^[6] and attention play an important role.^[7] For carrying out learning activity, an individual needs to put one's attention on the subject to be learned otherwise effective learning will not be achieved. It is seen that individual's attention and concentration depends on various factors such as possible external distracters, capability of focusing on any target and focus time and this affects response time. All these factors are related with individual's capability to direct their attention toward a certain target^[8] stating that attention is an important in developing complex response time.^[9] Thus, RT which is an interaction with concentration, attention, and arousal level, and information processing skills plays an important role in individual's learning process.

The purpose of this study was to find out (i) Whether the RT was faster for auditory or visual stimulus among the different sexes, (ii) Gender difference in the RT, and (iii) Correlation of the RT with the academic performance of the first year medical students.

MATERIALS AND METHODS

This is a cross-sectional study conducted on 100 first year medical students, out of which 50 were males and 50 females in the age group 18-20 years. Students with a history of hearing or visual disorder, smoking, alcoholism, cardiovascular and respiratory disease and on medication affecting cognitive performance were excluded from the study. Ethical clearance for the study was obtained from Institutional Ethical Committee. Participation in the test was voluntary and informed written consent was taken from every participant. ART and VRT were done using PC1000Hz RT r.

1. VRT measurement: When the Examiner pressed the "start" button in the component (a) which was out of the view of the subject and the subject was instructed to press the "Stop" button in component (b) with the right index finger first as soon as he/she sees the red light in the instrument. RT was recorded in audacity software.
2. ART measurement: Examiner presses the start button (a) which will be out of the view of the subject, and the subject is instructed to press the stop button (b) as soon as he/she hears the sound (1000 Hz's tone) through the headphone connected to it. RT is recorded in audacity software.

All subjects must be right handed and use their right index finger to press the switch to stop the quartz clock of the apparatus. Each Subject was instructed to press the switch as soon as she/he saw the light or heard the sound. Minimum five trials are given for both VRT and ART measurement. Minimum time recorded is calculated as final VRT and ART.

The readings were taken between 10 a.m. and 12 p.m. in a quiet secluded room.

Academic performance was considered by taking the average marks of the students scored in their internal assessment test (ten IA) in physiology during the academic year 2015-16. Finally, the RT both visual and auditory was compared between the two sexes and was correlated with the academic performance.

Statistical Methods

Descriptive statistical analysis has been carried out in this study. Results on continuous measurements are presented as mean \pm Standard deviation. Significance is assessed at 5% level of significance. Student *t*-test (two-tailed, independent) has been used to find the significance of VRT and ART between males and females. Pearson correlation has been used to find the significance of relationship between RT and academic performance.

RESULTS

The ART is (184 ms) faster than VRT (208 ms) in both males and females (Table 1). The VRT was 199.36 + 23.239 in males when compared to females 217.44 + 29.151 with $P = 0.049$ and ART was 178.20 + 29.928 and 190.12 + 19.442 with $P = 0.021$ (Table 2). Thus, the RT was significantly shorter in males when compared to females as reported by the previous studies (i,ii). No significant difference in academic performance was observed between the two genders though it was more in females. However, there was a significant negative correlation of the RT with the academic performance with VRT ($r = -0.290$, $P = 0.003$) and ART ($r = -0.271$, $P = 0.006$) (Tables 3 and 4). This signifies that the RT is shorter in students with high academic performance and longer in students with low academic performance.

DISCUSSION

Our study proves that the ART is faster than the VRT, with the mean ART around 184 ms and VRT 208 ms as shown in Table 1 and Figure 1. This goes in accordance with the previous studies by Welford *et al.*^[10] and Jayesh *et al.*^[11] which also indicates the ART is faster than visual. Evidence from the previous studies have shown that ART takes only 8-10 ms

Table 1: Differences in ART and VRT

Reaction time	N	Mean \pm SD	Standard error mean	P	t
VRT	100	208.40 \pm 27.757	2.776	0.000	6.395
ART	100	184.16 \pm 25.813	2.581		

VRT: Visual reaction time, ART: Auditory reaction time, SD: Standard deviation

Table 2: Difference in reaction time and academic performance in males and females

Parameters	Sex	N	Mean±SD	Standard error mean	P	t
VRT	Male	50	199.36±23.239	3.286	0.049	-3.429
	Female	50	217.44±29.151	4.123		
ART	Male	50	178.20±29.928	4.233	0.021	-2.362
	Female	50	190.12±19.442	2.749		
Academic performance	Male	50	47.98±12.210	1.727	0.948	-0.790
	Female	50	49.90±12.089	1.710		

VRT: Visual reaction time, ART: Auditory reaction time, SD: Standard deviation

Table 3: Correlation of visual reaction time with academic performance

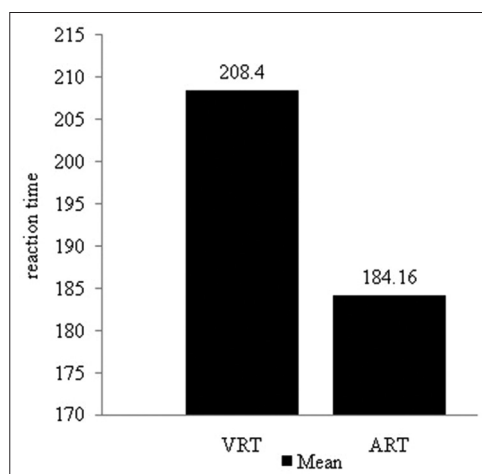
Parameters	Mean±SD	N	Correlation	P
VRT	208.40±27.757	100	-0.290*	0.003
Academic performance	48.94±12.126	100		

VRT: Visual reaction time, SD: Standard deviation, * $p < 0.05$

Table 4: Correlation of ART with academic performance

Parameters	Mean±SD	N	Correlation	P
ART	184.16±25.813	100	-0.271*	0.006
Academic-performance	48.94±12.126	100		

ART: Auditory reaction time, SD: Standard deviation, * $p < 0.05$

**Figure 1:** Differences in visual and auditory reaction time

to reach the auditory cortex when compared to VRT which takes 20-40 ms to reach visual cortex. Furthermore, auditory stimuli have a faster processing speed when compared to visual stimuli in the brain. Further, the number of synapses is more in the auditory pathway when compared to visual pathway which further proves the fact that ART is faster than VRT. Thus, our study supports other studies where ART is faster than VRT even in medical students.

Our analyses of RT with gender have proved that males have a better RT to both auditory and visual stimuli than females. This goes in accordance with previous studies by

Jose,^[12] Dane,^[13] Nikam,^[14] and Shelton.^[12] The reason for the difference is that the time taken for the motor response to the stimulus is faster in males when compared to females, though the time taken to reach the cortex is same. This is attributed to males being comparatively stronger than females.^[15] Further, studies have proved that moderate regular exercise and physical activity have faster RT,^[16,17] and therefore, this could be one of the reasons why the RT is faster in males. There are several possible explanations for this such as faster central nervous system processing speed,^[18] better muscular coordination with improved performance in the speed and accuracy task,^[19] improved motor response ability,^[20] and effect of sex hormone on nerve conduction velocity in females.^[21]

RT is affected by the intelligence of the subject^[22] and also very few studies have been conducted on the medical students.^[23] Students success in learning process depends on attention, concentration, arousal level, and processing speed. All the above parameter affect the response time to significant variables. Further studies clarify that there is a significant relation between response time and learning and that response time is parallel with learning speed.^[24] Also in learning skills, perception-motor development has a significant place and in meeting effective learning functions, there is a need for perception-motor development. Since response time is closely related to perception-motor development,^[25] it can be used to assess the effectiveness of learning process. Individuals with low level of arousal and attention deficit are known to have high response time and prove that they do not care about stimulant coming from outside.^[26] Furthermore, these individuals fail to focus exactly and have difficulty in concentration. Further studies have proven that individual having intelligent disability have worse RT when compared to high RT.^[27] Thus, this explains the possible attention problem of individuals having long response time, in course will affect learning in a negative way and be included in factors preventing them to succeed in courses. In our study also individuals with long response time had low academic success and vice versa. That is the study proves that as the RT prolonged, there was a fall in the academic performance. These results were similar to previous studies by Jagong and Shigehisa^[28,29] wherein there was a positive relation between intelligence and short response time.^[30]

CONCLUSION

RT still remains an age-old golden test to check subjective responsiveness of an individual to various stimuli that are essential for the survival of human race. Our study concluded that the ART is faster than the VRT in medical students. Male medical students have faster RTs as compared to female medical students for both auditory, as well as visual stimuli. Furthermore, there is a significant positive relation between intelligence and short response time.

ACKNOWLEDGMENT

I am thankful to the first year M.B.B.S. students of SRM Medical College, Potheri for their voluntary participation in the study. I am thankful to my colleague residents for helping me in my work.

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How to cite this article: Prabhavathi K, Hemamalini RV, Kumar TG, Amalraj C, Maruthy KN, Saravanan A. A correlational study of visual and auditory reaction time with their academic performance among the first year medical students. *Natl J Physiol Pharm Pharmacol* 2017;7(4):371-374.

Source of Support: Nil, **Conflict of Interest:** None declared.