

## Reaction Time and Academic Performance: An Association to Determine The Cognitive Status of First Year Medical Students

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### ABSTRACT

**Background:** Reaction time a psychomotor test is widely used in cognitive neuroscience. cognitive functions of human brain includes eg. attention, perception, memory, intelligency etc., all these affect the academics performance, learning, mental processing and motor performance. Reaction time a simple test can measures the time of mental information processing and motor response to it .The mental processing time is a main factor to affect the academics performance.

**Aim:** To find the relation between audio-visual reaction time and academic performance for assessing the cognitive status of first year medical students.

**Materials and Methods:** A cross-sectional study was conducted in the Department of Physiology, RUHS College of Medical Sciences, Jaipur from January 2018 to March 2018. A total of 64 first year MBBS healthy medical students of age group 18-20 years were enrolled in this study (males-36, females-28). The test was performed on Audio Visual Reaction Time (AVRT) machine of Medisystems by pressing the switch as soon as she/he saw the light for VRT or heard the sound for ART. Measurement of academic performance was assessed by their performance in the first MBBS university exam. Students with a history of hearing or visual disorder were excluded from the study. The Reaction time for both visual and auditory and academic performance was compared between the two groups and correlated the audio-visual reaction time with the academic performance in both male and females.

Statistical analysis was performed using SPSS software version 20.

**Results:** The VRT is (0.71ms) faster than ART (1.63ms). The RT was not significantly difference in males when compared to females and academic performance was significantly more in females 393.11±40.93 compared to male 368.56±28.87 with  $p=0.003$  and there was a non-significant, weak negative correlation of the RT with the academic performance with VRT ( $r = -0.040, P = 0.75$ ) and ART ( $r = -0.071, P = 0.57$ ).

**Conclusion:** The RT is shorter in students with high academic performance and longer in students with low academic performance.

**Keywords:** Auditory Reaction Time; Visual Reaction Time, Cognition, Academic Performance.

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### INTRODUCTION

Reaction time is used as a psychomotor cognitive test to measure the time duration after application of a sensory stimulus for information processing in central nervous system to its response in the form of motor response.<sup>1</sup> The simple reaction time task is an attention task that focuses primarily on speed of processing speed that may affects higher mental abilities and representative of individual's cognitive processing speed. It is used to study sensory and cognitive mediation skills (i.e. intelligence and creativity).<sup>2</sup> RT which is an interaction with concentration, attention, and arousal level, wakefulness, processing speed and information processing skills plays an important role in individual's learning process and affects the academic performance.<sup>3</sup> Time required to give

response to visual stimuli is visual RT (VRT) and time required to give response to auditory stimuli is auditory RT (ART). The motor coordination in brain is done using visual and auditory information. Males are more able to respond faster for both the visual and auditory stimuli, there might be intrinsic neurological advantage.<sup>4-6</sup> RT determines the alertness of a person and is an indirect index of processing capability of central nervous system. This psychomotor test refers to an individual's ability to co-ordinate timely and quickly to a stimulus depends on his reaction time and helps in determining sensory motor association.<sup>7</sup> The Standardized cognitive ability tests, universally used to measure intelligence, rely heavily on processing speed. Speed is an

integral component of the information processing and is assessed through reaction time (RT) which correlates negatively with intelligence.<sup>8-11</sup>

These correlations become stronger as the complexity of the task increases. The increased complexity demands more of working memory, which might slow down information processing, making processing speed a more informative index of intelligence.<sup>12</sup> Students studied with various sources as a complex task to learn eg. books, audio visual lectures, practical skills etc. The academic performance can be improved by mental practices.

In our study the main aim was to find the relation between AVRT and Academic performance for assessing the cognitive status of first year medical students and main objectives are 1. To compare the visual reaction time, audio reaction time and academic performance of first year medical students of both sex and 2. To assess the correlation of visual RT (VRT) and auditory RT(ART) with academic performance in first year medical students of both sex.

## MATERIALS AND METHODS

A cross-sectional study was conducted in the Department of Physiology, RUHS College of Medical Sciences, Jaipur from

January 2018 to March 2018. A total of 64 first year MBBS healthy medical students of age group 18-20 years were enrolled in this study (males-36, females-28). The test was performed on Audio Visual Reaction Time (AVRT) machine of Medisystems by pressing the switch as soon as she/he saw the light for VRT or heard the sound for ART. Measurement of academic performance was assessed by their performance in the first MBBS university exam. Students with a history of hearing or visual disorder were excluded from the study. The Reaction time for both visual and auditory and academic performance was compared between the two groups and correlated the audio-visual reaction time with the academic performance in both male and females. Statistical analysis was performed using SPSS software version 20.

### 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.

**Table 1: Difference in ART and VRT in first year medical students**

Reaction time	N	Mean $\pm$ S.D	p value	t value
ART	64	1.63 $\pm$ 1.07	0.001	6.071
VRT	64	0.71 $\pm$ 0.57		

VRT: Visual reaction time, ART: Auditory reaction time, SD: Standard deviation,  $p < 0.0$

**Table 2: Difference in reaction time and academic performance in males and female.**

Parameter	Sex	N	Mean $\pm$ SD	p value	t test
VRT	Male	36	0.71 $\pm$ 0.69	0.999	0.001
	Female	28	0.71 $\pm$ 0.38		
ART	Male	36	1.56 $\pm$ 1.07	0.558	-0.589
	Female	28	1.72 $\pm$ 1.09		
Academic performance	Male	36	368.56 $\pm$ 28.87	0.007	-2.81
	Female	28	393.11 $\pm$ 40.93		

VRT- Visual reaction time, ART –Auditory reaction time, SD-standard deviation

**Table 3: Correlation of visual reaction time with academic performance in first year medical students**

Parameter	Mean $\pm$ SD	N	Correlation	P value
VRT	0.708 $\pm$ 0.57	64	-0.040	0.75
Academic performance	379.2 $\pm$ 36.5	64		

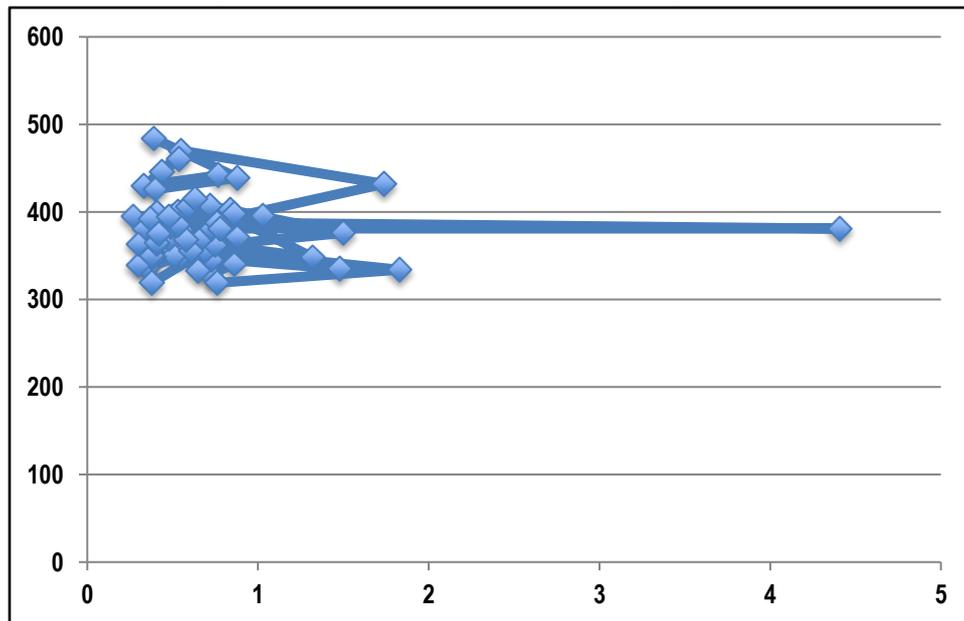
VRT: Visual reaction time, SD: Standard deviation

**Table 4: Correlation of audio reaction time with academic performance in first year medical students**

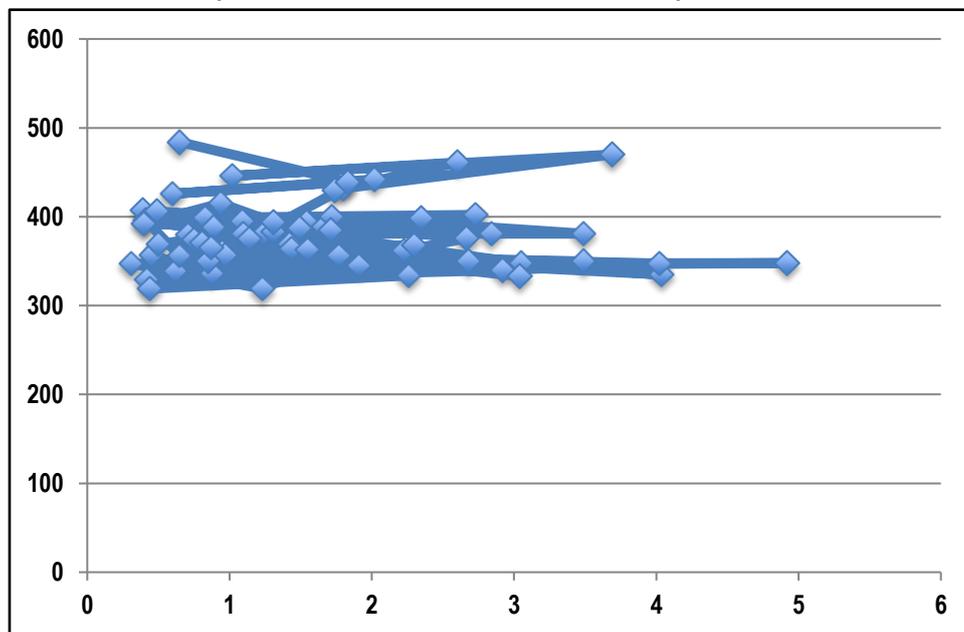
Parameter	Mean $\pm$ SD	N	Correlation	P value
ART	1.62 $\pm$ 1.15	64	-0.071	0.57
Academic performance	379.2 $\pm$ 36.5	64		

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

**Graph 1: Correlation between VRT & Academic performance**



**Graph 2: Correlation between ART & Academic performance**



**OBSERVATIONS AND RESULTS**

In present study total of 64 first year MBBS healthy medical students of age group 18-20 years were enrolled .The VRT is (0.71ms) faster than ART (1.63ms) in medical students (Table 1). The VRT was  $0.71 \pm 0.69$  in males when compared to females  $0.71 \pm 0.38$  with  $P = 0.999$  and ART was  $1.56 \pm 1.07$  and  $1.72 \pm 1.09$  with  $P = 0.558$  (Table 2). Thus, the RT was not significantly difference in males when compared to females. Significant difference in academic performance was observed between the two genders though it was more in females  $393.11 \pm 40.93$  compared to male  $368.56 \pm 28.87$  with  $p=0.003$ . However, there was a non-significant, weak negative correlation of the RT with the academic performance with VRT ( $r = -0.040, P = 0.75$ ) and ART ( $r = -0.071, P = 0.57$ ) (Tables 3 and 4). This shows that the RT is shorter in students with high academic performance and longer in students with low academic performance.

**DISCUSSION**

There are many researches available to find the relation of Audiovisual Reacton Time with students' academic performance, intelligence and higher functions of brain. The response time is important measure which is affected by the persons attention, concentration, arousal level and process speed and all these may affect perceptional motor development, learning and memory process requires for learning skill.<sup>13</sup> Academic performance and perception- motor development are of significance in medical profession. In our study The VRT is faster (0.71ms both in male and female) than ART (1.56ms male and 1.63ms female) although there is non-significant difference in found of RT between males and females. Significantly good academic performance was observed in females compared to male and a non-significant, weak negative correlation was found between RT (VRT and ART) and the academic performance in both male and females. RT is

shorter in students with high academic performance and longer in students with low academic performance.

The possible explanations for better AVRT in male is as faster central nervous system processing speed, better muscular coordination<sup>14</sup>, and improved motor response ability.<sup>15</sup>

Brain-Nerve Conduction Velocity in the visual nerve pathway may be faster in males than in females.<sup>16</sup> Males might be using a more complex and analytical strategy than females and females might be aiming at a target for accurateness.<sup>17,18</sup>

In our study the ART in females is less than male as the neural transmission for hearing sensation may be affected by estrogen secretion and its influence on acetylcholine synthesis.<sup>19</sup> Female sex steroids have sodium and water retaining property and alter the level of acetylcholine neurotransmitter at the synaptic level can modify the axonal conduction, reduces the velocity of nerve impulse, increases the synaptic delay and affect the sensory motor association with the processing speed at the Central Nervous System.<sup>20,21</sup>

Similar study was done by Cengiz Taskin (2016) on Adolescents to found the relation of Visual and Auditory Reaction Time with their Academic Achievements and shows the same results.<sup>22</sup>

Our study goes in accordance of previous studies done by Nikam and Shelton shows that RT of male for both auditory and visual stimuli was better than females.<sup>23,24</sup>

One study done by Prabhavathi K, et al 2016 similar results were there as students with good academic performance had faster RT, although ART is faster than the VRT as compare to our results.<sup>25</sup>

In daily life majority of work is done by use of visual information. VRT decreases with training and practice and it is beneficial for students, as in examination of various medical subjects, they have to identify the bones, instruments, graphs and questions etc so by practice students can identify, understand and answer quickly. The observer's mental processing time depends on distractions that add to his or her cognitive load. The higher cognitive load increased mental processing time.<sup>26</sup> In our study auditory stimuli of different tones may increase the cognitive load hence increases ART compare to VRT that is for visual stimuli of different coloured light.

our results were also similar to previous studies by Jagong and Shigehisa<sup>27,28</sup> showing a positive relation between intelligence and short response time.<sup>29</sup>

Shigehisa and Lynn (1991) found a positive relation between intelligence and response time in their research in Japanese children<sup>30</sup>, Myung, & Lynn (1992) observed on Korean children<sup>31</sup> and Lynn, Cooper and Topping (1990) did researches on children from different countries and determined a positive relation between children's psychometric intelligence, movement time and response time and said that intellectual practices affected response time, Attention and processing speed is very important in learning activities.<sup>32</sup>

Response time vary in age, gender and individuals' intellectual characteristics. Ganong, (2001) et. al observed that due to the low level of arousal and attention deficit, individuals do not care about stimulants coming from outside properly and have high response time.<sup>33</sup>

Lechair, Pollock, & Elliot, et al. (1993) study states that response time in individuals having intellectual disability have worse values rather than normal individuals' response time as they were not able to focus exactly, failure to concentrate may be seen.<sup>34</sup>

Mental imagery and practice is an activity related to the nervous system and it can have a direct influence on memory and it results in progress in performance influences the learning of cognitive activities.<sup>35,36</sup> Some studies concluded that training on a complex task both shortened reaction time and improved accuracy.<sup>37</sup>

It has been theorized that increased complexity demands more of working memory, which might slow down information processing, making processing speed a more informative index of intelligence (Jensen & Vernon, 1984).<sup>38</sup>

## CONCLUSION

Medical students with shorter reaction time have good cognitive status and better academic performance. Reaction time is simple measure of cognitive status, alertness etc. The academic performance can be improved by practices so performance enhancing program should be added in medical education to improve the standard of knowledge in medical students.

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