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RESEARCH ARTICLE

Effects of various distractions on audio and visual reaction time in 1st year MBBS students

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ABSTRACT

Background: Reaction time (RT) defines as it is time between the presentation of a sensory stimulus and the subsequent response. Simple RT is defined as the time required for an observer to find out the presence of a stimulus. It is used as a physical skill that correlates to human performance. RT valid and reliable tools for assess cognitive functions and measurement of sensorimotor coordination. **Aims and Objectives:** The aim of this study was to assess the effect of various distractions on auditory RT (ART) and visual RT (VRT). **Materials and Methods:** This observational study was conducted in the Department of Physiology at Rajasthan University of Health of Sciences College of Medical Sciences. The participants were 100 1st year medical students 36 girls and 64 boys, 19–23 years age group were exposed to different distractions, that is, conversing, music, calculations, and texting in both ART and VRT tests. The study was conducted over a period of January 2018-March 2018. In this study, we have found that VRT and ART were significantly different in males and females, that is, 290.61 ± 96.25 and 300.32 ± 85.32 ($P < 0.0001$; $t = 7.9731$), and 243.61 ± 69.25 and 267.42 ± 87.23 ($P < 0.0001$; $t = 6.0500$), respectively. It is also clear that overall the VRT was more than ART. Testing was performed using audio VRT by Medisystems. **Results:** In this study, we have found that VRT and ART were significantly different in males and females, that is, 290.61 ± 96.25 and 300.32 ± 85.32 ($P < 0.0001$; $t = 7.9731$) and 243.61 ± 69.25 and 267.42 ± 87.23 ($P < 0.0001$; $t = 6.0500$), respectively. Both ART and VRT with each distraction were found longer than normal ART. Sequence of ART in various distraction following in ascending order Normal ART < relaxing music < texting < calculation < conversing, while VRT in various distraction following in ascending order normal VRT < relaxing music < conversing < texting < calculation. **Conclusion:** As compare to ART and VRT, ART is faster than the VRT in medical students. Furthermore, for both auditory and visual stimuli male students have faster RTs as compared to female students. RT in response to a situation can significantly influence the performance of subjects due to its practical implications. By understanding the influence of distractions on RT the present study concludes that these distractions can be used as a progression in RT training thus improving the sensormotor coordination.

KEY WORDS: Auditory reaction time; Distractions; Sensorimotor coordination; Visual reaction time

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INTRODUCTION

In this fast and technologically advanced era, a person should be fast and quick. In this neck, to neck competitive world multitasking and quick person can easily survive. The importance of reaction time (RT) clarifies the characteristic feature of a behavioral response to the stimulus. RT is the time

between application of a sensory stimulus and subsequent appearance of appropriate behavioral response in a subject.[1] It is a physical skill closely related to human performance. At a time human body responses to different types of sensory stimuli and gives a desired and purposeful voluntary response to stimulus. There is time gap between stimulus and appropriate response. 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). Majority of motor coordination in brain is done using visual and auditory information so that RT has an importance in information processing for a stimulus and response programming.

RT defined as time between the application of a sensory stimulus andsubsequent behavioral voluntary response. The modern era can aptly be called the era of speed and competition for which cognitive functions must be assessed and improved.[2] RT is one of the valid and reliable tools for assessing cognitive functions[3] and is the measure of function of sensorimotor association.[4] Thus, it is a time from application of the stimulus to subsequent voluntary response and is expressed in milliseconds. RT includes the time required for the "activation of the receptors, sensory impulse to be transmitted to the brain, central processing within the brain, motor impulse to be transmitted from the brain to the effectors organ, and the activation of the effectors organ" to an threshold limit that response is produced.

Receptor ➡ Afferent impulses ➡ central integration ➡ efferent➡ effector organ

Shenvi *et al*. reported that the role of the cognitive system during mobility performance and the dependency of high-level cognitive processes that include sensorymotor coordination. Thus, mobility performance is a multi-dimensional process and requires a high level of motor coordination and cognitive processing to given attention to various external stimuli.[5]

Abū Rayhān al-Bīrūnī was the first to describe the concept of RT.[6] Franciscus Cornelis Donders was first to systematically measure human RT using a telegraph-like device discovered by Charles Wheatstone. Before his studies, there is no significant literature about RTs.

Three types of RT (1) simple RT: In this, there is one stimulus and one response, (2) recognition RT: Here, there is some stimulus that should be responded and some not get a response, and (3) choice RT: In this, there are multiple stimulus and multiple responses.[7-9]

Simple RT is the time required for an observer to detect the presence of a stimulus and given a response. It is a skill related to cognitive performance. It is an indicator of neuromuscular coordination in which the receptors through different physical, chemical, and mechanical stimuli decodes visual or auditory stimuli which travel through receptors toafferent pathways and reach the brain then efferents to effector organ and giving response.

Human RT affected by these factors, that is, age, sex, left or right hand, central versus peripheral vision, practice, fatigue, fasting, breathing cycle, personality types, exercise, and intelligence.[10]

In the literature very few studies[10,11] on RTs. Thus, the present study was conducted to determine the variation in ART and VRT in the presence of the various distractions such as conversing, music and texting, and calculations.

MATERIALS AND METHODS

The present observational study carried out in the Department of physiology at Rajasthan University of Health of Sciences College of Medical Sciences, total 100 first year MBBS students (36 girls and 64 boys) were included, aged between 19 and 23 years whole procedure explained and demonstrated and written informed consent was taken from the subject. Any subject with uncorrected visual deficit, hearing deficit, neurological disorder, or experienced a recent trauma or surgery was excluded from the study. Audio VRT assessed by Medisystems audio VRT. There are two sides in the instrument, that is, experimenter side and trainer side. A sheet separates the two sides. There are two modes of functions light and sound any of these two functions can be selected by the mode switch. There are four switches as well as four number of light emitting diode's on both the sides. Subjects were recruited as per the inclusion criteria. Whole test was performed in quiet room with 1 min of time gap between each section and two tests. ART and VRT were done under the five section, that is, normal or controlled, conversing, relaxing music, that is, raag bilhari, texting and calculation in both ART and VRT.

One-way ANOVA test was applied within the group and paired *t*-test was used to determine comparison between ART and VRT group. Control subjects were asked to complete the RT tasks with no added distractions, that is, conversing, relaxing music, that is, raag bilhari, texting, and calculation in both ART and VRT.

RESULTS

Results showed that VRT and ART different in males and females, that is, 290.61 ± 96.25 and 300.32 ± 85.32 ($P < 0.0001$; $t = 7.9731$) and 243.61 ± 69.25 and 267.42 ± 87.23 ($P < 0.0001$; $t = 6.0500$), respectively.

Table 1 depicts mean and standard deviation of normal values of ART and VRT and with various distractions, that is, relaxing music, texting a text, calculation, and conversing.

Results showed that comparison of ART to ART with various distractions, that is, conversing, music, calculation, and texting was statistically significant ($P < 0.001$) but slow music to texting, calculation was nonsignificant (Table 2).

Results showed that comparison of VRT to VRT with various distractions, that is, conversing, calculation, and texting was statistically significant ($P < 0.0001$), but comparison with music was nonsignificant (Table 3).

Intergroup comparison between ART and VRT with conversation, music, texting, and calculation was statistically significant (Table 4).

DISCUSSION

Results of the present study showed that the effects of various distractions on audio and VRT in 1st year MBBS students of 19–23 years age group using a RT of medisystem. RT is a simple, non-invasive method to assess neural integrity and sensorimotor coordination of an individual. The result of the present study showed that comparison of ART and VRT with various distractions, that is, conversing, music, calculation, and texting was statistically significant. Intergroup comparison between ART and VRT with conversation, music, texting, and calculation was statistically significant.

RT has two limbs one is mental processing time which is required for the responder to perceive, identifying, and analyzing of stimulus, and given the proper motor response, and the other one is movement time required to perform voluntary activity after selection of response.[12] This implies that the stimuli faster reaches the motor cortex; faster will be the RT.[13] Many studies reported that ART is faster than a reaction to light. This is because an auditory stimulus reaches the cortex faster only takes 8–10 ms to reach the brain, but a visual stimulus takes 20–40 ms[14-16] results were similar with the present study. Differences in RT between these types of auditory and visual stimuli persist whether the subject is asked to make a simple response or a complex response.

Table 1: Mean±SD of ART and VRT in various distractions

Parameters	ART (ms) mean±SD	VRT (ms) mean±SD
Normal	253.61±79.25	290.61±96.25
Relaxing music	786.10±521.55	590.10±367.89
Texting	925.38±283.33	840.85±619.53
Calculation	1100.28±300.33	1135.38±583.33
Conversing	1400.17±1100.23	1235.67±683.3

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

Table 2: Comparison of ART to ART with various distractions

Comparison	Mean difference	f-value	*P*- value
Normal ART to ART while conversing	895	7.83	<0.001
Normal ART to ART with music	554.5	4.23	<0.001
Normal ART while calculation	785.6	6.23	<0.001
Normal ART while texting	675.5	5.43	<0.001
Conversation ART to slow music ART	578.2	4.934	<0.0001
Conversation ART to texting ART	481.8	3.5999	<0.0001
Conversation ART to calculation	675.5	5.935	<0.0001
Slow music ART to texting ART	−98.36	0.635	NS
Slow music ART to calculation	−100.5	0.735	NS

ART: Auditory reaction time, VRT: Visual reaction time

Table 3: Comparison of VRT to VRT with various distractions

Comparison	Mean difference	f- value	*P*- value
Normal VRT to VRT while Conversing	480.78	5.08	<0.0001
Normal VRT to VRT with music	198	2.101	NS
Normal VRT while calculation	950.5	9.80	<0.0001
Normal VRT while texting	879.7	8.89	<0.0001
Conversation VRT to slow music ART	278.2	4.934	<0.0001
Conversation VRT to texting VRT	381.8	4.18	<0.0001
Conversation VRT to calculation	675.5	5.935	<0.0001
Slow music VRT to texting VRT	656.7	7.01	<0.0001
Slow music VRT to calculation	280.7	2.98	<0.0001

ART: Auditory reaction time, VRT: Visual reaction time

Table 4: Intergroup comparison between ART and VRT

Comparison	Mean difference	*t*-value	*P*- value
Normal VRT to normal ART	50.89	3.376	0.0014
Conversation VRT to conversation ART	−541.78	3.717	0.00008
Slow music VRT to slow music ART	−356	3.865	0.0003
Texting VRT to texting ART	245.6	2.005	<0.0500
Calculation VRT to calculation ART	286.6	3.005	<0.05

ART: Auditory reaction time, VRT: Visual reaction time

Studies[12,17,18] reported that males have faster RTs as compared to females in every age group. Results were similar with these studies done by Misra *et al*.,[18] Shelton and Kumar,[12] and Nikam and Gadkari.[19]

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.[20] Effects of various distractions, that is, conversing, slow music, texting, and calculation on average increase in RT as compared to the control.

Intragroup Comparison ART

The mean normal or controlled ART of the sample population came out to be 253.61 (Table 1). As conversing is an active listening process comprising of three elements, namely, comprehension, retention, and response that increases the mental processing time and which, in turn, can increase the RT; thus, in the present study conversation is affecting ART. It can be also due to decreased activation of parietal association area which may be due to auditory processing. Hence, in the present study, ART is maximally affected by the conversation with the mean of 1400.17 and $P < 0.001$ (Table 1). ART is affected by all the distractions, and the sequence of distractions affecting ART can be representezd as, "conversation (1400.17) > calculation (1100.28) and texting (925.38) > slow music (786.10)" (Table 1). As music is a passive listening process, Relaxing music has caused the minimal increase. This finding is similar with studies.[21,22]

RT in conversing, texting, music, and calculation as compared to the control condition had statistically significant differences ($P < 0.001$) Table 2. It should be noted that in the various distractions significant increase in RT than the control condition.

Intragroup Comparison VRT

Mean of normal VRT in the present study was 290.61 (Table 1). The sequence of distractions affecting VRT can be represented as calculation > texting (1135.38)> conversation (840.45)> slow music (590.10) (Table 1). RT in conversing, texting, and calculation as compared to the control condition had statistically significant differences ($P < 0.001$) and comparing with music is nonsignificant Table 3. These results were agreement with earlier studies Anderson *et al*.[21] and Abbas[22] and Shah *et al*.[23] To complete this task brain had to switch continuously between two visual stimuli which increases the time of responding to each visual stimuli and thus increases the RT. Therefore, the sequence of distractions affecting VRT can be represented as "texting (1216.81)> conversation (842.83)> slow music (565.10)> fast music (442.81)" (Table 1).

Intergroup Comparison between ART and VRT

When intragroup comparison was done between ART and VRT group, normal VRT is significantly slower than normal ART with a mean difference of 50.89 (Table 4). It can be justified by the fact that visual stimuli need 20–40 ms to reach the brain whereas auditory stimuli need only 8–10 ms, these finding similar with previous studies.[11,16]

Limitation of this study was assess only simple RT, choice and recognition RTs could be used in future studies.

Improvement in RT by practice will increase cognitive skills which improve the performance of subjects. Medical students who are afraid for academic pressure and fear of exam should improve their RT and ultimately their performance. Performance enhancing program can be added to the in medical education performance enhancing program, that is, exposure to adequate stimuli during repeated practices will improve the performance of subjects.

CONCLUSION

The study concluded that ART and VRT both affected by distractions the sequence of distractions in ART were following normal<slow music <texting <calculation <conversing and sequence of VRT normal<slow music <conversing <texting <calculation. ART is maximally affected by conversation and VRT by calculation. VRT is significantly slower than ART. RT in response to sensory stimuli can influence motor response due to its practical implications. By understanding the influence of distractions on RT, the present study concludes that these distractions can be used as a progression in RT training thus improving the sensorimotor coordination.

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