Indian J Physiol Pharmacol 2015; 59(2) : 194–198

Original Article

Effect of Dual-tasking on Visual and Auditory Simple Reaction Times

M. Balasubramaniam, K. Sivapalan, V. Nishanthi, S. Kinthusa and M. Dilani

Department of Physiology,
Faculty of Medicine,
University of Jaffna, Sri Lanka

Abstract

Visual and auditory simple reaction times were measured in Sri Lankan young adults to see the effect of dual-tasking on reaction time. Reaction times were measured using a reaction time program in a computer. Subjects responded to stimuli by pressing the spacebar with their dominant index finger. Visual and auditory simple reaction times (ms) in males (mean±SD) were 293.5±42.4, 302.2±41.9 respectively. In females respective values were 315.1±55.5, 313.1±45. Males had statistically significant faster reaction times ($p<0.05$) than females. The type of stimuli had no statistically significant effect ($p>0.05$) within the same sex. Dual-tasking significantly increases ($p<0.05$) both reaction times in both sexes. In females, dual-tasking affects simple auditory reaction time significantly more than simple visual reaction time ($p<0.05$).

Introduction

Reaction time is important in day to day life for efficient response to environment. Slow reaction time can be dangerous while controlling moving machineries. Speedy reaction is helpful in sports such as football, basketball, tennis etc. It can be used as an index of cortical arousal which is an easy method (2). It also shows the sensory motor association and reflects the alertness of a person.

Visual stimuli like flashing are used as a signal coding method in the marine, aviation and road transport. The auditory modality is used in transport and industrial environment. Also these input or output modalities are found in many industrial application systems like design of driving vehicle, military communication, smoke detector alarm and light control system to provide alertness (3).

Human brain doesn't perform multiple tasks at the same time. Rather, it handles the task sequentially by switching occurs between one task to other. At any one time only one task can be performed even when we are under the impression that we are doing two or more tasks simultaneously. Cognitive distraction prevents attention to visual scene which increases reaction time. Even a small increase may end up with fatal accidents in automobiles (4). Hence, reaction time is an important consideration in the designing of vehicle controlling systems.

Silverman claimed that the experiment on reaction time has a long history. He compared the reaction time values obtained by Galton in 1800 and later

***Corresponding author :**
M. Balasubramaniam, Department of Physiology, Faculty of Medicine, University of Jaffna, Sri Lanka
Email : mathu1481@yahoo.com
(Received on February 27, 2014)

studies and concluded that simple visual reaction time has increased markedly over time (5). According to him, the increase in the reaction time may be attributed to the development of technology used to measure the reaction time or actual changes in adults due to increase in height and body size, sedentary life style, increased neurotoxins in the environment and reduced infant and child death rates making less efficient people living to adulthood.

Auditory reaction time (ART) is faster than visual reaction time (VRT) (3, 6). Various factors like sex and age, physical fitness, type of stimuli, practice, distraction noise, weight, prenatal exposure of alcohol, alcohol and schizophrenia affect reaction time (7, 8, 9, 10, 11, 12). Athletes have faster reaction times than non-athletes.

There are few studies available in Sri Lankans on reaction time. Therefore this study was undertaken to measure visual and auditory simple reaction time of Sri Lankan young adults and to see the effect of dual-tasking on reaction time in Sri Lankan young adults.

Methodology

This was a descriptive cross sectional study among the students at faculty of Medicine, Jaffna. The study was approved by Ethical Review Committee of Faculty of Medicine, Jaffna. Only those students who volunteered were enrolled. The students were asked to come to the Department of Physiology at their convenient time. A data sheet was used to get information on conditions which may affect the normal reaction time. Volunteers who had hypertension diabetes, ophthalmic disease, auditory problem, epilepsy, or any injury to the head or the dominant upper limb were excluded from the study. Those who used drugs for depression also were excluded. Written informed consent was obtained from each participant. The procedures used were short, easy, and innocuous. The sex, age and ethnicity of the participant also were noted in the data record sheet.

Visual and auditory simple reaction time was measured using a reaction timer program which was developed and installed in a computer. The visual stimulus was a color change of the screen from pink to green and the auditory stimulus was a buzzer sound. The computer generates the selected stimulus after a delay. The duration of each delay was generated by random number. The timer displayed the time elapsed between the occurrence of stimulus and subject's response in milliseconds.

Each participant was allowed to sit in front of the computer comfortably. Clear instruction was given regarding the procedure and one demonstration was shown if necessary. The participants were asked to activate the reaction timer by pressing the space bar once and to keep the dominant index finger on the space bar. They were asked to respond to visual or auditory stimuli as soon as they could by pressing the space bar again with the same index finger. Once each type of reaction time was measured they were requested to do repeated the procedure while they are counting aloud in the reverse order starting from thousand (eg; 999, 998,) in their mother tongue. Three readings were obtained in each procedure from each participant. All tests were performed in a closed room while the participant and one of the investigators were present in the room. The minimum reaction time in each procedure was taken for analysis.

The data were analyzed in SPSS version 16. Mean and standard deviations of reaction times during single and dual-tasking were obtained for males and females separately. Student-T test was used to see the significance of differences between both sexes. The effect of dual- tasking on both visual and auditory reaction times was assessed by paired T test.

Results

Two hundred and fifty four students (144 females, 110 males) aged between 20-24 years were enrolled in this study. Sri Lankan Tamils were 75% of the study population. Sri Lankan Muslims and Sinhalese were 17% and 8% respectively. Majority of the study group (92%) uses right hand as their dominant hand.

The mean values of visual and auditory simple reaction times were given in Table I & II. Males have faster

TABLE I: Reaction time of males in milliseconds.

Simple reaction time	*Normal (Mean±SD)*	*During dual-tasking (Mean±SD)*
Visual (ms)	293.5±42.4	356.8±53.1
Auditory (ms)	302.2±41.9	355.6±59.6

TABLE II: Reaction time of females in milliseconds.

Simple reaction time	*Normal (Mean±SD)*	*During dual-tasking (Mean±SD)*
Visual (ms)	315±55.5	360.9±70.8
Auditory (ms)	313.2±45	371.8±59.7

reaction to both visual and auditory stimuli than females with differences (mean±SD) of 21.6±6.2, 10.9±5.5 milliseconds for visual and auditory stimuli respectively. Both these differences were significant ($p<0.05$).

Males had faster ART and females had faster VRT. However, the effect of different stimuli was not statistically significant ($p>0.05$) within the sex (Table III).

Dual-tasking increases both VRT and ART in both sexes (Table IV & V). All these increases were highly significant ($p<0.001$).

In males, dual-tasking affected VRT more than ART (Table IV). However, the difference between percentage increase in males to dual-tasking was not statistically significant. But in females dual-tasking affecedt ART significantly ($p<0.05$) more than VRT (Table V).

Reaction time obtained in our study was compared with reaction times of previous studies in various populations in India. Reaction times of our participants were higher than other studies.

TABLE III: Difference in reaction time between stimuli.

	VRT-ART	*P value*
Males	–8.5±46.1	0.057
Females	2±50.6	0.639

TABLE IV: Effect of dual-tasking on reaction time in males.

Stimuli	*Mean increase (ms)*	*Percentage increase*
Visual	61.8±52	22.3±17.7
Auditory	53.4±58.1	18.6±19.2

TABLE V: Effect of dual-tasking on reaction time in females.

Stimuli	*Mean increase (ms)*	*Percentage increase*
Visual	45.8±58.4	15.3±18
Auditory	58.6±52.9	19.4±18

Discussion

Faster reaction of males than females to visual and auditory stimulus was in conformity with earlier findings (6, 13, 14). This may be explained by males being more active and alert. But our finding is in contrast with Annie's finding that females respond quicker to visual stimuli than males (3).

Shelton & Kumar, Annie et al concluded that ART is faster than VRT (3, 6). However sex was not mentioned. Narhare (13) concluded that ART is faster than visual reaction time in both sexes. Data from

TABLE VI: Comparision of simple reaction time with other studies.

Study	*Age*	*No*	*Male*		*Female*	
			Simple VRT	*Simple ART*	*Simple VRT*	*Simple ART*
Present study	20-24	254	293.5±42.4	302.2±41.9	315±55.5	313.2±45
Shah etal (2010)		73	272.3±177.7	260.4	254.6±162.9	249.6±192
Karia et al (2012)	17-22	100	139.9±26.4		159.9±26.4	
Ghuntla et al (2012)		50	299.7±74.6			
Shenvi & Balasubramanian (1994)	17-18	79	470±140	620±170	420±80	530±70

our females were in consistent with the above studies but not males.

Faster VRT than ART in males was obtained earlier by Shenvi and Balasubramanian (15). This shows better eye hand coordination in males.

Increased reaction times due to cognitive distraction have been reported earlier (16, 17). This shows that the stimuli can be seen or heard while doing another task but not processed normally as the brain is overloaded.

Comparison of our results with studies done previously revealed that our values are higher than the studies of Ghuntla et al, Karia et al and Shah et al (1, 14, 17). VRT of our males was similar to participants in Ghuntla's study (1).

Our study had limitations. The age-range of the participants was narrow. Our study group had athletes involving in different type of sport activity and non-athletes, which was not considered in analysis because the distinction between athletes and non-athletes was not very clear in their response.

Reduced reaction times in athletes have been reported in earlier literature (1). This may have had an impact on our results. However none of our study participants were aware about the procedure before the test and they all were healthy.

As the data on normal simple reaction time are scarce in Sri Lankan literature, this study will be useful.

Conclusion

Dual or multi-tasking should be avoided in activities like driving, which requires high attention and precision as even a small increase in reaction time can end up in undesirable consequences.

Acknowledgements

The authors acknowledge Mr. V. Sasikumar for developing the reaction timer programme, Mr. S. B. Rameshkumar and the staff at the Department of Physiology for their help in arrangements and to the participants.

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