

Original Article

Effect of dual task activity on reaction time in males and females

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Abstract

The present study was designed to compare the auditory and visual reaction time on an Audiovisual Reaction Time Machine with the concomitant use of mobile phones in 52 women and 30 men in the age group of 18-40 years. Males showed significantly ($p < 0.05$) shorter reaction times, both auditory and visual, than females both during single task and multi task performance. But the percentage increase from their respective baseline auditory reaction times, was more in men than women during multitasking, in hand held (24.38% & 18.70% respectively) and hands free modes (36.40% & 18.40% respectively) of the use of cell phone. VRT increased non significantly during multitasking in both the groups. However, the multitasking per se has detrimental effect on the reaction times in both the groups studied. Hence, it should best be avoided in crucial and high attention demanding tasks like driving.

Introduction

To keep pace with the fast moving world, we are under a constant pressure of time, work and performance which has led to a need to do multiple tasks together- 'multitasking'. Multitasking, generally considered an important tool for maintaining efficiency, on the contrary, reduces the performance of an individual as our cognitive system inhibits the concurrently running irrelevant mental tasks over the

relevant ones. The cognitive functions of brain, involve the working memory (WM) which is understood as the working interface of the temporary storage and manipulation of information. WM is compromised by external interference, in the form of distractions (which can be ignored) or interrupters (which needs to be attended as in multitasking) (1). It has been shown in a study done by Wesley in 2010 that the interrupter stimuli are more detrimental on the working memory as compared to the distractions. Hence, any secondary task, which involves the attention, loads the working memory of the individual and has a detrimental effect on the cognitive performance. Dual-tasking also affects the cognitive or motoric interference that results in diminished gait performance and impaired secondary task performance (2).

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It becomes very important to analyze the effects of multitasking as there are certain jobs involving high attention span where even a slight deviation can result in a catastrophe. Several studies have been conducted on the relation of multitasking and cognitive performances as well as the effect of cell phones on driving, but there is dearth of literature to compare the effect of multitasking between males and females. The present study was designed to compare the differences in auditory and visual reaction times, between both the sexes, during single and multi tasking; and find their ability to handle the 'dual task' of simultaneously talking on cellphone and performing the test on the ART (Audiovisual Reaction Time) machine.

Material and Methods

The study was conducted in the Department of Physiology, Geetanjali Medical College and Hospital, Udaipur, on 82 healthy volunteers between the age of 18-40 years, which were divided into two groups based on gender, one group comprised of 52 females (mean age 23.12 ± 5.78) and other group comprised of 30 males (mean age of 24.25 ± 5.72 years). It was designed to be a comparative study. The subjects included in the study were non alcoholics and non smokers. A pretest evaluation and assessment of the subjects was done to ensure that the subjects had a normal vision, normal hearing ability and no deformity or pathology of the upper limb. The test was done, in the morning between 9-11 am, in the post fed state and the subjects had been given a prior instruction to have a good sleep, a night before the test. The nature and type of the test was well described to the subjects and their consent was obtained for the same.

The test was performed (3) in an isolated and well illuminated room on the Audio Visual Reaction Time Machine, RTM 608 (Medicaid Systems, Chandigarh). The instrument has a resolution of 0.001 second. This instrument provided the stimulus in two modes, auditory and visual. The auditory stimulus was provided by the continuous sound on the speaker using three different frequencies (250, 500 & 750 Hz) randomly. The visual stimulus was provided using three flashing lights (red, yellow and green) at

random. The reaction time was recorded for auditory and the visual stimuli. The subjects were given practice session before beginning the test, to acquaint them with the stimuli. As soon as the subject perceived the stimulus, they responded to it by pressing the response switch by the index finger of the dominant hand. The subjects were instructed to keep the finger at the same distance from the response key throughout the test. The reaction time was displayed on the Reaction Time Machine and was recorded in the prescribed performa. The pre-test, baseline values were recorded. Then the subjects were asked to perform the dual task of conversing on the hand held mode of the cell phone (HH), and simultaneously respond to the stimuli, and their ART and VRT were recorded. This process was repeated with cell phone with the hands free mode (HF), keeping both the hands free and simultaneously responding to the stimuli.

Statistical methods

The recorded data was statistically analyzed, using t-test for difference of means, paired t-test within the groups and unpaired t-test among the groups. The p-value for significance was considered at 0.05 and 0.01. The percentage change was determined to see the effect of dual task effect on the reaction time in both the groups studied.

Results

The present study has shown significantly longer auditory reaction time as compared to the visual reaction time during all the test conditions (Fig. 1) viz.

1. Pretest base line reaction time (ART & VRT), while performing a single task.
2. Reaction time while performing the test with simultaneous conversation on the mobile phone with hand held mode (HH)
3. Reaction time while performing the test with simultaneous conversation on the mobile phone with hands free mode (HF)

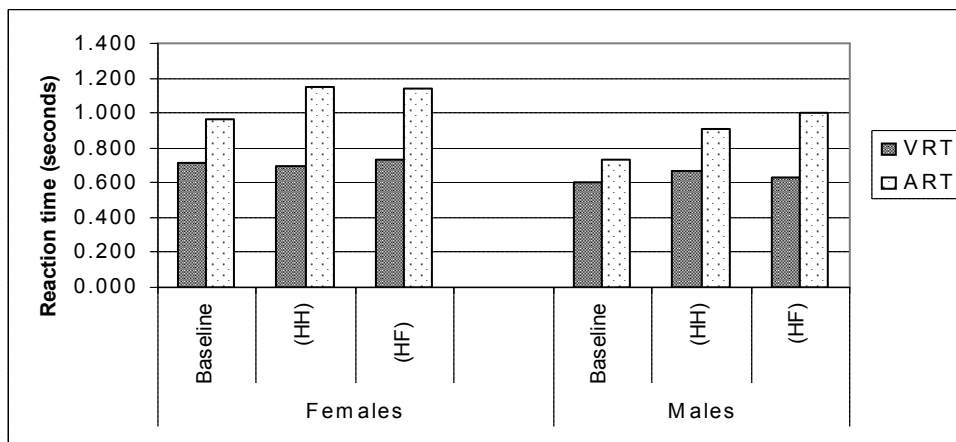


Fig. 1 : Chart showing comparison of ART & VRT in both the groups in all the test conditions.

The ART increased in both the sexes, as shown in Table I. It showed a significant ($p < 0.01$) increase of 24.38% in males and 18.75% in females, while performing a dual task of conversing on the cell phone (HH) and recording of reaction time, but this further increased significantly ($p < 0.01$) to 36.58% in males and decreased to 18.44% in females when the mode of conversation was switched to handsfree from the hand held device, as compared to the base line. The women showed a non significant decrease (0.26%) in ART between the two modes of conversation (HH & HF) while males showed a insignificant increase

of 9.8% for the same i.e. the ART in males was even longer in HF mode than that in HH mode.

The VRT increased significantly in males during HH mode showing an increase of 11.35%, against the insignificant decrease of 2.25% in females. Whereas, during HF mode, both the groups had shown an insignificant increase of 5.84% & 2.79% in males & females respectively. The comparison of VRT between HH & HF mode also shows a non significant increase in females (0.20%) and decrease in males (4.95%) in the HF mode compared to HH mode (Table II).

TABLE I : Showing comparison of ART in both the groups in all the test conditions.

	Base line reaction time (A)	Use of mobile phone (hand held conversation) (B)	Use of mobile phone (hands free conversation) (C)	Comparison of (A) and (B) t- value	Comparison of (A) and (C) t- value	Comparison of (B) and (C) t- value
Females n=52	0.965±0.30	1.146±0.30	1.143±0.38	3.105*	2.59*	0.044 ^{NS}
Males n=30	0.730±0.16	0.908±0.22	0.997±0.36	3.56*	3.71*	1.16 ^{NS}

Significant with $p < 0.05$
NS not significant

TABLE II : Showing comparison of VRT in both the groups in all the test conditions.

	Base line reaction time (A)	Use of mobile phone (hand held conversation) (B)	Use of mobile phone (hands free conversation) (C)	Comparison of (A) and (B) t- value	Comparison of (A) and (C) t- value	Comparison of (B) and (C) t- value
Females n=52	0.715±0.20	0.699±0.18	0.735±0.238	0.43 ^{NS}	0.465 ^{NS}	0.868 ^{NS}
Males n=30	0.599±0.18	0.667±0.13	0.634±0.122	2.13*	1.134 ^{NS}	0.99 ^{NS}

Significant with $p < 0.01$ and $p < 0.05$
NS not significant

On the contrary, the males responded faster to the visual stimuli while using hands free mode as compared to the hand held mode of mobile conversation, this is seen as a decrease of 4.95% ,though non significant, in the VRT whereas women took a non significantly longer time by 5.20% for the same.

On comparing the reaction times of both the groups, it was observed that

- a) for ART, the females had a significantly ($p < 0.05$) longer values of ART than males during base line and all the test conditions.
- b) An important observation worth mentioning was that the ART in males, in HF mode of cell phone conversation was still longer than that in HH mode.
- c) For VRT, a significantly ($p < 0.05$) longer baseline VRT as compared to the men.

d) Whereas, the values of VRT during dual task performance of HH & HF were non significantly higher in females than males (Table III, Fig. 2).

Discussion

Multitasking has emerged as a need of modern society, to overcome the pressures of time, imposed by the jobs and lifestyle. The ability to handle the stress of multitasking varies with the individuals and the amount of stress.

Although multitasking is thought to improve the performance, it is proved otherwise because it actually decreases the efficiency and focus of an individual (1). Our brain ignores the irrelevant tasks and focuses on the relevant one, depending on their importance. It has been seen in a study that the blood flow increases to the areas of brain showing active task handling and decreases to in the other areas, even though the later may be involved in the performance of simultaneous tasks (4, 5).

Multitasking can be good time saver in regular house hold activities but can be quite challenging in some of the crucial tasks. It should hence be best avoided while doing activities requiring precision, high attention, skill and considerable risk to life, like that in driving, working with heavy machinery, crossing the roads etc.

A lot of work has been done to study the effect of distractions on driving like, changing of radio station,

TABLE III: Showing comparison of ART & VRT in both the groups in all the test conditions.

	<i>Base line reaction time t- value</i>	<i>Use of mobile phone (hand held conversation) t- value</i>	<i>Use of mobile phone (hands free conversation) t- value</i>
Females n=52	5.10*	9.31*	6.37*
Males n=30	3.62*	5.31*	5.26*

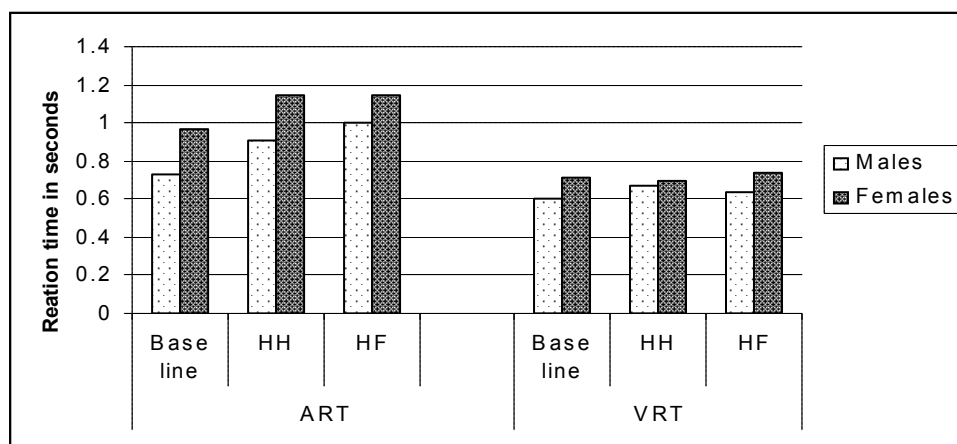


Fig. 2: Chart showing comparison of ART & VRT in all the test conditions in males and females.

talking to fellow passenger and conversing, texting, dialing a phone number on the mobile phone. Involvement with the mobile phone, in any form, appears to be distraction of highest order, as it involves the subject not only physically but also mentally and has a direct detrimental effect on the cognitive performance of an individual (5, 6, 7). Hence, the detrimental effect of multitasking cannot be negated and the extent to which it affects the men and women, needed further study. This study has attempted to highlight the difference in ability of men and women, to handle multitasking. The present study shows that, during all test conditions, at base line (a single task), dual task of conversing on mobile phone and performing the test, the women have a significantly ($p < 0.01$) longer reaction time as compared to men. This shows that men respond faster than women under same circumstances and are more focused than the women. When compared to their respective baseline activity, there had been a greater percentage increase in the reaction times (ART & VRT) of males as compared to females (Table I) while performing the same dual task activities.

ART shows a marked prolongation of 24.38%, during hand held and 36.40%, during hands free mode in males as compared to 18.70% and 18.40% during the similar test conditions in females. This shows that the quantum distraction in men from their baseline activity is more than that in women while performing a dual task. This increase may appear to be more significant in males due to their lower baselines. Thus conversation on mobile phone by either mode has apparently distracted men to a greater degree as that in females. VRT also showed a similar result although the increase was not significant amongst males and females; and that the females had non significantly higher values than males. The significant prolongation of ART, as compared to VRT, in both the groups (Figure 1), could be explained by the synaptic complexity of auditory pathways as compared to the visual pathway causing more synaptic delay (8).

A recent study has shown that the men outperformed the women in monitoring accuracy and the gender differences in multitasking (and spatial ability) were more pronounced during the luteal phase of the menstrual cycle and minimum in between the menstrual phases of women (9).

The gonadal hormones in both males and females have definitive neuromodulatory roles. The female sex hormones have a documented effect on the affective state and cognitive functions of women (10). Estrogen has been shown to increase the reaction time by enhancing the GABA activity and hence increasing the reaction time during the luteal phase where as a faster reaction time has been reported during menstrual phase when these hormones are at lowest levels (10, 11). On the other hand testosterone, in males, is an important hormone required for maintaining neural integrity and functions and doesn't show any cyclical variations (12). Hence the concentration and ability to focus in women may vary with phases of menstrual cycle

To conclude, men are more focused in a task performance than women and also can handle a dual task more efficiently though they experience a greater percentage change from their respective baseline. These differences could be attributed to sex hormones and their effect on the neuronal circuitry and hence the difference in handling of the dual task performance. These differences, though very small, could be highly significant in various sensitive situations like driving, crossing the roads and other such situations. Further, as seen in the study, the multitasking ability of women appears better than men but it should be strictly restricted to the household management rather than serious and risky situations though it should be better avoided by all. Further, while men can handle both single and multitasking more efficiently than women, the deterioration in focusing ability during multitasking is more prominent in males when compared to their own ability in doing a single task.

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