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# A STUDY OF AUDITORY AND VISUAL REACTION TIME IN MALE AND FEMALE GROUP DURING SINGLE AND MULTITASKING PROCESS

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**ABSTRACT** Present work involves the comparison of the auditory and visual reaction time recorded on Audiovisual Reaction Time Machine for the 18-40 years age groups, women (56) and men (34) whom concomitantly use mobile phones. Significantly shorter reaction times ($p<0.05$) was observed in male both for auditory and visual than females subjects both during single task and multi task performance. The percent increase of auditory reaction times from their respective baseline, was recorded more in men than women during multitasking, in hand held (25.48% & 19.86% respectively) and hands free modes (39.68% & 20.45% respectively) of the use of cell phone. Increase in VRT was observed non significantly during multitasking in both the groups. However, the multitasking has negative effect on the reaction times in both the groups studied. Therefore, multitasking should best be neglected in important and high awareness challenging errands like driving.

**KEYWORDS** : Reaction Time, Dual Tasking, Vrt, Art, Visual, Auditory, Single Tasking

## 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 (Shinde and Pazare, 2003). 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 (Annie et al., 2012).Dual task methodology, which requires subjects to perform a postural task and a cognitive task simultaneously, has been used to assess the cognitive demands necessary for performing postural tasks. The underlying assumptions for a dual-task paradigm are derived from a well-known "capacity sharing" model ofinformation processing (Kahneman, 1973; Navon and Gopher, 1979; Tombu and Jolicoeur, 2003).

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) (Clapp et al., 2010).

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.

There are various factors that affect the reaction time to a stimulus. Factors like intensity and duration of the stimulus, age and gender of the participant, effect of practice can affect the reaction time of an individual to a particular stimulus. For example, there are relative differences between the reaction time to visual and auditory stimuli between genders. Male athletes tend to be faster than their female counterparts in responding to different stimuli. Researches done by Engel et al. (1976) , show the reaction time to sound to be faster in males when compared to females (Dane and Erzurumluoglu, 2003).

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 90 healthy volunteers, between the age group of 18-40 years, out of which 56 were females and 34 were males. The mean age of the subjects was 27.5 ± 5.75 years. Only non alcoholic and non smoker subjects were included in the study. A pre-test 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 morning time between 9 -11am was test time, in the post fed state and the subjects had been given a prior instruction to have good sleep, a night before the test. The scenery and type of the test was well described to the subjects and their assent was obtained for the same. The test was performed 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 pretest, 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 analysis

Statistical analysis was done, 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**

There was significantly longer auditory reaction time observed as compared to the visual reaction time during all the test conditions.

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

Increase in ART observed in both the sexes, as shown in Table I. It was observed ($p<0.01$) increase of 25.48% in males and 19.86% in females, while performing a dual task of conversing on the cell phone (HH) and recording of reaction time, Whereas this further increased significantly ($p<0.01$) to 39.68% in males and decreased to 20.45% in females when the mode of conversation was switched to hands free mode from hand held device, as compared to the base line. In case of women group, non significant decrease (0.27%) in ART between the two modes of conversation (HH & HF) while males showed a insignificant increase of 10.1% 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 11.79%, against the insignificant decrease of 2.30% in females. Whereas, during HF mode, both the groups had shown an insignificant increase of 5.87% & 2.83% in males & females respectively. In contrast of data of VRT between HH & HF mode showed a non significant increase in females (0.22%) and decrease in males (4.99%) (Table II).

**Table I: Comparison of ART between male and female subjects, in all the test conditions.**

| | Base line Reaction time (A) | Use of mobile phone (HH) (B) | Use of mobile phpone (HF) (C) | Comparison of (A) and (B) t-value | Comparison of (A) and (C) t-value | Comparison of (B) and (C) t-value |
|---|---|---|---|---|---|---|
| **Females (56)** | 0.972±0.30 | 1.149±0.31 | 1.145±0.39 | 3.123* | 2.65* | 0.050**NS** |
| **Males (34)** | 0.739±0.18 | 0.912±0.24 | 0.999±0.37 | 3.66* | 3.80* | 1.34**NS** |

Significant with $p<0.05$
NS not significant

**Table II: Comparison of VRT between male and female subjects, in all the test conditions.**

| | Base line Reaction time (A) | Use of mobile phone (HH) (B) | Use of mobile phpone (HF) (C) | Comparison of (A) and (B) t-value | Comparison of (A) and (C) t-value | Comparison of (B) and (C) t-value |
|---|---|---|---|---|---|---|
| **Females (56)** | 0.735±0.22 | 0.708±0.20 | 0.755±0.24 | 0.45**NS** | 0.471**NS** | 0.876 NS |
| **Males (34)** | 0.608±0.20 | 0.669±0.15 | 0.642±0.22 | 2.19* | 1.189 **NS** | 0.100 **NS** |

Significant with $p<0.01$ and $p<0.05$

NS not significant

On the contrary, respond to visual stimuli was observed faster in males during hands free mode of cell phone uses as compared to the hand held mode of mobile conversation, there was 4.95% decrease recorded ,though non significant, in the VRT whereas women took a non significantly longer time by 5.20% for the same. Comparison of the ART between both the group (Male and female ) showed that, during base line and all the test conditions, the females had a significantly ($p<0.05$) longer values of ART than males. An important inspection was that the ART in males, in HF mode of cell phone conversation was still longer as compare to in HH mode. For VRT, a significantly ($p<0.05$) longer baseline was observed. d) While, VRT value during dual task performance of both HH & HF were non significantly higher in females than males (Table III)

**Table III: Comparison of ART & VRT between mal and female subjects**

| | Base line Reaction time t- value | Use of mobile phone (HH) t-value | Use of mobile phpone (HF) t-value |
|---|---|---|---|
| **Females (56)** | 5.34* | 9.43* | 6.41* |
| **Males (34)** | 3.69* | 5.35* | 5.32* |

**Discussion:**

Faster reaction of males than females to visual and auditory stimulus was in conformity with earlier findings (Shelton and Kumar, 2010; Narhare et al., 2012; Karia et al., 2012). 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 (Annie et al., 2012).

Reaction time is dependent on several factors like arrival of the stimulus at the sensory organ, conversion of the stimulus by the sensory organ to a neural signal, neural transmissions and processing, muscular activation, soft tissue compliance, and the selection of an external measurement parameter (Pain and Hibbs, 2007). Re- searches by Kemp et al. (1973), show that an auditory stimulus takes only 8-10 milliseconds to reach the brain, but on the other hand, a visual stimulus takes 20-40 milliseconds. This implies that the faster the stimulus reaches the motor cortex, faster will be the reaction time to the stimulus. Therefore since the auditory stimulus reaches the cortex faster than the visual stimulus, the auditory reaction time is faster than the visual reaction time.

A lot of work has been done to study the effect of distractions on driving like, changing of radio station, 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 (Spiers and Maguire, 2007; Redelmeier and Robert, 1997; Strayer et al., 2011). Hence, the detrimental effect of multitasking cannot be negated and the extent to which it affects the men and women, needed further study.

The two-process model of Schneider and Shiffrin (1977) accounts for the degree of concentration necessary to successfully complete activities related to the level of processing required by the task. The processing level required may range from "automatic processing," requiring minimal resources, to "controlled processing," which carries a high resource demand. The cognitive activities used in our study, such as visual selective attention and visual scanning activities, may require more automatic processing. Similarly, the findings of Strayer and Johnson found that passive listening to the radio or an audio book had no significant impact on driving performance. Apparently these automatic processing abilities are evidenced in both auditory and visual cognitive domains. However, more complex tasks such as working memory, lexical, and form discrimination represent controlled processing cognition. These findings agree with previous findings of working memory tasks (Alm and Nilsson, 1995; Briem and Hedman, 1995), reasoning tasks (Goodman et al, 1999), and perception and decision-making tasks (Brown et al, 1969) that were shown to have a greater negative impact on dual task performance ability. 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.

Present study revealed the difference in ability of men and women, to handle multitasking. 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. Thus male 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.

Increased reaction times due to cognitive distraction have been reported earlier (Anderson et al., 2014). 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 (Allport, 1980; Karia et al., 2012). VRT of our males was similar to participants in Ghuntla's study (Allport, 1980).

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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