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AUDITORY AND VISUAL REACTION TIME IN YOUNG ADULTS WITH CONCOMITANT USE OF CELL PHONES

Manjinder Kaur[1], Harpreet Singh[2], Sangeeta Nagpal[3], M.L. Suhalka[1]

[1]Department of Physiology, Geetanjali Medical College and Hospital, Manwa Khera, Eklingpura Chouraha, Udaipur, Rajasthan,India
[2]Department of Orthopaedics, Geetanjali Medical College and Hospital, Manwa Khera, Eklingpura Chouraha, Udaipur, Rajasthan, India
[3]Department of Physiology, Maharishi Markandeshwar Medical College, Solan, H.P., India

E-mail of Corresponding Author: drmanjinder@yahoo.com

ABSTRACT

The use of mobile phones while doing tasks which require high attention span, can affect the reaction time of the individual which can lead to serious and undesirable consequences, for example while driving. The present study was conducted on 82 young healthy volunteers, comprising 52 females and 30 males, to study the change in their auditory reaction time (ART) and visual reaction time (VRT) with the concomitant use of mobile phones. The mean age of the volunteers was 23.5 ± 5.75 years. The ART and VRT were measured using Audio Visual Reaction Time Machine, RTM 608. After recording the baseline reaction time when not using mobile phone, ART & VRT were measured when the subjects conversed on the mobile phone, in conventional hand held method and then later when they continued their conversation in the hands free mode. Results showed that the ART significantly increased from the baseline ($p<0.01$) in both the above mentioned conditions (22.82% & 25.07% respectively), suggesting mental or cognitive distraction due to multitasking and the subjects took significantly longer time to respond to the auditory stimuli. The dual task performance, with both the modes of conversation yielded non significant difference ($p= 0.705$), suggesting that the use of mobile phone per se, whether in hands free or hand held mode, equally impaired the auditory reaction time .

Keywords: reaction time, handsfree mobile, driving, dual task performance

INTRODUCTION

Cellular or mobile phone has been a revolutionary invention and has completely enslaved the world, since it serves not only as a source of voice communication but its scope has widened by the development of data enabled devices. Needless to say, it has become a self sufficient and convenient mode of communication, information, social networking and efficient utilization of time, thereby increasing productivity and growth. Any technology, if used injudiciously, has its own hazards and the same is true for cell phones.

The use of mobile phones while doing certain tasks which require high attention span, can affect the reaction time of the individual which can lead to serious and undesirable consequences, for example while driving. Driving is a task requiring the coordination of a number of physical and mental skills It is documented world- wide that the cell phones, if used while driving, may affect the person's skills by impairing reaction time, visual search patterns, ability to maintain speed and position on the road, ability to judge safe gaps in the traffic and general awareness about other road users. [1] It has also been reported that using the hand held

mobile phone can cause physical, visual and cognitive distraction which impairs driving performance in the form of riskier decision making, slower reactions, wandering out of lane and not being alert to the surroundings. [1]

The use of cell phones have increased manifolds in recent years, with more than 927.37 million subscribers in India as published on July 5 , 2012.[2] This increase has also led to an increase in the number of individuals concomitantly driving and talking on the cell phone.[3] Few recent studies have shown that the cell phone users spend 60% of their cell phone time while driving .[4] Drivers while talking on their cell phones, have an increased headways time, increased brake reaction time and tend to reduce speed while driving.[5,6,7] It has been reported that the use of hands-free mode in cellular phones also involves significant verbal and cognitive distraction, which impairs the driving performance and skill; and that the driving performance further worsens if cognitive load involved in the dialogue is higher .[7]

Hence, the present study was done to see the effect of use of mobile phone, both in handheld and hands free mode, on the auditory and visual reaction time of an individual.

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 group of 18- 40 years, out of which 52 were females and 30 were males. The mean age of the volunteers was 23.5 ± 5.75 years. Only non alcoholic and non smoker subjects were included in the study. 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 - 11am, in the post fed state and the subjects had been given a prior instruction to have 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 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 provides the stimulus in two modes, auditory and visual. The auditory stimulus was provided by the continuous sound on the speaker using three different frequencies (250Hz, 500Hz and 750Hz) randomly. The visual stimulus was provided using three flashing lights (red, yellow and green) at random. The reaction time was recorded for both the 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.[7] The pre-test, baseline values were recorded. Then the subjects were asked to perform the dual task of conversing on the hand held cell phone and simultaneously responding to the stimuli; and their ART and VRT was then recorded. The ART and VRT were again recorded with the cell phone on the hands free mode, keeping both the hands free and simultaneously responding to the stimuli.

The above data was statistically analyzed using paired t- test and confirmed with Krausel Wallis test.

RESULTS

The auditory reaction time increased significantly ($p<0.01$) from the baseline, as shown in Table I and figure I, with the concomitant use of mobile phone showing the percentage increase of 22.82

% with the use of hand held mobile phone and 25.07 % with hands free mode. This increase in ART from baseline, in the two modes of mobile phone usage, i.e. hand held and hands free when compared between each other did not show a significant variation (p= 0.705).

The visual reaction time on the other hand, showed a non significant increase from the baseline, as shown in Table II and figure I, with the concomitant use of mobile phone, 6.18% with the use of hand held mobile phone and 8.63 % with hands free mode. The VRT did not show a significant variation (p= 0.613) on comparing the mode of mobile phone usage.

DISCUSSION

A complex task, like driving, involves the coordination of many skills requiring a perfect balance of cognition, reaction time and general awareness of the surroundings. Most of the time people drive their vehicles based on the conditioned reflexes, learned through experience but sometimes the lack of attention can cause fatal crashes and serious injuries. With the advent of the cellular era, people have started utilizing the driving time in conversing on their mobile phones, without realizing that these conversations affect the cognitive functions of the driver in various ways due to attention deficit.

Various researches have shown that using the mobile phone while driving increases the risk of crashing by at least four times and the most common types are “run-off-the-road” and “rear end” crashes.[1] It has been studied that the mobile phones distract the various drivers in many ways like physical distraction which occurs due to taking the hands off the steering wheel to answer or dial a phone call, visual distraction which results if the driver takes his eyes off the road and the mental distraction (cognitive distraction) due to multitasking i.e. conversing and driving.

The present study doesn’t involve any parameters resulting in physical and visual distraction, but if these are also considered, it would have been more informative in analyzing the complete assessment of the effect of mobile phone usage while driving. But, it clearly shows that mobile phones are equally distracting whether used in the conventional method or used in the hands free mode, as they mask the auditory impulses from the surroundings leading to the longer reaction time and impaired judgment.

Various studies conducted to establish the effect of cell phone usage on driving have shown that performing other cognitive tasks while driving degrades the driving performance. [8,9,10,11,12,13] In addition, the data from real world accident studies also suggests that the users of handsfree devices are equally prone to accidents as are the users of hand held devices.[8,14] It has also been seen that the use of mobile phones while driving can lead to impaired decision making, especially when the driver has to turn in the traffic, choose the lane or to keep safe gaps. In a recent study conducted in Pennsylvania, researchers have shown that while driving, we use the parietal lobes, occipital cortex, motor cortex and the cerebellum along with increased activity in left thalamus, left subcortical structures (putamen, pallidum, caudate and hippocampus) and left cortical areas of insula, inferior frontal gyrus and middle frontal gyrus.[15] But when dual task of driving and listening was performed, there was an activation of all the areas associated with driving along with the activation of bilateral temporal regions and inferior frontal regions. Also, there was an associated decrease in activation of bilateral parietal cortex when the subject was involved in speaking and listening task while driving. It has also been observed that if multitasking does not involve the higher functions, as is seen in conditioned reflexes like driving and conversing, there is not much activation of frontal cortex; but in case of any driving emergency, the latency of the activation of higher centers will be longer.[16] The present study has tried to analyze the degree of mental or

cognitive distraction due to multitasking in a subject and we found out that the subjects took significantly longer time to respond to the auditory stimuli than to the visual stimuli, when compared to the baseline values. The use of mobile phone per se, may be with hands free or hand held mode, impairs the auditory reaction time almost equally and considerably; although the visual reaction time is not affected till the subject doesn't lose his focus from the apparatus. Hence, when a person converses on phone while driving, his auditory reaction time should increase but his visual reaction time should not be affected until he experiences visual distraction. The seriousness of this impaired cognitive functions further depend on the involvement of the driver in conversation. Thus with the evidence so far suggesting the increase in reaction time with handsfree devices almost equal to that with the use of handheld devices, there appears to be no justification to legally allow telephonic conversation while driving even with a handsfree device.

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Table I: Showing mean and the percentage change in ART of 82 subjects using of mobile phone (in hand held & hands free mode) as compared to the baseline reaction time values

	Base line (in msec) (A)	RT with the use of mobile phone; hand held mode (in msec) (B)	RT with the use of mobile phone; hands free mode (in msec) (C)	Comparison of A & B (p value)	Comparison of A & C (p value)	Comparison of B& C (p value)
ART	0.857± 0.20	1.053±0.29	1.072± 0.35	0.0000017*	0.0000040*	0.705^{NS}

p> 0.01- significant
NS- not significant

Table II: Showing mean and the percentage change in VRT of 82 subjects using of mobile phone (in hand held & hands free mode) as compared to the baseline reaction time values

	Base line (in msec) (A)	RT with the use of mobile phone; hand held mode (in msec) (B)	RT with the use of mobile phone; hands free mode (in msec) (C)	Comparison of A & B (p value)	Comparison of A & C (p value)	Comparison of B& C (p value)
VRT	0.657± 0.14	0.697±0.16	0.713± 0.24	0. 083^{NS}	0.070 ^{NS}	0.613^{NS}

p> 0.01- significant
NS- not significant

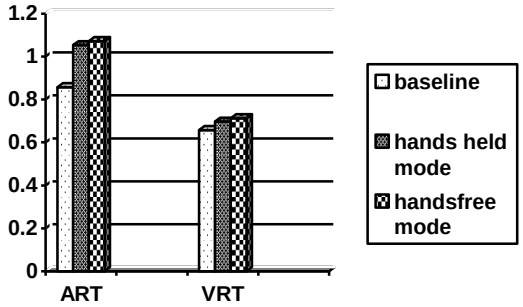

Figure 1: Auditory (ART) and Visual (VRT) reaction time in 82 subject recorded as baseline (without the phone), with concomitant use of mobile phone in hands held mode and in hands free mode