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Research Article

ALTERED ART AND VRT FREQUENCIES DUE TO DUAL TASK ACTIVITY: HANDS FREE AND HAND HELD USE OF MOBILE PHONE

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ABSTRACT

The inability to maintain balance under dual-task conditions is a common occurrence. Because impaired dual-task balance performance predicts adverse outcomes such as falls, and declines in both cognitive and physical function, interventions that improve dual-task balance performance are a critical health care need. Present work was performed on 90 young healthy volunteers, includes 56 females and 34 males, and they studied for change in their auditory reaction time (ART) and visual reaction time (VRT) with the concomitant use of mobile phones.

Mean age of volunteers included in this work was 27.5 ± 5.75 years. Audio Visual Reaction Time Machine, RTM 608 was used to measure ART and VRT of subjects. Recording of the baseline reaction time while 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. Obtained results showed that ART significantly increased from the baseline ($p<0.01$) in both hand held method and hands free mode i.e. 21.81% & 24.06% respectively. Both mental or cognitive disturbance due to multitasking and the subjects took remarkably longer time to take action to the auditory stimuli. The twin task recital, with both the modes of dialogue yielded no noteworthy disparity ($p= 0.701$), suggesting that the use of mobile phone per se, whether in hands free or hand held mode, equally impaired the auditory reaction time .

INTRODUCTION

Among older adults, an impaired ability to maintain balance while simultaneously performing cognitive tasks is a common occurrence. Because poor dual-task balance performance is associated with increased fall risk and a decline in cognitive function, interventions to improve dual-task balance performance are needed. Cellular phones were introduced in 1983 and have infiltrated every aspect of modern day life. A growing concern is the increased use of cell phones by individuals while operating a motor vehicle. Cell phones can distract motorists in a number of ways. Simply finding, turning on and off, answering, and ending a phone call redirects the driver's hands from steering and his or her eyes from watching the road. Phone conversations can also affect the driver's attention and performance. 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 (www.dpti.sa.gov.au).

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 (www.dpti.sa.gov.au). 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 (articles.timesofindia.indiatimes.com).

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Talking on a cell phone appears to disrupt drivers' attention to their visual environment. Strayer *et al*. (2003) found that talking on a cell phone impairs recognition memory of objects (billboards) presented in the driving scene. Drivers were two times as likely to recall billboards that were looked at during the single-task (driving only) condition than the dual-task condition (driving while talking on their cell phone). In addition no difference was observed between single-task and dual-task conditions on the amount of eye fixation which shows that drivers looked at the billboards in the dual-task condition even though they were unable to recall what they looked at. This study supports the attention blindness theory which refers to the withdrawal of attention away from the visual scene (Strayer & Johnston, 2001). 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 (Lin and Chen, 2006).

Further research needs to be conducted that examines the effect that cell phone use has on the way that one walks before legislation can be implemented that bans the use of cell phones while crossing the street. While talking appears to cause a lack of situation awareness due to the cognitive demands of the conversation, text messaging while walking may pose a whole new set of problems.

Thus, the purposes of this study were to determine the effect of use of mobile phone, both in handheld and hands free mode, on the auditory and visual reaction time of an individual and to evaluate the effect of instructional set on dual-task balance performance

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. Two types of stimulus is provided by this instrument in two modes, auditory and visual. Three different types of frequencies i.e. 250Hz, 500Hz and 750Hz randomly were used for auditory stimulus. Whereas, three flashing lights (red, yellow and green) were used as random, for visual stimulus.. 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. 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

Results suggested that, there was significant increase in ART observed ($p<0.01$) from the baseline, as shown in Table I , with the concomitant use of mobile phone showing the percentage increase of 21.81% with the use of hand held mobile phone and 24.06 % with hands free mode. Increase value of 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 with the concomitant use of mobile phone, with the use of hand held mobile phone (7.47%) and with hands free mode (9.36 %). The VRT did not show a significant variation ($p= 0.613$) on comparing the mode of mobile phone usage.

Descriptives

SOUND250HZ

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Normal	90	.9968	.29816	.03039	.8871	.9743	.56	2.54
Without handfree	90	1.0994	.45560	.05110	.9946	1.1971	.27	4.22
With handfree	90	2.0105	.49253	.04976	.9987	1.1979	.44	3.35
Total	270	1.0667	.41351	.02699	.9611	1.0914	.26	4.20

ANOVA

SOUND250HZ

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.997	3	.987	6.564	.006
Within Groups	41.311	347	.176		
Total	43.308	350			

Multiple Comparisons

SOUND250HZ
Tukey HSD

(I) Response	(J) Response	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Normal	Without handfree	-.18544*	.07113	.017	-.3668	-.03798
	With handfree	-.18670*	.07113	.015	-.3880	-.04110
Without handfree	Normal	.18554*	.07113	.017	.0423	.4168
	With handfree	-.00216	.07113	1.000	-.1544	.1786
With Handfree	Normal	.18560*	.07113	.015	.0434	.3167
	Without handfree	.00226	.07113	1.000	-.1511	.1985

Multiple Comparisons

SOUND250HZ
Tukey HSD

(I) Response	(J) Response	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Normal	Without handfree	-.18544*	.07113	.017	-.3668	-.03798
	With handfree	-.18670*	.07113	.015	-.3880	-.04110
Without handfree	Normal	.18554*	.07113	.017	.0423	.4168
	With handfree	-.00216	.07113	1.000	-.1544	.1786
With Handfree	Normal	.18560*	.07113	.015	.0434	.3167
	Without handfree	.00226	.07113	1.000	-.1511	.1985

*. The mean difference is significant at the 0.05 level.

500 Hz

Descriptives

Sound500hz

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Normal	90	.9848	.28899	.03112	.8925	1.0061	.31	1.88
Without Handfree	90	1.0976	.44401	.04888	1.0023	1.1986	.52	3.98
With Handfree	90	1.9856	.46624	.04829	1.0598	1.4515	.56	2.53
Total	270	1.0423	.40727	.03580	.9843	1.0963	.31	3.98

ANOVA

SOUND500HZ

	Sum of Squaresn	Df	Mean Square	F	Sig.
Between Groups	4.872	3	2.988	14.120	.100
Within Groups	36.982	253	.556		
Total	41.584	256			

Multiple Comparisons

SOUND500HZ
Tukey HSD

(I) response	(J) RESPONSE	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Normal	Without handfree	-.24765*	.06425	.100	-.4130	-.1284
	With handfree	-.31189*	.06425	.100	-.4532	-.1886
Without handfree	Normal	.24876*	.06425	.100	.1024	.4110
	With handfree	-.09071	.06425	.779	-.2135	.0990
With handfree	Normal	.31189*	.06425	.100	.1586	.4876
	Without handfree	.18021	.06425	.779	-.1021	.2543

*. The mean difference is significant at the 0.05 level.

Descriptives

RESPONSE TIME

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Normal	90	.8899	.24017	.02916	.7865	.9791	.57	1.89
Without handfree	90	.9990	.36151	.03998	.9432	1.2926	.49	2.39
With hand free	90	.9940	.41987	.04870	.9198	1.9113	.04	2.42
Total	270	.9890	.35107	.02431	.8976	.9820	.04	2.42

ANOVA

RESPONSE TIME

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.988	3	.991	6.979	.002
Within Groups	28.987	253	.345		
Total	30.975	256			

Multiple Comparisons

Response Time
Tukey HSD

(I) mode	(j) mode	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Normal	Without handfree	-.17368*	.05711	.005	-.3101	-.0499
	With hand free	-.17015*	.05567	.006	-.3112	-.0454
Without handfree	Normal	.17224*	.05450	.005	.0673	.3001
	With hand free	.00438	.05450	.999	-.1345	.1345
With hand free	Normal	.16995*	.05450	.006	.0534	.3002
	Without handfree	-.00478	.05450	.999	-.1432	.1456

*. The mean difference is significant at the 0.05 level.

DISCUSSION

With increases in technology and a fast-paced lifestyle, individuals rarely ever just walk. People typically dual- or even triple- task while walking. Whether they are engaged in a cognitive activity such as talking on the cell phone or listening to an Ipod or are taking part in a motor task such as text messaging, smoking, or drinking a cup of coffee, or any combination of these, individuals seem to be negotiating over multi-surface terrains and navigating through obstacles while dual- or triple-tasking . Based on empirical studies, many researchers have concluded that using a cellular phone while driving significantly increases the risk of a crash at least four times and the most common types are “run-off-the-road” and “rear end” crashes.. According to Redelmeier and Tibshirani (1997), the estimated risk of a crash while using cellular phones was an average of four times higher than driving while not using a cellular phone, similar to driving while intoxicated. The researchers also concluded that hands-free phones seemed to offer no safety advantage over hand-held phones. Redelmeier and Tibshirani (1997) reiterated earlier findings and suggested that earlier studies have even underestimated the risk associated with driving while using a cell phone. Seo and Torabi (2004) reported that 21 % of the college students surveyed experienced an accident or near accident with at least one of the drivers using a cell phone.

It has been studied that the mobile phones divert 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.

In this study, not any parameters involve which result in physical and visual distraction, but if these are also measured, it would have been more instructive in analyzing the complete measurement of the effect of mobile phone practice while driving. However it is clear that mobile phones are equally distracting either used in the conventional method or used in the hands free mode because 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 (Chinmay *et al*, 2010; Suzanne *et al*., 2005).

There is widespread agreement in research that using a cell phone while driving increases the risk of an accident (Collet, Guillot, & Petit, 2010a, 2010b; McCartt, Hellinga, & Bratiman, 2006). Naturalistic studies found that talking on a cell phone increases the risk of collision by over 30 percent (Wilson & Stimpson, 2010). In general, research has shown that drivers' talking on a hand-held or hands-free cell phone increased crash risk by about four times compared to the drivers who were not using cell phones (Dragutinovic & Twisk 2005; McEvoy *et al*., 2005). In contrast, Olson *et al*. (2009) found in a naturalistic study of truck drivers that talking or listening to a hand-held phone was not related to increased risk, and that talking or listening to a hands-free phone had a significant protective effect, i.e., decreasing the risk of a safety-critical event (OR = 0.4).Whenever dual task of driving and listening was performed, activation of all the areas associated with driving along with the activation of bilateral temporal regions and inferior frontal regions was observed. Also, there was an linked decrease in commencement of bilateral parietal cortex when the subject was occupied in speaking and listening task while driving. It has also been pragmatic that if multitasking does not entail 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

In the present research analysis has been made to understand the degree of mental or cognitive distraction due to multitasking in a subject and results suggested that the subjects respond to the auditory stimuli than to the visual stimuli tae significantly longer time as compared to the baseline values. It was found that use of mobile phone with both hands free as well as hand held mode, impairs the auditory reaction time nearly evenly and significantly; even though the visual reaction time is not affected till the subject doesn't lose his focus from the apparatus. Consequently, Conversation of subjects on phone during driving leads increase in auditory reaction time however visual reaction time would not be affected until he experiences visual disturbance. Involvement of the driver in conversation may increase seriousness of impaired cognitive functions. Accordingly results suggested that increase in reaction time with hands free devices round about alike to that with the use of handheld devices, thus, evidence suggested that telephonic conversation while driving even with a hands free device cannot be legally allowed as well.

CONCLUSION

It can be concluded that cell phone use negatively affects performance on a fine motor task. The researchers performed this simple task in a controlled environment without any notable internal or external distractions. There are reasons to believe that the effects of cell phone use and a task that requires the coordination of fine motor functioning, such as driving a motor vehicle, would be amplified in a real world situation. There are many internal and external distractions in play when operating a motor vehicle.

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