Impact of Cell Phone Use on Driver Performance in Delhi

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Abstract: Since the past decade the cell phone has become an integral part of our daily lives. We have seen a rise in cell phone usage while driving, and this has been well established to be one of the many distractions faced by drivers that lead to crashes. In this study we employ naturalistic observation techniques to study the prevalence of cell phone usage by drivers in Delhi. The study also aims to ascertain the changes in driving parameter, which can further give an indication into the cognitive load cell phone usage pose on a driver. The study indicates to nearly 6% of the drivers using handheld cell phone devices while driving on Delhi roads and we also observe a reduction in vehicle speed during the call.

Keywords: Cell phone Usage; Driver Distraction; Naturalistic Observation Studies; Driver Behaviour

1. INTRODUCTION

According to the Telecom Regulatory Authority of India (TRAI) there were 1,183 million active cell phone connections in India in March 2018 with a monthly growth of over 2% (TRAI, 2018). About 90% of the population of 1.3 billion has access to cell phones. With the rise of the smartphone technology a cell phone culture has embedded itself in many aspects of daily lives of people in India also. With widespread use of cell phones their use by car drivers seems to be ubiquitous. This has prompted researchers to conduct studies on the prevalence of their use while driving and the effect of this on the incidence of road traffic crashes. Similar studies have not been conducted in India, but recently a civil society organization released a report based on interviews with 1,749 drivers in India and found that while 94% of them believed that use of cell phones while driving is dangerous, 41%-47% continued to receive and make calls while driving (SaveLIFE Foundation, 2017). However, the study did not report the actual incidence of cell phone use by drivers or the influence if this use on road safety.

Studies from other countries around the world have reported the use of cell phones to be around 10% of the driver population. This includes but is not limited to talking on the cell phone using a handheld and hands-free mode, texting, handling the cell phone and keeping the phone in hand or on the lap. The main method of this interaction has been talking on the cell phone. Farmer et al. (2015) reported that 11.7% drivers were found interacting with their phones with 6.5% talking on the phone and 3.7% with the phone in their hands or laps. A study from Doha, Qatar reported a 7.5% use of cell phones for talking and found a positive correlation with drivers who drove without use of seatbelts (Mahfoud *et al*., 2015) and drivers of SUVs. Yanis *et al.* (2015) report a similar trend of talking on the cell phone and driving a

SUV among Greek drivers with 7.6% of drivers talking on the phone while driving. The study also showed a reduction of drivers talking on the phone to 3.5% when they were driving with children in the car. This probably points to the fact that people are aware of the risks of using cell phones while driving and avoid use when they consider themselves to be behaving more responsibly. Nearly 75% of the calls made during driving are work related, as a result even though the drivers know the increased risk of attending to a call they don't opt for any self-regulatory methods such as "Driving Mode" apps or simply not attending to the call (Musicant *et al.*, 2015). Due to the phone calls themselves being work related and considered important by the driver Oviedo-Trespalacios *et al.* (2017) found an increase of 1.48 odds of phone usage with every additional hour of driving amongst the Australian drivers.

The loss in performance in the driving task, which leads to the increase in the risk of crashes and near crash events, have their roots in the cognitive load theory. The addition of any Split-Attention effect (Sweller, 2013) causes a reduction in the cognitive load on the working memory of the subject. In case of a driving task any form of distraction to the driver acts as an additional cognitive load that causes loss in the performance of the driving task. (Lamble *et al.*, 1999) reported an impairment of the time headway (TH) and time to collision (TTC) of a driver engaging in a non-visual cognitive task such as talking, by 0.5s and 1.0s respectively. The most common compensatory response of the driver in case of a distraction is reduction in vehicle speed (Haigney *et al.*, 2000; Alm *et al.*, 1995).

This study examines the incidence of use of cell phones for talking by drivers on the roads in Delhi and the change in the driver's performance of the driving task due to the additional task of talking on the cell phone. To find the effect of cell phone use on driver behaviour we used naturalistic observation techniques and to assess the changes an instrumented car was used to observe the changes in vehicle velocity before, during and after phone call. The phone call incident is categorized as the time the subject notices and receives the call to the end of the call with the subject putting the phone down. During this study we only observed calls with hand-held device and no hands-free device was used.

2. METHODS

This study employed two methods for data collection: (i) observation of cell phone use by drivers in the road, and (ii) naturalistic data collection techniques to study the changes in vehicle velocity before, during and after a cell phone call. Due to the limitations posed by the study methodology we were only able to observe any active phone calls with a hand held device that were evident to a visual observation. Calls or text messages using a hands-free or non-observable method were not included.

For the first objective, observers were stationed on 4 major roads of Delhi at different times of the day to observe the proportion of drivers talking on a cell phone. For the second objective a vehicle was outfitted with a driver facing camera and an on-board system to record the CAN (Controlled Area Network) data was used. This recorded the changes in vehicle velocity during a cell phone call by the driver as observed on the video feed of the driver camera.

2.1 Cell Phone Use

To estimate the percentage of drivers using cell phone both for calling and texting, 4 major roads of Delhi were chosen. For each location every third hatchback car and every third sedan car was observed to see if the driver of the car was talking or texting using a handheld phone. Here the cell-phone usage is defined as observable interaction with the device both in the form of physical interaction with the device (Texting) and the act of holding the device to the ear of the user (talking) A total of 500 hatchback cars and 500 sedans were observed at each location totalling 4,000 cars. The hatchback and sedan cars were chosen because they make up a majority of the fleet of cars on Delhi roads. Due to the nature of data collection it was not possible to determine if any of the drivers were talking using a hands-free device. The results are shown in tables 1 – 6.

Table 1: Number of Drivers Calling while Driving

Category	Not Calling	Calling	Total	Percent calling
Road 1	965	35	1000	3.5%
Road 2	958	42	1000	4.2%
Road 3	951	49	1000	4.9%
Road 4	938	62	1000	6.2%
Total	**3812**	**188**	**4000**	**4.7%**

Table 2: Number of Sedan Drivers Calling while Driving

Category	Not Calling	Calling	Total	Percent calling
SD Road 1	479	21	500	4.2%
SD Road 2	479	21	500	4.2%
SD Road 3	483	17	500	3.4%
SD Road 4	475	25	500	5.0%
Total	**1916**	**84**	**2000**	**4.2%**

Table 3: Number of Hatchback Drivers Calling while Driving

Category	Not Calling	Calling	Total	Percent texting
HB Road 1	486	14	500	2.8%
HB Road 2	479	21	500	4.2%
HB Road 3	468	32	500	6.4%
HB Road 4	463	37	500	7.4%
Total	**1896**	**104**	**2000**	**5.2%**

Table 4: Number of Drivers Texting while Driving

Category	Not Texting	Texting	Total	Percent texting
Road 1	989	11	1000	1.1%

Road 2	987	13	1000	1.3%
Road 3	985	15	1000	1.5%
Road 4	984	16	1000	1.6%
Total	**3945**	**55**	**4000**	**1.4%**

Table 5: Number of Sedan Drivers Texting while Driving

Category	Not Texting	Texting	Total	Percent texting
SD Road 1	493	7	500	1.4%
SD Road 2	495	5	500	1.0%
SD Road 3	495	5	500	1.0%
SD Road 4	498	2	500	0.4%
Total	**1981**	**19**	**2000**	**0.95%**

Table 6: Number of Hatchback Drivers Texting while Driving

Category	Not Texting	Texting	Total	Percentage
HB Road 1	496	4	500	0.8%
HB Road 2	492	8	500	1.6%
HB Road 3	490	10	500	2.0%
HB Road 4	486	14	500	2.8%
Total	**1964**	**36**	**2000**	**1.8%**

Total cell phone use observed were 6.1% of all drivers with 4.7% of the drivers engaged in a call and 1.4% texting while driving. This number seems to be lower than those reported by other studies, probably because we missed on any hands-free operation of the cellphone. In addition, the modal share of the four-wheeler vehicles is one of the lowest on Indian roads with the national average at 8% and in big city like Delhi it's 12.8% (Census of India 2011), but due to the large population the number of people affected is very large. Also with the increase in voice activated dialing and texting capabilities of some of the smartphones, we believe the number of hands-free operations to be higher. There is also a difference in the cell phone use by sedan and hatchback drivers of about 2%. A possible explanation for this difference could be that a higher proportion of sedan owners employ chauffeurs and they themselves are passengers. The chauffeurs are probably less likely to use cell phones in the presence of their employers. This aspect can be explored further in future studies.

2.2 Cell Phone Use Observation

The second part of the study was to determine the changes in driving behaviour during a phone call. An SUV was fitted with various cameras including a driver-facing camera. The vehicle also recorded CAN data that gave the speed of the vehicle at a sampling rate of 10 Hz. We recorded data with a total of 8,032 km travelled by 7 different drivers (5 male and 2 female) for a total driving time of 160 hours. We manually parsed through the video data to record all events of cell phone use. We took the vehicle speed data corresponding to the event along with 5 second prior to the event and 5 second after the event. To normalize the vehicle speed each of these sets of data were divided by the maximum speed in that event set. This allowed the speeds to be distributed uniformly between 0 – 1 irrespective of the speed ranges

in the different sets.

We took the maximum, minimum and average speeds for pre-event, during-event and post-event categories. To see the change in speeds in the three categories, we took the average slope of the curve for each event set and took the average. A total of 70 events were observed with total call duration of 1 hour 45 minutes. The calls themselves ranged between a maximum of 18 min 8s to a minimum of 7s with a mean call duration of 1min 29s. More importantly we can also say that the actual time spent by the driver on the phone was very little compared to the total driving time. The results are shown in table 7.

Table 7: Normalized Velocities Before, During and After a Call Event

	Pre-Call	**During-Call**	**Post-Call**
Minimum	0.52	0.28	0.50
Maximum	0.66	0.93	0.68
Mean	0.58	0.60	0.58
Slope	4.31	-0.48	15.04

There is a decrease in vehicle speeds compared to speeds before the call and soon after the call was finished the vehicle velocity increases at a high rate. The mean speed of the vehicle is similar in all three phases, which indicates there is not a great change in the vehicle speed between phases. But we see a higher variance in the 'During-Call' period compared to pre and post call phases. This correlates to the negative slope we see in the 'During-Call' phase.

From the data we can infer that there is a measurable cognitive load on the driver during a cellphone call, which exhibits itself in the form of a decrease of vehicle velocity when the call is in progress and a high acceleration after the call has ended.

3. DISCUSSION

Driver distraction is not limited to use of cell phones, and can be caused by a number of non-cellphone related tasks, which include talking to co passengers (12%), interacting with car radio and other things (6%), talking / singing to oneself (5%) or engaging in other 'eyes off driving' tasks (10%) (Farmer *et al.*, 2015). Despite a co-passenger being a source of distraction a driver with a co-passenger who doesn't engage in cellphone use tends not to use a cellphone themselves (Trivedi *et al.*, 2017). We also see a trend of driver getting acclimatized to the distraction caused by a cellphone. A report from the USA notes that even though cellphone use increased the risk of a crash for individual drivers the total population risk of a crashes does not seem to change with increase in cell phone use (IIHS-HLDI Status Report, 2014).

This leads to the policies related to cell phone use while driving, especially the bans on cellphone activities like talking or texting and the use of hands-free vs. handheld devices. Texting while driving does take the attention of the driver from the road to the cellphone screen and has been well reported as a dominant factor in crash risk. This distraction can be similar to simply dialing a number before a cellphone call initiated by the driver (Caird *et al.*, 2018). While using a hands-free device this aspect is not present but the act of talking on either a handheld or a hands-free device causes similar cognitive load impairment (Tornros *et al.*, 2005). Separate studies on the ban of cellphone usage while driving (Nicholev *et al.*, 2010) and (IIHS-HLDI 2010) have shown contradictory results on decrease of traffic crashes with the implementation of a ban. Which indicates a set of more complex dynamics of cellphone

usage ban and crash risk which can be examined further. We also see evidence of cellphone ban to be detrimental to fatality risk in high driver density traffic (Jacobson *et al.*, 2012). Anecdotal reports in newspapers suggest that such traffic dynamics may be operating on Indian roads also, where having access to cellphones by drivers can help in reporting a crash to emergency response personnel. Interestingly Sweden which is considered to have the best road safety track record does not impose a ban on cellphone usage while driving

Law in all states of India including Delhi bans use of cell phones. However, this study shows that on Delhi roads the cell phone use both for talking and texting is little over 6%, which is similar to other locations in the world and has not disappeared because of the law. This number does not include any hands-free operation that couldn't be observed, using a naturalistic approach and the actual cellphone usage will be higher than this. But it does give an indication of percentage of the driver populace that interacts with the cell phone. With many car manufacturers are offering built in hands-free systems not just for calling but general interaction with a cell phone the number will definitely be higher.

The second part of the study shows that drivers do decrease their vehicle velocity as a compensatory mechanism before taking a call. Since using a cellphone is not the only distraction a driver is subjected to, other elements like interaction with co-passengers, vehicle info-entertainment system or just personal thought process can decrease the ability to perform a driving task. As the actual speed of the vehicle decreases the severity of the injury sustained in case of a crash is also low. All these factors need to be studied in coherence to see not just individual effects but the interactions the different stimuli have on the performance of a driver. All this in turn requisites a question on what kind of policy decision is taken by the government of India to regulate the use of cell-phones while driving.

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