AUTOMOBILE DRIVER BEHAVIOR AND CELL PHONE USE WHILE DRIVING

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Abstract

This study focuses on the effect of cell phones use on the behavior of automobile drivers, which often causes distraction to the driver and leads to the violation of road traffic laws in the traffic environment. In Brasilia, DF, the capital of Brazil. Observations were made of 6,749 drivers. Of these, 4,957 were men, 1,370 were assessed as youths, 4,954 as middle-aged drivers, and 335 as elderly drivers. Among all drivers observed, 1,169 were observed to be using cell phones. The results indicate an age-related difference among the drivers observed. The study also reveals that young drivers commit more road traffic violations than middle-aged and older drivers, and that drivers using cell phones are more likely to cross red lights and fail to stop at pedestrian crossings. The study concluded that the use of cell phones is associated with driver distraction and the violation of road traffic rules and regulations.

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1. Cell phone use while driving

The improvements and ease of access to internet has made communication easier and less costly. As a result of this, people are becoming addicted their phones and often use them at inappropriate times such as while driving. Driving requires a high level of concentration and alertness. Failure to concentrate and remain alert often leads to poor observance of driving rules and to accidents. Certain behaviors have been identified to affect driver concentration and alertness such as smoking and driving under the influence of alcohol. With technological advances and widespread access to cell phones, it is now believed that the use of cell phones by drivers is another source of distraction and the cause of many accidents. Thus, phone use distracts drivers and puts them and others at risk.

The use of any form of cell phone or mobile technology has a negative impact on driving because the interval required for the driver to respond in a prevailing circumstance by taking adequate and substantial action to avoid collision or obey traffic rules is reduced. In this regard, driving is a complex task in which experience and skills are simultaneously involved. Engagement in cell phone tasks while driving can cause distractions and result in potentially dangerous situations.

Inattention and distraction of drivers contribute to a great number of road traffic accidents. It should be noted that there has been a significant increase in both the number cell phone subscribers and the proportion of people who use cell phones while driving (Royal, 2003). Consequently, drivers using cell phones have contributed to the increase in road accidents.

Brazil, in this perspective, is experiencing an unprecedented moment in its history of road accidents. In 2001, records from the Brazilian Federal Department for Road safety show a cost implication of 3.6 billion reais on urban road accidents. In 2010, 182,900 accidents were registered on Brazilian highways. In the same year, 43,256 accidents were recorded by the National Traffic Department - DENATRAN in urban areas. Data obtained from the National Insurance Company show that the use of cell phones while driving contributes to 23% of total road accidents registered in Brazil.

Data from the Brazilian Telecommunication Intelligence Company TELECO (February 2014), estimates that there are 272,723,263 cell phones in Brazil, while the fleet of automobile vehicles in 2013 was 70,000,000 million. Faced with this reality, the use of cell phones by Bra-

zilian drivers has become a recurrent practice. For example, in the city of Brasilia, where the use of cell phones by drivers was observed, the Brasilia Traffic Police (BATRAN) issued approximately 83,000 fines in 2013. Given the relevance of the problem, the aim of the study was to observe the behavior of drivers that use cell phones while driving, as well as to evaluate the likely association between the use of cell phones and the violation of road traffic laws.

From the cognitive point of view of human information processing, the use of cell phones by drivers constitutes a situation of shared attention, in which driving represents a primary task, and talking on the phone a secondary task (Shinar et al, 2005). Inattention and distraction of drivers are considered major contributors to a significant number of road accidents (Talbot et al, 2013).

In Brazil and many other countries around the world, the use of cell phones while driving is prohibited and legally restricted due to its negative impact on the performance of the task of conducting a vehicle. Only the use of earphones with cell phones is permitted. The Brazilian Road Traffic Code (Codigo de Transito Brasileiro, 1997) prohibits the use of only one hand on the steering wheel, while driving. Item VI of Article No. 252 of the Traffic Code prohibits the use of cell phones while driving, which is penalized with a fine and is considered a medium level traffic violation.

In New York laws were enacted that significantly reduced the rate of cell phone use by drivers from approximately 2.3% to 1.1% through educative measures that included phases of information, warning and punishment. Several surveys were carried out in the period before and after the enactment of the laws for the purpose of investigating a possible decline in the rate of cell phone use and the consequent effectiveness of the law through the implementation of this educative system (McCartt and Geary, 2004).

Since 1990, many surveys have been conducted to evaluate the impact of the use of cell phones on the behavior of drivers in different experimental contexts. A study carried out in Denmark found that the psychological function is an indicator of risky behavior when a driver decides to drive and speak on the phone simultaneously (Møller and Petter, 2008). Another Danish study showed that young drivers are involved in 27% of all fatalities and severe accidents that occur in traffic, often using cell phones when the accident happens (Sullman and Bass, 2004). This indicates greater likelihood among young drivers to infringe traffic rules and violate regulations.

In the United States, 50% of car accidents that occur are attributed to driver inattention (Gladwel, 2001). It has also been demonstrated that the handling of mobile devices and in-vehicle devices has a negative effect on driving (Brookhius, de Vries and Waard, 1991; Lesch and Hancock, 2004;

Westlake and Boyle, 2012) suggesting that cell phones hamper driver performance by dividing attention towards cognitive engagement (Strayer, Drews and Johnston, 2003). In France, a gender-based survey revealed that more men use cell phones while driving than women. The predominant use by men is due to the occupational activities they perform and is not related to demographic characteristics (Brusque and Alauzet, 2006).

It is said that the use of cell phones by drivers is as much of a potential risk to others as is the driver who drinks and drives (Strayer et al, 2001). These results are convergent with the conclusions presented by Bruyas et al. (2006) that the use of cell phones has a negative impact on driving, irrespective of the type of phone being used (Alm and Nilsson, 1995; Bruyas et al. 2003; Lamble et al. 1999).

The use of cell phones by drivers can be detrimental to driving performance by slowing the time of response by the driver to highway traffic situations that demand quick decisions, such as sudden need for the driver to brake or reduce speed (Haigney, Taylor, and Westerman, 2000; Westlake and Boyle, 2012) when a car ahead suddenly slows down or a pedestrian unexpectedly steps into the street. There is also a negative impact on the ability of the driver to identify traffic signals and perceive safety-critical situations (Mccarley et al, 2004; Strayer, Drews and Johnston, 2001).

A more recent study on technology and risky behavior in driving indicates that the use of cell phones, iPods and other technological devices, can increase the risk of accidents (Rosenbloom, 2006). The study also reported that among pedestrians observed, women who used headphones and iPods to listen to music while they crossed the street were less likely to pay attention to traffic movement and crossed the street at a slower pace than men. The study also showed that drivers observed talking on cell phones while driving faced more difficulty in critical situations.

Road traffic accidents associated with the use of cell phones by drivers has been demonstrated to be a source of much concern for researchers (Mcknight and Mcknight, 1993). It has been observed that the speed of the car decreases when the driver talks on the phone. However, no conclusion has been reached as to whether the decrease in speed increases the driver safety margin enough to offset the loss in driving performance (Törnros and Bolling, 2005). Drivers have been reported to be more likely to crash into a parked car when distracted by a second task (Langham et al, 2002). Road traffic error provoked by inattention has been the most common factor leading drivers to make wrong turns (on-coming traffic) and cause accidents (Larsen and Kines, 2002).

Gladwel (2001) reported that for every 3 kilometers that is covered, the driver makes 400 observations, 40 decisions, and commits one error. Günther (2001) showed that for every 800 km of driving, one of these errors

becomes a likely involvement in a crash, while for every 100,000 km, one of these errors eventually ends up in rear-end collisions. These errors, which include travelling above the speed limit, rollovers, driving in zigzag, drifting towards the left side of the roadway, also occur when using a cell phone while driving and driving performance is possibly affected by distraction (Lesch and Hancock, 2004).

However, the degree of a driver's distraction is more affected by the complexity and intensity of a telephone conversation, than by the simple handling of the telephone equipment (Strayer et al, 2001). In addition to increasing the chances of an accident, the use of cell phones leads to driver distraction and cognitive overload (Lesch and Hancock, 2004).

The engagement of drivers in telephone conversations is detrimental to the performance of the driving task because it diminishes the reaction time in a situation that demands a reduction in vehicle speed (Alm and Nilsson, 2001). Further, there is a significant increase in risks of collisions with injuries (Laberg-Nadeau et al, 2003). Studies show a risk of collision twice as high among drivers who present 0.06% of alcohol in their blood (Brick,1996), in contrast to 4 times as much risk of collision when drivers use the cell phone while driving (Reldelmeier and Tibshirani, 1997).

Given the relevance of the problem under discussion and the limited amount of research on this subject in Brazil, the aim of this study is to investigate, through observation, the association between the use of cell phones by drivers and the violation of road traffic laws. The study further analyzes the potential impact of the use of cell phones by drivers on distraction in attention-demanding traffic conditions, such as stopping at red lights, travel speed reduction and braking at pedestrian crossings. Finally, it examines differences in behavioral propensity towards the use of cell phones while driving, based on demographic categories, such as gender (male and female drivers); age (young, middle-aged and older drivers); as well as vehicle ownership (government, company and privately-owned).

2. Method

A systematic observational method was used to collect survey data. For the purpose of this study, the use of cell phones by drivers while driving was defined to include following scenarios: drivers holding a cell phone; drivers holding a phone close to his ear or looking at the phone while driving. In this context the definition of the use of cell phones included involvement in a telephone conversation while driving, the use of other functions

of a Smartphone, such reading or sending text messages, receiving and sending emails, accessing the internet on the phone or playing music.

2.1 Collection of data

The survey data included cars, utility vans, buses, vans, minivans and trucks. Two research assistants were used to observe the drivers, one on each side of the roadway, in nine different locations. Priority was given to the two traffic lanes that were located closest to the observers for ease of driver observation. The age groups observed included young drivers, middle-aged drivers and older drivers.
Observation procedure: The observation was carried out from a fixed point located on the side of the roadway, by the pedestrian crossing or the traffic light. The observations were carried out in the morning (7a.m. to 8 a.m., 9 a.m. to 10 a.m., and 11 a.m. to 12 a.m.), at midday (12 a.m. to 1 p.m.), and in the afternoon (2 p.m. to 3 p.m. and 4 p.m. to 5 p.m.), for twelve consecutive days, including Saturdays. Prior to the observation process, a pilot study was carried out to adjust the methodology for the collection of the data and to pre-determine the indices of concordance between the research assistants. Initially, a routine based on observing 5 cars in each interval was used on the survey site, to enable the research assistants become familiarized with the procedure.

Figure 1 shows the location of Brasilia, the federal capital of Brazil

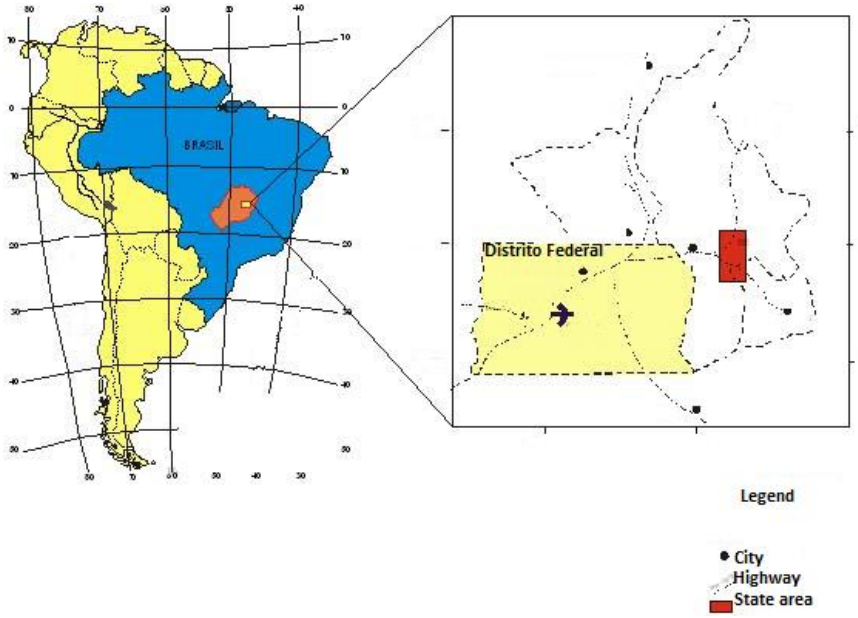


Figure https://www.google.com.br/search?

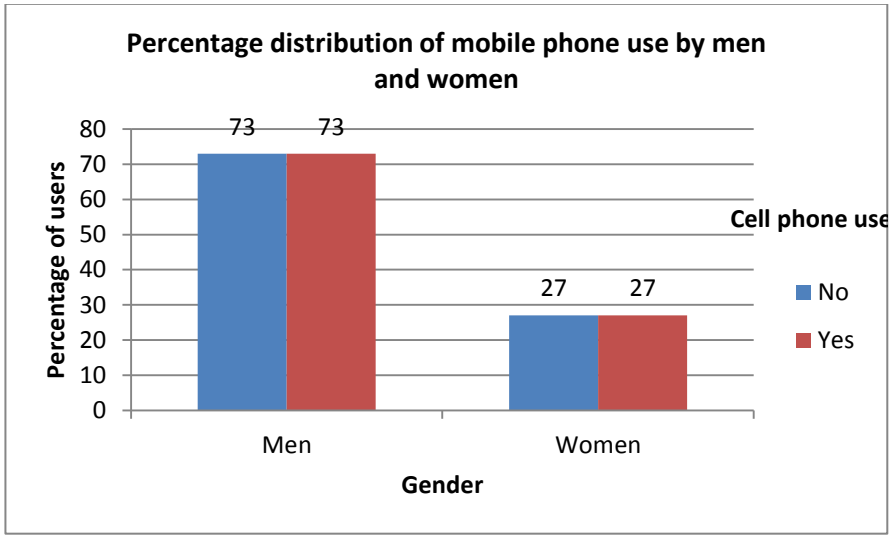
The observations were made in the city of Brasilia, at those sites with greater pedestrian and automobile circulation: Brasilia International Airport, the Eixo Rodoviário; L2 North and L2 South; East and West Eixo Monumental; the Via Estrutural; and highway 010. These sites were chosen for being the main traffic routes of the urban area of Brasilia. Commercial areas were not considered for this study.

2.2 Sample

The sample contained observations from 6,749 drivers, 1,169 (17.3%) of whom were observed to be using cell phones. According to the survey, 4,957 (73.4%) were male drivers, 1,370 (20.3%) of those observed were young drivers, 4,954 (73.4%) were middle-aged drivers and 335 (5%) were older drivers, while the other 90 (1.3%) were not classified. Regarding car ownership the survey indicated that 5,722 (84.8) were considered to be private, 100 (1.5%) were cars for official use, and 857 (12.7%) were company owned vehicles, while the other 70 (1%) were not classified.

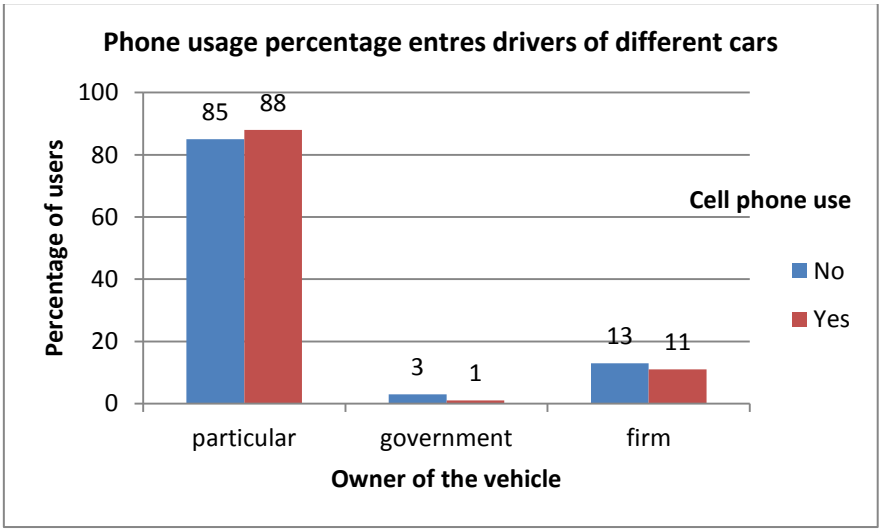
3. Results

Chart 1 shows the distribution of cell phone use by men and women. As can be seen, there is no difference in the percentage of cell phone use by men and women.



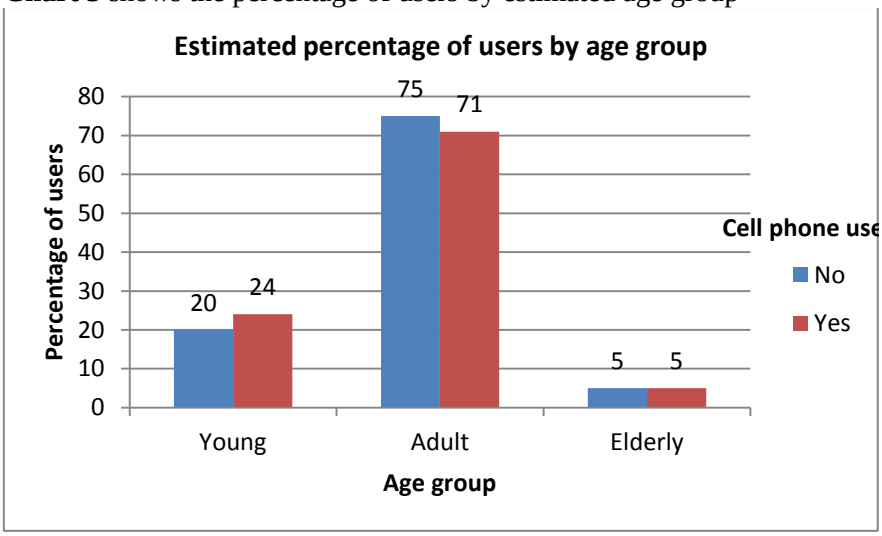
A chi-square test was performed on cell phone use by drivers, based on gender and age group. The chi-square analysis shows a significant difference between male and female drivers and among young, middle-aged and older drivers with regard to the use of cell phones while driving. The analysis also indicated that more young drivers violate road traffic rules and regulations than the middle-aged and older drivers; they were also observed to cross red traffic lights and fail to stop at pedestrian crossings more frequently.

Chart 2 shows the percentage of cell phone use among drivers according to car ownership



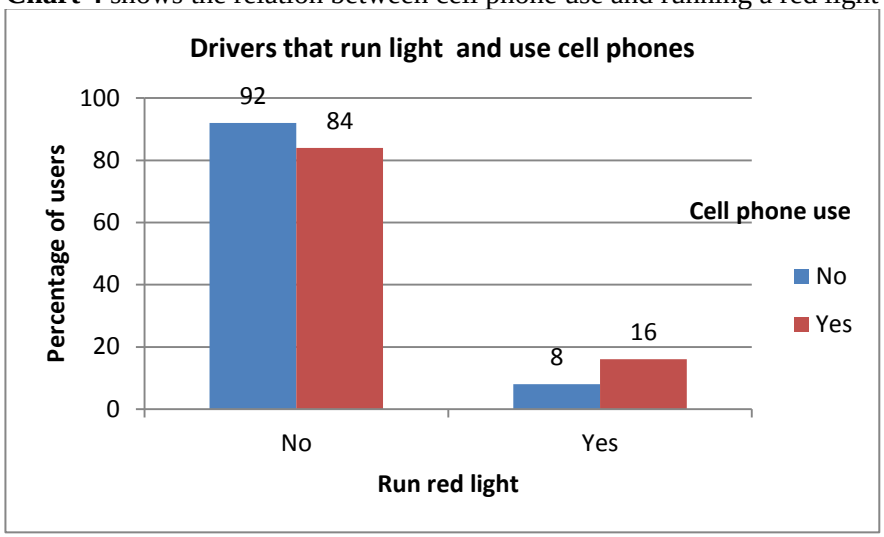
The statistical analysis between male and female drivers indicated no difference in the percentage of cell phone usage by both sexes. The chi-square analysis indicated a statistically significant interaction between privately owned vehicles and official and company owned vehicles ($\chi 2$ = 6.88, p = 0.032), whereby more drivers were observed using cell phones in privately owned vehicles, than those observed driving official and company owned vehicles.

Chart 3 shows the percentage of users by estimated age group



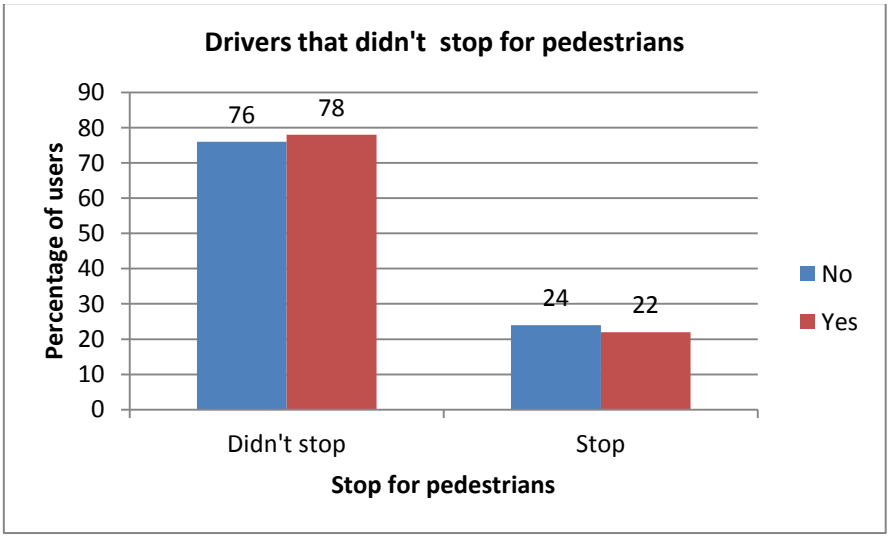
Comparison involving cell phone use and driver age, indicated a statistically significant interaction ($\chi 2 = 9.07$, $p = 0.011$), which shows that more young drivers use cell phones while driving than middle-aged and older drivers. This demonstrates greater propensity for younger drivers to violate traffic laws than the middle-aged and older drivers.

Chart 4 shows the relation between cell phone use and running a red light



A statistically significant interaction ($\chi 2 = 73.22$, $p = 0.000$) was obtained when a chi-square analysis was performed between cell phone use and stop light compliance, whereby a larger number of drivers were observed to be using the cell phone among those who did not stop for the red light, as compared to those who complied. This indicates a greater tendency for drivers who concurrently drive and use cell phones to infringe traffic laws. A chi-square analysis based on driver brake response at pedestrian.

Chart 5 shows the relation between cell phone use and stopping for pedestrians



A chi-square analysis based on driver brake response at pedestrian crossings and cell phone use, suggested a statistically significant interaction ($\chi 2 = 2.17$, $p = 0.075$), whereby more drivers using cell phones were observed to fail to stop at the pedestrian crossing, in comparison with the observed number of those who stopped for pedestrians. This implies that the use of cell phones while driving could distract a driver's attention.

4. Discussion and Conclusions

The results shown here are based on different urban segments with greater pedestrian and automobile traffic: Brasilia International Airport, the Eixo Rodoviário; L2 North and L2 South; East and West Eixo Monumental; the Via Estrutural; and highway 010. These sites were selected for being the main traffic routes of the urban area of Brasilia, which regardless of peak hours have a great amount of traffic.

Cell phone use was observed to be predominant in the afternoon and in times of greater traffic jams. The cell phone use rate was found to be 17.3%. It is possible, however, that the actual rate is higher given the contextual circumstances, such as the limitations of the observation method, which only recorded two lanes, when there were, in fact, three or four lanes. This, however, was necessary in order to maintain the consistency of the records among the observers.

Recent advances in technology and the proliferations of mobile devices have captivated the young and teenage population. Consequently, mobile phones are widely used by young drivers while driving. The findings of

this survey are consistent with previous studies that reveal that more young drivers use cell phone while driving, in comparison with middle-aged and older drivers. However, an expressive number of middle-aged subjects have been observed to engage in both tasks simultaneously. Finally, a statistically significant interaction was observed between cell phone use, disobeying of traffic signals, and disrespecting pedestrian crossings.

This study demonstrated that the gender of the driver has no reliable influence on the use of cell phones while driving. The results show that both male and female drivers are prone to cell phone use while driving. However, it was observed that the age of the driver influenced the use of cell phone. Young drivers are more likely to use cell phones while driving than middle-aged and older subjects. The findings of this study are consistent with the findings of a similar survey done in Denmark, which showed that young drivers were involved in 27% of the total numbers of fatalities and severe crashes in the traffic environment, and were observed to be using mobile devices at the time of the accident (Møller and Petter, 2008).

The study depicts greater willingness of young drivers to violate traffic rules and regulations. There are indications that the distractions caused by concurrently driving and speaking on the phone could cause as many different risky behaviors as does the use of alcohol associated with driving (Strayer et al, 2001).

A statistically significant tendency was observed in relation to the use of cell phones and drivers' compliance with pedestrian crossing. While a large number of drivers were observed to be talking on the cell phone among those who did not stop at the pedestrian crossing, a comparatively small number of subjects who were observed to be performing both tasks simultaneously stopped for pedestrians. These findings show evidence that the use of cell phones while driving has a negative impact on the drivers' response to attention-demanding situations in the traffic environment. Consequently, the findings of this study are consistent with previous studies (Alm and Nilson, 1994; Haigneyatal, 2000; Macknight, 1993; Strayer et al, 2001), which show that the concurrent use of cell phones and driving can pose a risk to the successful driving performance.

The behavioral trend of violating road traffic rules and regulations has become a major road safety theme. According to records from the Brazilian Road Safety Department, 42,000 deaths are registered annually from road traffic accidents. These alarming figures suggest an urgent need for government policies that introduce more effective measures such as road safety advertising campaigns that educate drivers on their responsibilities in the traffic environment, as well as respect towards pedestrians and other drivers. Additionally, there is a need for a review of regulatory legislations for driving schools in Brazil. The driving schools should be closely monitored concerning efficiency of the methodology applied in instructing driv-

ers, especially on issues related to road safety habits and compliance of traffic rules and regulations. They should also be made to meet the minimum requirements, in line with current contemporary road safety issues.

5. Limitations and Future Research

There are some limitations in this study, one of which is the fact that the survey did not include investigation of the impact of the legislation that restricts the use of cell phones while driving on driver compliance to this regulation and the consecutive reduction in the rate of cell phone users in the traffic environment. This should be considered for future studies.
The study is represents the first observational survey in Brazil on the use of cell phones by drivers while driving. The results obtained from this survey provide parameters through which distraction and inattention of drivers can contribute to violation of road traffic rules and regulations.
The findings can be used as database for comparison studies on the increase or reduction of cell phone use by drivers. It also provides an important database that can be used to estimate the level of driver compliance with specific legislations on cell phone use in the traffic environment.

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