SOUTHWEST REGION UNIVERSITY TRANSPORTATION CENTER

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Distracted Driving and Associated Crash Risks

INTRODUCTION

Over the past decade, a number of bodies, including government agencies, traffic safety advocacy groups, and law enforcement agencies, have successfully increased the public awareness level of the traffic safety risks from distracted driving. However, a lack of substantial crash data with adequate reporting tools on distracted driving causes means that the underlying statistics from police-reported distracted driving crashes could be misleading. The acquisition of a driving simulator at LSU has provided research opportunities for conducting research in the area of driver distraction.

OBJECTIVE

The main goal of this research was to utilize a driving simulator to measure the risks associated with three distractions that are routinely faced by the driving population: handheld phone conversation, texting, and front-seat passenger conversation. More specifically, the study achieved the following objectives: (1) conducted a thorough literature review on driver distraction and roadway safety, including the cause and extent of distraction associated with driving tasks; (2) identified a set of cognitive tasks that are believed to have the most impact on driver distraction; (3) established a set of performance measures for the type and level of distraction based on the driving behavior; (4) designed and conducted simulation experiments involving a sample of human subjects; (5) compared using appropriate statistical techniques the driving behavior of the human subjects with and without the identified distraction factors; and (6) analyzed the results and made conclusions.

SCOPE

The research was restricted to the use of the driving simulator at LSU to measure the level of driver distraction. Experimental work was conducted with the simulator using human subjects as drivers. Volunteers were sought from the LSU community of students and staff members, DOTD staff, and the general public to participate in the experimental work. No monetary compensation was provided for participants.

METHODOLOGY

Prior to the main study, a pilot study was initially conducted on 13 participants primarily to obtain familiarity with the experimental set-up, test out the route and secondary tasks, test the ease of data collection, undertake a preliminary data analysis for evidence of distraction, and decide on an appropriate statistical technique that will be used for data analysis for the main study. Findings from the pilot study suggested that: (1) the initial six secondary tasks tested should be reduced to three: handheld phone conversation, texting, and front-seat passenger conversation; (2) lane position variability and mean velocity were appropriate performance measures to represent lateral control and longitudinal control of the vehicle, respectively, and were thus used as surrogate measures of distraction; and (3) ANOVA was an appropriate statistical tool to be used for data analysis.

For the main study, several experimental designs were developed according to the factor being investigated. For each secondary task, the factors considered were to test for overall distracting effect from that specific secondary task, and also to check for effect of age, driving environment, weather conditions, gender, and the time of day. A total of 67 participants comprising 18 females and 49 males with an average age of 26.8 years (standard deviation of 8.6 years) successfully participated in the experiment. Each participant was asked to undertake a treatment drive comprising random events of front-seat passenger conversation, handheld phone conversation, and texting as well as a control drive of the same scenario where the participant did not perform any other task. The control drive spanned the length of the treatment drive to enable each section to be

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directly compared. Data on lane position variability and mean velocity were collected for both the treatment and control drives for all participants. It was seen that the average lane position variability increased for participants in the order of control, handheld phone conversation, front-seat passenger conversation, and texting, suggesting that distracted drivers tend to have larger lane position variability. Also, the mean velocity increased for participants in the order of texting, passenger conversation, handheld phone conversation, and control, suggesting that distracted drivers tend to have lower speeds.

Statistical analysis was then conducted at a 95% confidence level to determine if the data distributions of the control and distribution drives are identical. A significant distracting effect was said to have occurred when the tests failed to reject the null hypothesis (of identical distributions) in favor of the alternative hypothesis (of non-identical distributions). To check for overall distracting effect of a specific secondary task, the data for all 67 participants were used un-partitioned. However, to check for the factor effects, the data were first partitioned to represent the specific factor and the respective summed differences between their control and treatment drives compared mathematically and not statistically because of the small partitioned sample sizes. For instance, to check for environment effect, data was first partitioned to urban vs. freeway settings, then the respective magnitudes of their summed deviations from their corresponding control drives compared. The one with the greater magnitude is said to have a more distracting effect than the other.

CONCLUSIONS

For an overall distracting effect, the statistical results revealed that being engaged in a handheld cell phone conversation while driving did not provide significant lateral or longitudinal deviation from driving without distraction, and it appears participants significantly slowed their speeds to compensate for distraction. While this study failed to find any significant effects from this task, it is acknowledged that the nature of the conversation itself could cause different reactions on drivers. Conversations that involve significant cognitive effort such as retrieval of information from memory and other emotional and distressing types will have higher impact on a driver's concentration levels than would a normal conversation. On the contrary, the results of this study suggest that texting while driving resulted in significant lateral and longitudinal deviations from what would be observed when not distracted. While participants still significantly slowed their speeds during the texting event, the extent of the distraction was such that the speed reduction could not compensate for it. The significant distracting effect of texting could be attributed to the fact that texting involves more visual demand on the participant than cell phone conversation. This may also explain why front-seat passenger conversation produced more significant lateral deviations but cell phone conversation did not. Nevertheless, there were no significant longitudinal deviations from the front-seat passenger conversation. Table 1 shows the summarized results, with p-values and the conclusion at a 5% level of significance.

For the factor effects, testing for gender and age effect revealed that generally younger drivers (aged under 25 years) demonstrated better lateral control but worse longitudinal control than older participants (aged 25 years and above). Females, in general, also demonstrated better lateral and longitudinal control of the vehicle than males. For the environment effect, drivers on freeways produced worse longitudinal and lateral control of the simulator than drivers in urban surroundings. This could be a result of the generally lower speeds and "stop and go" driving conditions of urban surroundings as a result of the interrupted traffic flow caused by traffic lights and probably higher traffic densities.

Table 1
P-values of overall distraction effect for all participants

	Lateral Control	Longitudinal Control
Handheld Phone	0.4487 Non-significant	0.5368 Non-significant
Texting	< 0.0001 Significant	< 0.0001 Significant
Passenger Conversation	< 0.0001 Significant	0.3063 Non-significant

For the time of day effect (day or night), the effect of night time driving on freeways for the texting task produced significant lateral deviations than texting during the day time. This could be explained by the reduced visibility at night and the fact that texting is usually more difficult on freeways. For the remaining tasks, the loss of control was more noticeable during the day. For the effect of weather conditions (snow, normal, fog, and rain) on the freeways, participants seemed to perform best in normal and rainy conditions. For urban settings, surprisingly, texting during the day was worse than at night, but engaging in handheld phone and passenger conversation during the night was worse than during the day. For the weather effects, participants seemed to perform best in normal conditions.

RECOMMENDATIONS

The objectives of the proposal have been met but because of the availability of the vast experimental data collected for this project and the recent availability of naturalistic driving data, it is recommended to further explore both data sources to develop a distraction index from several surrogate measures of distraction that will accurately predict the crash risk of several secondary tasks.