PASSENGER AND CELL-PHONE CONVERSATIONS IN SIMULATED DRIVING

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Previous work on use of cell phones while driving compared cell phone conversations while driving with driving only conditions. This study investigated how conversing on a cell phone differs from conversing with a passenger. Participants conversed about close-call situations they experienced. We compared how well drivers followed task instructions when driving only, when driving and conversing on a cell phone, and when driving and conversing with a passenger. The results show that the number of driving errors was highest in the cell-phone condition. Analyzing the conversations we found that in passenger conversations more references were made to traffic and more turn taking followed those references than in cell phone conversations. The results show that passenger conversations differ from cell phone conversations because the surrounding traffic becomes a topic of the conversation, helping driver and passenger to share situation awareness, and mitigating the potential effects of conversation on driving.

INTRODUCTION

There is ample evidence that conversing on a cell-phone while driving affects driving performance negatively. Previous studies have found that cell phone use impairs the driving performance of younger adults (Alm & Nilsson, 1995; Briem & Hedman, 1995; Brookhuis, De Vries, & De Waard, 1991; Brown, Tickner, & Simmonds, 1969; Goodman et al., 1999; McKnight & McKnight, 1993; Redelmeier & Tibshirani, 1997; Strayer & Johnston, 2001; Strayer, Drews, & Johnston, 2003), and older adults (Strayer & Drews, 2003). The level of impairment can be compared to being intoxicated at a blood alcohol level of .08 (Strayer, Drews, & Crouch, 2003). Still unexamined is whether and how conversing on a cell phone differs from a conversation with a passenger. There are at least two competing hypotheses: One hypothesis is that there is no difference between cell-phone conversations and passenger conversations, and that both negatively affect driving performance. An alternative hypothesis is that the passenger in a passenger conversation shares the same situation as the driver. The passenger may monitor the surrounding traffic, and respond to changes in driving demands. This supportive behavior can be explicit, for example by referring to traffic dangers, or more implicit by moderating the conversational flow in response to increased difficulty of the driving task. Of course, this assumes that the passenger has at least a rudimentary understanding of potential dangers of traffic and the driving task. Directing the driver's attention towards potential danger creates situation awareness (Endsley, 1995) of the surrounding traffic that is shared by the driver and the passenger. Contrary to this, in a cell-phone conversation, the person not driving lacks awareness of the traffic surrounding the driver. As a consequence, he or she is unlikely to support the driver with regard to the driving task.

One of the major problems for research on impact of cell-phone conversations on driving performance relates to the issue of naturalistic conversations. Some investigators have used conversations in which confederates converse with the driver about some topic of interest identified earlier, others have use word repetition tasks to create a situation which is equivalent to a conversation. These approaches are frequently criticized because of their failure to mimic naturalistic conversations. An alternative to these approaches in studying the impact of conversations on driving is to use close call stories (Bavelas, Coates, & Johnson, 2000) as the topic of the conversation. Close call stories are defined as stories about times when "your life was threatened." The advantage of using close call conversations is that they involve the kinds of stories that are often told among friends, and the type of story which is engaging for participants. In the current study this paradigm was chosen with the intention to create a situation which comes as close as possible to naturalistic conversations.

The goal of this research is to increase the understanding of how conversing on a cell-phone while driving differs from conversing with a passenger while driving.

Method

Participants. 96 adults participated in the study. Participants ranged in age 18 from to 49, with an average age of 20 years. 49 participants were male and 47 participants were female. All participants had normal or corrected-to-normal visual acuity, normal color vision (Ishihara, 1993), and a valid Utah driver's license. Participants were recruited in friend dyads, and received course credit for participating.

Stimuli and Apparatus. A PatrolSim™ high-fidelity driving simulator, manufactured by GE Capital I-Sim was used in the present study (Figure 1). For the purpose of this study the computer panel and the radio were removed from the dashboard of the simulator. The simulated vehicle bases on the vehicle dynamics of a Crown Victoria® model with automatic transition build by the Ford Motor Company.

Figure1. I-Sim driving simulator.

A freeway road database simulated a 24-mile multi-lane beltway with on and off-ramps, overpasses, and two-lane traffic in each direction. Participants were driving under an *irregular-flow* driving condition (Drews, Strayer, Uchino, & Smith, in press) where vehicles changed lanes and speeds frequently, making it difficult for the participant to proceed smoothly and requiring varying attentional demands.

Procedure. After providing informed consent, subjects answered questionnaires assessing their mood and driving attitudes. Next, participants were familiarized with the driving simulator using a standardized 20-minute adaptation sequence. After finishing the familiarization, one participant was randomly selected to drive the vehicle, the other, based on condition was either the passenger or talking on the cell-phone to the driver from a different location. Speaker (provides the close call story) and listener assignments were counterbalanced. The participants were instructed to drive safely and to follow all the traffic rules. Their task was described as having a conversation about a close call story, and as leaving the highway once they arrived at a rest area located approximately 8 miles after the beginning of the drive. All driving participants additionally drove in a single task condition, where they were driving only. The dual task condition consisted of either driving while conversing on a cell-phone or driving while talking to a passenger. The order of the single and dual task conditions was counterbalanced.

Measures. As a measure of performance in dealing with the driving task the number of occasions when the drivers exited the highway at the designated destination was counted. In addition, references to the traffic while conversing were analyzed. The rationale for this measure was that referring to the surrounding traffic partly directs attention towards an event, thus participants share situation awareness. A third measure was the number of turn takes after a reference to traffic was made. The number of turn takes reflects the interest both partners have towards conversing about traffic rather than the close call story.

Design. In the current study a one factorial design (passenger and cell phone conversation) with conversation as a between subject factor was used (24 couplets in the passenger conversation condition, 24 dyads in the cell-phone conversation condition). In addition every driver had to drive in a control condition, where they were driving only.

RESULTS

Task completion. One part of the analysis focused on driving performance, that is successfully accomplishing the driving task. Table 1 shows the number of participants that finished the task successfully or failed to finish the task for the two experimental conditions and the control condition.

Table 1. Successful task completion.

	Cell-phone	Passenger	Control
Correct exit	12	21	46
Missed exit	12	3	2

Analyzing task accomplishment for cell-phone conversation and passenger conversation a difference between the two conditions ($X^2_{(1)}$=7.9; p<.05) was found: drivers in the cell-phone condition were four times more likely to fail in finishing the task than drivers in the passenger condition. No change in performance was observed in the passenger conversation condition compared to the control condition (driving only), though the change in performance between cell-phone condition and control condition was significant ($X^2_{(1)}$=8.9; p<.01) .

Shared situation awareness. The transcripts of the conversations were analyzed for references to traffic and number of turn takes following such reference. The latter indicates the extent to which the driving task became a conversational topic in its own right, temporarily superceding the close-call stories. The number of references to surrounding traffic in the passenger conversation condition and the cell phone conversation condition are shown in Table 2. Fewer references to traffic were made in the cell phone condition (t(46)=3.0; p<.01).

	Cell-phone	Passenger
References	2.1 (1.6)	3.8 (2.4)
Turns at speech	8.6 (6.7)	19.2 (13.8)

Table 2. Mean number (sd) of references to traffic and turns.

The next analysis focused on the number of turns between the two partners which continued conversing about traffic after an initial reference to traffic was made. The number of turns for both conditions is shown in Table 2. Overall more than twice as many turns occurred in the passenger condition compared to the cell-phone condition (t(46)=3.4; p<.01).

DISCUSSION

The present study investigated the question how driving while talking on a cell-phone differs from driving while conversing with a passenger. The findings about task completion demonstrate that a driver who converses on a cell phone pays less attention to the surrounding traffic as indicated by the large number of drivers who missed the exit, because they did not notice it. This failure to successfully

complete the task in the cell-phone condition can be explained by the fact that a person on a cell-phone is less likely to extract information from his environment than someone who is not conversing on a cell-phone (Strayer, Drews, & Johnston, 2003). The analysis of the conversation data suggests that the driver and the passenger are more frequently talking about the surrounding traffic and that the traffic and driving task become part of the conversation, as indicated by the fact that pairs spent more conversational turns on the traffic topic in the passenger condition. This indicates that the passenger supports the driver in his task of driving by directing attention to the surrounding traffic when necessary and by supporting the driver in devoting attention to the traffic rather than the storytelling. Thus, the better driving performance of participants in the passenger condition is partly due to the fact that the driver and the passenger share situation awareness.

The present findings indicate that when a driver converses with a passenger, the dyad more often collaborates in the task of driving safely by referring to traffic and conversing about it to a larger extent. This helps to maintain a higher level of shared situation awareness something a person on the other end of a cell-phone can not do.

One important limitation of this study is that a high fidelity driving simulator was used to study passenger and cell-phone conversations. Despite the fact that there is more and more evidence indicating the validity of driving simulator based findings with regard to real driving, additional research investigating passenger conversations and cell-phone conversations in real driving would be important to show that the current findings can be generalized beyond simulated driving.

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