Gender Effects in Mobile Phone Distraction from Driving

Julia Irwin, Louise Geaghan and Eugene Chekaluk
Macquarie University

Recent research using a driving simulation task examined the effects of conversing over a mobile phone to that of conversing with a passenger in the number of errors made by the driver. Young drivers (18-25 years) were engaged in a naturalistic conversation in these two conditions and their performance was compared to that of a group of drivers who simply listened to two passengers conversing, or to a group that completed their drive in silence. This study noted a gender difference in that female drivers appeared to be more distracted when conversing on a mobile phone than did the male drivers; and that the male drivers appeared to be more distracted when conversing with a passenger. A second study examined the question of why a gender difference might exist for mobile phone conversations and varied the content of the conversation so that it was either cognitive or emotive in nature. This manipulation not only confirmed the previous finding that female drivers make more errors than do male drivers but also found that the patterns of responses in terms of type of errors made differed for male and female drivers. Overall both males and females made more errors when the conversation was emotive rather than cognitive in content, especially so for the female drivers. Female drivers were particularly prone to making lateral or lane position errors and there was a tendency for the male drivers to make more errors of a longitudinal or temporal type. These studies are aimed at gaining a better understanding of the apparent gender specificity of some sources of distraction for young drivers, with a view to better targeting safety messages to this at-risk group of drivers.

> “What happens when people try to do two things at once? The answer clearly depends on the nature of the two “things”. Sometimes the attempt is successful, as when an experienced motorist drives a car while holding a conversation.” (Eysenck, 2001, p.130).

In corroboration of Eysenck’s comment, the participants in a study by Kames (1978) reported that conversing with passengers had a difficulty factor of 1.3 on a scale of 1-10 – the lowest of all the in-vehicle tasks they were asked to rate. Clearly this is perceived as being a very easy task for experienced drivers. This raises the question then of when, and why, is this seemingly effortless and everyday dual-task of conversing and driving not successful? According to the legislators of over 50 countries (Cellular-News, 2008) when the driver is using a hand-held mobile phone. The scientific literature however has demonstrated that when it comes to remote conversations it is not the mechanical act of holding the phone that is the problem, but rather it is the conversation itself that results in an impairment in driving (Brace, Young, & Regan, 2007; Caird, Scialfa, Ho & Smiley 2004; Horrey & Wickens 2006). If the biomechanical distraction is eliminated with a hands free phone could we expect conversing on a mobile phone to be comparable then to that of conversing with a passenger? On this point, the literature is more equivocal. Drews, Pasupathi, and Strayer (2004) found that remote conversations were in fact worse. Likewise Burns, Parkes and Lansdown (2003) found that driving performance in terms of reaction time tasks was significantly poorer for the phone condition than when the driver was talking to a passenger. The drivers in Burns et al.'s study also noted that the mental effort of the phone condition was significantly more demanding than conversing with a passenger. To explain the poorer performance in the remote conversation condition it has been proposed that passengers modulate their conversation according to the traffic conditions to assist the driver, (Haigney & Westerman, 2001; McKnight & McKnight, 1993; Parkes, 1991; Spence & Read, 2003); however, Laberge, Scialfa, White and Caird (2004) and Gugerty, Rakauskas and Brooks (2004) could find no evidence to support the modulation hypothesis.

Horrey and Wickens (2006) on the other hand in their meta-analysis of the literature observed that the costs associated with a phone conversation versus a passenger conversation to be roughly equivalent; and again no evidence of passengers modulating their conversation. The evidence suggests that it is the complexity of the conversation and not whether the other party to the conversation was in the car or not, that determines the degree of distraction (Amado & Ulupınar, 2005; Nunes & Recarte 2002). Violanti and Marshall (1996) and McKnight and McKnight (1993) also found that mobile phone users who were engaged in intense conversations were significantly impaired in their ability to drive.

Strayer, Drews, Crouch, and Johnston (2005) observed that listening to the radio or books on tape did not impair driving performance, it was the act of being involved in a conversation that detracted attention away from the primary task of driving. Similarly, Recarte and Nunes (2003) found, under real driving conditions, that tasks that were limited to attending to incoming verbal information, such as listening to the radio or to another person, did not impair the cognitive and perceptual processes required for driving. It would seem that if there is no need to perform a response there is minimal distraction. Indeed Almor (2008) has recently shown that merely planning to speak as well as actually speaking increases distraction on a visual task by as much as four times relative to a listening only condition.

Very little research has been done to investigate the role and the effect of the presence of passengers *per se* in cars. There is a growing body of evidence, both epidemiological and behavioural, to suggest that the presence or absence of passengers considerably influences the crash risk for young novice drivers (Chen, Baker, Braver, & Li, 2000; Preusser, Ferguson & Williams, 1998; Reiß & Krüger, 1995). Stutts, Reinfurt, Staplin, and Rodgman (2001) ranks passengers as the third most reported cause of distraction-related accidents at 11 percent, compared to 1.5 percent for mobile phones. It has been suggested that passengers explicitly encourage risky driving practices, but the evidence is largely anecdotal. The extent to which these drivers are distracted by the conversation of passengers or by their mere presence has not been determined. If there is more than one passenger, it might be assumed that less distraction would occur if the driver is not required to attend to, or respond to the conversation, however this assumption has not been empirically evaluated. The objective of this study was to compare the degree of driving impairment resulting from distraction from mobile phones to the distraction caused by conversations with a single passenger, and to the distraction caused by *listening only* to the conversation of two passengers. The nature of the conversations was to be as natural as possible to try and emulate the type of distractions that drivers might encounter on a frequent basis. This study limited the age range of the participants so that only drivers in the 17-25 year age group were used. Younger drivers are over represented in severe crashes by a factor of 10, compared with adult drivers (Lee, 2007; Williamson, 2003); and 94% of Australians in the 18 to 39 age range regularly use a mobile phone (Wajcman, Bittman, Jones, Johnstone, & Brown, 2007).

Method

Participants

Participants were 80 first year psychology students from Macquarie University. Recruitment took place on the university subject pool website and participants took part in order to fulfil a course requirement. There were 29 males and 51 females with an age range of 17 – 25 years with a mean of 19.95 years. Participants all had or had previously held a driver's license and had been driving for a period ranging from three months to eight years. All participants had mobile phones and were recruited into the study by leaving their mobile phone number as a basis for contact with the researchers. They were unaware of the true purpose of the study.

Apparatus

The apparatus used in this experiment was the 'STISIM' (version 8, model 100) driving simulator developed by Systems Technology Incorporated. The apparatus includes a steering wheel, a brake and an accelerator set in front of three computer screens that mimic the view through a windscreen, allowing a 135-degree field of view. The simulator allowed control, manipulation and measurement of driving variables. In this experiment the system was programmed to include a number of elements intended to simulate driving in both urban and rural environments. There were sections of open road as well as traffic lights, speed and hazard signs. Cars were regularly overtaking, emergency vehicles passing and pedestrians periodically stepping onto the road ahead. Displays on both side screens simulated side-view mirrors and a rear-view mirror was present at the top of the centre screen. The display also included a speedometer in miles per hour. A cardboard strip containing recalibration to kilometres per hour was attached below the existing speedometer. A siren would sound when the speed limit was exceeded or a red traffic light was run.

Participants brought their own hand-held mobile phones with them to the study.

Procedure

After providing informed consent and brief demographic details, the participants (regardless of condition) were asked to leave their mobile phones on during testing. Participants were randomly assigned to one of four conditions: control, one passenger condition, two passenger condition and a mobile phone condition. Upon allocation to one of the four conditions, participants were given a practice run on the STISIM drive simulator in order to gain confidence with the controls and were instructed to drive as they normally would. In all conditions participants completed the same driving simulation. After the practice run the participants were told that the real experiment was beginning but that everything was the same as the practice run. Variables in the simulator environment were manipulated once the experimental drive began. In the silent (control) condition the course was completed without interference from either a confederate posing as a "passenger" or from a phone call. In the mobile condition an experimenter outside of the room phoned the participant while they were driving. The experimenter followed a script under the pretence of making sure they had turned up to the study at the right time and place, resulting in a brief conversation. In the two passengers condition two confederates pretending to be fellow students waiting to undergo the experiment carried on a scripted conversation about their shared experiences of the course they were doing at university. The confederates followed a script that was designed to engage the driver's attention but didn't actually talk to the driver. The final condition involved one confederate, again pretending to be a peer, talking directly to the driver. The confederate followed the outline of the script that was used in the two passenger condition, but of course could not mimic it directly.

Following the simulated drive, the control group was asked to recall/indicate various items (emergency vehicles, speed signs etc.) that they encountered during the drive and then to complete the NASA-TLX subjective workload questionnaire (Hart & Staveland, 1988). For the one passenger, two passenger and mobile conditions, participants were asked at the end of the drive not only to recall/indicate various items (emergency vehicles, speed signs etc) like the control group, but also participants in these three groups were also asked to recall six short questions pertaining to the confederate conversations. Like the control group, participants in the one passenger, two passenger and mobile phone conditions were also asked to complete the NASA-TLX subjective workload questionnaire. Debrief forms were administered to all participants at the end of the experimental session.

Measures
Driving was assessed in terms of the number of on- or off-road crashes, collisions, pedestrians hit, traffic light violations, speeding tickets, traffic light tickets, and stops at traffic lights as well as time taken to complete the simulation. As a measure of distraction, the drivers were also given a checklist to see how much of the conversation they could recall and how many items they encountered on the drive.

Results

Two measures of performance were analysed: the total number of crashes and the total number of tickets. These variables may indicate different effects on driving. Crashes may be due to factors such as poor ability to control the wheel (lapses and errors), whereas speeding and running red lights may indicate deliberate risk taking (violations).

An Analysis of Variance (ANOVA) was performed to compare all four groups in respect to their total number of crashes. The total number of crashes score was computed by adding the number of off-road collisions, on-road collisions and pedestrians hit. While it looked like the mobile group had more crashes (see Figure 1) no significant group effect was observed, $F(3,76) = 0.329$, $p = 0.805$.

Groups were also compared according to the total number of tickets acquired during the simulation. Total tickets included speeding tickets and instances of running red lights. An ANOVA again revealed there were no significant differences between the groups, $F(3,76) = 0.954$, $p = 0.419$. Figure 1 shows the total number of tickets and crashes across groups.

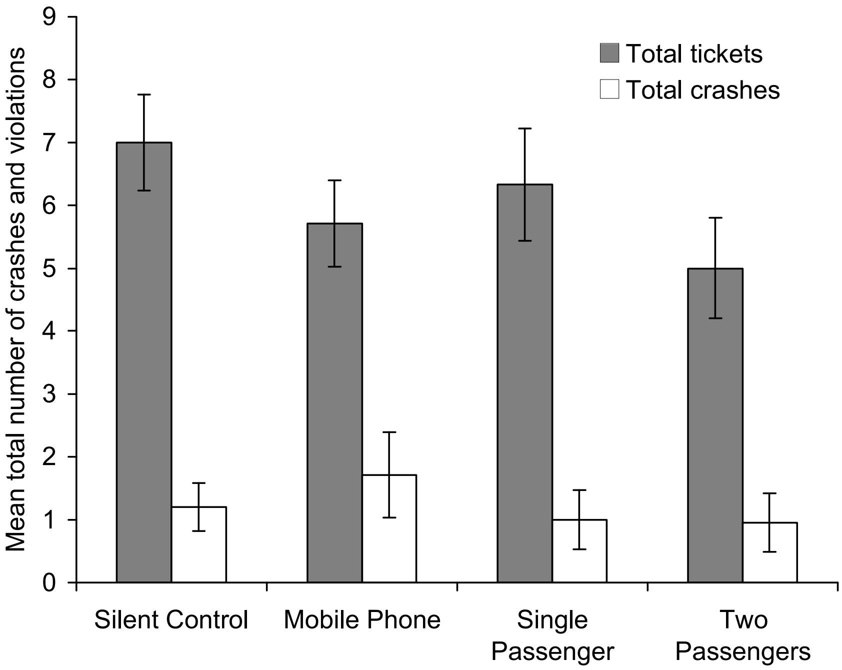

Figure 1. Mean Number of Crashes and Number of Tickets (for driving violations). Error bars represent one standard error above and below the mean

Given that there were no between group differences for the two types of violations (crashes and tickets), they were combined for further analysis. When the data were analysed by gender of driver a different pattern of results emerged. Although a factorial ANOVA did not reveal a main effect for gender $F(1,72) = 3.178$, $p = 0.79$; there was a significant group by gender interaction $F(1,72) = 6.16$, $p = 0.001$.

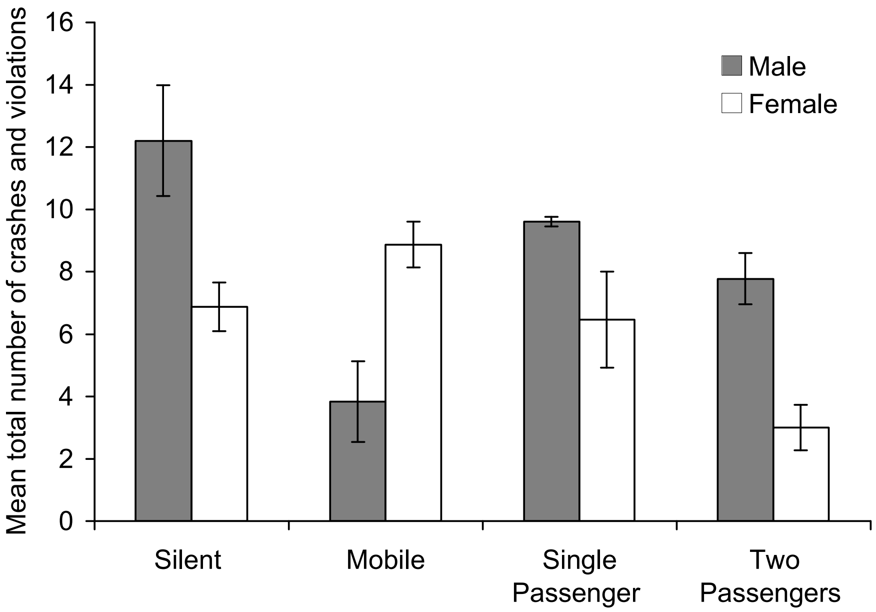

Figure 2 The mean number of errors and violations incurred by the male and female drivers. Error bars represent one standard error above and below the mean

In Figure 2 it can be seen that more males than females experienced crashes and violations in the control condition, but were significantly better than females when they were required to use a mobile phone and drive at the same time $F(1,72) = 13.97$, $p < 0.0005$. Female drivers on the other hand appeared to be less distracted by the presence of passengers than did the male drivers.

Speed is an important factor in crashes and is also a measure that has been related to workload. An independent samples t-test was performed in order to compare males and females in their time taken to finish the course. The average time taken for males was 359.38 seconds and for females it was 429.38 seconds, this faster performance of the male drivers was significant $t(78) = 4.81$, $p < 0.0005$. To avoid the confounding of the crash measures with the speed at which the task was performed, speed was entered into the previous data analysis as a covariate.

Driving experience, as measured by the mean amount of time that participants had been driving, was also entered into the analysis as a covariate. While all participants were relatively new drivers it was expected that there may be a difference between drivers due to driving experience.

With regard to the driver workload measures the groups were compared according to the attention that was paid to peripheral information during the simulated drive. Participants were asked to recall information about the frequency of certain items during their simulated drive. Cross tabulation of frequency of correct peripheral recall by experimental group revealed that more participants were correct in the two passenger condition than any other condition. The two conditions in which the participants were required to talk were the least accurate in their recall of scenes encountered during their drive, but in neither case were the differences significant using Chi-Square tests.

Participants in the experimental conditions were also scored for their ability to recall events that were relevant to the secondary task of conversing. As the control condition involved no secondary task there was no memory data for this group. The other three groups were compared on these scores using a one-way ANOVA. A significant group effect was found, $F(2,56) = 4.92$, $p = .01$. Post hoc Bonferroni adjusted comparisons revealed the significant differences lay between the two passenger and one passenger conditions, $t(36) = 2.24$, $p = .013$, and the two passenger and mobile conditions, $t(40) = 2.70$, $p = .012$. Participants in the two passenger condition recalled fewer aspects of the conversation than did participants in either of the other two conditions. This suggests that participants in the two passenger condition paid less attention to the conversation than did the participants who were actively involved in conversing in the mobile and single passenger conditions.

In order to investigate the perceived mental workload and cognitive demands associated with different driver distraction conditions, the scores from the NASA-TLX subjective workload were compared between groups using ANOVA. Results of the ANOVA revealed that there is no significant difference between groups in participants' subjective workload appraisals and the differing driving conditions $F(3,76) = .116$, $p = .951$.

Discussion

The general pattern of results from the driving measures indicates a clear effect for gender dependent upon the different conversational tasks. The driving performance for males under the mobile phone condition actually improved and was even superior to that when they did not speak at all in the control condition. In contrast, the driving performance for females deteriorated when they were required to use their mobile phone and drive at the same time. The facilitory effect of a dual task was not maintained for males in the presence of passengers, but females, on the other hand, performed significantly better in the presence of others, especially in the presence of two passengers.

Few studies examine their data for gender effects or their interaction with distractors and even fewer find an effect. Woo and Lin (2001) found no significant gender differences in the effects of a hand-held phone conversation task on reaction times, but Briem and Hedman (1995) did find that males exhibited slightly better vehicle control than females on simulated slippery roads during both radio and hands free phone conversation tasks. It might be argued that males are more experienced in performing this dual task, given the findings of Horberry, Bubnich, Hartley and Lamble (2001). These authors observed an average 1.5% of Australian drivers in Perth were using handheld mobile phones during the daytime. These observed users were predominantly male (78%) and under the age of 40 (64%).

Hancock, Lesch & Simmons (2003) required their participants to stop their vehicle as quickly and as safely as possible whenever a traffic signal changed from green to red as the vehicle approached the intersection. Brake response time was significantly higher in performing this critical driving manoeuvre when participants were also required to press a key on the mobile phone in a “matching to sample” task. This distraction was found to have a greater influence on the female drivers than it did on the male drivers, with a disproportionate disadvantage for the older females. The poorer performance of males in the presence of passengers is consistent with the literature that males are more vulnerable on the road when they are carrying passengers. A facilitory effect of carrying passengers for young females has not been specifically noted in the literature before.

Experiment 2

This study focussed upon the question of why a gender difference in the degree of distraction experienced by the male and female drivers was observed in the previous experiment. The literature tells us that the more cognitively engaging the conversational task is, the greater the distraction, but little has been said about the degree of emotional engagement; Goodman Tijerina, Bents and Wierwille (1999) in reference to this void of knowledge regarding emotionally laden conversations suggested that it “may have a deleterious impact on highway safety that is even greater than that found with cognitively demanding tasks” (p.23). The telephone task used in Experiment 1was not cognitively demanding; but because the participants believed that they were engaging in a genuine conversation with one of the experimenter’s research assistants it could be argued that perhaps the desire to engage socially with the caller created an emotional distraction that the female drivers were more susceptibility to experiencing.

The communications literature suggests that women do invest more emotional energy into their telephone conversations than do men. Wajcman et al. (2007) noted that women tend to ring family and friends more often than do men, whereas men tend to use the phone more for work-related issues than do women. Brusque and Alauzet (2008) also noted that male drivers were much more likely to use the phone for work purposes than were female drivers, and furthermore the male drivers demonstrated a much greater willingness to use a phone while driving than the female drivers. The women who were most likely to use their phone whilst driving were the high frequency users and those who also spent a lot of time driving.

Experiment 2 was designed to examine whether the emotional content of a conversation could account for the gender difference observed in the mobile phone condition in the previous experiment. We contrasted performance of both male and female participants under three different driving conditions. In the control condition they drove without conversing, in the cognitive condition they drove and conversed about where and what they had been doing on a particular day (autobiographical recall task, similar to that used by Recarte & Nunes, 2003) using a hand-held phone; and in the emotional condition they drove and conversed about a personal moral dilemma that was posed to them by one of the experimenters' confederates. All participants knew that they would receive a phone call, and that it would be made by an assistant of the researcher. A male and female caller of similar age to the participants placed the calls, counterbalancing the gender of the driver with that of the caller. A higher fidelity simulator to that used in Experiment 1 was used in this experiment. After participants had completed each of the conditions, they were asked to rate how effortful each task had been to do.

Method

Participants

The participants in the study were 48 first year psychology students from Macquarie University. Recruitment took place on the university subject pool website and participants took part in order to fulfill a course requirement. There were 26 females and 22 males with ages ranging from 17 to 26 (mean age 21; SD= 2.46) and a range of driving years from 1 to 13 years (mean driving experience of 4 years; SD=2.82). Participants all owned mobile phones and were told the purpose of the study was to investigate driver error while using a mobile phone in city and rural driving conditions.

As the literature indicates there is little overall difference between the cognitive distraction effects of hand-held and hands-free mobile phones, this study used a hand-held Panasonic cordless phone to investigate driver distraction. The cordless phone was used to ensure there was no degradation in sound quality, that could occur with a mobile phone in the laboratory, thereby inadvertently increasing the cognitive load on the drivers (Kawano, Iwaki Azuma, Toshimichi, Moriwaki, & Hamada, 2005). The hand piece had a "talk" button, which was pressed by the participant to answer the phone call. The participants were required to pick up the phone to carry out the conversation.

Procedure

Apparatus and Stimuli
An interactive driving simulator produced by Systems Technology, Inc., a STISIM Drive Version 400 was used in this experiment. This model included a simulated vehicle cab with fixed seat, steering wheel, dashboard, brake and accelerator pedals.

Each participant carried out three drives in this experiment. Three different drives were specifically designed and programmed for this purpose. Each drive was five kilometers and with an similar drive environment or background consisting of a mix of urban and rural environments. There was a combination of two and three lanes of traffic each way. Speed limits of 60 and 90 kilometers per hour (kph) were set. The 90 kph was the closest setting available to regular found Australian settings of 80 or 110 on rural roads.

The NASA-TLX workload questionnaire was given to the participants between conditions to assess how effortful each task had been to do; and following the final condition the participants filled in a questionnaire providing details about their driving history and mobile phone use.

Experimental Phone conditions
There were two phone conditions used as distracter tasks in the experimental conditions and one control condition with no phone task. The cognitive condition was a series of four autobiographical recall tasks requiring the participants to give detailed answers to where they were and what they were doing at particular times on particular days in the past two weeks.
To replicate the role of emotion in contributing to the levels of distraction a phone call may cause on the task of driving three moral dilemmas were selected from a series of hypothetical scenarios which were adapted from a previously published set (Greene, Nystrom, Engell, Darley, & Cohen, 2004). The personal moral dilemmas required the drivers to tell the caller how they would react in three different hypothetical situations that had been selected for their high rating on emotional salience (Koenigs et al., 2007).

Results

A mixed 2 X 3 repeated measures analysis of variance (ANOVA) was carried out to investigate the effect of the three conversation conditions on driving performance measured by the total number of errors made in each condition. The main effect for the conversing condition was significant, $F(2, 45) = 22.33$, $p < .0005$). There was also a significant interaction between conversation condition and gender $F(2, 45) = 4.58$, $p = .013$). The pattern of differences for the three conditions was therefore different for males and females, as is shown in Figure 3.

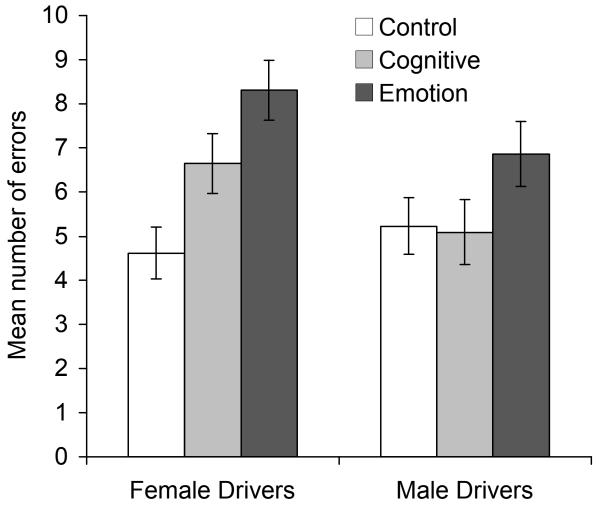

Figure 3. Mean number of errors made by male and female drivers during three different phone-task conditions. Error bars represent one standard error above and below the mean.

A set of comparisons, setting a decision wise error-rate of □ . .05, revealed that there was a significant difference between the control and the cognitive conditions $F(1, 46) = 5.28$, $p < .026$; between the control and the emotional condition $F(1, 46) = 42.69$, $p < .0005$ and also the between the cognitive and the emotional conditions $F(1, 46) = 19.29$, $p < .0005$.

Of particular interest was whether the difference between the male and female drivers in any of the three conditions was significant. The results showed there was a significant difference between males and females in the control and the cognitive conditions $F(1,45) = 6.90$, $p = .012$ and between the control and the emotion conditions $F(1, 45) = 3.55$, $p = .015$, but not between cognitive and emotional conditions $F(1, 45) = .02$, $p = .880$, see Figure 3.

To investigate where the differences occurred for each gender, planned tests of simple effects for condition and gender were carried out. Females made significantly less errors in the control condition compared with the cognitive condition $t(46) = 3.64$, $p = .001$; significantly less errors in the control condition compared with the emotional condition $t(46) = 6.69$, $p <.0005$ and significantly less errors in the cognitive condition compared to the emotional condition $t(46) = 3.13$, $p=.003$. For males there was a significant difference between the control and the emotional condition $t(46)= 2.73$, $p =.009$ and between the cognitive and the emotional condition $t(46)= 3.09$, $p=.003$ however there was no significant difference between the control condition and the cognitive condition $t(46) = .22$, $p=.824$. In fact the mean number of total errors for the control condition for males was slightly more than in the cognitive condition. Age and number of years of driving and were entered as covariates but were highly non-significant and did not change the effect of the interaction between gender and driving conditions.

Driving performance deteriorates when a secondary task is imposed upon drivers in a number of consistent ways (Young, Regan, & Hammer, 2003). In keeping with Young et al.'s classification, the performance measures recorded in this experiment were subsequently sub-divided into three categories for further analysis to see if driver workload affected control of the vehicle differently for male and female drivers. The two main categories were: maintenance of the vehicle's lateral position on the road and longitudinal control of the vehicle as determined by speed maintenance and control. In addition a third category was included that recorded the number of external events that the driver didn't respond to because they had apparently failed to see them. Lateral control of the vehicle was measured in this experiment by the number of off-road collisions, centre line crossings and road edge excursions. Longitudinal control of the vehicle was measured by the number of collisions with other cars and the number of pedestrians that were hit; and the third category of errors was composed of the number of stop signs and traffic lights that the drivers missed.

The results of this categorisation can be seen in Figure 4. With regard to lateral errors, the results of interest were that female drivers did make more lateral errors in the emotional condition than the male drivers, although in the control condition the opposite outcome was achieved $F(1,46) = 4.29$, $p = .044$. To investigate the differences in lateral errors within gender and between each condition simple effects for condition and gender were carried out. Female drivers made significantly fewer lateral errors in the control condition than they did in the emotional condition $t(46) = 3.24$, $p = .002$ and significantly fewer lateral errors in the cognitive condition than they did in the emotional condition $t(46) = 3.38$, $p = .002$. There were no significant differences in lateral errors for male drivers between any of the three conditions.
With regard to the longitudinal errors female drivers had significantly fewer collisions in the control condition than they did in the cognitive condition $t(46) = .299$, $p = .004$ and in the emotional condition $t(46) = 4.10$, $p < .0005$ and significantly fewer collisions in the cognitive condition than they did in the emotional condition $t(46) = 2.01$ $p = .051$. Male drivers had fewer collisions in the control condition than the emotional condition $t(46) = 2.23$, $p = .030$ and significantly fewer collisions in the cognitive condition than they did in the emotional condition $t(46) = 2.29$, $p = .027$; but no more in the cognitive condition than they did in the control condition ($p > .05$). Finally, the third category of errors found that more stop signs and traffic lights were missed in the emotional condition than in the control condition, but not between the cognitive and control conditions and male and female drivers were impaired to a similar extent with regard to this type of error.

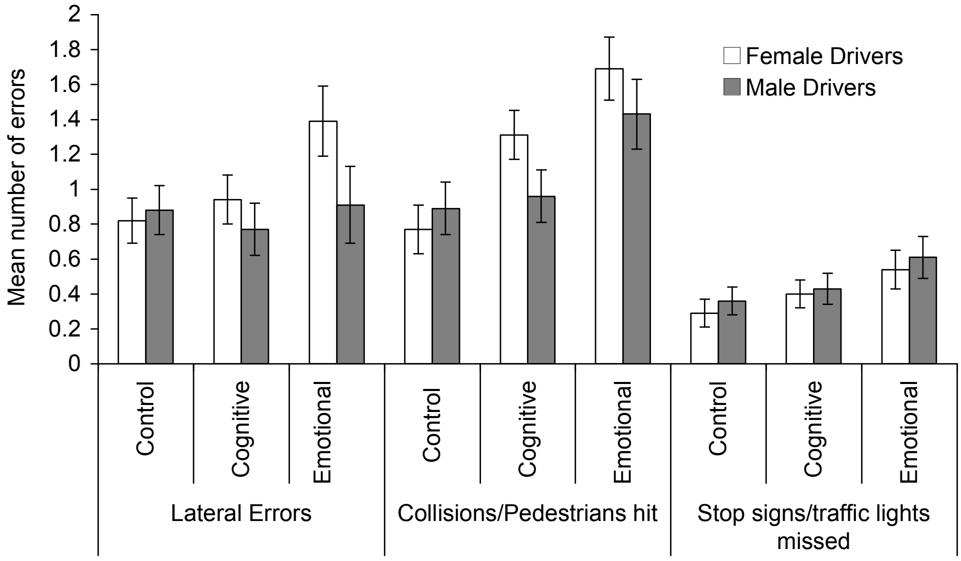

Figure 4: Mean number of errors, classified by category, made by male and female drivers under three different phone-task. Error bars represent one standard error above and below the mean.

An analysis of the time taken to complete the drives under the three task conditions, revealed that relative to the silent control condition the drivers took significantly longer to complete the task in both the cognitive condition $F(1,46) = 9.35$, $p = .004$ and in the emotional condition $F(1,46) = 25.80$, $p < .0005$; furthermore the drivers took significantly longer to complete the drive in the emotional condition than they did in the cognitive condition $F(1,46) = 4.46$, $p = .040$ see Figure 5 for details. Interestingly there was no significant interaction with gender $F(2,45) = 1.04$, $p = .362$, indicating that both the male and female drivers adapted to the demands of the phone task by slowing their driving to a similar degree. This result is paralleled in the finding that there were no significant differences in the number of speeding tickets given between conditions or between the male and female drivers over the course of the drives.

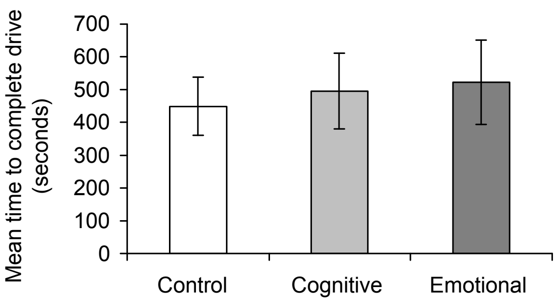

Figure 5: Mean amount of time spent conversing time during the emotion phone task for male and female drivers. Error bars represent one standard error above and below the mean

Duration of time spent engaged in conversation was also examined for gender effects in terms of both the gender of the driver as well as the caller. There were no differences in the mean call time between the male and female drivers and a male and female caller in the cognitive condition. In the emotional condition however there was a significant interaction between gender of caller and gender of driver $F(1,47) = 3.99$, $p = .05$ (see Figure 6 below). A test of simple effects revealed there was a significant difference between the call time when the caller was male and the driver was female and when the driver was male $F(1,44) = 5.46$, $p = .024$; with no significant difference when the caller was female between the male and female drivers $F(1,44) = .058$, $p = .810$.

Female drivers talk for a similar length of time regardless of the gender of the caller, however the male drivers were relatively brief in their conversations when talking to another male, but when talking to a female they talked for a similar length of time to that of the female drivers. As a broad indicator of how much attention the drivers were paying to the conversation, when later asked to recall the name the person who had called them, the female drivers were significantly better at doing so than the male drivers, $F(1,46) = 3.93$, $p = .05$.

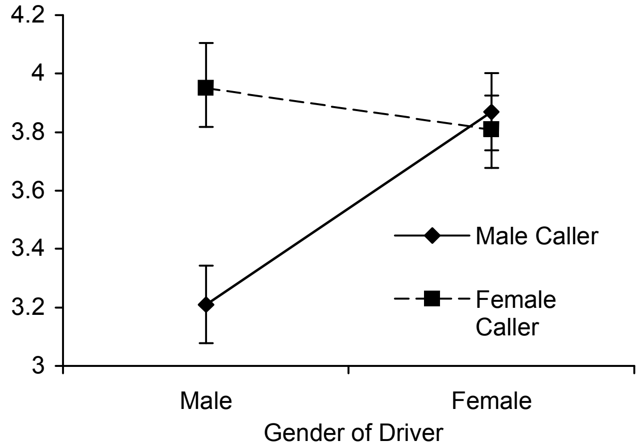

Figure 6. Mean duration of conversation engaged in by male and female drivers with either a male or female caller. Error bars represent one standard deviation above and below the mean

The participants responses to the NASA-TLX measure of how effortful they found the two tasks to be under the dual task conditions can be seen in Figure 7. With regard to the driving task (left panel) both male and female drivers found the driving task in the emotion condition to be significantly more effortful than in the cognitive condition $F(1,46) = 5.28$ $p = .026$. On a scale of 1-10 the female drivers reported a higher subjective workload than males in both the cognitive condition $F(1, 46) = 4.436$, $p = .041$ and the emotional condition $F(1,46) = 4.328$, $p = .043$. There was a significant main effect $F(1,46) = 4.42$, $p = .041$ between the measure of subjective workload for the conversation experienced in the two conditions. In the cognitive condition mean subjective workload for conversation was significantly higher for female drivers $F(1,46) = 5.76$, $p = .020$ as well as in the emotional condition $F(1,46) = 4.23$, $p = .045$.

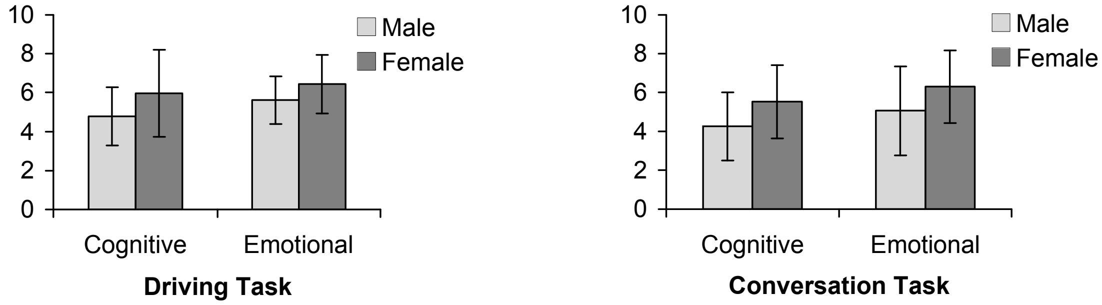

Figure 7. Mean score of subjective workload on the six dimensions of the NASA-TLX for the *driving* task (left panel) and the *conversation* task (right panel). Error bars represent one standard deviation above and below the mean.

In a subjective assessment of the difficulty of various components of the dual task: conversing, searching for pedestrians whilst conversing, keeping within lane while conversing and keeping to the speed limit; the only significant gender difference was for keeping within lane while conversing that is: maintaining lateral control of the vehicle whilst driving $F(1,46) = 14.667$, $p < .000$.

Discussion

The nature of the conversation is an important factor in determining the degree of distraction experienced by the drivers. Conversations that evoke an emotional response detract the drivers' attention away from driving to a greater extent than the cognitive conversation. Goodman et al.'s (1999) speculation regarding an emotionally laden communication, appears to be supported by our findings, but with the qualification that this effect is more pronounced for female drivers than it is for male drivers. In similar fashion to the pattern of results observed in Experiment 1 the male drivers again appeared to derive some small benefit from the dual task, but in the cognitive conversation condition only. No such benefit however, was observed in the emotional conversation condition. The size of the decrement in driving performance between the two conversation tasks is similar for both the male and female drivers, the problem for the female drivers is that this decrement is over and above that which is already apparent in the cognitive phone task relative to the no-conversation driving condition. This apparent greater difficulty that the female drivers have with performing the dual task, is partly an artefact from the finding that the female drivers made slightly fewer errors in the no-conversation driving only task than did their male counterparts.

The analysis of the types of errors that the drivers made when performing the dual task, showed that the female drivers appear to not only have greater difficulty in maintaining the vehicle within their lane than the male drivers, but they also displayed greater difficulty in avoiding collisions than the male drivers.

The male drivers, had no difficulty in maintaining their lane position in either phone condition, but in the emotional phone condition the male drivers, displayed reduced reaction times in response to sudden and unexpected events resulting in more collisions than they incurred in either the control or the cognitive conditions.

The dual task did increase the mental workload of the drivers, this was apparent in the additional length of time it took for them to complete the drives under the cognitive and emotional phone task conditions, and this was similar for both the male and female drivers.

Both men and women drove significantly more slowly in the cognitive condition than they did in the control condition and slower still in the emotional phone task. The additional effort to complete the drive while conducting an emotional phone conversation was reflected in the higher ratings given by the female drivers on the NASA-TLX. We also observed in the history of the drivers' actual experiences of using a mobile while driving that the women did report that they had experienced greater difficulty in maintaining lane position while performing the dual task, a finding that adds support to the validity of these results gained under simulated conditions.

Taken together, our findings show that the dangers of driving and conversing on a mobile phone is a multi-dimensional problem. The degree of difficulty in performing this dual-task not only depends on the nature of the conversation but also with who is doing the driving and to a lesser extent who is doing the calling. Emotional conversations should clearly be kept out of the car and a future study could examine whether the same is true for an emotional conversation with a passenger. Given the results from Experiment 1 that the male drivers did tend to be more distracted by conversing with a passenger than they were by a mobile phone conversation, then this trend might well be exacerbated if the conversation was of an emotional nature.

The second significant outcome of this study is that the gender of the driver is clearly an important factor in determining the degree of distraction that this dual-task elicits. The female drivers both exhibited and admitted that it required more mental effort for them to perform the dual–task than did the male drivers, and given that more female drivers were able to recall the name of the person who called them, this finding suggests that perhaps more of their attentional resources were being directed to the secondary task than the male drivers were doing. The male drivers were also less inclined to engage in the emotional conversation if they were conversing with another male, but this reluctance was not apparent if the caller was female. The observation that the male drivers tended to make slightly fewer errors in the cognitive phone condition than they did in the control condition suggests that they were able to summon some additional attentional resources (cf. Kahneman, 1973) to perform the dual task benefiting their primary task of driving as well being able to conduct the conversation; whereas no such "spare" resource was available for the female drivers to call upon when they had to perform the dual task.

Stutts, Reinfurt, Staplin and Rodgman (2001) refer to a survey in the United States that has revealed that whilst the vast majority (84%) of mobile phone users believe that using a phone is a distraction and increases the likelihood of a crash, the same respondents report however that 61% of them use their mobile phone while driving and around 30% use their phone frequently or fairly often. A National Highway Traffic Safety Administration survey completed in January 2001 found that 54% of motor vehicle drivers in the United States usually have a mobile phone in their vehicles or carry mobile phones when they drive. Almost 80% of these drivers leave their phone turned on while driving, and 73% report having talked on the phones while driving.

This inconsistency between belief and behaviour would seem to suggest that an optimism bias is operating such that the drivers are not identifying with the risk they incur each time they talk and drive at the same time. A worrying aspect to these results is the deterioration in performance for the female drivers when they were required to perform a simple, short, natural conversation on their own mobile phones. If female drivers were to hold the belief that they are safer drivers than males, they might not be identifying with the media warnings of the dangers of using their mobile phone whilst driving their car. Lesch and Hancock (2004) found a negative relationship between female drivers' confidence to perform a mobile phone task whilst driving. The more confident the women felt in their capacity to use the phone and drive at the same time, the poorer was their performance on the task. In contrast the male drivers' level of confidence matched their ability to perform the task at the same time. Since it is well known that male drivers are more at risk of being involved in a serious road crash, most media campaigns employ male actors to depict the wrong-doer. Perhaps the authors of these campaigns should include female actors and tailor their campaigns to target women as well as to men and also to encourage those individuals who inadvertently make the phone calls to drivers to be aware of the dangers that they are placing the drivers under.

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