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Driving performance during concurrent cell-phone use: are drivers aware of their performance decrements?

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Abstract

Prior research has documented the manner in which a variety of driving performance measures are impacted by concurrent cell-phone use as well as the influence of age and gender of the driver. This current study examined the extent to which different driver groups are aware of their associated performance decrements. Subjects' confidence in dealing with distractors while driving and their ratings of task performance and demand were compared with their actual driving performance in the presence of a cell-phone task. While high confidence ratings appeared to be predictive of better driving performance for male drivers (as confidence increased, the size of the distraction effects decreased), this relationship did not hold for females; in fact, for older females, as confidence increased, performance decreased. Additionally, when drivers were matched in terms of confidence level, brake responses of older females were slowed to a much greater extent (0.38 s) than were brake responses of any other group (0.10 s for younger males and females and 0.07 s for older males). Finally, females also rated the driving task as less demanding than males, even though their performance was more greatly affected by distraction. These results suggest that many drivers may not be aware of their decreased performance while using cell-phones and that it may be particularly important to target educational campaigns on driver distraction towards female drivers for whom there tended to be a greater discrepancy between driver perceptions and actual performance.

Keywords: Driver distraction; Driving performance; Age; Gender; Confidence

1. Introduction

Seemingly, studies examining the impact of cell-phone use on driving performance have proliferated almost as quickly as drivers who use cell-phones (see Cain and Burris, 1999; Crawford et al., 2001; Goodman et al., 1997, for excellent reviews). This research indicates that concurrent cell-phone use results in a reduction in headway in following a lead-vehicle and an increase in brake response time (e.g. Lamble et al., 1999) as well as an impaired ability to maintain lane position and greater variability in steering wheel angle and speed control (e.g. Reed and Green, 1999). Brookhuis et al. (1991) found that concurrent phone use reduced the frequency of rear-view mirror checking (but only in certain road situations) and resulted in a decreased ability to respond to other road users (i.e. slowed reaction times to variations in speed).

There is also growing evidence that driver characteristics influence distraction effects due to concurrent cell-phone use (see McKnight and McKnight, 1993, 1999; Verwey, 2000; Alm and Nilsson, 1994, 1995; Lyda et al., 2002). In a recent study, we found that the distraction effects of cell-phone use while driving are moderated by the age and gender of the driver (Hancock et al., 2003). The effects of simulated cell-phone use were examined during a critical driving maneuver in which drivers were to treat a light change at a signalized intersection as an emergency stopping situation. We found that in the presence of a cell-phone task, brake response times were delayed by approximately one-third of a second for older drivers (aged 55–65 years) compared to about one-tenth of a second for younger (aged 25–35 years) drivers. Additionally, while stopping times were reduced by about one-tenth of a second for younger drivers, they were reduced by one-half of a second for

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older drivers. This result suggests that drivers braked more intensely in order to compensate for their slowed brake responses (see Hancock et al., 1999). Even so, on average, drivers ended up 50% closer to the intersection (70% closer for older drivers and 20% closer for younger drivers).

Drivers were also more likely to "miss" the red light in the presence of the cell-phone task—younger drivers stopped for 93% of the red lights in the absence of the cell-phone task, but only 87% of the red lights in the presence of the cell-phone task. Older drivers stopped for 97% of the red lights in the absence of the cell-phone task compared to only 74% of the red lights in the presence of the cell-phone task. While age of the driver influenced all four performance measures, gender of the driver only influenced brake response time and stop light compliance: brake responses were delayed by approximately one-tenth of a second for males compared to about a quarter of a second for females and compliance with the red light fell 4% for males compared to 25% for females.

While prior research has documented the manner in which a variety of performance measures are impacted by the distracting effects of cell-phone use, little attention has been given to the degree to which drivers are aware of these performance decrements and their ability to compensate for them. Here, we document the extent to which the drivers in our prior study (Hancock et al., 2003) felt confident in their ability to deal with distractors (i.e. cell-phone use) and the relationship between their confidence level and the actual decrement in performance observed. The driver's a priori confidence in their ability to deal with distractors may impact decisions to engage in compensatory behaviors and, consequently, the observed effects of distraction. To determine the extent to which drivers recognize performance decrements, despite having high confidence in their ability to deal with distractors, the relationship between drivers' ratings of their own performance and their actual performance was examined.

This investigation should be considered exploratory as the sample size is relatively small ($N = 36$). However, the strength of the study lies in the use of three different approaches to assess the relationship between driver perceptions and driver performance: analyses of variance of confidence ratings as a function of age and gender to determine whether expressed confidence in dealing with distractors while driving was consistent with actual performance while dealing with distractors (i.e. with those drivers expressing higher confidence being less affected by distraction and those drivers expressing lower confidence being more greatly affected by distraction), correlational analyses to determine the direction and magnitude of the relationship between confidence ratings and effects of distraction on the four performance measures (brake response time, stopping time, stopping distance, and stop light compliance) as a function of age and gender, and analyses of variance of the distraction effects for drivers "comfortable" in dealing with distractors to determine whether actual performance varied as a function of age and gender of the driver when level of confidence was held constant.

2. Methods

2.1. Participants

Thirty-six licensed Massachusetts drivers were recruited through advertisements in local newspapers. Nineteen of these participants were between the ages of 25 and 36 years and comprised the "younger" group while the other 17 participants were between the ages of 55 and 65 years and comprised the "older" group. Males ($N = 19$) and females ($N = 17$) were approximately equally distributed across the two age groups.

2.2. Procedure

The experiments were conducted between June and September 1998 using an instrumented vehicle and a driving range equipped with a signalized intersection (see Hancock et al., 2003). An experimental trial consisted of one lap around the track. Participants were instructed to maintain a speed of 25 mph. Prior to each trial, drivers were required to memorize seven digits (i.e. a phone number) to be recalled at the end of the trial. On some trials, as the vehicle approached the intersection the light changed from green to red and drivers were instructed to treat the light change as an emergency stopping situation. Additionally, on some trials, a cell-phone task was presented: a tone sounded as drivers approached the intersection. At that point, a digit was displayed on a simulated cell-phone (mounted in the center of the dashboard), and the driver had to decide whether the number matched the first digit of the number they had been asked to memorize. Drivers input their responses on the simulated cell-phone display. Four performance measures focused on control of the vehicle: brake response time, stopping time, stopping distance, and stop light compliance. Brake response time refers to the time taken to initiate the braking response after the light change. Stopping time refers to the time for the vehicle to come to a complete stop following initiation of the braking response. Stopping distance refers to the distance from the intersection at which the vehicle came to a complete stop while stop light compliance refers to whether or not the driver stopped for the red light.

Participants filled out a demographic questionnaire prior to performing the driving tasks and memory tasks. Following performance of the driving and memory tasks, participants rated how demanding the various tasks were as well as their perception of their own performance on those tasks.

2.3. Questionnaire

The demographic questionnaire asked for general information such as age and gender as well as questions

regarding years of driving experience, frequency (How often do you drive an automobile? 1 = Every day, 2 = most days, 3 = once/twice a week, 4 = once/twice a month, 5 = rarely), and experience using a cell-phone (Do you have a cellular phone in your car? If yes, what type is it? Hand-held, hands-free? Do you operate it while driving?). Drivers were also asked regarding their confidence and experience dealing with distractors: How confident are you dealing with distracting tasks (e.g. having conversations, making calls) while driving? 1 = Very uncomfortable, 2 = uncomfortable, 3 = comfortable, 4 = very comfortable. How often do you have to deal with distracting tasks while driving? 1 = Never, 2 = rarely, 3 = occasionally, 4 = frequently.

For all self-reported demand and performance measures, participants responded by placing a mark along a continuum. The "anchors" of the continuum were dependent on the question being asked. In order to rate the demand imposed by the drive (or the stopping task), drivers marked a continuum from "not at all" to "extremely". In order to rate their performance during the drive (or during the stopping task), drivers marked a continuum from "total failure" to "perfect".

3. Results

The drivers' responses to the survey questions were related to their performance on the driving tasks reported earlier (Hancock et al., 2003). In the presence of the cell-phone task, brake responses were slowed by 0.18 s, stopping times were reduced by 0.34 s, drivers ended up about 50% closer to the intersection, and stop light compliance fell 14% (Table 1). Additionally, the effects of distraction were moderated by age and gender of the driver such that older drivers showed a larger distraction effect than younger drivers on all four performance measures while female drivers showed a larger distraction effect than male drivers on both brake response time and stop light compliance. Brake responses were slowed by 0.27 s for older drivers compared to 0.10 s for younger drivers and stopping times were reduced 0.54 s for older drivers compared to 0.14 s for younger drivers. Older drivers ended up about 70% closer to the intersection in the presence of the cell-phone task while younger drivers ended up about 21% closer to the intersection. Finally, in the presence of the cell-phone task, stop light compliance fell 22% for older drivers compared to 6% for younger drivers. As regards the influence of gender, female drivers initiated braking responses 0.25 s slower in the presence of the cell-phone task compared to 0.13 s slower for male drivers. For female drivers, stop light compliance fell 25% in the presence of the cell-phone task compared to 4% for male drivers (Table 1).

3.1. Demographic information

3.1.1. Age

The mean age of the "younger" drivers was 30 years (31.0 years for males and 29.1 years for females). The mean age of "older" drivers was 60 years (61.4 years for males and 58.8 years for females).

3.1.2. Driving experience

Older participants had more years driving experience (mean = 43.1; S.D. = 3.2) than younger participants (mean = 13.1; S.D. = 3.6), $F(1, 32) = 680.40$, $P < 0.01$, M.S.E. = 8034.8, but reported similar driving frequency (1.2 for both groups, where 1 = every day, 2 = most days, 3 = once/twice a week, 4 = once/twice a month, 5 = rarely).

Males and females reported similar levels of driving experience (28.6 years versus 27.6 years, for males versus females) as well as driving frequency (1.2 for both groups) (see Table 2).

3.1.3. Cell-phone experience

Relatively low levels of cell-phone ownership were reported—older males reported the lowest level of ownership (11%) while older females reported the highest level of ownership (50%). However, of those owning a cell-phone, 100% of the older males and 50% of the older females indicated that they operate it while driving. Younger males and females did not differ in level of ownership (30% versus 33%) or in terms of reporting they operate the cell-phone while driving (67% for both groups).

Of those drivers owning cell-phones, the majority reported owning a hand-held version. Only younger male drivers reported owning "hands-free" versions (67%) (Table 2).

Table 1
Driving performance as a function of driver group and distractor presence (see Hancock et al., 2003)

Driver group	Brake response time (s)		Stopping time (s)		Stopping distance (ft)		Stopping accuracy (%)	
	No distraction	Distraction	No distraction	Distraction	No distraction	Distraction	No distraction	Distraction
Males								
Younger	0.52	0.63	2.39	2.27	10.94	9.24	91.3	91.3
Older	0.58	0.72	2.33	2.09	11.81	5.81	92.9	85.7
Females								
Younger	0.49	0.59	2.77	2.60	7.20	5.05	94.4	81.9
Older	0.51	0.91	2.78	1.94	9.25	0.42	100	62.5

Table 2
Mean responses to survey questions as a function of gender and age group

Survey questions/topics	Males		Females	
	Younger ($N = 10$)	Older ($N = 9$)	Younger ($N = 9$)	Older ($N = 8$)
Age (years)	31.0 (3.4)	61.4 (3.5)	29.1 (3.6)	58.8 (2.5)
Driving experience				
Years	13.0 (1.2)	44.1 (1.3)	13.2 (1.3)	42.0 (0.70)
Frequency[a]	1.3 (0.2)	1.1 (0.1)	1.0 (0)	1.4 (0.2)
Cell-phone experience				
Own a cell-phone (%)	30	11	33	50
If yes				
Hand-held (%)	33	100	100	100
Operate while driving (%)	67	100	67	50
Confidence and experience dealing with distractors while driving				
Confidence in dealing with distractors[b]	3.1 (0.3)	2.2 (0.3)	3.1 (0.2)	2.8 (0.3)
Often deal with distractors[c]	3.0 (0.2)	3.1 (0.1)	3.2 (0.2)	2.9 (0.1)
Task demand[d]				
Driving task	52 (7)	62 (8)	31 (8)	31 (8)
Stopping task	61 (27)	65 (19)	52 (23)	49 (35)
Task performance[e]				
Driving task	78 (5)	70 (5)	72 (5)	71 (6)
Stopping task	79 (18)	65 (30)	78 (12)	68 (24)

The values are given as mean (S.D.).
[a] 1 = Every day, 2 = most days, 3 = once/twice a week, 4 = once/twice a month, 5 = rarely.
[b] 1 = Very uncomfortable, 2 = uncomfortable, 3 = comfortable, 4 = very comfortable.
[c] 1 = Never, 2 = rarely, 3 = occasionally, 4 = frequently.
[d] 0 = Not at all, 100 = extremely.
[e] 0 = Total failure, 100 = perfect.

3.2. Experience dealing with distractors while driving

There were no differences as a function of age or gender in reported frequency of dealing with distractors while driving. The overall mean of 3 (where 1 = never, 2 = rarely, 3 = occasionally, 4 = frequently) indicates that participants "occasionally" deal with distractors while driving.

3.3. Relationship between (a priori) confidence ratings and driving performance

3.3.1. Analysis of variance of confidence ratings

When asked to indicate their level of confidence (i.e. 1 = very uncomfortable, 2 = uncomfortable, 3 = comfortable, 4 = very comfortable) in dealing with distracting tasks (making phone calls, having conversations) while driving, younger participants expressed somewhat greater confidence than older participants in their ability to deal with distractors (3.1 versus 2.5), $F(1, 32) = 5.27$, $P < 0.05$, M.S.E. = 3.4, while confidence did not vary as a function of gender, $F < 1$ (Table 2). Younger males were somewhat more confident (mean confidence rating = 3.1) than older males (2.2), $F(1, 17) = 2.07$, $P = 0.05$, S.E. = 0.4, while the difference between confidence ratings reported by younger and older females, 3.1 versus 2.8, did not approach significance (see Table 2). There was little variation in confidence ratings with most respondents (67% overall) reporting that they are "comfortable" (confidence rating = 3) in dealing with distractions while driving—for female drivers, especially, the distribution of confidence ratings was skewed towards the higher end of the scale (see Fig. 1). However, among older participants, none rated themselves as being "very comfortable" in dealing with distractors.

3.3.2. Correlational analyses

In order to further explore the relationship between driver confidence in dealing with distractors and actual decrements in performance in the presence of the cell-phone task, Spearman's rho correlations were computed between confidence ratings and the demographic variables (i.e. age in years, experience in years) and actual performance measures (brake response time, stopping time, stopping distance, stop light compliance).

3.3.2.1. Male drivers. For male drivers, significant negative correlations were observed between level of confidence and age ($r = -0.71$, $P < 0.01$) indicating decreasing confidence with increasing age (Table 3).

To examine the relationship between confidence and actual performance, confidence ratings were correlated with the difference in performance with and without the cell-phone task. For males, as confidence level increased,

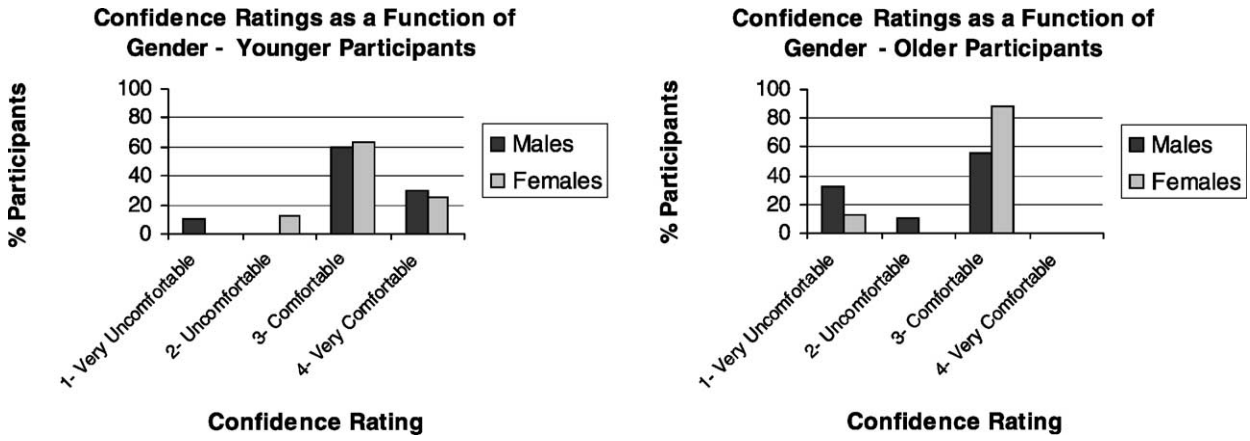

Fig. 1. Distribution of confidence ratings as a function of gender and age.

the effect of distraction on brake response time and stopping distance decreased ($r = -0.49$, $P < 0.05$ for brake response time; $r = -0.56$, $P < 0.05$, for stopping distance) (Table 3)—that is, the slowing down in initiating the braking response and the reduction in stopping distance in the presence of distraction (i.e. stopping closer to the stopping line) became less. As confidence increased, the reduction in stopping time in the presence of distraction decreased ($r = 0.45$, $P = 0.06$).

3.3.2.2. Female drivers. For female drivers, however, confidence ratings did not correlate significantly with age or any of the performance measures examined (Table 3).

3.3.2.3. Younger drivers. Similarly, for younger drivers, confidence ratings did not correlate significantly with any of the demographic variables or performance measures examined (Table 3).

3.3.2.4. Older drivers. For older drivers, however, confidence ratings correlated significantly with age ($r = -0.71$, $P < 0.01$) and experience ($r = -0.69$, $P < 0.01$), indicating that the older and more experienced the driver (even within the limited age range within the "older" group), the lower the confidence ratings. However, confidence ratings did not significantly correlate with any of the performance measures (Table 3).

The pattern of significant correlations reflects the following relationships between confidence and performance. Male drivers consistently showed a reduction in the magnitude of the distraction effects as a function of confidence level (Figs. 2–4). For younger males, the change in brake response time was 0.23 s for the "low confidence" drivers (those reporting being "very uncomfortable" or "uncomfortable" in dealing with distractions while driving) compared to only 0.10 s for "high confidence" drivers (those reporting being "comfortable" or "very comfortable" in dealing with distractions while driving) (Fig. 2). For older males, the change in brake response time was 0.36 s for "low confidence" drivers compared to only 0.07 s for "high confidence" drivers. However, for females, the relationship between decreasing confidence and increased brake response time did not hold. For younger females, the change in brake response time only shifted from 0.13 s for "low confidence" drivers to 0.10 s for "high confidence" drivers. For older females, "high confidence" drivers were actually more greatly affected by distraction than were the "low confidence" drivers, brake response times were slowed 0.38 s versus 0.28 s, respectively (Fig. 2).

The same general pattern held for stopping times (Fig. 3). For older males, the reduction in stopping times was 1 s less in the presence of distraction for "high confidence" drivers relative to "low confidence" drivers (1.1 s versus 0.1 s). However, for younger males, the reduction in stopping times was actually somewhat greater for "high confidence" drivers than for "low confidence" drivers (0.13 s versus 0.04 s, respectively). Neither "high confidence" younger nor "high confidence" older female drivers demonstrated a

Table 3
Correlations between confidence and distraction effects (Δ = distraction − no distraction) and age as a function of driver group

Driver group	Age	ΔBrake response time	ΔStopping time	ΔStopping distance	ΔStopping accuracy
Males	−0.71*	−0.49*	0.45*	−0.56*	0
Females	−0.40	−0.31	−0.22	−0.24	0.26
Younger	−0.36	−0.30	−0.21	−0.31	−0.04
Older	−0.71*	−0.22	0.43	−0.16	0.23

* Denotes significance at $P < 0.05$.

Fig. 2. Change in brake response time (s) (distraction − no distraction) as a function of confidence, gender, and age.

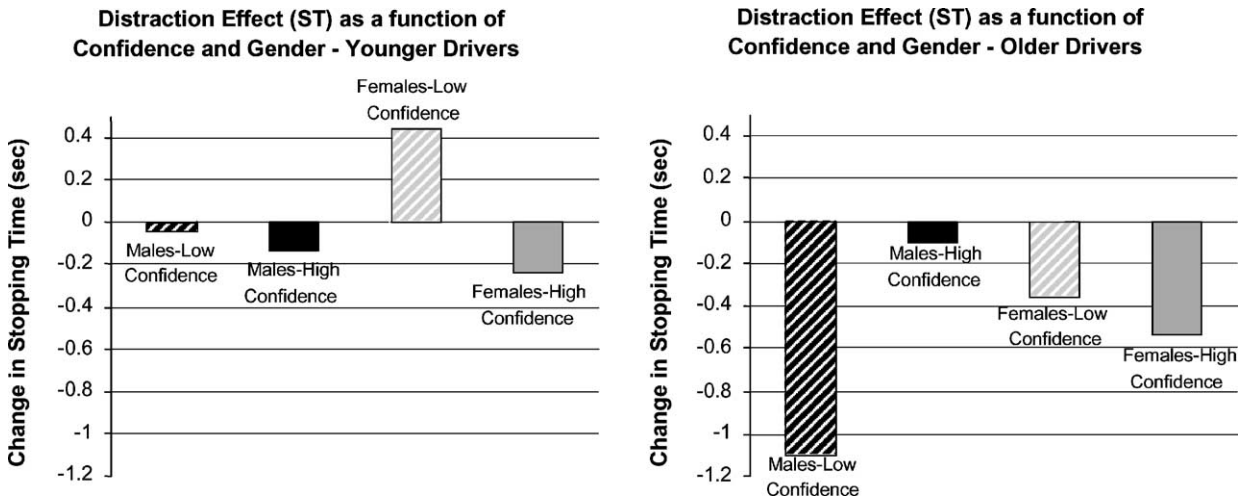

Fig. 3. Change in stopping time (s) (distraction − no distraction) as a function of confidence, gender, and age.

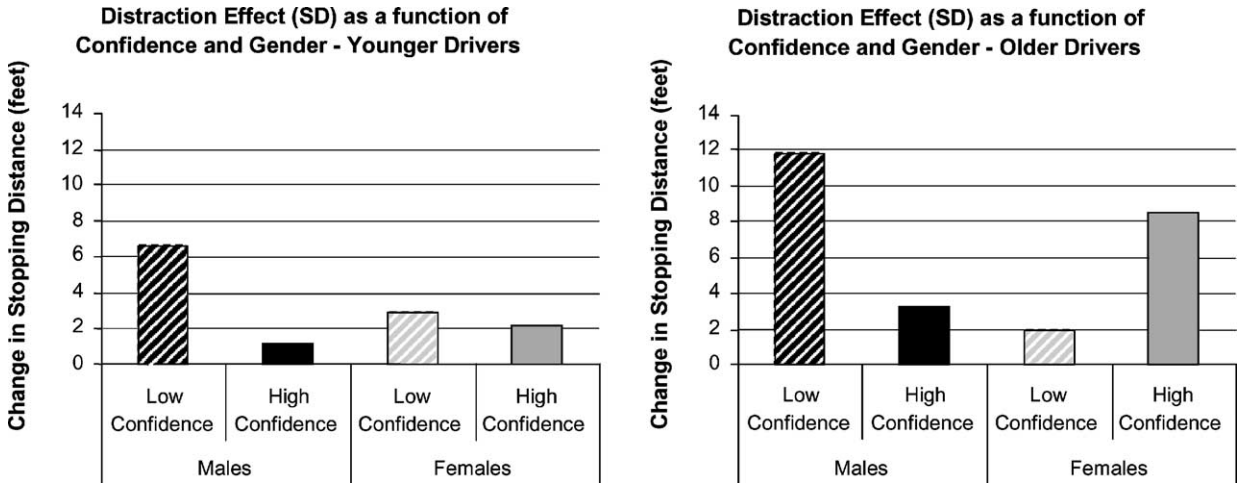

Fig. 4. Change in stopping distance (ft) (distraction − no distraction) as a function of confidence, gender, age.

smaller distraction effect (i.e. a smaller reduction in stopping times) than their "low confidence" counterparts. "High confidence" older females again showed larger effects of distraction (stopping times were reduced 0.53 s for "high confidence" older females compared to 0.36 s for "low confidence" older females) (Fig. 3).

Finally, the change in stopping distance was much less for "high confidence" males than for "low confidence" males, irrespective of age (1.2 ft versus 6.6 ft and 3.2 ft versus 11.8 ft, for younger and older males, respectively). "High confidence" younger females showed a much smaller reduction in the change in stopping distance as a function of distraction (2.1 ft versus 2.9 ft, for "high" versus "low" confidence) and "high confidence" older females again showed a larger effect of distraction than "low confidence" older females (8.5 ft versus 2 ft) (Fig. 4).

3.3.3. Analyses of variance—drivers "comfortable" dealing with distractors while driving

Since variation in confidence ratings was limited (see Fig. 1), analyses of variance of the driving performance measures were conducted with just those drivers reporting a confidence rating of three ("comfortable" in dealing with distractors)—the most frequently provided rating (67% of respondents). These analyses allow for a determination of whether decrements in performance in the presence of the cell-phone task varied for drivers expressing the same level of comfort in dealing with distractions. Age and gender were included as between subjects variables.

3.3.3.1. Brake response time. Females "comfortable" in dealing with distractors demonstrated greater changes in brake response time as a function of distraction (0.24 s) than

Table 4
Mean change in performance (Δ = distraction − no distraction) as a function of driver group for drivers "comfortable" in dealing with distractors while driving

Driver group	ΔBrake response time (s)	ΔStopping time (s)	ΔStopping distance (ft)	ΔStopping accuracy (%)
Males	0.09 (0.05)	−0.13 (0.13)	−2.02 (1.35)	−2.9 (6.3)
Younger	0.10 (0.07)	−0.17 (0.18)	−0.86 (1.90)	4.2 (8.4)
Older	0.07 (0.08)	−0.09 (0.20)	−3.24 (2.09)	−10.0 (9.2)
Females	0.24 (0.05)	−0.36 (0.13)	−5.42 (1.37)	−17.7 (7.30)
Younger	0.10 (0.07)	−0.19 (0.20)	−2.34 (1.90)	−14.6 (8.4)
Older	0.38 (0.06)	−0.53 (0.17)	−8.49 (1.98)	−20.8 (11.9)

S.D. values are given in parentheses.

did males "comfortable" in dealing with distractors (0.09 s), $F(1, 19) = 4.90$, $P < 0.05$, M.S.E. = 0.14 (Table 4). Additionally, age interacted with gender, $F(1, 19) = 4.56$, $P < 0.05$, M.S.E. = 0.13, such that there was no difference between the magnitude of the distraction effect for younger males and females (both groups initiated the brake response 0.10 s later in the presence of the distractor task), but brake responses were slowed by an additional 0.31 s for older females relative to older males. Furthermore, there was no reliable difference between younger and older males (0.10 s versus 0.07 s), $t < 1$, but older females were slowed by an additional 0.27 s relative to younger females (0.38 s versus 0.11 s), $t(9) = 2.42$, $P < 0.05$, S.E. = 0.11.

3.3.3.2. Stopping time. None of the driver groups differed significantly in terms of stopping time. However, as can be seen in Table 4, the pattern was similar to that observed with brake response time: while there was little difference for younger males and females (0.17 s versus 0.19 s), stopping time was reduced to a much greater extent for older females than for older males (0.53 s versus 0.09 s).

3.3.3.3. Stopping distance. Stopping distance increased 5.87 ft (i.e. drivers ended 5.87 ft closer to the intersection) in the presence of distraction for older drivers "comfortable" in dealing with distractors and 1.57 ft for younger drivers who expressed a similar level of confidence, $F(1, 20) = 5.02$, $P < 0.05$. No other differences were significant.

3.3.3.4. Stop light compliance. While stop light compliance decreased more for female than for male drivers (17.7% for females versus 2.9% for males) and more for older than for younger drivers (15.4% for older versus 5.2% for younger), these differences were not reliable (see Table 4).

3.4. Ratings of task demand and performance

Demand was rated on a continuum from "not at all" (0) to "extremely" (100) while performance was rated on a continuum from "total failure" (0) to "perfect" (100). These scales were then transformed to a numerical scale from 0 to 100 for analysis.

While actual performance varied as a function of age and gender, ratings of task demand and performance did not (Table 2)—the one exception being that females rated the drive as significantly less demanding than did males, 31 versus 57, $F(1, 32) = 11.04$, $P < 0.01$, M.S.E. = 6110. The overall rating of demand was 44 (S.E. = 4) for the driving task and 57 (S.E. = 4) for the stopping task while the overall rating of performance was 73 for both the driving and the stopping tasks.

4. Discussion

While studies examining the impact of cell-phone use on driving performance are proliferating at a rapid rate, we are unaware of any other study which has systematically attempted to relate driver ratings of confidence in dealing with distraction due to cell-phone use with actual driving performance during (simulated) cell-phone use. While the number of cases in our study is relatively small, the results are consistent across all areas examined. Three different analytical approaches provided converging evidence for discordant patterns of confidence level and actual performance for female drivers, in particular—confidence ratings did not correlate with any of the performance measures examined and females "comfortable" in dealing with distractors demonstrated greater changes in brake response time than did their male counterparts.

For male drivers, expressed confidence was more reflective of actual performance. As confidence level increased, the effect of the cell-phone task on brake response time and stopping distance decreased. Additionally, while male drivers' confidence generally decreased with age, it was also the case that those older males that *did* express high confidence *also* performed well in the face of distraction—for example, brake responses of older males "comfortable" in dealing with distractions were slowed no more so (actually, less) than the brake responses of younger males (0.07 s versus 0.10 s, for older versus younger males). Additionally, stopping times were reduced more for these same younger males (0.17 s) than for older males (0.09 s) perhaps indicating a greater propensity for younger males to "slam" on the

brakes in order to compensate for slowed response times. High confidence in dealing with distractions while driving may, in part, derive from a belief that it is possible to compensate for the effects of distraction.

One approach to dealing with the problem of driver distraction due to cell-phone use is to introduce legislation prohibiting the use of cell-phones while driving (McKinley, 2001). Curry (2001, 2002) has argued that laws already exist that require that drivers be in full control of their vehicle at all times. Therefore, new legislation specifically targeting cell-phone use is unnecessary. He further argues that the driving public recognizes that there is some risk associated with using a cell-phone while driving and that they should be given the responsibility for deciding when and where it is appropriate and modify their behavior accordingly. However, the problem with this argument is that it presumes that drivers can accurately assess the risks involved. Our results indicate that some groups of drivers (i.e. females, and especially older females) express disproportionately high confidence relative to their actual performance in the presence of the cell-phone task. Additionally, for the most part, the driver groups did not differ in terms of their ratings of task demand and performance. One exception is the significantly lower mean rating of driving task demand provided by females (31) relative to males (57). These results are discordant with actual task performance in which both older drivers and female drivers showed greater decrements than their counterparts. Therefore, even when asked to rate task performance and demand *following* actual task performance, there was little relationship between driver perceptions and actual performance. Together, these results suggest that many drivers are relatively unaware of actual performance decrements resulting from concurrent cell-phone use.

The driving public needs to be educated regarding the possible effects of distraction and their relative ability (or inability) to compensate for them. One difficulty is that it is necessary to educate drivers regarding effects of distraction that they may not be able to observe themselves (i.e. "missed" red lights or other failures to detect or respond to events in the driving environment). Additionally, our results suggest that it may be particularly important to target educational campaigns towards female drivers as they appear to have the greatest disconnect between actual and perceived ability.

The underlying basis of observed differences across driver groups is unclear—the survey responses indicated that the driver groups were well-matched in terms of driving experience and driving frequency. However, there were some differences in terms of cell-phone ownership—while cell-phone ownership was generally low (about 30% overall), it was the case that it was highest for older females (50%) and lowest for older males (11%). Therefore, it might have been expected that the older females would demonstrate a stronger correspondence between driver perceptions and driver performance due to their greater experience with cell-phones. This was not the case. Whether there is a causal relationship between cell-phone ownership and reported confidence is unknown as is the direction of the relationship, if any (i.e. is higher confidence in older females due to owning a cell-phone or do more older females own cell-phones since they are more confident in their ability to deal with distractors?).

Because of the relatively small number of participants, our results should be considered suggestive and should be replicated with larger groups of drivers and with a more sensitive measure of confidence (i.e. instead of a scale from 1 to 4, a continuum ranging from 1 to 100). It is critical to conduct additional research focusing on drivers' perceptions of distraction effects to better understand differences among driver groups and how to best target educational campaigns to address the problem of driver distraction. It will also be critical to examine the relationship between driver age and gender and involvement in accidents due to concurrent cell-phone use (and distraction more generally) (see Lam, 2002).

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