Distracted Driving

Do drivers' perceptions of distractions become more accurate over time?

By David G. Kidd and William J. Horrey

ACCORDING TO A RECENT SURVEY conducted by the AAA Foundation for Traffic Safety (2008), 83% of respondents believe that distracted drivers pose a serious threat to traffic safety. Despite these concerns, drivers commonly engage in distracting activities on the roadway (Stutts, Feaganes, Reinfurt, et al., 2005). If drivers are generally aware that distractions are a safety hazard, why are they willing to accept the associated risks? One possibility is that people have inaccurate beliefs about their own ability to handle distractions while driving. Moreover, these beliefs may become more inaccurate as drivers become increasingly familiar and comfortable with distractions over time.

Accurate perceptions of driving ability are believed to positively influence driving behavior because they help people take on an appropriate and acceptable amount of risk (Deery, 1999). In general, however, people seem to hold inaccurate beliefs about their own driving ability. Numerous studies have shown that people are overly optimistic about their own driving ability and believe that they are more skilled than the average driver (DeJoy, 1989; Horswill, Waylen & Tofield, 2004; Svenson, 1981). Additionally, when asked to rate their own driving performance, drivers' estimated driving ability has been shown to be unrelated to on-road driving tests (Martolli & Richardson, 1998) and lane-keeping performance (Biggs, Smith, Dorrian, et al., 2007). Overconfident and inaccurate perceptions of driving ability may jeopardize safety if drivers are willing to accept more risk than they are capable of handling.

One risky behavior is performing a distracting activity while driving. Distractions have repeatedly been shown to degrade driver performance (Caird, Willness, Steel, et al., 2008; Horrey & Wickens, 2006) and increase crash risk (Klauer, Dingus, Neale, et al., 2006; Redelmeier & Tibshirani, 1997). Although the negative effects of distractions are well established, drivers who are overconfident in their own driving abilities may not be aware of how distractions affect their driving performance and, as a result, may continue to engage in distracting activities.

Only a few studies have evaluated drivers' perceptions of distracted driving performance. Lesch and Hancock (2004) showed that female drivers' level of confidence in their ability to deal with distractions was not related to their actual performance. Additionally, Horrey, Lesch and Garabet (2008) found that subjective estimates of distracted driving performance were unrelated to actual distracted driving performance. These findings suggest that people do not accurately perceive their own ability to drive while distracted.

However, these studies only assessed drivers' estimates of distracted driving performance at a single point in time. A single estimate does not provide information about how drivers' perceptions change over time with increased exposure to distractions. As exposure increases, drivers may become more aware of their own abilities and performance limitations, and, as a result, form more accurate representations of their distracted driving ability.

On the other hand, greater exposure may not

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Abstract: *If drivers acknowledge distraction as a safety risk, why do they continue to engage in distracting activities on the roadway? It may be that people have inaccurate perceptions of their ability to drive while distracted. Studies have shown that drivers are not aware of their distracted driving ability, however, it remains unclear whether their perceptions of this ability change over time as their exposure to distractions increases. This article discusses a study to measure the accuracy of drivers' estimates of distracted driving performance over time. The findings provide initial evidence that drivers' inability to accurately estimate distracted driving performance persists over time.*

lend itself to improved perceptions of distracted driving ability. People may become overconfident in their ability to drive while distracted as their distracted driving performance improves over time (Chisholm, Caird & Lockhart, 2008; Shinar, Tractinsky & Compton, 2005). If drivers' perceptions of distracted driving ability become more inaccurate over time, then they may be more willing to engage in distractions or fail to manage these distractions appropriately while driving (Horrey & Lesch, 2009).

The current study is designed to extend on Horrey, et al.'s (2008) study and measure the accuracy of distracted driving performance estimates over time.

Study Method

Twelve drivers (9 females, 3 males) between the ages of 20 and 24 (*M* = 21 years; *SD* = 1.2) completed four experimental sessions within a 2-week time span. During each session, drivers drove an instrumented 2002 Ford Windstar minivan around a 0.5-mile closed-loop test track and completed several driving tasks with and without distractions.

The driving tasks were lane keeping and speed control. For the lane-keeping task, drivers were instructed to keep the vehicle in the center of the lane and not to exceed the lane edge markings. Cameras and sensors on the van recorded distance to the lane markings and were used to calculate variability in lane keeping.

For the speed-control task, drivers had to adjust their speed in response to five pace clocks positioned around the test track. The bottom half of each pace clock face was green and the top half was red (Photo 1, p. 42). An arrow hand moved around the pace

Photo 1: One of five pace clocks positioned around the test track. The bottom half of each pace clock face was green and the top half was red. An arrow hand moved around the pace clock at a constant rate and drivers were told to pass by the pace clock when the arrow was in the green portion of the clock face.

clock at a constant rate and drivers were told to pass by the pace clock when the arrow was in the green portion of the clock face. Additionally, drivers could not come to a complete stop when approaching a pace clock nor exceed 30 miles per hour. Researchers recorded the percentage of pace clocks that were passed correctly for each drive.

During some sessions, drivers answered math problems presented through speakers behind the driver seat headrest. The purpose of this task was to induce additional cognitive load comparable to that of conventional distractions, and was similar to a math task used by Shinar, et al. (2005), that significantly impaired driving performance. Math problems consisted of a sequence of numbers between 0 and 9 with math operations between each number.

Numbers and operations were presented at a rate of one number or operation every 1.5 seconds. Drivers kept a mental running total as they heard each component of the math problem and said an answer out loud once they heard "equals." The math problems were between three and five numbers in length, and resulted only in positive whole numbers. Math task performance was measured as a percentage of correct answers during a given block.

Each session consisted of three experimental blocks of 10 laps: one block during which drivers performed only the driving tasks (baseline driving condition); one block during which drivers answered math problems with the car in park (baseline math condition); and another block during which drivers performed the tasks concurrently (dual-task condition). After each block, drivers estimated their performance on the tasks they had just completed (i.e., lane keeping, speed control and/or the math task) by placing a tick mark along a continuum ranging between total failure and perfect.

Study Results

Dual-Task Performance Over Time

In general, task performance was expected to be worse in dual-task conditions as compared to baseline conditions. Although the observed trends in driving performance were in the anticipated direction (i.e., more variable lane keeping and more speed errors in dual-task conditions), the differences did not reach conventional levels of statistical significance. Distraction effects were clearly seen, however, in math task performance. Drivers performed significantly worse when answering math problems while driving compared to baseline math task performance.

As in previous studies, distraction effects were expected to decrease over time (Chisholm, et al., 2008; Shinar, et al., 2005). Speed control improved in both dual-task and baseline conditions. Speed control performance improved 7% in the last session compared to the first session. As shown in Figure 1 (a & b), lane keeping and math task performance also improved across sessions and this improvement was greater in the dual-task conditions. Note that lane keeping actually became slightly more variable in the baseline condition from the first to last session (Figure 1a).

Estimated Distraction Effects Over Time

Estimated distraction effects were calculated as the percent difference in subjective performance ratings between the baseline and dual-task conditions. Similarly, actual distraction effects were calculated as the percent difference in objective performance measures. A positive distraction effect indicates poorer performance in the dual-task condition compared to baseline. Estimated distraction effects were evaluated in terms of calibration and accuracy over time. If drivers' estimates of distraction effects were well-calibrated with actual distraction effects, then a strong, positive relationship should be found between estimated and actual distraction effects. Additionally, if exposure improves calibration, then the relationship between estimated and actual distraction effects would be stronger in the last session compared to the first session.

A correlation approach was used to examine the calibration between estimated and actual distraction effects. Estimated distraction effects were positively related to actual distraction effects for math task performance in the first and last sessions, indicating that drivers appeared to be well-calibrated to distraction effects in math task performance in both sessions (Table 1, p. 44). Drivers also appeared to be well-calibrated to their speed control performance in the last session; however, while the strength of the relationship between estimated and actual distraction effects for the speed control task improved between the first and last session, a comparison using Fisher's z' transformations and 95% confidence intervals showed that the difference between the two correlation coefficients was not statistically significant.

In general, drivers were not well-calibrated to their lane-keeping performance. Estimated distraction effects in lane-keeping performance were not strongly related to actual distraction effects in either session. Thus, drivers' estimates of distraction effects corresponded well to actual distraction effects in performance on the math task, but less so for measures of driving performance. Additionally, increased exposure did not significantly improve calibration between estimated and actual distraction effects.

Repeated measures analysis of variance was used to determine the accuracy of estimated distraction effects. If estimated distraction effects were accurate, then they should be similar in magnitude to actual distraction effects. Moreover, if the accuracy of estimates increased with exposure, then the magnitude of estimated and actual distraction effects should be more similar in the last session compared to the first session.

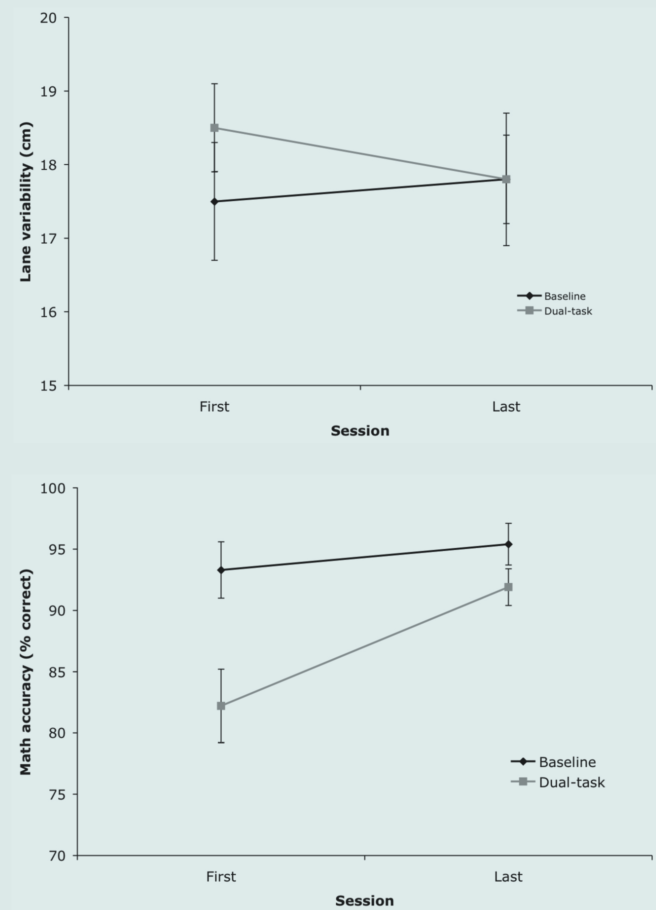
The results suggest that estimated distraction effects in speed control and math task performance were not accurate. That is, estimated distraction effects were significantly different from actual distraction effects. In both tasks, drivers thought they were more impaired in dual-task conditions than was reflected by their actual performance (Figure 2, p. 44). Estimated distraction effects in lane-keeping performance were also larger than actual distraction effects; however, this difference was not statistically reliable.

No significant differences in estimated and actual distraction effects were found across sessions, indicating that accuracy of estimated distraction effects was also unaffected by increased exposure.

Figure 1

Lane Variability & Math Accuracy

a) (top) Lane keeping; b) (bottom) math task performance in baseline and dual-task conditions for the first and last session.



Drivers' estimates of distraction effects corresponded well to actual distraction effects in performance on the math task, but less so for measures of driving performance.

Discussion

This study assessed the effects of exposure on the accuracy of estimated distraction effects in drivers' speed control, lane keeping and math task performance. The results suggest that the accuracy of these estimates did not change significantly from the first session to the last session, a finding which indicates that exposure does not enhance perceptions of distraction effects.

Note that the relationship between drivers' estimated and actual distraction effects varied from the first to last session (Table 1, p. 44); however, the small sample size may have hindered the research team's ability to detect significant changes in calibration. That said, the average differences between estimated and actual distraction effects did not change significantly from the first session to the last session, providing some converging evidence that increased exposure did not enhance estimates of distracted driving ability. Additional research is warranted to continue exploring the accuracy of estimated distraction effects over time.

Drivers' perceptions of their distracted driving performance may not have changed significantly over time because they did not have adequate feedback to calibrate their perceptions to actual performance. External feedback has been shown to be effective in increasing the accuracy of risk perceptions. Donmez, Boyle and Lee (2008) show that drivers' risk perceptions were more aligned with their distracted driving performance when they were provided with external feedback than when they were not provided with any feedback. Perceived driving ability is one factor that determines risk perceptions (Deery, 1999), so external feedback may have provided drivers a method for calibrating their perceptions of driving ability to develop more accurate risk perceptions.

External feedback was not given to drivers in the current study, but drivers could have used feedback incorporated into each driving task to calibrate their performance estimates (e.g., proximity to lane markings, location of arrow hands on pace clocks). Differences in the saliency of feedback built in to each task could have differentially affected the accuracy of drivers' estimates—more salient feedback leading to more accurate estimates.

Feedback inherent to the speed control and math tasks was perceptible and salient (i.e., color in which the pace clock arrow hand was located, difficulty answering math problems). Fittingly, estimated distraction effects in these tasks were positively related to

The relationship between drivers' estimated and actual distraction effects varied from the first to last session.

Table 1

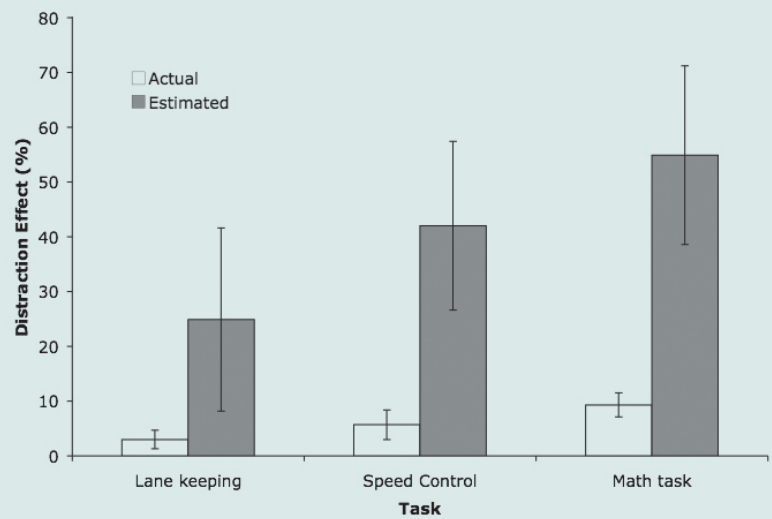
Correlation Between Estimated & Actual Distraction Effects

	Correlation coefficient		
Session	**Lane keeping**	**Speed control**	**Math task**
First	0.40	0.43	0.74
Last	-0.14	0.72	0.87

In both tasks, drivers thought they were more impaired in dual-task conditions than was reflected by their actual performance.

Figure 2

Actual & Estimated Distraction Effects



Interestingly, the adverse effects of dual-task conditions appeared to be borne primarily by the math task rather than the driving tasks. One possible explanation for this finding is that participants may have given higher priority to the driving tasks than to the math task because the math task did not directly serve the driving tasks. Distractions in service of the driving tasks, such as entering a destination into a GPS, demand more of a person's attention (Cnossen, Meijman & Rothengatter, 2004) and may not be as easy to neglect as irrelevant distractions such as answering math problems.

As drivers became more familiar and proficient at performing the speed-control and lane-keeping tasks, they may have devoted more attention to the math task. Average math task performance improved by almost 11% from the first session to the last session in the dual-task condition, which provides some support for this explanation. Regardless, because math tasks are commonly used to simulate the cognitive demand of distractions (Alm & Nilsson, 1995; Shinar, et al., 2005) future research might consider how distraction effects might be influenced by a secondary task's relevance to successful driving performance.

actual distraction effects. Feedback built in to the lane-keeping task was not as conspicuous or salient (i.e., small changes in lane variability). Accordingly, estimated distraction effects in lane keeping performance were not related to actual distraction effects (Horrey, et al., 2008; Lesch & Hancock, 2004). The pattern of findings provides some initial evidence that the saliency of feedback built into a task can influence the accuracy of drivers' performance estimates.

Although feedback may have helped drivers calibrate estimates of distraction effects in the speed control and math tasks, drivers still estimated substantially larger performance decrements than were actually observed (Horrey, et al., 2008). On average, drivers' estimated distraction effects were nearly 5 times larger than actual performance decrements in math task performance and more than 6 times larger than actual decrements observed in speed control. Thus, feedback may help drivers estimate general directions of distraction effects but not the actual magnitude of performance impairment. Future research might explore the effectiveness of feedback as a method of shaping people's estimates of driving ability.

Lastly, as alluded to, the findings are based on a limited sample of the driver population. The 12 participants in this study were young drivers between age 20 and 24. Drivers in this age group commonly engage in more risk-taking behavior than their older counterparts (Jonah, 1986). Because perceptions of driving ability are associated with risk-taking behavior (Deery, 1999), the accuracy of the younger participants' perceived distracted driving ability observed in this study might not be representative of older, risk-averse drivers.

However, some evidence suggests that the young drivers in this study were not prone to excessive risk-taking behavior. First, the tendency to engage in risky driving behavior may not be associated with age, per se, but with a lack of experience that leads inexperienced drivers to place themselves in overly demanding situations (Groeger & Brown, 1989). The young drivers in this study were experienced and should have already developed the skills needed to handle the driving demands in this study.

Second, study participants did not exhibit risky driving behavior when distracted. Lane-keeping and speed-control performance were not significantly affected by the distracting math task. Furthermore, drivers actually seemed to be safety conscious as evidenced by the extent to which they overestimated the effects of distractions on their driving performance. Thus, the findings do not seem biased by excessive risk-taking associated with younger drivers and can inform future studies about perceptions of distracted driving ability in the general driver population.

Conclusions

Distracted drivers are common on today's roadways. Although many people believe that distraction is a threat to safety, they may engage in distracting activities while driving because they believe that they can handle distractions with ease. Research has shown that people's estimated ability to drive while distracted does not reflect their actual performance, but has not shown that perceptions become accurate over time.

The results from this study suggest the following:

1) Drivers' estimates of their distracted driving ability do not become more accurate over time.

2) Feedback may play a role in calibrating people's estimates of their distracted driving ability.

This study represents an initial effort to examine the influence of exposure on estimates of distracted driving ability. Due to time constraints of the fellowship under which the study was conducted, only 12 participants were able to complete all four sessions. As a result, the results have low statistical power and it was difficult to detect changes in drivers' estimates over time. Therefore, the findings should be interpreted with care.

Despite this limitation, the findings highlight the fact that providing feedback about driving performance may be a useful intervention to improve drivers' calibration. Feedback can be provided when people are driving a vehicle (concurrent) or after driving has occurred (retrospective). Both forms of feedback have shown the potential to mitigate the impacts of distractions on driving performance (Donmez, Boyle & Lee, 2007; 2008) and may improve the accuracy of people's perceptions of their distracted driving ability by helping them understand their own abilities and the conditions under which their performance suffers, such as when they engage in distractions.

Companies can provide concurrent feedback through in-vehicle training and evaluation programs or driver monitoring systems. Retrospective feedback can be provided using video-based report cards (McGehee, Raby, Carney, et al., 2007) or regular performance reports. Providing performance feedback is a simple and promising strategy that could help drivers form accurate perceptions of their own driving skills and promote safer driving behavior. ■

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