Effects of a Computer-Based Training Module on Drivers' Willingness to Engage in Distracting Activities

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Objective: This study examines the effect of a computer-based training module on drivers' attitudes and behaviors with respect to in-vehicle distraction. **Background:** Research findings on the negative performance implications of distraction call for the need to mitigate these adverse effects. **Method:** Forty drivers (ages 18 to 20 yrs) were divided into two groups: a training group that completed the module and a control group that viewed an unrelated video. The training promoted enhanced metacognitive skills (e.g., planning, monitoring) and strategies to deal with distraction. Measures of willingness to perform in-vehicle activities while driving (involving the use of short videos) were assessed before and after the intervention. Drivers also performed in-vehicle tasks while driving an instrumented vehicle on a closed test track. **Results:** Following the training, drivers in the training group showed a decline in their ratings of willingness to engage in distracting activities along with a corresponding increase in perceived risk. In contrast, ratings from drivers in the control group did not change on any measures. Drivers in the training group were also more likely to perform in-vehicle tasks while the vehicle was parked compared with the control group—an obvious safety benefit. However, there was no observable benefit of training for drivers who performed the distracting tasks while the vehicle was in motion. **Conclusion:** There may be some promise to such a training approach. The implications for distraction and training are discussed. **Application:** Training general skills in dealing with potentially distracting in-vehicle tasks may help offset some of the negative outcomes associated with their use.

INTRODUCTION

The distracting effects of concurrent in-vehicle tasks on driving performance have been well established. Controlled studies have shown that distracted drivers exhibit degraded driving performance—they have slowed responses and are susceptible to missed traffic information (Alm & Nilsson, 1994; Brookhuis, de Vries, & de Waard, 1991; Horrey & Wickens, 2006; McKnight & McKnight, 1993; Strayer & Johnston, 2001). Epidemiological studies have shown that drivers have increased crash risk while using their cell phone (Laberge-Nadeau et al., 2003; Redelmeier & Tibshirani, 1997), and one naturalistic on-road study estimated that distraction attributable to secondary tasks is implicated in approximately 38% of crashes and 28% of near-misses (Klauer, Dingus, Neale, Sudweeks, & Ramsey, 2006).

Young drivers are an important group for targeted remediation because they tend to be heavy users of new technologies, including those that can be used while driving, such as cell phones, text messaging, and MP3 and music players (Lee, 2007), and they also tend to express greater willingness to perform potentially distracting tasks while driving than middle-aged and older adults (Lerner & Boyd, 2005). Furthermore, young drivers, ages 16 to 24, are more likely to be using their cell phones while driving than older age groups (Glassbrenner, 2005) and are estimated to be 6.5 times more likely to be involved in a motor vehicle crash when using

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a cellular phone than when not using a phone, compared with 3.6 times more likely for drivers ages 40 to 54 (Redelmeier & Tibshirani, 1997).

Distraction Mitigation

Although legislation is often proposed as a means of reducing driver distraction (e.g., Sundeen, 2005), laws are difficult to enforce and effectiveness in reducing crash rates is still unknown. Alternatively, technological innovations aimed at mitigating driver distraction—for example, by monitoring drivers in real time and providing feedback on when they should refocus on the driving task (e.g., Donmez, Boyle, & Lee, 2007)—have shown promise (see also the SAVE-IT [Safety Vehicles Using Adaptive Interface Technology] initiative; e.g., Lee, Hoffman, Bricker, & Sohn, 2007; Smith, Bakowski, Witt, & Zhang, 2008). However, the long-term effectiveness, ease of implementation, and cost in production remain unknown.

Given that for the most part, drivers decide when and under what circumstances they will perform potentially distracting tasks (Lee & Strayer, 2004; Lerner & Boyd, 2005), driver training may complement other mitigation approaches by enhancing drivers' decisions regarding distraction in the shorter term. Prior research indicates that drivers may not be fully aware of the distracting effects of in-vehicle tasks on their own performance (Horrey, Lesch, & Garabet, 2008; Lesch & Hancock, 2004). Perception or awareness of distraction effects may influence drivers' decisions or their willingness to engage in distracting activities while on the road. For example, drivers who are not calibrated with respect to the magnitude of distraction effects may engage in activities because they do not realize their performance or safety is compromised.

Driver training could target and promote adaptive behaviors, for example, strategic decisions to postpone or delay certain in-vehicle activities within a given trip on the basis of awareness of the current demands of the driving tasks, knowledge of upcoming road and traffic conditions, knowledge of the driver's current state, and expected challenges and difficulties in performing additional in-vehicle activities. Earlier research suggests that drivers do not take into account shifting traffic or road demands when deciding to engage in distracting tasks (Horrey & Lesch, 2009; Lerner & Boyd, 2005).

Training Approaches

There are many different approaches to driver training. Insight and error training have focused on tactical and strategic aspects of driving, offering drivers firsthand experience of negative consequences of unsafe behaviors (e.g., collisions in a simulator or loss of control on a closed test track). In general, these and similar approaches have yielded positive results (e.g., Gregersen, 1996; Ivancic & Hesketh, 2000; Senserrick & Swinburne, 2001); however, it is not always cost-effective or possible to train individual drivers on a closed test track or in a driving simulator.

Another training method involves the generation of a concurrent verbal commentary while performing the to-be-learned activity (a verbalization of one's own thought processes; e.g., Ahlum-Heath & Di Vesta, 1986). In the driving context, it is called a *commentary drive* (e.g., McKenna, Horswill, & Alexander, 2006), and it is a well-known training approach used by driver-training providers. Instructors (and accompanying students) in the vehicle observe the commentary and offer feedback to the trainee after the drive concludes. In McKenna et al.'s (2006) study, a group of drivers who viewed videos of commentary drives by a police driving instructor showed enhanced skill in detecting hazards and reduced tolerance to risk compared with a control group that watched the videos but did not hear the commentary. A strong benefit of this approach is that it can be administered via Internet or computer.

Current Study

In the current study, we employed an interactive training module aimed at improving driver decision making with respect to potentially distracting tasks. To increase the robustness of the training, we incorporated different aspects of approaches described earlier. The module included general facts and information about distraction, video demonstrations of distraction involving other drivers (following a guided error approach, e.g., Ivancic & Hesketh, 2000), interactive demonstrations of distraction (opportunity for insight training; e.g., Senserrick & Swinburne, 2001), training in a technique for dealing with distraction (detailed later), and video demonstrations of this technique including commentary drives (e.g., McKenna et al., 2006). Thus, the current approach should capitalize on the benefits of these alternate approaches while employing an easy-to-administer, risk-free computer application.

The training is based on the promotion and development of metacognitive skills and strategies (e.g., planning, monitoring, evaluating; Flavell, 1976; Sternberg, 1998) and emphasizes that drivers should monitor their own performance, look for cues to unusual events or situations, be alert to potential unpredictable events, think about future courses of action, and recognize changes in task demands, among other things. Thus, the focus is on the decision-making process that precedes any potentially distracting situation.

In the study, 40 young drivers (ages 18 to 20) were assigned to either a control or a training group. Measures of willingness to perform in-vehicle activities while driving were assessed before and after the training intervention. Drivers were also asked to perform several in-vehicle tasks while driving in an instrumented vehicle on a closed test track. We hypothesized that compared with the control group, drivers who completed the training module would subsequently rate themselves as less willing to perform distracting activities while driving and would exhibit more adaptive behaviors (make less risky decisions) in performing the in-vehicle tasks while on the test track.

METHOD

Drivers

Forty drivers, ages 18 to 20 years, were recruited through newspaper and online advertisements ($M = 19$ years, $SD = 0.8$). There were 21 males and 19 females. Average driving experience was 28.9 months ($SD = 12.5$) and average annual mileage was 19,600 km ($SD = 16{,}400$). All participants had normal or corrected-to-normal visual acuity. Drivers were paid $20 for each hour of participation and an additional $25 if they completed a follow-up questionnaire that was administered 1 month after their experimental session.

Materials

Video clips. Several short driving videos were created for this study. Video was captured from a position near the driver's eye point, using a Canon Elura™ 20MC digital video camera. Several hours of video were captured while traveling on urban and rural roads and freeways. From this footage, 80 short (8-s) clips were isolated and compressed using a QuickTime™ compression algorithm. This initial set was reduced to 58 clips depicting normal driving conditions (i.e., there were no hazardous or unusual events that occurred). The clips varied in terms of road type and type of traffic. Figure 1 depicts still images from three sample clips. Based on results from a pilot study ($N = 8$), 34 clips that varied in perceived demand were selected for the main study. These clips were divided into two sets (one for preintervention and one for postintervention), balanced by demand ratings.

Instrumented vehicle. A 2002 Ford Windstar minivan, equipped with multiple sensors and computers, was used in the study. In-vehicle tasks were presented on a 26-cm High Bright LCD touch screen (Earth Computer Technologies, Inc.; San Juan Capistrano, CA) mounted near the center console. An interface was programmed to simulate an embedded phone and e-mail system.

Test track. A two-lane 0.8-km closed-loop test track, delineated for continuous driving, was used for the experiment. The track was divided into seven different sections, varying in terms of demands. The relative workload demands of these sections were assessed in previous work (see Horrey & Lesch, 2009, for details). These sections included the following:

(a) Narrow: Several narrow gates (2.4 m wide) were set up using traffic cones. Precise lateral control was required to avoid knocking the cones over (the van was approximately 1.9 m wide).
(b) Pace clocks: Two pace clocks, used in a speed control task, were placed adjacent to the driver's lane. The bottom half of the clock was green and the top half was red. Drivers had to adjust their speed, by accelerating or braking, during the

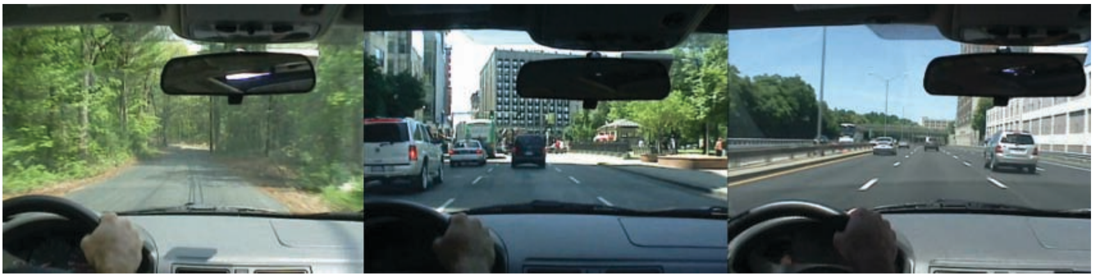

Figure 1. Sample still images from video clips.

approach to the clock to pass it when the arrow hand was in the green half.

(c) Curves: This section involved four turns (radius; $M \approx 19$ m), requiring overt (though not precise) steering.

(d) Traffic light: On a straight section of the track, a traffic light changed from green to yellow to red during the driver's approach. The timing of the light varied randomly from 2.8 to 5.8 s (controlled by on-track sensors and GPS information). Drivers had to make a go or no-go decision (as they would in normal driving conditions).

(e) Turn: This section involved a single turn of relatively constant radius (radius ≈ 20 m).

(f) Straight: This section involved a wide straightaway.

(g) Shoulder: There were several locations where drivers could pull over to the side of the road.

Interventions. The training involved a self-paced computer-based module (programmed in Microsoft PowerPoint™) that took 12 to 14 min to complete. The first part conveyed the negative implications of performing distracting activities while driving. Participants were provided with general statistics and facts regarding different forms of distraction, followed by several demonstrations of distractions using video clips and interactive change blindness demos (see Pringle, Irwin, Kramer, & Atchley, 2001). These latter demos used the flicker technique, wherein the observer tries to detect a changing element in two alternating images that are interrupted by a brief visual disruption (for more details, see Rensink, O'Regan, & Clark, 1997; Simons, 2000). In general, observers often fail to detect the change. With respect to training, subsequent demonstration of the changing element can be a compelling indicator of how easily relevant information can be missed–even when the disruption (or distraction) is very brief.

The second part of the module promoted metacognitive strategies and enhanced situation awareness. Participants were instructed, when faced with possibly distracting activities, to "Assess the situation" (e.g., How difficult are the current driving demands?), "Consider the options" (e.g., Can the other activity wait? Is a safer part of the road upcoming?), and "Take the appropriate action" (described collectively as the ACT technique). This portion was supplemented with several videos of the ACT technique in which a subject matter expert, engaged in a commentary drive, made decisions about distracting tasks in different traffic contexts.

The control group viewed a 13-min video introduction to the research institute. This included basic historical information and did not contain any information specific to driving or related safety behaviors.

Procedure

The experimental procedures and protocol were approved by the Liberty Mutual Research Institute for Safety Institutional Review Board for the ethical treatment of human participants. An overview of the experimental session is shown in Figure 2. Participants were randomly assigned to either the training or control group; however, steps were taken to ensure that the groups were approximately balanced by gender. At the start of the 2.5-hr session, drivers completed an informed consent form and were tested for static visual acuity and color vision (Titmus Vision Tester, Titmus Optical, Inc.; Chester, VA). The stated purpose of the study was "to examine how people performed in-vehicle tasks." The participants completed several questionnaires and scales, including (a) demographic and driving history information, (b) self-rating of various driving-related skills and abilities (from Horswill, Waylen, & Tofield, 2004), (c) ratings of how distracting several in-vehicle tasks are as well as how frequently they perform these activities while driving, and (d) several personality scales, including sensation seeking (Zuckerman, Kolin, Price, & Zoob, 1964), impulsivity (Patton, Stanford, & Barratt, 1995), and cognitive failures (Broadbent, Cooper, Fitzgerald, & Parkes, 1982).

Initial video ratings. Following the completion of the questionnaires, participants viewed 17 different video clips on a 17-inch monitor powered by a 2.2 GHz PC. The order of clips was randomized for each observer. Participants were told to imagine that they were the driver in the video and that they were driving under normal circumstances (i.e., on time). Following each video, drivers rated several factors along an unscaled line or continuum (anchor points shown in parentheses):

- How willing are you to (a) engage in a cell phone conversation, (b) change a CD or song on an MP3 player, (c) look at a paper map on the road at that time? (*I would absolutely not do this task* to *I would be perfectly willing to do this task*)
- How risky do you think performing these activities would be on this road? (*no additional risk beyond my normal driving* to *very likely I would be in an accident*)
- How difficult or demanding was the road? (i.e., How much mental and physical effort would be required to control the vehicle safely?) (*not at all demanding* to *very demanding*)
- In the past, how often have you engaged in these or similar activities while driving on a road like the one in the video? (*I've never performed these activities* to *I always perform these activities*)
- How familiar to you was the road in the video? (i.e., Did you recognize the location?) (*not at all familiar/did not recognize* to *very familiar/easily recognized*)

Training or control intervention. The training group completed the interactive training module, and the control group viewed the introductory video. To provide a more compelling rationale for showing the video, the control group was told that the investigator had to leave briefly to prepare some things for the study.

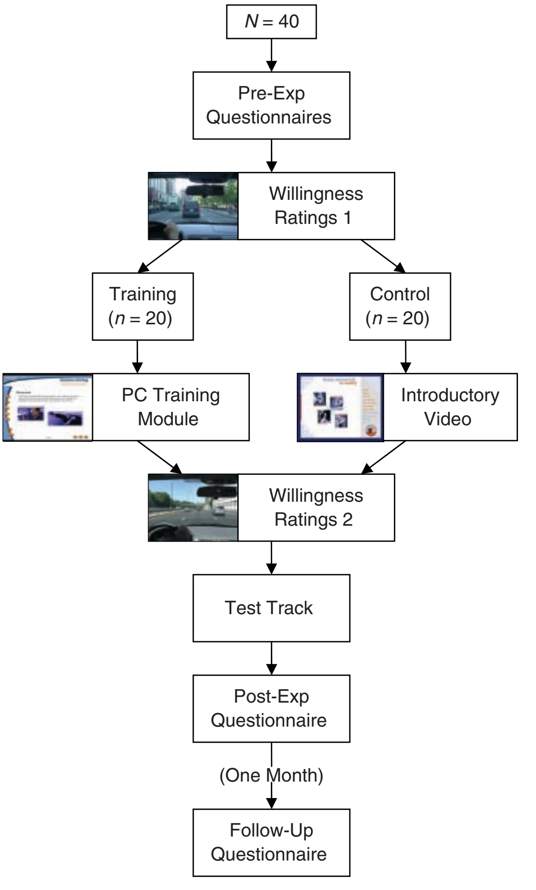

Figure 2. Overview of experimental session. Pre-Exp = preexperimental; Post-Exp = postexperimental.

Follow-up video ratings. Following the completion of the intervention or video, participants viewed and rated a second set of 17 video clips, following the same procedure described earlier. The two sets of videos for the pre- and postintervention were counterbalanced across participants.

In-vehicle tasks. After completing the video ratings, drivers were introduced to the safety features of the instrumented van and given several minutes (three to four laps) of practice to familiarize themselves with the handling of the vehicle and the various driving tasks. More important, the practice allowed drivers to familiarize themselves with the demands associated with each section of track. The experimenter indicated locations where drivers could pull over (i.e., the shoulder). Drivers were free to select their speed; however, they were instructed not to exceed 48 km/h (30 mph).

The experimenter then explained the in-vehicle tasks and demonstrated them for the drivers. Drivers practiced each task twice and were offered further practice if they so desired. Both tasks used the touch screen interface:

(a) Dial phone number: Drivers used the menu to access the phone system and dialed any number from their own memory (including area code).
(b) Read text: Drivers accessed and read a brief e-mail message from a list of 20 messages. Each message was two to four sentences long ($M = 21$ words; 87 characters). Drivers were instructed which e-mail to open first. Subsequent to-be-read messages were identified in the text of the previous message.

Drivers completed two experimental blocks, each lasting several minutes. Within each block, drivers were asked to repeat one of the two in-vehicle tasks three times (e.g., they dialed three different numbers or read three different messages). Following procedures used by Horrey and Lesch (2009), drivers were told that they could perform the tasks "*however* and *whenever*" (words were emphasized) they wanted, provided they finished the tasks before they reached their destination (i.e., after two full laps of the track). The blocks were always initiated at the start of the narrow section of the track, which was the most challenging section. The order of blocks was counterbalanced across drivers.

After the experimental blocks, drivers were asked to rate each section of track on the perceived workload using the NASA-TLX (Task Load Index, Hart & Staveland, 1988), their self-reported comfort in performing in-vehicle activities, and hypothetical driving performance had they been performing an in-vehicle task while driving. Finally, they completed a brief postexperimental questionnaire and were thanked and remunerated for their participation.

One-month follow-up. One month following the experimental session, participants were mailed a follow-up questionnaire and were asked to return the completed form in a prepaid envelope. This questionnaire included some of the material from the preexperimental questionnaires with a few additional questions. Participants were asked whether their driving habits had changed since participating in the experiment, whether they had engaged in more adaptive behaviors when dealing with potentially distracting tasks (e.g., purposely delaying in-vehicle tasks) than before, and whether they thought they were safer and made better decisions than before.

RESULTS

Baseline Group Comparisons

We compared the groups (control and training) on a number of demographic and driving history variables and personality traits gathered at the start of the experiment to ensure that there were no a priori group differences. As shown in Table 1, there were no significant differences along these variables.

Video Ratings of Willingness

Subjective ratings of willingness to perform in-vehicle activities (use cell phone, CD player, or map), past behavior, estimated risk, demands of road section, and familiarity with clips were each aggregated by averaging the ratings across the videos (17 pre- and 17 postintervention). Because the willingness ratings for the three tasks were significantly correlated (r = .52 to .78, $p < .01$), we averaged the ratings to produce a single measure for subsequent analyses. There were no significant associations between subjective ratings of familiarity with the driving scenes and willingness ($r = .08$, $p = .49$) and risk ratings ($r = .10$, $p = .37$). Risk was negatively associated with willingness ($r = –.53$, $p < .01$) and positively associated with demand ($r = .82$, $p < .01$).

The subjective ratings of the video clips were analyzed using 2 (group: control, training) × 2 (time: pre-, postintervention) mixed ANOVAs. As shown in Table 2, there were significant main effects of time for the risk and demand estimates and for the willingness ratings and a significant main effect of group for the willingness ratings. However, all of these results are best interpreted in the context of the significant Time × Group interactions on each dependent measure

TABLE 1: Demographics, Driving History, and Personality Characteristics for the Control and Training Groups

Variable	Control (n = 20)	Training (n = 20)	Comparison
Age (in years)	19.2 (0.2)	18.8 (0.2)	$t(38) = 1.4$, $p = .17$
Driving experience (in months)	29.7 (2.8)	28.1 (2.9)	$t(38) = 0.4$, $p = .68$
Number of accidents	0.85 (0.2)	0.75 (0.3)	$Z(38) = 0.7$, $p = .58$[a]
Number of moving violations	0.30 (0.1)	0.47 (0.3)	$Z(37) = 0.3$, $p = .86$[a]
CFQ	39.9 (2.6)	37.1 (3.6)	$t(38) = 0.6$, $p = .54$
SSS	0.49 (0.05)	0.50 (0.05)	$t(38) = 0.2$, $p = .83$
Impulsivity	61.8 (1.9)	67.3 (2.9)	$t(38) = 1.6$, $p = .12$
Confidence	77.3 (4.5)	84.2 (2.7)	$t(38) = 1.3$, $p = .19$
Distractions	3.0 (0.2)	3.2 (0.2)	$t(38) = 0.6$, $p = .57$

Note. Standard errors appear in parentheses. CFQ = score on Cognitive Failures Questionnaire (Broadbent, et al.,1982); SSS = Sensation Seeking score (Zuckerman et al.,1964); Impulsivity = score on Barrett Impulsivity Scale (Patton et al., 1995); Confidence = score on response to the question, "How confident (comfortable) are you in dealing with distracting tasks (e.g., conversations, adjusting radio) while driving?" (rated along continuum anchored *by incredibly uncomfortable* and *perfectly comfortable*); Distractions = score on response to the question, "How often do you have to deal with distracting tasks while driving?" (5-point Likert-type scale anchored by *never* and *always*).
a. Mann-Whitney test used because data were not normally distributed.

TABLE 2: ANOVA Results for the Subjective Ratings of Willingness, Risk, and Demands

	Willingness			Risk			Demand		
Source	*df*	*MSE*	*F*	*df*	*MSE*	*F*	*df*	*MSE*	*F*
Between subjects									
Group (G)	1	2040.8	4.2*	1	190.8	0.3	1	378.5	0.6
Error	38	491.5		38	649.0		38	591.1	
Within subjects									
Time (T)	1	610.5	16.1**	1	278.1	5.6*	1	522.3	14.0**
T × G	1	587.6	15.5**	1	335.6	6.8**	1	327.0	8.8**
Error	38	37.9		38	49.6		38	37.4	

Note. MSE = [AU: pls provide.]
*$p < .05$. **$p < .01$.

(willingness, risk and demand estimates). As shown in Figure 3a, there were no differences in willingness ratings between the two groups before the intervention, $t(38) = 0.90$, $p = .38$. Following the training intervention, the willingness ratings for the training group declined significantly, $t(19) = 5.1$, $p < .001$; however, there was no such drop in the ratings for the control group, which viewed the video about the research institute, $t(19) = 0.10$, $p = .95$.

Similarly, prior to the intervention, there were no differences between the two groups on subjective estimates of risk, $t(38) = 0.2$, $p = .87$, or demand, $t(38) = 0.1$, $p = .96$. However, as shown in Figure 3, subjective estimates of risk (Figure 3b) and demand (Figure 3c) increased for the training group following the intervention, $t(19) = 3.1$, $p < .01$, and $t(19) = 4.1$, $p < .01$, respectively, but there was no corresponding change in the ratings by the control group on risk, $t(19) = 0.2$, $p = .85$, or demand, $t(19) = 0.7$, $p = .51$.

Test Track Data

As noted previously, we were interested in whether drivers in the training group exhibited more adaptive behaviors (e.g., safer decisions

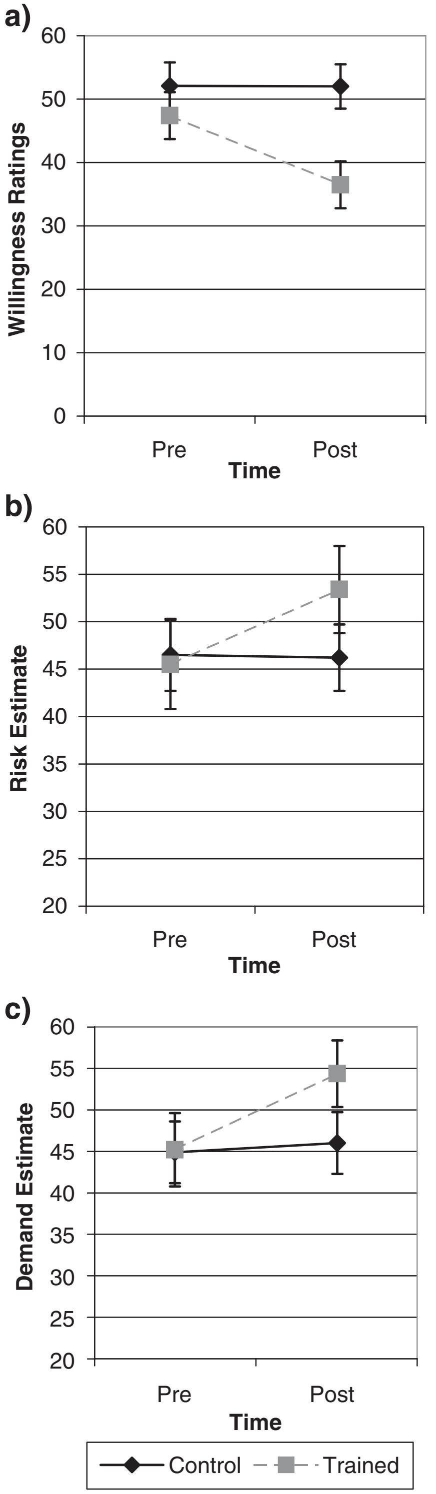

Figure 3. Mean (a) willingness ratings and estimates of (b) risk and (c) demand before and after the intervention for the training and control groups. Standard error bars are shown.

regarding where to initiate the in-vehicle tasks) than did those in the control group when faced with a potentially distracting task. We therefore examined whether the training group drivers were more likely to perform the tasks while the vehicle was stationary. For this, we compared the groups on the likelihood that the driver would perform the in-vehicle task while the vehicle was stopped or while the vehicle was in motion. A chi-square analysis revealed a significant effect of group, $\chi^2(1) = 8.1$, $p < .01$, with drivers in the training group pulling over (stopping) to perform the task more often (for 18% of the tasks) than the control group (6% of the tasks).

In instances where drivers did not pull over, we examined whether drivers in the training group were more likely to postpone the in-vehicle task until road demands were reduced (e.g., waited until the straight section). Given that the trial began at the more difficult road sections, we would expect longer time delays in the training group. However, there were no differences in the time until the driver initiated the first task, $F(1, 32) = 0.1$, $p = .79$, or in the total task time (time to complete all of the in-vehicle tasks), $F(1, 32) = 0.3$, $p = .61$.

Following the experimental blocks, drivers completed a workload assessment of the various sections of track. Analyses did not reveal any significant group differences in the (unweighted) composite estimates of workload, $F(1, 38) = 0.1$, $p = .78$; in drivers' self-reported comfort in performing distracting tasks for each track section, $F(1, 38) = 1.7$, $p = .20$; or in their estimated performance had they been performing an in-vehicle task at the time, $F(1, 38) < .001$, $p = .99$.

In the postexperimental questionnaire, on a scale ranging from 0 (*strongly disagree*) to 100 (*strongly agree*), the training group ($M = 66$, $SD = 21$) reported that they would be less likely to use their cell phone while driving in the future, compared with the control group ($M = 50$, $SD = 28$), $t(38) = 2.0$, $p = .05$.

One-Month Follow-Up Questionnaire

The response rate was 73% for the follow-up questionnaire, approximately balanced by group (control, $n = 15$; training, $n = 14$). Although the two groups did not differ in their estimations of how often they drive, $t(27) = 0.9$, $p = .38$, or how often they dealt with in-vehicle distractions since the experimental sessions, $t(27) = 1.1$, $p = .27$, participants in the training group ($M = 53$, $SD = 11$; scale ranging from 0 = *much less often than before* to 100 = *much more often than before*) rated themselves as more likely to purposely delay performing in-vehicle activities given the current road demands, a result that was marginally significant (control group, $M = 41$, $SD = 19$), $t(27) = 1.8$, $p = .09$. However, there were no significant differences between the groups with respect to their subjective ratings of the quality of their own decision-making ability, $t(27) = 1.0$, $p = .34$; comfort in performing in-vehicle activities, $t(27) = 0.6$, $p = .56$; or overall level of safety, $t(27) = 0.3$, $p = .76$.

DISCUSSION

The purpose of this study was to examine the effect of a computer-based training module on young drivers' willingness to perform and their decision making with respect to in-vehicle distractions. The training module promoted enhanced metacognitive skills for drivers dealing with distraction and advocated strategic adaptation to increased roadway demands. The content was targeted toward a wide range of potentially distracting activities, as opposed to focusing on any one activity (e.g., use of cell phones).

Drivers in the study rated their willingness to perform distracting activities and the associated risks both before and after the experimental treatment. Overall, and consistent with Lerner and Boyd (2005), drivers' ratings of willingness were strongly and negatively associated with estimates of risk. Following the training module, drivers reported themselves as being less willing to perform in-vehicle activities while driving than they were before the training. They also reported that engaging in distracting activities in the driving scenarios would be more likely to result in a crash (i.e., were riskier) and were more demanding. In contrast, the control group's ratings did not change from pre- to postintervention on any of the measures. Thus, it appears as though the training module had a positive effect on these self-reported measures.

To determine whether these benefits would carry over to the actual performance of in-vehicle tasks, both groups were tested in an instrumented van. If drivers in the training group performed distracting tasks while stopped or had a greater tendency to postpone them until they were on less demanding parts of the road, this would be considered a positive outcome of the training. The results were mixed. For the training group, there were more instances in which drivers performed the in-vehicle tasks while the vehicle was stopped (either they performed the tasks before they began the drive or they pulled over after they had driven a certain distance). It should be noted that this behavior (i.e., performing noncritical tasks before leaving or after reaching a destination) was consistent with the material in the training module.

In contrast, we did not see any training advantage in instances in which drivers performed the distracting tasks while the vehicle was in motion—that is, drivers in the training group did not delay task initiation until they reached the easier parts of the track. Why was there no strategic postponement of the in-vehicle tasks for the training group? It is possible that drivers did not feel that the demands of the track sections were sufficient to justify delay of the in-vehicle tasks. Unfortunately, in a closed track environment, it is impossible to replicate real-world traffic and associated risks.

Although the training module was intended to be sufficiently generic to apply to many different road and traffic situations, it is also possible that the track-based analogues for these road types were not as readily apparent as intended. For example, the training module included discussion about the challenges associated with narrow and curvy roads as well as in situations in which timing is critical. We tried to replicate such situations on the track; however, the linkages to the content in the module may not have been compelling.

Although we were not able to observe naturalistic behaviors of drivers following the experimental session, the follow-up questionnaire data suggest that trained drivers may have enjoyed some real-world benefits from the training. An extensive examination of real-world behaviors, for example, through the use of on-board monitoring devices, both before and after a training intervention is merited to see whether there is an impact on actual behaviors with respect to in-vehicle distractions.

Limitations

As noted earlier, the test track was not truly representative of real-world roads, even though the road sections varied in associated demands. As such, decisions made on the track may not represent decisions made in the real world. That said, data gathered in a previous study do suggest, however, that drivers were cognizant of the potential risks associated with the different road types used in the study and that they would be uncomfortable performing in-vehicle tasks in certain track situations (Horrey & Lesch, 2009).

Another issue is that our study lacked a motivational component that usually comes with in-vehicle tasks. For example, drivers usually have a reason for distracting themselves while behind the wheel, whether it be social connectedness via phone conversation or the need to pick up an object from the floor because they are afraid they will forget about it when they reach their destination. Such motivations may be more difficult to overcome compared with more sterile tasks used in a laboratory setting. As mentioned previously, more in situ examinations of driver behavior in conjunction with training or other mitigation approaches is an important step for future research.

We also did not assess retention of the lessons in the training section, primarily in the interest of limiting the amount of time required to complete the lesson. As such, it is not clear whether some of the mixed results found on the test track are attributable to failures in the understanding of the ACT technique, willful ignorance of the lessons, or some other factor. Future research could address these questions along with a decomposition of the different components of the training to determine whether certain parts are more or less effective. Shifting emphasis to different parts of the training might also improve the overall effectiveness.

Another limitation in the current design is the reliance on self-reported data—particularly in the follow-up questionnaire. However, it should be noted that self-reported intentions to perform certain activities (here, willingness to perform is a proxy for behavioral intentions) tend to be linked to actual performance (Ajzen, 1991). Unfortunately, a more comprehensive examination is beyond the scope of the current study. However, future work should incorporate a more extensive exploration, including a thorough assessment of real-world behaviors. Longer-term exploration of real-world behavior would also help offset potential demand characteristics in the training group in the current laboratory session. It should be noted that although we did not attempt to mask the purpose of the training, the connection between the training material and the specific outcome measures was not made explicit.

Although young drivers are cited as being particularly relevant for targeted remediation with respect to distraction, it is expected that other age groups or driver types would also benefit from this sort of training (e.g., older drivers, professional drivers, and drivers with high accident rates). Further research should explore the application of computer-based training modules across different driver groups. In the future, it is possible that this form of training could supplement existing driver training programs as well as complement the application of other approaches aimed at mitigating distraction.

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