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Publications on Distracted Driving

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♦ indicates a project was funded with U.S. DOT funds either directly or through a State DOT using SPR funds.

Distractions Inside the Vehicle

Title:	**Behavioral Aspects of Younger At-Fault Drivers in Fatal Traffic Crashes in Florida**
Source:	Transportation Research Board Annual Meeting 2009 Paper #09-0916
Abstract:	A study of fatal traffic crashes in Florida examined contributing factors among crashes in which younger (under age 25) drivers were found to be at fault. A case-based analysis was used to improve the accuracy and completeness of the data from the original crash reports. Results were presented using over-representation factors (ORB), a simplified but statistically significant approach to frequency distributions. Case studies found that non-human factors were primary contributing causes in only six percent of the crashes in which younger drivers were at fault, but secondary and tertiary contributing factors in up to 25 percent of those crashes. The most common non-human factor was tire blowouts/tread separation. Younger drivers were at fault in 62 percent of the crashes in which they were involved, and they were highly overrepresented in fault in forward impacts with control loss and in left roadside departure crashes. These two crash types generally involved high speeds and abrupt steering input. Common human factors included alcohol use, inattention, and high speed. Approximately one in four younger at-fault drivers was under the influence of alcohol at the time of the fatal crash. No significant differences were noted between younger drivers (above or below the legal drinking age) and older drivers. Younger at-fault drivers were more likely to have had passengers in the vehicle at the time of the crash than older drivers. Most (91 percent) of the young at-fault drivers were in compliance with graduated driver licensing statutes at the time of the fatal crash.
Pagination:	14p
Authors:	Alam, Bhuiyan Monwar; Spainhour, Lisa K
Corporate Authors:	Transportation Research Board
Publication Date:	2009
Index Terms:	Blowouts; Case studies; Death; Fatal accidents; Fatalities; Florida; Graduated licensing; Highway accidents; Juvenile automobile drivers; Public safety; Ran off road accidents; Roadway departure accidents; Running off roadway; Safety; Safety measures; Teenage drivers; Traffic accidents; Traffic fatalities; Young adults
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**Importance of Integrating Driving and Traffic Simulations: Case Study of Impact of Cell Phone Drivers on Traffic Flow**
Source Data:	Transportation Research Board Annual Meeting 2009 Paper #09-0224
Abstract:	This paper argues the case for integrating driving and traffic simulators by explaining the research opportunities and illustrates this through a case study. The different nature of physical driving simulators and mathematical traffic simulations makes the integration between them difficult. Currently, it is impossible to use the output data from experiments using a driving simulator as the inputs for traffic related research without an optimization technique. The benefits of permanent integration could be profound. The design of driving simulation experiments would be more accurate, controlled, and versatile than it is now. Also, the driving environment would be more realistic, since it would come from traffic microsimulation. Traffic simulation would benefit from receiving driver behavior data directly from the driving simulator, which would improve the reliability of driver behavior theories used in the microsimulation software. The case study presents the current state of research practice of using driving simulator results in traffic related research. We relate a case-specific solution to integration, by applying a genetic algorithm optimization technique, between driver and traffic simulations to find the impact of cell phone drivers on traffic flow in congested conditions. The results show that the traffic's level of tolerance toward cell phone drivers decreases with an increase in congestion.
Pagination:	14p
Authors:	Vladisavljevic, Ivana; Cooper, Joel M; Martin, Peter T; Strayer, David L
Corporate Authors:	Transportation Research Board
Publication Date:	2009
Index Terms:	Algorithms; Automobile drivers; Automobile driving; Automobile driving simulators; Behavior; Behaviour; Case studies; Cell phones; Cellular telephones; Driving simulators; Gridlock (Traffic); Human behavior; Mathematical models; Optimisation; Optimization; Traffic congestion; Traffic flow
Subject Areas:	Highways; Safety and Human Factors; Society; I72: Traffic and Transport Planning; I83: Accidents and the Human Factor

Title:	**Difference in Response of Male and Female Drivers to Everyday Distractions**
Source:	Transportation Research Board Annual Meeting 2009 Paper #09-2433
Abstract:	Two experiments using a driving simulation task examined the distracting effects of the most common secondary tasks that young drivers engage in: conversation and listening to music. The first experiment, by the use of experimental confederates engaged the drivers in a naturalistic conversation either over a mobile phone or as a passenger. The distracting consequences of these conditions had different effects for the male and female drivers. Relative to a silent control condition the female drivers appeared to be more distracted when conversing on a mobile phone than did the male drivers, and the male drivers appeared to be more distracted by the conversation with a passenger. The second experiment examined the effect of listening to music, and whether its tempo was important in determining its role as a source of distraction. Young drivers listened to music that had been chosen on the basis of its current popularity that either had a fast or a slow tempo, and drove a programmed route that required both easy and difficult driving maneuvers. Gender influences were again observed in the easy driving environment. Male drivers made more errors listening to slow tempo music, than they did to fast tempo music; whereas the opposite was found for the female drivers. The increased errors made by all drivers in the more difficult driving environment did not reveal any differential effects due to tempo or gender. The results of this study are interpreted in terms of differences in gender susceptibility to optimal mental workloads for driving.
Authors:	Faulks, Ian J; Irwin, Julia Deborah; Chekaluk, Eugene
Corporate Authors:	Transportation Research Board
Publication Date:	2009
Conference:	Transportation Research Board 88th Annual Meeting
Index Terms:	Automobile driving simulators; Design of experiments; Distraction; Driving simulators; Experimentation; Experiments; Gender; Public safety; Response time; Safety; Safety measures; Travel behavior; Young adults; Younger drivers
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**The influence of Driver Distractions on the Likelihood of Rear-End, Angular, and Single-Vehicle Crashes in Missouri**
Source Data:	Transportation Research Board Annual Meeting 2009 Paper #09-3397
Abstract:	Driver distraction has been associated with a higher likelihood of crash involvement. Using crash data from the state of Missouri for the years 2001 to 2006, the highest number of distraction-related crash incidents occurred while using cell phones, having passengers in the car, and operating other electronic devices. A multinomial logit model was used to predict the odds that a driver with a specific type of distraction will be involved in one of the most frequent crash types: rear-end, angular, or single-vehicle collision in comparison to each other. Results of this study showed that distractions can have varying influences on crash type. More specifically, passenger-related and cell phone distractions are more likely in angular crashes, whereas for other electronic device-related distractions the most probable type of crash is a single-vehicle crash. Inferences made in this study should be considered in light of the fact that the data was limited in the number of reported distractions, and was conducted only from one state. Future research comparing similar distraction factors across other states and nationally may provide a broader view on the impact to the type and severity of crashes.
Pagination:	19p
Authors:	Ghazizadeh, Mahtab; Boyle, Linda Ng
Corporate Authors:	Transportation Research Board
Publication Date:	2009
Conference:	Transportation Research Board 88th Annual Meeting
Index Terms:	Accident data; Accident severity; Automobile drivers; Cell phones; Cellular telephones; Distraction; Missouri; Public safety; Rear end collisions; Safety; Safety measures; Single vehicle accidents
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**Do Drivers' Estimates of Distraction Become Calibrated to Their Actual Distracted Driving Performance with Greater Exposure?**
Source:	Transportation Research Board Annual Meeting 2009 Paper #09-3251
Abstract:	Numerous studies have documented the negative effects of distractions on driving performance, but are drivers aware of these effects and do they accurately perceive their distracted driving ability? Previous empirical work suggests that drivers' perceptions are not well-calibrated to actual dual-task decrements; however, these studies only assessed drivers' perceptions during a single session. The current study evaluated how drivers' estimates of distracted driving performance changed with increased exposure relative to their actual performance. Twelve young drivers drove an instrumented van around a closed-loop test track while performing several driving tasks with and without a secondary task over 4 experimental sessions. Driving performance and secondary task performance measures were collected along with drivers' estimates of performance on the various tasks during each session. A significant decrease in the dual-task decrement observed in secondary task with greater exposure was found; however, dual-task decrements in driving performance were not seen in most measures. In general, drivers' estimated dual-task decrements tended to be greater than their actual dual-task decrements, and this was especially true in the stop light task where performance estimates became increasingly inaccurate with greater exposure. The impact of under and overestimating distracted driving ability on driving behavior and safety are discussed along with the possible role of feedback in improving the accuracy of estimates.
Pagination:	14p
Authors:	Kidd, David; Horrey, William J
Corporate Authors:	Transportation Research Board
Publication Date:	2009
Conference:	Transportation Research Board 88th Annual Meeting
Index Terms:	Age; Automobile drivers; Automobile drivers' tests; Behavior; Behaviour; Distraction; Driver tests; Driving; Driving tests; Highway safety; Human behavior; Motor vehicle handling; Multitasking; Perception; Road safety; Self evaluation; Task analysis; Vehicle handling; Vehicle navigation
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**Cognitive Task Complexity and the Impact on Drivers' Visual Tunneling**
Source:	Transportation Research Board Annual Meeting 2009 Paper #09-2953
Abstract:	Cognitive distractions are increasingly impacting drivers and are a leading cause of accidents. Research indicates that drivers alter how they allocate their visual attention while engaging in cognitive secondary tasks. To evaluate the potential impact of cognitive secondary tasks on the allocation of driver's visual attention and driving performance, we presented drivers with increasingly complex forms of an auditory cognitive task while they drove in an instrumented vehicle. Measures of vehicle performance and eye gaze were assessed. Consistent with theories on visual tunneling, drivers' gaze distributions were significantly smaller while performing any version of the secondary task, thereby reducing peripheral vision. During the most difficult level of the secondary task, gaze dispersion was significantly smaller than at any other level of the task. Results indicate that changes in visual attention can provide earlier indications of cognitive distraction than decreased driving performance, which was only observed during the most difficult level of the secondary task. An increase in vertical eye position at the easiest level of the secondary task suggested that drivers compensated for the additional cognitive demands by increasing their sight distance before increases in workload exceeded drivers' abilities. In conclusion, this study indicates that current research efforts are not adequately addressing the impact of incremental increases of cognitive distraction on driver performance. Finally, although current legislative efforts focused on hands-free cellular phone usage may be well intended, it is clear that any on-road communication increases cognitive workload that decreases drivers' peripheral vision and can lead to impacts on safety.
Pagination:	15p
Authors:	Reimer, Bryan
Corporate Authors:	Transportation Research Board
Publication Date:	2009
Conference:	Transportation Research Board 88th Annual Meeting
Index Terms:	Attention; Attention lapses; Automobile drivers; Cell phones; Cellular telephones; Cognition; Distraction; Highway safety; Peripheral vision; Road safety; Visual perception
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	Effect of Wireless Communication and Entertainment Devices on Simulated Driving Performance
Full Text URL:	http://dx.doi.org/10.3141/2069-07
Abstract:	An analysis of the effect of wireless telephone communication using text and voice modalities as well as an Apple iPod on lane keeping, speed, speed variability, lateral speed, and lane position variability was conducted with a driving simulator. Participants (young adult licensed drivers) drove in an unusually curvy simulated driving environment while using wireless devices, controlling an iPod, and participating in conversations and word games. As expected on the basis of previous research, lane-keeping performance was robust for voice communication tasks; however, the text messaging and iPod tasks that required significant manual manipulation of the device resulted in significant decrements in lane-keeping performance. In addition, all wireless communication tasks and the iPod task resulted in significant increases in speed variability throughout the driving scenario. Lateral speed increases occurred for all wireless communication tasks other than the cellular phone conversation as well as the iPod task. Increases in lane position variability were observed for the text messaging conditions. In addition to establishing the dramatic performance decrement caused by text messaging tasks, this experiment suggests that driving performance may be affected by distraction in ways not captured by lane-keeping measures alone and explores potential alternative measures of driving performance that may be useful for identifying and quantifying the effects of distracted driving.
Pagination:	pp 48-54
Authors:	Crisler, Matthew C; Brooks, Johnell O; Ogle, Jennifer H; Guirl, Chris D; Alluri, Priyanka; Dixon, Karen K
ISBN:	9780309113410
Publication Date:	2008
Serial:	Transportation Research Record: Journal of the Transportation Research Board Issue Number: 2069 Publisher: Transportation Research Board ISSN: 0361-1981
Index Terms:	Automobile driving simulators; Bends (Roads); Cell phones; Cellular telephones; Distraction; Drivers; Driving; Driving performance; Driving simulators; Highway curves; Highway safety; iPod (Digital music player); Lane position; Lanekeeping; Motor vehicle handling; Motor vehicle operators; Road curves; Road safety; Short message service; SMS (Short message service); Speed; Speed variability; Text messaging; Texting; Vehicle handling; Vehicle navigation; Wireless communication systems
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**Effects of Simulated Internet Tasks on Driving Performance**
Source Data:	Transportation Research Board Annual Meeting 2007 Paper #07-0204
Abstract:	Twenty subjects were asked to drive a fixed base driving simulator and use a laptop computer to search for information to perform four types of simulated internet tasks in two task conditions, and in three different road conditions. The tasks types included: 1) obtaining weather information, 2) reading headline news, 3) retrieving stock quotes, and 4) obtaining airline flight information. These tasks were performed in two task conditions: 1) driver inputs with the laptop's touch pad, and 2) a simulated voice input method. The road conditions were: 1) open road, 2) car following and 3) car following with fog. The subject's driving performance was measured with and without the tasks to assess the effect of the tasks relative to the baseline driving condition. The results showed that: 1) lane position standard deviation doubled when performing these tasks as compared to when the subjects did not perform the tasks. 2) voice activation reduced lane position standard deviation by about 20%, 3) while using the laptop with touch pad, the mean velocity decreased by about 2 ft/sec as compared to when the voice activation was used, 4) no differences were observed due to task types and road conditions, and 5) the subject effect was found to be significant on all performance measures.
Pagination:	23p
Authors:	Bhise, Vivek D; Ambeti, Yogesh Raju G
Corporate Authors:	Transportation Research Board
Publication Date:	2007
Conference:	Transportation Research Board 86th Annual Meeting
Index Terms:	Automobile driving simulators; Data retrieval; Distraction; Distribution theory; Distributions (Statistics); Driving simulators; Information retrieval; Internet; Probability distribution functions; Speech processing systems; Speech recognition; Statistical distributions; Voice recognition
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**Driving Without a Clue: Evaluation of Driver Simulator Performance During Hands-Free Cell Phone Operation in a Work Zone**
Full Text URL:	http://dx.doi.org/10.3141/2018-02
Abstract:	Crashes continue to be a problem in work zones. Analyses have indicated that rear-end and sideswipe crashes are the most frequent. Investigators have hypothesized that distractions are often the cause of both types of crashes. These distractions will only increase as more drivers attend to other tasks, such as cell phone conversations. To address this issue, virtual worlds that reflect various work zone geometries were developed for an advanced driving simulator. The worlds contained 32 virtual work zones; 38 drivers navigated through these worlds. On one portion of a trip, drivers were asked to respond to a series of short sentences that mimicked a hands-free cell phone conversation. A lead vehicle ahead of the participant driver braked occasionally in the work zone activity area. Braking scenarios involved either the lead vehicle stopping after an advanced clue that traffic ahead would stop or the lead vehicle stopping for no apparent reason, most often after passing a roadside obstacle (potential distraction). Drivers not engaged in a cell phone task were able to reduce their speed earlier in response to a slowing lead vehicle than were drivers engaged in the cell phone task. The drivers not engaged in a cell phone task were also less likely to brake hard and more likely to make a mirror glance when changing lanes. Finally, they scanned almost twice as far to the left and right. Results strongly suggest that cell phone use reduces driver awareness and may increase the likelihood of a crash in work zone activity areas.
Pagination:	pp 9-14
Authors:	Muttart, Jeffrey W; Fisher, Donald L; Knodler Jr, Michael A; Pollatsek, Alexander
Publication Date:	2007
Serial:	Transportation Research Record: Journal of the Transportation Research Board Issue Number: 2018 Publisher: Transportation Research Board ISSN: 0361-1981
Index Terms:	Accident analysis; Automobile driving simulators; Cell phones; Cellular telephones; Deceleration; Distraction; Driving simulators; Hands free cellular telephones; High risk drivers; Rear end collisions; Side collisions; Side impact collisions; Sideswiping accidents; Sideways collisions; Unsafe drivers; Work zone safety
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**Acceptable Distraction? Evaluating the Effects of In-Vehicle Technologies on Driving**
Source:	Transportation Research Board Annual Meeting 2007 Paper #07-0094
Abstract:	The number of new in-vehicle devices is increasing and techniques must be developed to ensure that these devices do not produce unacceptable levels of distraction. Ideally these techniques should be quick and easy to use and applicable early in the design process. One approach is to use the time required to use the device (static time on task) to decide whether a device produces unacceptable levels of distraction (e.g. the 15 second rule). However, this practice makes three critical assumptions: 1) Static time on task predicts time on task while driving; 2) Time on task measured in a hazard-free environment predicts time on task when drivers expect periodic hazards; 3) Time on task predicts perceived distraction, collisions, and driving errors. This study was designed to test these assumptions by comparing two in-vehicle tasks, one relatively safe (radio manipulation) and other relatively dangerous (dialing a hand held cellular phone). Thirty-two participants were tested in a driving simulator. Static time on task underestimated dynamic time on task, though the difference between the radio and cellular tasks were roughly consistent across testing conditions (with the cellular task taking more time). Participants who expected hazards had slightly longer time on task than those that did not, but the effect was only marginal ($p = .09$) and consistent across tasks. Finally, the task with higher static time on task also produced significantly more lane deviations and perceived interference, though the predicted pattern of results did not emerge for collisions and hazard response time.
Pagination:	16p
Authors:	Reed Jones, James; Trick, Lana; Matthews, Michael
Corporate Authors:	Transportation Research Board
Publication Date:	2007
Index Terms:	Cell phones; Cellular telephones; Collisions; Computer simulation; Crashes; Distraction; Driver communications; Driver information systems; Drivers; Driving; Highway communications; Highway safety; In vehicle advisory; In vehicle communications; Motor vehicle handling; Motor vehicle operators; Reaction time; Road safety; Simulation; Time lag; Traffic information systems; Vehicle handling; Vehicle navigation
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**In-Vehicle Glance Duration: Distributions, Tails, and Model of Crash Risk**
Full Text URL:	http://dx.doi.org/10.3141/2018-04
Abstract:	In general, the unsafe conditions that are likely to produce a motor vehicle crash reside not at the mean of a given distribution (in other words, under typical conditions), but rather in the tails of the distribution. For example, an unusually slow response to a traffic obstacle, rather than an average response, may result in a collision. Although that situation means that crashes are the exception and not the norm, it has implications for how safety-critical data are approached and handled. In this current paper, experimental data collected in a driving simulator are used to demonstrate how an analysis of the average glance durations to an in-vehicle display might lead to different conclusions about safety compared with an alternative analysis of the tail end of the distribution. In addition, a model of crash risk based on the distribution of in-vehicle glances is described, as well as several characteristics of the traffic environment.
Pagination:	pp 22-28
Authors:	Horrey, William John; Wickens, Christopher D
ISBN:	9780309104456
Publication Date:	2007
Serial:	Transportation Research Record: Journal of the Transportation Research Board Issue Number: 2018 Publisher: Transportation Research Board ISSN: 0361-1981
Index Terms:	ADIS; Advanced driver information systems; Attention lapses; Automobile driving simulators; Distraction; Distribution theory; Distributions (Statistics); Drivers; Driving simulators; Eye fixations; Eye movements; Glance duration; Mathematical models; Mean (Statistics); Motor vehicle operators; Probability distribution functions; Risk analysis; Statistical distributions
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**Impact of Presence of Passengers on Freeway Crash Potential**
Source:	Transportation Research Board Annual Meeting 2007 Paper #07-0589
Abstract:	This study examines the impact of passengers on driver's crash potential on freeways. To estimate the impact, a set of bivariate probit models were developed using the 5-year (1999-2003) crash records on a 36.3-mile stretch of Interstate-4 freeway (I-4) in Orlando, Florida. Bivariate probit models identify the correlation between potentially inter-related choices of three passenger characteristics and three crash characteristics. The analysis using bivariate probit models showed that there exist strong correlations between passenger and crash characteristics. It was found that drivers generally display safer driving behavior when they are accompanied by passengers, and more number of passengers reduces driver's crash potential. It was also found that young driver's crash potential increases with the presence of a young passenger only. In addition, the analysis of crash type using traffic flow parameters at the time of crashes showed that young drivers with young passengers only are more likely to be involved in single-vehicle crashes in high-speed and low-volume conditions. The findings in this study provide insight into how the presence of passengers has an impact on driver behavior and traffic safety in various conditions.
Pagination:	18p
Authors:	Lee, Chris; Abdel-Aty, Mohamed A
Corporate Authors:	Transportation Research Board
Publication Date:	2007
Conference:	Transportation Research Board 86th Annual Meeting
Index Terms:	Age; Behavior; Behaviour; Collisions; Crashes; Distraction; Driving; Human behavior; Logit models; Logits; Mathematical models; Motor vehicle handling; Passengers; Probit models; Probits; Risk assessment; Vehicle handling; Vehicle navigation; Vulnerability assessment
Subject Areas:	Highways; Passenger Transportation; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**Young Driver Preferences and Experimental Investigation of Audio and Visual Interface Designs for In-Vehicle Information Systems**
Source:	Transportation Research Board Annual Meeting 2007 Paper #07-0190
Abstract:	Of all the in-vehicle information systems (IVISs) available, Collision Avoidance Warning Systems (CAWSs) and in-vehicle Route Guidance Systems (RGSs) are particularly helpful and attractive to drivers, enabling them to reach their destinations with greater ease and safety. As these two advanced systems become popular, it is important to design system user interfaces that do not distract the drivers and threatening their safety. This study used focus groups to investigate drivers concerns and preferences regarding CAWS and RGS audio and visual interface designs. Four types of IVIS devices were included: beep sounds, voice messages, a heads-up display (HUD) and a liquid crystal display (LCD). A driving simulation experiment was conducted to determine the best HUD location. Focus group discussions suggest that the CAWS interface should have an audio message combining beep sounds and a voice message indicating the direction of danger (e.g., beep-beep-right), or provide beeps and display the direction of danger on a HUD. Considering gender, road event and road type factors, data analysis reveals that the best HUD location is positioned at column -5 degrees and row -5 degrees.
Pagination:	18p
Authors:	Chen, Wan-Hui; Lee, Szu-Wei; Kao, Kui-Chuan; Chiou, Jeng-Min
Corporate Authors:	Transportation Research Board
Publication Date:	2007
Conference:	Transportation Research Board 86th Annual Meeting
Index Terms:	Advanced driver information systems; Automotive sensors; Collision avoidance systems; Collisions; Computer aided routing system; Crashes; Driver communications; Driver information systems; Dynamic route guidance; Guidance computers; Highway communications; In vehicle advisory; In vehicle communications; In vehicle route guidance; In vehicle sensors; Juvenile automobile drivers; LCDs; Liquid crystal displays; Navigation computers; Navigation systems; Navigational computers; Route guidance; Teenage drivers; Traffic information systems; Warning devices; Young adults
Subject Areas:	Highways; Operations and Traffic Management; Planning and Forecasting; Vehicles and Equipment; I72: Traffic and Transport Planning

Title:	**Eyeglance Behavior of Novice Teen and Experienced Adult Drivers**
Full Text URL:	http://dx.doi.org/10.3141/1980-10
Abstract:	Eyeglance behavior and scanning patterns may be learned as a driver gains experience and lead to greater situation awareness on the part of the driver. This may help to explain differences observed in the safety records of novice teen and experienced adult drivers. For example, new drivers may focus almost exclusively on the road ahead and spend little time scanning the vehicle's mirrors. However, a novice driver performing a secondary task may spend more time with his or her eyes on the task than on the road, because of unfamiliarity with the vehicle or in-experience with consequences of long glances away from the forward view. For this study, 18 novice teen (under 17.5 years old and within 4 weeks of licensure) and 18 experienced adult drivers performed a set of in-vehicle tasks on a test track. A baseline driving segment was also included. Measures consisted of percentage of eyes-off-road (EOR) time, number of glances, and mean single-glance time. Results showed that teens glanced at the rearview mirror significantly fewer times than did adults, both during baseline driving and while performing in- vehicle tasks. Teens also had a significantly higher percentage of EOR time than adults had while performing a challenging reading task. The novice teen drivers spent more of their overall EOR time looking at the task display (e.g., cell phone), whereas adults used some EOR time to check mirrors or windows. Overall findings indicate that novice teens may lack the situation awareness of experienced adults.
Pagination:	pp 57-64
Authors:	Lee, Suzanne E; Olsen, Erik C B; Simons-Morton, Bruce G
ISBN:	0309099900
Publication Date:	2006
Serial:	Transportation Research Record: Journal of the Transportation Research Board Issue Number: 1980 Publisher: Transportation Research Board ISSN: 0361-1981
Index Terms:	Adults; Attention lapses; Driver experience; Drivers; Eye location; Eye movements; Glance duration; Human subject testing; In-vehicle tasks; Juvenile automobile drivers; Mirrors; Motor vehicle operators; Novices; Public safety; Rearview mirrors; Safety; Safety measures; Teenage drivers; Test tracks
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**Effects of Adaptive Cruise Control and Alert Modality on Driver Performance**
Full Text URL:	http://dx.doi.org/10.3141/1980-09
Abstract:	Adaptive cruise control (ACC) is a rapidly emerging in-vehicle technology that can enhance or degrade driving safety. A critical factor governing the safety benefit of ACC concerns the driver's ability to assume control of the vehicle in situations that exceed ACC capabilities. The effectiveness of various warning modalities for reengaging distracted drivers during severe braking situations that exceed ACC capability was examined. Warnings that paired a visual icon with sound, seat vibration, or brake pulsation or that combined all three cues were compared. A total of 60 participants drove for 35 min in the National Advanced Driving Simulator. Drivers experienced two severe, four moderate, and eight mild braking situations. ACC could accommodate all but the two severe situations without driver intervention. It also provided a substantial benefit during mild events of lead vehicle braking, enabling drivers to maintain a longer, more consistent minimum time to collision. Unlike performance in previous studies, ACC did not decrease safety during severe braking situations. The combination of a visual icon with sound, seat vibration, or brake pulsation led to slower brake reaction time in severe braking situations, but the grouping of all four warning strategies led to a similar minimum time to collision and maximum braking. In contrast to several previous studies, these results suggest that drivers can effectively assume control when warned that ACC braking authority has been exceeded. Additional research is needed to identify the boundary conditions that specify when drivers can successfully intervene and retake control and whether a multimodal combination of cues can be crafted to speed rather than slow driver response.
Pagination:	pp 49-56
Authors:	Lee, John D; McGehee, Daniel V; Brown, Timothy L; Marshall, Dawn
ISBN:	0309099900
Publication Date:	2006
Serial:	Transportation Research Record: Journal of the Transportation Research Board Issue Number: 1980 Publisher: Transportation Research Board ISSN: 0361-1981
Index Terms:	Adaptive cruise control; AICC; Audible warning devices in vehicles; Autonomous intelligent cruise control; Braking; Distraction; Drivers; In vehicle warning systems; In-vehicle alerting systems; In-vehicle icons; Intelligent cruise control; Motor vehicle operators; National Advanced Driving Simulator; Reaction time; Seat vibration
Subject Areas:	Highways; Safety and Human Factors; Vehicles and Equipment; I83: Accidents and the Human Factor; I91: Vehicle Design and Safety

Title:	**Effects of Cognitive Distraction on Driving Behavior During Lane Change Course**
Source:	Transportation Research Board Annual Meeting 2006 Paper #06-1385
Abstract:	This study develops a procedure for quantitatively estimating cognitive distraction without involving any visual diversions in order to examine the impact of non-visual distractions on driving. Both laboratory and track experiments are conducted. In the laboratory experiment, the mental capacities (measured in bits/sec) for three arithmetic tasks are estimated for each subject using the functional relation between the reaction time and the number of alternatives in choice reaction tasks through a subsidiary task method. The spare capacities are found to correlate significantly with the measures of speed control and physiological load during a lane change negotiation on a test track. Eighteen subjects participated in a two-part experiment. Laboratory experiment results show that the reaction time and the amounts of information are positively correlated, implying that the arithmetic tasks increase the subject's mental capacities. In the track experiment, it is observed that the arithmetic tasks significantly affect lateral acceleration, speed before entering the lane change area, reaction time, and accuracy. There is a marked gender difference in lateral acceleration, speed before entering the lane change area, speed during lane change, speed of leaving the lane change area, and reaction time. A significant difference in the speed before entering the lane change area, speed during lane change, speed of leaving the lane change area, and accuracy is found among different age groups.
Pagination:	14p
Authors:	Woo, Hugh; Ho, Shih-Ming; Tseng, I-Shien
Corporate Authors:	Transportation Research Board
Publication Date:	2006
Conference:	Transportation Research Board 85th Annual Meeting
Index Terms:	Auditory perception; Distraction; Driving; Hearing; Lane changing; Motor vehicle handling; Reaction time; Testing; Trials (Testing); Vehicle handling; Vehicle navigation
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**How Multitasking Interacts with Visual Impairment and Age on Measures of Driving Performance**
Full Text URL:	http://dx.doi.org/10.3141/1980-11
Abstract:	This study investigates the impact of visual and auditory secondary tasks on the driving performance of participants (14 younger and 14 older) with simulated visual impairment. Participants drove around a closed road circuit under single- and dual-task conditions. Driving performance measures included road sign recognition, detection and avoidance of low-contrast hazards, gap judgment, and time to complete the course. Driving with two levels of visual impairment was compared against a baseline condition: goggles designed to replicate the effects of cataracts or blur (uncorrected refractive error visual impairment were used to simulate), and goggles were used to reduce binocular visual acuity to a mean level of 20/40. Secondary tasks required participants to add orally pairs of numbers presented through a computer speaker (auditorily) or via a dashboard-mounted monitor (visually). Results indicate that visual impairment significantly reduces driving performance ($P < 0.05$) and the differences are greatest under the cataract condition. Multitasking (e.g., talking on a cell phone or using in-vehicle navigational devices) further exacerbated these effects, and the visual dual task had a greater detrimental effect on driving performance than did the auditory dual task ($P < 0.05$), particularly for the older drivers. Overall, results indicate that multitasking impairs driving performance and the effects are exacerbated for older drivers and younger drivers with visual impairment. This finding has important implications as driving and in-vehicle environments become increasingly complex and older people comprise the fastest-growing segment of the driving population.
Pagination:	pp 65-69
Authors:	Wood, Joanne Mary; Chaparro, Alex; Carberry, Trent Patrick; Hickson, Louise
ISBN:	0309099900
Publication Date:	2006
Serial:	Transportation Research Record: Journal of the Transportation Research Board Issue Number: 1980 Publisher: Transportation Research Board ISSN: 0361-1981
Index Terms:	Aged drivers; Cataracts; Cell phones; Cellular telephones; Driver performance; Driving; Elderly drivers; In-vehicle navigation devices; Motor vehicle handling; Multitasking; People with visual disabilities; Vehicle handling; Vehicle navigation; Visually impaired persons
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**Assessing Driver Distraction from Cell Phone Use: A Simulator-Based Study**
Full Text URL:	http://dx.doi.org/10.3141/1980-14
Abstract:	The relative driving performance of 37 drivers was compared in a controlled laboratory environment to assess how cell phone use affects driver performance on urban arterials and local roads. The stimulus consisted of answering a call on a hand-held cell phone and engaging in a scripted conversation with study researchers. A driving simulator replicated various typical real-world driving environments and roadway situations. Subjects drove a control scenario (baseline condition) and a test scenario in which they were asked to answer a set of questions using a hand-held cell phone while driving. The subjects were required to navigate various conditions, such as respond to traffic signs and signals, negotiate vehicular traffic when turning, and yield to unexpected pedestrians and bicyclists. Driver performance was assessed for overall driver performance scores, speed profiles, vehicular lateral placement within travel lanes, and number of crashes that occurred during the simulator experiment. Changes in measures between control and test scenarios were subjected to a series of statistical tests. Analysis results indicated that when cell phones were used while driving, subject performance scores were significantly lower, average speeds significantly slower, and proportions of improper lateral placement observed significantly higher. In addition, twice as many crashes (also statistically significant) were observed when subjects used cell phones while driving as were observed under the control condition. In this controlled laboratory experiment, the distraction caused by answering a call and engaging in a conversation on a hand-held cell phone significantly degraded driving performance.
Pagination:	pp 87-94
Authors:	Schattler, Kerrie L; Pellerito Jr, Joseph; McAvoy, Deborah S; Datta, Tapan K
ISBN:	0309099900
Publication Date:	2006
Serial:	Transportation Research Record: Journal of the Transportation Research Board Issue Number: 1980 Publisher: Transportation Research Board ISSN: 0361-1981
Index Terms:	Automobile driving simulators; Cell phones; Cellular telephones; Collisions; Crashes; Distraction; Driver performance; Driving; Driving simulators; Lateral placement; Mathematical statistics; Motor vehicle handling; Speed; Statistical analysis; Statistical methods; Vehicle handling; Vehicle navigation
Subject Areas:	Data and Information Technology; Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**Effects of Interface Workload of In-Vehicle Information Systems on Driving Safety**
Full Text URL:	http://dx.doi.org/10.3141/1937-11
Abstract:	Driver distraction and lack of awareness of the driving situation are major causes of accidents in the urban areas in Taiwan; failing to obey traffic signals is the third leading accident cause. Numerous innovative in-vehicle information systems (IVIS) could be used collectively to provide drivers with a variety of information, such as messages from intersection collision warning systems (ICWS) by way of different in-vehicle interfaces. How the different IVIS interfaces influence driver workload and safety is always an important issue. This study investigates the effects of auditory ICWS messages on driver performance while the driver's visual, hearing, or mental processing attention resources (or all three) are engaged by secondary tasks. This type of engagement or distraction commonly occurs when a driver uses IVIS. The secondary tasks used to distract drivers were created by different types of mathematical questions presented with different types of display devices (e.g., voice from a speaker or numbers shown on a liquid crystal display screen or head-up display). Mixed linear models were employed to examine the factors influencing driver perception–reaction time with the consideration of repeated measures. Several factors, including several main factors and an interaction, were found to be significant. The most important finding was that the interaction between provision of ICWS information and the display format indicated that an auditory warning message could increase driver perception–reaction time while a driver was distracted by an auditory task. In addition, it was found that driver distraction due to different mental processing tasks had a significant impact on driver perception–reaction time.
Pagination:	pp 73-78
Authors:	Chen, Wan-Hui; Lin, Chih-Yung; Doong, Ji-Liang
ISBN:	0309094119
Publication Date:	2005
Serial:	Transportation Research Record: Journal of the Transportation Research Board Issue Number: 1937 Publisher: Transportation Research Board ISSN: 0361-1981
Index Terms:	ADIS; Advanced driver information systems; Auditory messages; Auditory warnings; China (Republic : 1949-); Collision avoidance systems; Distraction; Driver vehicle interfaces; Formosa; Mental workload; Perception; Reaction time; Secondary tasks; Taiwan; Traffic safety
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**Vehicle Occupancy and Crash Risk**
Full Text URL:	http://dx.doi.org/10.3141/1908-23
Abstract:	This study explores the association between vehicle occupancy and a driver's risk of causing a fatal crash, not wearing a seat belt, and using alcohol. The survey population is the set of drivers represented in the Fatal Analysis Reporting System for 1992 to 2002. The independent variables are driver age, driver gender, passenger age, passenger gender, and vehicle occupancy. The outcome variables are whether the driver was at fault in causing the fatal crash, whether the driver wore a seat belt, and whether the driver had used alcohol. For male teenage drivers, driving with teenage passengers correlated with an increased risk of causing a crash. For all female drivers and for male drivers over age 40, passenger presence correlated with a reduced risk of causing a fatal crash. Drivers ages 15 to 30 were less likely to wear a seat belt when passengers were present than when driving solo. Drivers age 50 and older had higher rates of seat belt use when passengers were present. This protective effect of passengers was stronger for male drivers than female drivers, and for male drivers the effect increased by age. Drivers ages 15 to 34 accompanied by passengers were more likely to have consumed alcohol than solo drivers of the same age group. These results offer an interesting perspective for research in the area of driver distraction, and they update current knowledge on older drivers and the role of seat belt and alcohol awareness.
Pagination:	pp 187-194
Authors:	Geyer, Judy A; Ragland, David R
ISBN:	0309093805
Publication Date:	2005
Serial:	Transportation Research Record: Journal of the Transportation Research Board Issue Number: 1908 Publisher: Transportation Research Board ISSN: 0361-1981
Index Terms:	Age; Aged drivers; Crash risk; Death; Distraction; Drinking drivers; Drunk drivers; Elderly drivers; Fatal accidents; Fatalities; Fatality Analysis Reporting System; Gender; Juvenile automobile drivers; Passengers; Seat belts; Teenage drivers; Traffic fatalities; Vehicle occupancy
Subject Areas:	Highways; Passenger Transportation; Safety and Human Factors; Society; I83: Accidents and the Human Factor

Title:	**Effects of Passenger and Cellular Phone Conversations on Driver Distraction**
Record URL:	http://dx.doi.org/10.3141/1899-15
Abstract:	The distracting effects of a simulated conversation with passengers and those of a conversation over a hands-free cellular phone were compared. The conversation was also analyzed to determine if passengers modulated their conversations as driving demands changed. Eighty participants were randomly assigned to one of three conditions: driving alone, driving with a passenger, and driving with a cellular phone. Drivers drove through residential and urban traffic environments in a fixed-based driving simulator in which a variety of events occurred, such as pedestrian activity, oncoming vehicles, and intersections. The results indicated that lane and speed maintenance were influenced by increased driving demands. Response times to a pedestrian incursion increased when the driver was driving and talking compared with those detected when the driver was not talking at all. Contrary to what some researchers have assumed, there was little practical evidence that passengers adjusted their conversations to changes in the traffic environment. The workload was rated higher when the driver was driving and talking and was also rated higher by drivers than by nondrivers. The discussion focuses on future research and implications for driver safety and training.
Pagination:	p. 109-116
Authors:	Laberge, J; Scialfa, C; White, C; Caird, J
Features:	Figures (2) ; References (21)
Corporate Authors:	Transportation Research Board
ISBN:	0309094917
Publication Date:	2004
Serial:	Transportation Research Record Issue Number: 1899 Publisher: Transportation Research Board ISSN: 0361-1981
Index Terms:	Automatic steering control; Automobile driving simulators; Behind the wheel instruction; Cell phones; Cellular telephones; Distraction; Driver training; Drivers; Driving simulators; Lateral control; Lateral guidance; Motor vehicle operators; Passengers; Reaction time; Speed maintenance; Steer by wire; Traffic safety; Workload
Subject Areas:	Highways; Passenger Transportation; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**Effects of a Controlled Auditory-Verbal Distraction Task on Older Driver Vehicle Control**
Full Text URL:	http://dx.doi.org/10.3141/1865-01
Abstract:	Engaging in conversation diverts attention from cognitive processes associated with driving. Drivers tend to commit errors that may lead to crashes when their attention is focused away from the driving task. The interference occurs at the level of central attentional processes that are especially susceptible to aging. The current study assessed the effects of a controlled auditory-verbal processing load induced by the Paced Auditory Serial Addition Task (PASAT) on vehicle control by 160 legally licensed older drivers. Of these drivers, 78 were neurologically normal (mean age of 71 years) and 82 (mean age of 75 years) had impairments of selective attention but no diagnosable neurological disease. Measurements aboard the instrumented vehicle Automobile for Research in Ergonomics and Safety showed that performing the PASAT reduced speed and steering control of the older drivers relative to baseline (no-task) driving conditions and was associated with greater counts of at-fault safety errors. Yet, driving performance did not differ significantly between neurologically normal and attention-impaired older drivers between PASAT and no-PASAT (baseline) conditions. It may be that the PASAT, which involves auditory-verbal and working-memory, sustained-attention, and executive-function components, commands different resources than driving on uneventful highways, which might rely on overlearned, automatic cognitive processes. Interference produced by PASAT, like that of cell phone operation, might become more evident during demanding driving conditions, as exist at busy traffic intersections. Relevant studies in these potentially unsafe circumstances can be conducted in a driving simulator, as in our ongoing research on older drivers.
Pagination:	p. 1-6
Authors:	Rizzo, M; Stierman, L; Skaar, N; Dawson, J D; Anderson, S W; Vecera, S P
Corporate Authors:	Transportation Research Board
ISBN:	0309094585
Publication Date:	2004
Serial:	Transportation Research Record Issue Number: 1865 Publisher: Transportation Research Board ISSN: 0361-1981
Index Terms:	Aged drivers; Attention; Cornering; Curve negotiation; Distraction; Driving; Elderly drivers; Errors; Instrumented vehicles; Motor vehicle handling; Speed; Steering; Test vehicles; Vehicle handling; Vehicle navigation
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**Driver Distraction: Evaluation with Event Detection Paradigm**
Full Text URL:	http://dx.doi.org/10.3141/1843-01
Abstract:	The effects of eight in-vehicle tasks on driver distraction were measured in a large, moving-base driving simulator. Forty-eight adults, ranging in age from 35 to 66, and 15 teenagers participated in the simulated drive. Hand-held and hands-free versions of phone dialing, voicemail retrieval, and incoming calls represented six of the eight tasks. Manual radio tuning and climate control adjustment were also included to allow comparison with tasks that have traditionally been present in vehicles. During the drive the participants were asked to respond to sudden movements in surrounding traffic. The drivers ability to detect these sudden movements or events changed with the nature of the in-vehicle tasks that were being performed. Driving performance measures such as lane violations and heading error were also computed. The performance of the adult group was compared with the performance of the teenage drivers. Compared with the adults, the teens were found to choose unsafe following distances, have poor vehicle control skills, and be more prone to distraction from hand-held phone tasks.
Pagination:	p. 1-9
Authors:	Greenberg, J; Tijerina, L; Curry, R; Artz, B; Cathey, L; Kochhar, D; Kozak, K; Blommer, M; Grant, P
Corporate Authors:	Transportation Research Board
ISBN:	0309085772
Publication Date:	2003
Serial:	Transportation Research Record Issue Number: 1843 Publisher: Transportation Research Board ISSN: 0361-1981
Index Terms:	Adults; Automobile driving simulators; Cell phones; Cellular telephones; Distraction; Drivers; Driving simulators; High risk drivers; In vehicle controls adjustment; In vehicle tasks; Juvenile automobile drivers; Motor vehicle operators; Performance; Teenage drivers; Unsafe drivers
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**Measuring Divided-Attention Capability of Young and Older Drivers**
Full Text URL:	http://dx.doi.org/10.3141/1779-06
Abstract:	A divided-attention task was used to measure the ability of young and older drivers to obtain information from an in-vehicle display. Performance with the in-vehicle display was compared with performance with information superimposed on the driving scene. Ten young and 10 older drivers drove on a curvy road by using a fixed-based driving simulator. Older drivers were less accurate in obtaining information from the in-vehicle display, the average lane-position error of older drivers was greater, and older drivers spent more time driving outside their lanes. These results suggest that the use of in-vehicle displays, in their present configuration, is not appropriate for older drivers. When viewing information superimposed on the driving scene, older drivers were much more accurate and controlled their vehicles better. This indicates that the poor performance of older drivers with the in-vehicle display was due to vision-related changes, such as longer eye accommodation times, rather than cognitive processes.
Pagination:	p. 40-45
Authors:	Mourant, R R; Tsai, F-J; Al-Shihabi, T; Jaeger, B K
Corporate Authors:	Transportation Research Board
ISBN:	0309072379
Publication Date:	2001
Serial:	Transportation Research Record Issue Number: 1779 Publisher: Transportation Research Board ISSN: 0361-1981
Index Terms:	Aged drivers; Attention; Automobile driving simulators; Distraction; Driving simulators; Elderly drivers; In-vehicle displays; Instrument displays; Juvenile automobile drivers; Lane position; Superimposed displays; Teenage drivers; Vision; Young adults
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**Cellular Telephone Conversation While Driving: Effects on Driver Reaction Time and Subjective Mental Workload**
Full Text URL:	http://dx.doi.org/10.3141/1724-01
Abstract:	The effects of conversation through a cellular telephone while driving on driver reaction time and subjective mental workload (SMWL) were investigated. Two vehicles equipped with measurement devices were used to measure reaction time. The drivers' SMWL was measured by the National Aeronautics and Space Administration Task Load Index procedure. The experiment was conducted on an expressway in Japan. Thirty-one subjects participated in the experiment; 19 were young and 12 were elderly drivers. Each subject was asked to follow a leading vehicle and to keep a constant distance while following. The subjects performed four tasks: (a) following a leading vehicle, (b) operating a cellular telephone while following the leading vehicle, (c) performing a simple conversation task, and (d) performing a complex conversation task on a cellular telephone with the experimenter while following the leading vehicle. The results of these experiments indicated that the performance of the telephone tasks increases the reaction time and SMWL of the drivers, as was shown in a previous study. The results also indicated that the complex conversation task produced an increase in reaction time as compared to the simple conversation task, independent of age group. Furthermore, the experiment indicated that the SMWL also increased significantly in the complex conversation task as compared to the other tasks.
Pagination:	p. 1-6
Authors:	Tokunaga, RA; Hagiwara, T; Kagaya, S; Onodera, Y
Corporate Authors:	Transportation Research Board
ISBN:	0309067278
Publication Date:	2000
Serial:	Transportation Research Record Issue Number: 1724 Publisher: Transportation Research Board ISSN: 0361-1981
Index Terms:	Aged drivers; Cell phones; Cellular telephones; Driving; Elderly drivers; Express highways; Expressways; Japan; Limited access highways; Motor vehicle handling; Reaction time; Subjective mental workload; Task load index; Vehicle handling; Vehicle navigation; Young adults
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**Driving and Using Mobile Phones: Impacts on Road Accidents**
Full Text URL:	http://dx.doi.org/10.3141/1694-04
Abstract:	Despite multidimensional efforts to improve road traffic safety in Kuwait, traffic violations and road accidents have increased steadily in recent years. Official statistics, although incomplete, indicate that the rates of road accident and accident fatalities in Kuwait are three to four times those in the United States. It is argued that the rapidly growing use of mobile phones by drivers has added a new dimension to the complexity of the driving task and further contributes to the deterioration of road safety, particularly in undisciplined driving environments like Kuwait's. A random sample of 2,000 drivers was surveyed. Data on socioeconomic traits and on mobile phone availability, frequency of use, and contribution to road accidents were obtained. Seventy-three percent of the sample drivers owned a mobile phone, has owned it for nearly 2.5 years, and had made 1.4 calls during an average daily trip. An average individual in the sample had been involved in 0.4 road accidents since acquiring a mobile phone; 0.21 accidents occurred while he or she or the other driver(s) was using a mobile phone. It is strongly recommended that driver mobile-phone use be banned while the driver's vehicle is in motion.
Pagination:	p. 27-33
Authors:	Koushki, P A Ali, S Y; Al-Saleh, O I
Corporate Authors:	Transportation Research Board
ISBN:	0309071216
Publication Date:	1999
Serial:	Transportation Research Record Issue Number: 1694 Publisher: Transportation Research Board ISSN: 0361-1981
Index Terms:	Accident frequency; Accident rates; Data acquisition; Data collection; Death; Driving; Fatal accidents; Fatalities; Impact studies; Kuwait; Mobile telephones; Motor vehicle handling; Recommendations; Surveys; Traffic fatalities; Traffic safety; Vehicle handling; Vehicle navigation
Subject Areas:	Highways; Research; I83: Accidents and the Human Factor

Distractions Outside the Vehicle

Title: **Effect of Auditory Road Safety Alerts on Brake Response Times of Younger and Older Male Drivers: A Simulator Study**

Full Text URL: http://dx.doi.org/10.3141/2069-06

Abstract: In-vehicle technology is increasingly being implemented to assist drivers. These technologies could improve driver safety or, conversely, introduce distractions that reduce safety. The purpose of this study was to evaluate the effectiveness of a newly developed, commercially available road safety device (Otto Driving Companion, Persen Technologies Inc.) that provides drivers with auditory alerts based on position and velocity data acquired via the Global Positioning System. Auditory alarms warn of situations such as speeding, crosswalks, and red light cameras. To study emergency braking situations, simulated driving was used (STISIM Driving Simulator). Younger male drivers (30 to 50 years old, n = 16) and older male drivers (70+, n = 14) participated in two sessions. In the first session, they were tested for underlying driving abilities, and they practiced driving on the simulator. In the second session, they were refamiliarized with the simulator and then drove two blocks of 10 trials, with and without auditory alerts. Braking events in each trial were either expected (e.g., person crossing at a crosswalk) or unexpected (e.g., person jaywalking). The presentation of auditory alerts resulted in faster brake response times with expected events for both groups ($p < .01$), and they resulted in even faster response times for the older subjects for unexpected events ($p < .05$). The auditory alerts also reduced the proportion of events with crashes for the older subjects (from 25.3 ± 21.7% to 10.8 ± 11.9%, $p < .05$). In conclusion, this simulator study demonstrated that there may be road safety benefits associated with auditory alerts.

Pagination: pp 41-47

Authors: Porter, Michelle M; Irani, Pourang; Mondor, Todd A

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Serial: Transportation Research Record: Journal of the Transportation Research Board
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Index Terms: Aged drivers; Audible warning devices in vehicles; Automobile driving simulators; Braking; Crosswalks; Distraction; Drivers; Driving simulators; Elderly drivers; Global Positioning System; GPS; Highway safety; Males; Men; Motor vehicle operators; Overspeed; Pedestrian crossings; Reaction time; Road safety; Speeding

Subject Areas: Highways; Safety and Human Factors; Vehicles and Equipment; I83: Accidents and the Human Factor; I91: Vehicle Design and Safety

Title:	**Changeable Message Sign Displays During Non-Incident, Non-Roadwork Periods♦**
Full Text URL:	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_383.pdf
Abstract:	This synthesis examines the use of Changeable Message Signs (CMSs) to display types of messages other than real-time messages for non-recurrent, environmental, special event traffic, and other special problems, as well as AMBER alerts, during non-incident/non-roadwork periods as an alternative to leaving the CMS blank. Guidelines for design and display of CMS messages for incidents and roadwork are available; however, guidelines are not available for non-incidents/non-roadwork periods. This synthesis provides that state of the practice as a first step toward developing guidelines. This report is about the state of the practice as it involves state departments of transportation (DOTs) and toll road, turnpike, and parkway transportation agencies. The primary intent was to identify practices that have proven effective, as well as those that have not. It intends to offer guidance in making more effective uses of CMSs for non-incident/non-roadwork periods. It appears that a division of opinion may still exist among traffic management centers (TMCs) that do not have the capability or need to display travel time information about whether or not it is best to leave the CMS blank during non-roadwork/non-incident periods or to display messages. TMCs reported that some motorists prefer messages, some do not. Objective data are needed to assist TMCs in their decisions. The information presented here is based on an extensive literature review and a nationwide survey of state DOT TMCs and of agencies that operate toll roads.
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Authors:	Dudek, Conrad L
ISBN:	9780309098137
Publication Date:	2008
Serial:	NCHRP Synthesis of Highway Practice Issue Number: 383 Publisher: Transportation Research Board ISSN: 0547-5570
Index Terms:	AMBER Alert; Changeable message signs; Dynamic message signs; Guidelines; Literature reviews; Literature surveys; Messages (Communications); Special events; State departments of transportation; State of the practice; Surveys; Toll operating authorities; Traffic control centers; Traffic management centers; Traffic operations centers; Variable message signs
Subject Areas:	Highways; Operations and Traffic Management; Society; Terminals and Facilities; I73: Traffic Control

Title:	**Analysis of Fatal Run-Off-the-Road Crashes Involving Overcorrection**
Full Text URL:	http://dx.doi.org/10.3141/2069-01
Abstract:	In an attempt to identify characteristics that have a strong positive association with overcorrection, data on 579 fatal run-off-the-road (ROR) crashes on state roadways in Florida were analyzed with logistic regression techniques. To overcome shortcomings of traditional analysis methods relying primarily on crash reports, this study relied on case reviews using a broad variety of resources from various disciplines. The data set in this study represents a significant enhancement in accuracy and completeness over that in the initial crash reports; overcorrection was identified using traffic homicide investigation reports. A full model involving 23 explanatory variables was developed, and backward stepwise regression was conducted to identify the most predictive variables. Overcorrection cases were strongly associated with alcohol, inattention, high speed, and fatigue and sleeping. Outcomes ranged from roadway departure in the opposite direction, to vehicle impact on returning to the roadway. The study indicated that females were approximately 40% more likely to overcorrect in a fatal ROR crash than males were, with the greatest disparity occurring among middle-aged drivers. Further, while fewer than 20% of fatal ROR crashes occurred where rumble strips were present, drivers were more than 50% more likely to overcorrect than when they were not present. On high-speed (70 mph) roadways with rumble strips, there was almost an 80% higher risk of overcorrection in the crash. Thus, while it appears that rumble strips are effective in preventing many ROR crashes, the contribution of auditory and vibratory sensations of rumble strips to panic oversteering should also be investigated.
Pagination:	pp 1-8
Authors:	Spainhour, Lisa K; Mishra, Abhishek
ISBN:	9780309113410
Publication Date:	2008
Serial:	Transportation Research Record: Journal of the Transportation Research Board Issue Number: 2069 Publisher: Transportation Research Board ISSN: 0361-1981
Index Terms:	Attention lapses; Case studies; Death; Driving under the influence; Driving while intoxicated; Drunk driving; DUI; DWI; Falling asleep at the wheel; Fatal accidents; Fatalities; Fatigue (Biology); Fatigue (Physiological condition); Florida; Gender; Highway safety; Logistic regression analysis; Overspeed; Oversteer; Ran off road accidents; Risk assessment; Road safety; Roadway departure accidents; Rumble strips; Running off roadway; Speeding; Traffic fatalities; Vulnerability assessment
Subject Areas:	Highways; Safety and Human Factors; I82: Accidents and Transport Infrastructure; I83: Accidents and the Human Factor

Title:	**The Less-Than-Perfect Driver: A Model of Collision-Inclusive Car-Following Behavior**
Full Text URL:	http://dx.doi.org/10.3141/2088-14
Abstract:	Unlike traditional car-following models that preclude vehicle collisions, a proposed model aims to emulate less-than-perfect everyday driving while capturing both safe and unsafe driver behavior. Most important, a realistic perception–response process is incorporated into the model on the basis of developments from visual perception studies. Driver inattention is characterized by a driver-specific variable called the scanning interval. This variable, when coupled with the driver's visual perception–response process, results in variable reaction times that are dependent not only on each driver's individual characteristics but also on instantaneous traffic conditions such as speed and density. This allows closer emulation of real-life human driving and its interactions with surrounding vehicles. Both inter- and intradriver variations in reaction time are captured in a plausible and coherent manner; in earlier studies, reaction time either was presumed fixed or was of limited variability. Furthermore, parameters of this model have a direct physical and behavioral meaning; this implies that vehicle collisions, if any, can be analyzed for behavioral patterns rather than simply being treated as numerical artifacts. In all, 54 detailed and accurate vehicle trajectories extracted from 10 real-life crashes were used to test the model's capability of replicating freeway rear-end collisions. High-resolution crash-free trajectory data were used to validate the model against normal driving behavior. Test results indicate that the proposed model is able to replicate both normal and unsafe driving behavior that could lead to vehicle collisions. The feasibility of integrating the proposed model with existing microsimulators is discussed. The outcome of this work could facilitate studying crash mechanisms at a high-definition microscopic level and could enable safety-related system design improvements and evaluation through microsimulation software.
Pagination:	pp 126-137
Authors:	Xin, Wuping; Hourdos, John; Michalopoulos, Panos G; Davis, Gary A
ISBN:	9780309126038
Publication Date:	2008
Serial:	Transportation Research Record: Journal of the Transportation Research Board Issue Number: 2088 Publisher: Transportation Research Board ISSN: 0361-1981
Index Terms:	Attention lapses; Behavior; Behaviour; Car following; Collisions; Crashes; Drivers; Following distance; Human behavior; Microsimulation; Motor vehicle operators; Reaction time; Rear end collisions; Traffic flow; Traffic simulation; Vehicle spacing; Vehicle trajectories
Subject Areas:	Highways; Operations and Traffic Management; Safety and Human Factors; I71: Traffic Theory; I83: Accidents and the Human Factor

Title:	**Empirical Evaluation of Diverse Threat Assessment Algorithms for Intersection Collision Warning**
Source:	Transportation Research Board Annual Meeting 2007 Paper #07-2292
Abstract:	Thousands of crashes occur at intersections every year, and many of these collisions result in injuries or fatalities. Among these intersection crashes, those that occur in a Straight Crossing Path (SCP) configuration represent a sizable portion and tend to be of substantial severity. These SCP crashes are typically due to an unintentional violation by a driver. In these collisions, distraction is typically present as a causal factor. Potential countermeasures to mitigate these crashes could be aided by the development of robust warning activation algorithms that detect these potential violations in sufficient time to warn the violating driver and avert the violation and potential crash. This investigation tested several previously proposed Forward Collision Warning algorithms, along with some novel options, for use in an Intersection Collision Warning application. Simulations of the algorithms, driven by the available empirical datasets of normal and distracted intersection approaches, were created and run. Two dependent performance measures were used: 1) algorithm accuracy in appropriately identifying violation and no-violation approaches, and 2) indication of the timeliness of the warning, based on the average required constant deceleration after alarm onset. Results indicated that nuisance, missed, and late alarms are quite possible in this warning application but can be reduced by careful adjustment of algorithm warning thresholds. In addition, several of the algorithms tested performed very well during the simulations and should be considered in future development and evaluation efforts for intersection collision warning systems.
Pagination:	19p
Authors:	Perez, Miguel A; Doerzaph, Zachary R; Neale, Vicki
Corporate Authors:	Transportation Research Board
Publication Date:	2007
Index Terms:	Algorithms; Collision avoidance systems; Cross roads; Distraction; Driver errors; Highway safety; Intersections; Junctions (Traffic); Kinematics; Mathematical models; Road safety; Warning systems
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	Guidance for Implementation of the AASHTO Strategic Highway Safety Plan. Volume 14: A Guide for Reducing Crashes Involving Drowsy and Distracted Drivers♦
Full Text URL:	http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_500v14.pdf
Abstract:	The goal of the AASHTO Strategic Highway Safety Plan is to reduce annual highway fatalities to 1.0 fatality per 100 million vehicle miles of travel. This goal can be achieved through the widespread application of low-cost, proven countermeasures that reduce the number of crashes on the nation's highways. This fourteenth volume of NCHRP Report 500, "Guidance for Implementation of the AASHTO Strategic Highway Safety Plan," provides strategies that can be employed to reduce the number of crashes involving drowsy and distracted drivers. The report will be of particular interest to safety practitioners with responsibility for implementing programs to reduce injuries and fatalities on the highway system.
Pagination:	110p
Authors:	Stutts, Jane; Knipling, Ronald R; Pfefer, Ronald; Neuman, Timothy R; Slack, Kevin L; Hardy, Kelly K
Publication Date:	2005
Serial:	NCHRP Report Issue Number: 500 Publisher: Transportation Research Board ISSN: 0077-5614
Index Terms:	Countermeasures; Death; Distraction; Drowsiness; Fatal accidents; Fatalities; Goals; Guidelines; Highway accidents; Highway safety; Implementation; Injuries; Injury; Objectives; Priorities; Road safety; Strategic planning; Strategies; Traffic accidents; Traffic fatalities; Trauma
Subject Areas:	Highways; Research; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**Impact of Video Advertising on Driver Fixation Patterns**
Full Text URL:	http://dx.doi.org/10.3141/1899-10
Abstract:	To assess driver distraction because of video advertising signs, eye fixation data were collected from subjects who passed four video advertising signs, three at downtown intersections and one on an urban expressway. On average, drivers glanced at the signs on 45% of the occasions on which the signs were present. When drivers looked, they made 1.9 glances, on average, with an average duration per glance of 0.48 s. The distribution of eye fixations on intersection approaches where video signs were visible was compared with that on approaches on which video signs were not visible. No significant differences were found in the number of glances made at traffic signals or street signs. On the video approach, a greater proportion of glances were made at the speedometer and rearview mirrors. Glances were made at short headways and occasionally in unsafe circumstances. In the downtown area, glances at static commercial signs were made at larger angles and at shorter headways than was the case for video signs. A comparison of the results with those of other studies showed that video signs were less likely to be looked at than traffic signs (about half the time versus virtually every time, respectively) and that individual average glance durations and total durations were similar to those found for traffic signs in rural environments. These results apply to particular video signs in particular environments. Another on-road study indicates that a video sign on a curve that is close to the line of sight and visible for an extensive period is particularly distracting.
Pagination:	p. 76-83
Authors:	Smiley, A; Smahel, T; Eizenman, M
Corporate Authors:	Transportation Research Board
ISBN:	0309094917
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Serial:	Transportation Research Record Issue Number: 1899 Publisher: Transportation Research Board ISSN: 0361-1981
Index Terms:	Advertising; Central business districts; City centers; Data acquisition; Data collection; Distraction; Downtowns; Drivers; Eye fixations; Glance duration; Motor vehicle operators; Traffic safety
Subject Areas:	Highways; Operations and Traffic Management; Safety and Human Factors; I73: Traffic Control; I83: Accidents and the Human Factor

Title:	**Observed Driver Glance Behavior at Roadside Advertising Signs**
Full Text URL:	http://dx.doi.org/10.3141/1899-13
Abstract:	Express routes in North America are becoming more crowded, both in traffic density and in visual clutter. Higher demand for driver attention is a possible concern for regulators. Advertising signs add to this demand on visual attention. This study focused on the glance behavior of 25 drivers at various advertising signs along an expressway in Toronto, Ontario, Canada. The average duration of the glances for the subjects was 0.57 s [standard deviation (SD) = 0.41], and in total there was an average of 35.6 glances per subject (SD = 26.4). Active signs that contained movable displays or components made up 51% of the signs and received significantly more glances (69% of all glances and 78% of long glances). The number of glances was significantly lower for passive signs (0.64 glances per subject per sign) than for active signs (greater than 1.31 glances per subject per sign). The number of long glances was also greater for active signs than for passive signs. Sign placement in the visual field may be critical to a sign being noticed or not. Empirical information is provided to assist regulatory agencies in setting policy on commercial signing.
Pagination:	p. 96-103
Authors:	Beijer, D; Smiley, A; Eizenman, M
Corporate Authors:	Transportation Research Board
ISBN:	0309094917
Publication Date:	2004
Serial:	Transportation Research Record Issue Number: 1899 Publisher: Transportation Research Board ISSN: 0361-1981
Index Terms:	Attention; Billboards; Distraction; Drivers; Field studies; Glance behavior; Government policy; Motor vehicle operators; Outdoor advertising; Policies; Policy; Regulatory policy; Roadside advertising; Signing; Signs; Toronto (Canada)
Subject Areas:	Highways; Operations and Traffic Management; Policy; Safety and Human Factors; I73: Traffic Control; I83: Accidents and the Human Factor

Title:	**Viewing Ground-Mounted Diagrammatic Guide Signs Before Entrance Ramps at Night: Driver Eye Scanning Behavior**
Full Text URL:	http://dx.doi.org/10.3141/1843-08
Abstract:	The driver eye scanning study is part of a larger study conducted for the Ohio Department of Transportation to evaluate the effectiveness of ground-mounted diagrammatic guide signs placed before entrance ramps at highway freeway interchanges. This nighttime study investigated driver eye scanning behavior while approaching ground-mounted diagrammatic guide signs placed before entrance ramps. Six highway-freeway interchanges were selected in the Greater Columbus, Ohio, area for placement of the diagrammatic signs in the field. Subjects were six unfamiliar drivers, between the ages of 22 to 42. Two diagrammatic signs were located at each of the six interchanges, .5 mi (805 m) and .25 mi (402 m) before the last point of the gore, where a driver can still gain access to the correct freeway entrance ramp. Driver eye scanning behavior measurements were recorded at night to determine if the presence of the diagrammatic signs elicited an excessive number of eye fixations or was visually distracting to the drivers or both. The results indicate that the diagrammatic signs are not looked at excessively often or excessively long. The average look numbers and average look duration times indicate a normal and reasonable level of information acquisition processing employed by the drivers. These values agree with those previously obtained for regular traffic signing determined in previous eye scanning studies. Ground-mounted diagrammatic signs on multilane arterials in advance of highway freeway interchanges were not demonstrated to unduly distract drivers and detrimentally affect a driver's looking behavior.
Pagination:	p. 61-69
Authors:	Zwahlen, H T; Russ, A; Schnell, T
Corporate Authors:	Transportation Research Board
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Serial:	Transportation Research Record Issue Number: 1843 Publisher: Transportation Research Board ISSN: 0361-1981
Index Terms:	Drivers; Entrance ramps; Eye fixations; Eye movements; Ground-mounted diagrammatic guide signs; Guide signs; Interchanges; Motor vehicle operators; Night; On ramps
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor

Title:	**Effect of Warning Timing on Collision Avoiding Behavior in a Stationary Lead Vehicle Scenario**
Full Text URL:	http://dx.doi.org/10.3141/1803-01
Abstract:	Warning timing and how drivers with and without forward collision warning (FCW) systems react when distracted at the moment a stationary vehicle is revealed directly ahead were investigated. The study was conducted using the Iowa Driving Simulator (IDS). The IDS was equipped with an FCW system that provided auditory warnings based on two warning criteria. A total of 30 subjects were split across three conditions--a baseline of 10 subjects (no warning display), and two warning conditions (early and late) with 10 subjects each. The two warning conditions differed by the duration of an a priori driver reaction component (1.5 and 1.0 s) in the warning algorithm. Drivers' collision avoidance performance in the two warning conditions was compared with that in the baseline condition. Results indicated that the early warning condition showed significantly shorter accelerator release reaction times, fewer crashes, and less severe crashes than both the baseline condition and the late warning condition. The results indicate that the timing of a warning is important in the design of collision warning systems.
Pagination:	p. 1-7
Authors:	McGehee, D V; Brown, T L; Lee, J D; Wilson, T B
Corporate Authors:	Transportation Research Board
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Index Terms:	Algorithms; Audible warning devices in vehicles; Automobile driving simulators; Collision avoidance systems; Driving simulators; Human subject testing; Reaction time; Warning timing
Subject Areas:	Highways; Safety and Human Factors; I83: Accidents and the Human Factor