from Research to Reality

Driver Safety

In-Vehicle Distractions

LIBERTY MUTUAL RESEARCH INSTITUTE FOR SAFETY

SCIENTIFIC UPDATE

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Distracted Driving

Do In-Vehicle Glances Impact Driver Safety?

In 2012, distracted driving killed 3,328 people in the U.S. and injured 421,000 more.[1] Researchers at the Liberty Mutual Research Institute for Safety conducted a study to better understand how momentary visual disruptions — a quick look at a cell phone or navigation screen, for example — affect hazard anticipation and potential crash risk.

Initial findings show that in-vehicle glances as brief as two seconds can have a serious effect on a driver's ability to notice an upcoming hazard. And drivers are typically unaware of the extent of this impaired ability to react safely.

Study @ a Glance

Study: **In-vehicle glances while driving are known to increase crash risk, but the mechanisms behind this increased risk remain relatively unexplored. We examined what happens to a driver's ability to detect and monitor oncoming hazards during visual disruptions.**

Methods: **Fifty-six participants navigated various hazardous scenarios on a driving simulator. Researchers measured glance duration and eye movements during four experimental conditions involving visual disruptions.**

Findings: **The results demonstrated that drivers who performed a secondary task (involving visual interruption) while driving showed lower hazard identification skills than drivers who were not interrupted. What's more, even though their hazard identification performance was worse, drivers in the visual interruption conditions were not necessarily aware of it.**

Implications: **In-vehicle glances while driving can compromise one's ability to identify and respond to oncoming hazards. Drivers who use in-vehicle technologies, such as cell phones, GPS, etc., should adapt their practices to help reduce crash risk.**

[1]National Highway Traffic Safety Administration, Report No. NHTSA-2010-005.

The Issue:

A vehicle going 70 mph will travel about 200 feet — more than half the length of a football field — during a two-second glance at a GPS, a phone or any other in-vehicle device. While this illustration may convince even the most dedicated multitaskers to stay focused on the road while driving, findings from a recent Liberty Mutual Research Institute for Safety (LMRIS) study show that the effects of momentary in-vehicle glances may extend beyond the few seconds when the eyes are off the road.

"Current National Highway Traffic Safety Administration (NHTSA) recommendations[2] suggest that in-vehicle glances be restricted to two seconds or less (per single glance); however, our research showed that there is a period of readjustment that occurs after the eyes have returned to the road. In other words, the driver's attention or awareness is disrupted for more than those few seconds of the in-vehicle glance itself," explains Avinoam Borowsky, Ph.D., LMRIS postdoctoral research fellow and the study's principal investigator. "We decided to take a closer look at this readjustment period and examine what happens to drivers' ability to identify an emerging hazard when they are confronted with different types of in-vehicle interruptions."

The Study:

LMRIS teamed up with Dr. Borowsky and his colleagues at the University of Massachusetts Amherst to explore the effects of in-vehicle distractions on drivers' detection and monitoring of road hazards. "We wanted to observe what happens when the ongoing processing of road information is disrupted by different types of short interruptions," explains LMRIS scientist William Horrey, Ph.D., co-investigator on the study.

> "We were especially interested in situations where the drivers observed an emerging hazard prior to the visual interruption. We wanted to see whether they remembered to look for that hazard again, once their attention returned to the road."

To do this, researchers recruited 56 experienced drivers and observed them as they navigated various hazardous scenarios in the Research Institute's state-of-the-art, fixed-base driving simulator. Each driver completed a total of 20 two-minute driving scenario trials (12 "hazard" and eight "no-hazard" trials) as researchers monitored eye movements and driving performance.

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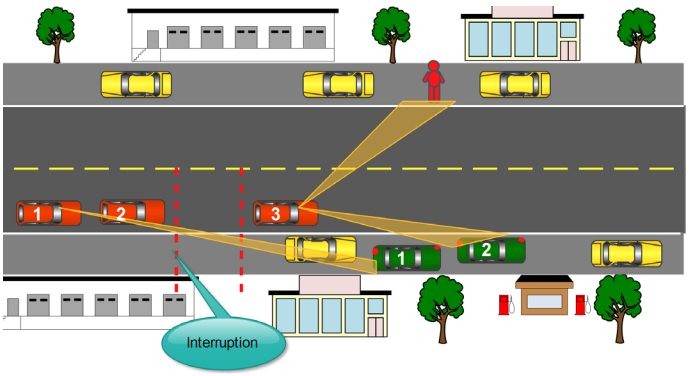
[2]NHTSA (2012). Visual-manual NHTSA driver distraction guidelines for in-vehicle electronic devices (pp. 1-117).

Figure 1

1. The driver is on a commercial road and sees a parked car on the right with its brake lights on.
2. The parked car starts to move forward from its parking spot (cue), which makes it obscured by the car parked behind it. >>Interruption>>
3. The driver passes the car with the brake lights activated and should glance to the right to make sure it does not pull out (expected hazard).



In the 12 hazard scenarios, drivers were presented with a visual cue (a nonmoving road sign, a moving vehicle or a pedestrian), which indicated the presence of an upcoming hazard, followed by the corresponding hazard in the roadway (Figure 1). For some of the drivers, following the appearance of the visual cue, the image of the roadway was replaced with a two-second interruption. The various types of interruptions were a spatial task, a nonspatial task and a simple gray screen with no associated task.

At the end of each interruption, the forward view of the roadway reappeared. Other drivers encountered the same hazard scenarios, but without any visual interruptions.

"We were especially interested in situations where the drivers observed an emerging hazard prior to the visual interruption. We wanted to see whether they remembered to look for that hazard again, once their attention returned to the road," explains Dr. Horrey. "And, since people process and store spatial and nonspatial information differently, we wanted to examine whether the different task conditions yielded different outcomes."

Following the experimental driving tasks, participants completed a questionnaire designed to explore their perceived levels of workload and performance while engaged in these task sets.

The Findings:

The study results, presented at the 2014 Annual Meeting of the Human Factors and Ergonomics Society in Chicago, indicated that drivers who performed a secondary visual task while driving — regardless of the type of task — demonstrated lower hazard identification skills than did those who experienced no visual interruption.

When drivers engaged in the secondary visual tasks, they were less likely to remember to scan for hazards after completing the task — even when they had been aware of an emerging hazard prior to the task. Researchers note that current guidelines do not consider the impairments that occur when memory is disrupted by a secondary in-vehicle task and further speculate that in-vehicle glances even shorter than two seconds may impair a driver's recall of an upcoming threat.

> We need to find ways to illustrate to drivers just how much in-vehicle distractions can impair their driving performance.

The study also found that drivers rated their own driving performance high (70% out of a possible 100%), even under the different task conditions. Consistent with past LMRIS research, this finding suggests that drivers are typically not aware of the extent of the detrimental impact of secondary tasks on their driving performance.

"The fact that drivers consistently missed critical information but were unaware of having missed it suggests that they would be likely to continue unsafe behaviors," says Horrey. "We need to find ways to illustrate to drivers just how much in-vehicle distractions can impair their driving performance," Horrey notes, citing the use of driver simulations as one possible strategy.

A researcher observes an experienced driver as he navigates a driving scenario in the LMRIS state-of-the-art fixed-base driving simulator.

Relevant Publications:

Borowsky, A., Horrey, W.J., Liang, Y., Garabet, A., Simmons, L. and Fisher, D.L. The effects of momentary visual disruption on hazard anticipation and awareness in driving. *Traffic Injury Prevention*, (3), 1-7, 2014.

Horrey, W.J. Assessing the effects of in-vehicle tasks on driving performance. *Ergonomics in Design*, 19(4), 4-7, 2011.

Liang, Y., Lee, J. and Yekhshatyan, L. How dangerous is looking away from the road? Algorithms predict crash risk from glance patterns in naturalistic driving. *Human Factors*, 54(6), 1104-1116, 2014.

For a complete list of all LMRIS citations, visit www.libertymutualgroup.com/researchinstitute, and click on Publications.

Research to Reality

Safety Professionals Discuss Distracted Driving Research

Distracted driving is nothing new. Even when automobiles first came into general use, people engaged in "distracted" behaviors such as eating, reading and personal grooming while driving. But in today's world, distracted driving is more prevalent than ever with the upsurge in mobile devices, such as cell phones, CD players and onboard navigation systems.

"The question is no longer 'Are you distracted?'" says David Melton, managing director of Global Safety, Liberty International, "but rather, 'How distracted are you, and do you realize that you are distracted?'" In answer to the latter question, findings from a prior Liberty Mutual Research Institute for Safety study suggest that most drivers do not have an accurate perception of how in-vehicle distractions impact their driving performance. "Some people, especially those who have grown up using mobile devices, think they are perfectly capable of safely using these devices while driving. Crash statistics reveal just how dangerous that attitude can be," notes Melton.

"The ability to anticipate hazards is a big part of safe driving," states Melton. "The recent in-vehicle glance study findings prove that when you are driving and your brain is preoccupied with another task, your ability to notice approaching hazards and react to them is compromised." Melton adds that this type of situation can become even more dangerous when two drivers are disengaged from the driving task at the same time.

Peter VanDyne, technical director, Liberty Mutual Risk Control Services, comments, "The recent study findings provide tangible evidence about the real dangers of in-vehicle distractions. It's very important to get research like this into the hands of senior management as a way to promote awareness and dialogue about driver distraction. It is also a good motivator for the development of effective driver distraction policies."

Brian Piccolo, manager, Operations and Systems Integration for Liberty Mutual Insurance, Personal Insurance Distribution, notes, "It's very important to look at the intricacies and safety implications of distracted driving. The more we know about in-vehicle distractions and how people manage them, the better we will be able to provide guidance on how to design and implement these new technologies as safely as possible."

Looking ahead, Melton considers the implications of the recent LMRIS findings for the rapidly evolving world of autonomous vehicles. "Imagine being engrossed in a good book or on a conference call when the autonomous vehicle 'decides' that it doesn't want to 'be in control' anymore," Melton says. "What happens at that moment of readjustment back to driving is a critical safety question that researchers around the world continue to explore."

DISTRACTED DRIVING FACTS

Driver distraction is any activity that has the potential to divert a driver's attention from the primary driving tasks — vehicle control, navigation and hazard detection. Distractions can occur both within and outside the vehicle. Most research focuses on in-vehicle distractions since these are usually in the driver's control and therefore offer the most promise for safety intervention. In-vehicle distractions can be broken down into three types:

Visual

Distractions that cause the driver to look away from the road (e.g., reading a text message, glancing down to find an object or navigating a road map while driving).

Manual

Distractions that cause the driver to take a hand off the steering wheel and can result in loss of vehicle control (e.g., holding a cell phone, adjusting in-vehicle controls or reaching for an object).

Cognitive

Distractions where internal thought processes cause drivers to take their mind off the driving task (e.g., cell phone conversations involving stressful or important topics or decisions, or even thinking about routing options).

DID YOU KNOW…

Texting involves visual, manual and cognitive distractions and is therefore of particular concern.

Forty-four states, D.C., Puerto Rico, Guam and the U.S. Virgin Islands ban text messaging for all drivers, and 14 states, D.C., Puerto Rico, Guam and the U.S. Virgin Islands prohibit all drivers from using handheld cell phones while driving.[1]

Engaging in visual-manual subtasks (such as reaching for a phone, dialing and texting) associated with the use of handheld phones and other portable devices increases the risk of getting into a crash by three times.[4]

Ten percent of all drivers under the age of 20 involved in fatal crashes were reported as distracted at the time of the crash, making up the largest proportion of drivers who were distracted.[1] This is consistent with a LMRIS study that showed that younger male drivers (ages 18-34 years) consistently underestimated the negative impact that distraction has on driving performance.[2]

For the most part, drivers do not strategically postpone tasks even when fully aware of increasing road demands, but tend to initiate a task based on the momentary demands of the road, frequently leading to driving errors.[3]

Five seconds is the average time your eyes are off the road while texting. When traveling at 55 mph, that's enough time to cover the length of a football field (120 yards).[5]

[1] National Highway Traffic Safety Administration. Facts and Statistics. Available from http://www.distraction.gov/content/get-the-facts/facts-and-statistics.html. Accessed Dec. 19, 2014. [2] Horrey, W.J., Lesch, M.F. and Garabet, A. "Assessing the awareness of performance decrements in distracted drivers," *Accident Analysis & Prevention*, 40(2), 675-682, 2008. [3] Horrey, W.J. "Assessing the effects of in-vehicle tasks on driving performance. *Ergonomics in Design*, 19(4), 4–7, 2008. [4] 100-Car Naturalistic Driving Study, Virginia Tech Transportation Institute, 2006, www.vtti.vt.edu. [5] Virginia Tech Transportation Institute, 2009, www.vtti.vt.edu.

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