GHSA
Governors Highway Safety Association
The States' Voice on Highway Safety

Distracted Driving

WHAT RESEARCH SHOWS AND WHAT STATES CAN DO

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State Farm

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Acronyms

AAAFTS	AAA Foundation for Traffic Safety
CTIA	CTIA – The Wireless Association
FARS	Fatality Analysis Reporting System
GES	General Estimates System
GHSA	Governors Highway Safety Association
HLDI	Highway Loss Data Institute
IIHS	Insurance Institute for Highway Safety
LTCCS	Large Truck Crash Causation Study
NHTSA	National Highway Traffic Safety Administration
MMUCC	Model Minimum Uniform Crash Criteria
NMVCCS	National Motor Vehicle Crash Causation Study
NOPUS	National Occupant Protection Use Survey
NSC	National Safety Council
TIRF	Traffic Injury Research Foundation
VTTI	Virginia Tech Transportation Institute

Executive summary

This report reviews and summarizes distracted driving research available as of January 2011 to inform states and other organizations as they consider distracted driving countermeasures. It concentrates on distractions produced by cell phones, text messaging, and other electronic devices brought into the vehicle. It also considers other distractions that drivers choose to engage in, such as eating and drinking, personal grooming, reading, and talking to passengers. It addresses distractions associated with vehicle features only briefly. They have been studied extensively by automobile manufacturers, but states have little role in addressing them.

What is distracted driving? There are four types of driver distraction:

- Visual – looking at something other than the road
- Auditory – hearing something not related to driving
- Manual – manipulating something other than the wheel
- Cognitive – thinking abut something other than driving

Distraction occurs when a driver voluntarily diverts attention to something not related to driving that uses the driver's eyes, ears, or hands.

Most distractions involve more than one of these types, with both a sensory – eyes, ears, or touch – and a mental component. For this report, distraction occurs when a driver voluntarily diverts attention to something not related to driving that uses the driver's eyes, ears, or hands.

How often are drivers distracted? Driver distraction is common in everyday driving and in crashes.

- Drivers on the road: Most drivers in surveys reported that they sometimes engaged in distracting activities. A study that observed 100 drivers continually for a full year found that drivers were distracted between one-quarter and one-half of the time.
    - Cell phone use: In recent surveys, about two-thirds of all drivers reported using a cell phone while driving; about one-third used a cell phone routinely. In observational studies during daylight hours in 2009, between 7% and 10% of all drivers were using a cell phone.
    - Texting: In recent surveys, about one-eighth of all drivers reported texting while driving. In observational studies during daylight hours in 2009, fewer than 1% of all drivers were observed to be texting.

- Drivers in crashes: At least one driver was reported to have been distracted in 15% to 30% of crashes. The proportion of distracted drivers may be greater because investigating officers may not detect or record all distractions. In many crashes it is not known whether the distractions caused or contributed to the crash.

How does distraction affect driver performance? Experimental studies show conclusively that distractions of all types affect performance on tasks related to driving. But experimental studies cannot predict what effect various distractions have on crash risk.

How does distraction affect crash risk? The limited research suggests that:

- Cell phone use increases crash risk to some extent but there is no consensus on the size of the increase.
- There is no conclusive evidence on whether hands-free cell phone use is less risky than hand-held use.
- Texting probably increases crash risk more than cell phone use.
- The effects of other distractions on crash risk cannot be estimated with any confidence.

Are there effective countermeasures for distracted driving? There are no roadway countermeasures directed specifically at distracted drivers. Many effective roadway design and operation practices to improve safety overall, such as edgeline and centerline rumble strips, can warn distracted drivers or can mitigate the consequences if they leave their travel lane.

Vehicle countermeasures to manage driver workload, warn drivers of risky situations, or monitor driver performance have the potential to improve safety for all drivers, not just drivers who may become distracted. Some systems are beginning to be implemented in new vehicles and others are still in development. Their ultimate impact on distracted driving cannot be predicted.

Countermeasures directed to the driver offer an opportunity to reduce distracted driving incidence and crashes in the next few years. They have concentrated on cell phones and texting through laws, communications campaigns, and company policies and programs. Systems to block or limit a driver's cell phone calls are developing rapidly but have not yet been evaluated.

Laws banning hand-held cell phone use reduced use by about half when they were first implemented.

In summary, the limited research on these countermeasures concludes that:

- Laws banning hand-held cell phone use reduced use by about half when they were first implemented. Hand-held cell phone use increased subsequently but the laws appear to have had some long-term effect.
- A high-visibility cell phone and texting law enforcement campaign reduced cell phone use immediately after the campaign. Longer-term effects are not yet known.
- There is no evidence that cell phone or texting bans have reduced crashes.

- Distracted driving communications campaigns and company policies and programs are widely used but have not been evaluated.

What can states do to reduce distracted driving? States should consider the following activities to address distracted driving. While each has been implemented in some states, there is no solid evidence that any is effective in reducing crashes, injuries, or fatalities.

- Enact cell phone and texting bans for novice drivers. Novices are the highest-risk drivers. A cell phone ban supports other novice driver restrictions included in state graduated licensing programs and helps parents manage their teenage drivers. As of June 2011, 30 states and the District of Columbia prohibited the use of all cell phones by novice drivers and 41 states and the District of Columbia prohibited texting by novice drivers. But there is no evidence that novice driver cell phone or texting bans are effective.
- Enact texting bans. Texting is more obviously distracting and counter to good driving practice than cell phone use. As of June 2011, 34 states and the District of Columbia had enacted texting bans for all drivers. But texting bans are difficult to enforce.
- Enforce existing cell phone and texting laws. Enforcement will increase any law's effect, while failing to enforce a law sends a message that the law is not important. But enforcing cell phone or texting laws will divert resources from other traffic law enforcement activities.
- Implement distracted driving communication programs. Cell phone and texting laws should be publicized broadly to increase their effects. Other communication and education activities can address the broader issues of avoiding distractions while driving. Thirty-seven states and the District of Columbia conducted a recent distracted driving communications campaign. But distracted driving communication programs will divert resources from other traffic safety communications activities.
- Help employers develop and implement distracted driving policies and programs. Many companies have established and implemented cell phone policies for their employees. Company policies can be a powerful influence on employees' driving. But they have not been evaluated.

Enforce existing cell phone and texting laws ... But enforcing cell phone or texting laws will divert resources from other traffic law enforcement activities.

States can and should take four steps that will help reduce distracted driving immediately and in the future.

- Continue to implement effective low-cost roadway distracted driving countermeasures such as edgeline and centerline rumble strips.
- Record distracted driving in crash reports to the extent possible, to assist in evaluating distracted driving laws and programs.
- Monitor the impact of existing hand-held cell phone bans prior to enacting new laws. States that have not already passed handheld bans should wait until more definitive research and data are available on these laws' effectiveness.
- Evaluate other distracted driving laws and programs. Evaluation will

provide the information states need on which countermeasures are effective and which are not.

What should others do to reduce distracted driving?

- Employers: Consider distracted driving policies and programs for their employees. Evaluate the effects of their distracted driving policies and programs on employee knowledge, behavior, crashes, and economic costs (injuries, lost time, etc.).
- Automobile industry: Continue to develop, test, and implement measures to manage driver workload and to warn drivers of risky situations.
- Federal government: Help states evaluate the effects of distracted driving programs. Continue tracking driver cell phone use and texting in the National Occupant Protection Use Survey (NOPUS). Work with states to improve data collection on driver distractions involved in crashes. Continue to develop and conduct national communications campaigns on distracted driving.

1 // Introduction

Distracted driving is receiving unprecedented attention. U.S. Secretary of Transportation Ray LaHood has made it a top traffic safety priority. The Department of Transportation held distracted driving summits in 2009 and 2010 and has developed a distracted driving website (distraction.gov). The National Conference of State Legislatures reports that 43 states considered 273 distracted driving bills in 2010, mostly dealing with cell phones and texting (www.ncsl.org/?TABID=13599). The Governors Highway Safety Association (GHSA) surveyed the states and found that 37 states and the District of Columbia conducted a distracted driving communications campaign recently (GHSA, 2010).

The premier traffic safety research journal, Accident Analysis & Prevention, reported in January 2011 that the top four articles downloaded recently from its website all address cell phone use.

Distracted driving also has produced a mountain of research. A search of eight major research databases conducted for this report produced over 350 scientific papers published between 2000 and 2010 on some aspect of distracted driving. The premier traffic safety research journal, *Accident Analysis & Prevention*, reported in January 2011 that the top four articles downloaded recently from its website all address cell phone use.

This report reviews and summarizes distracted driving research available as of January 2011. It recommends how this research can inform states and other organizations as they consider distracted driving countermeasures. It concentrates on the distractions that have received the most attention: driver use of cell phones, text messaging, and other electronic devices brought into the vehicle. It also considers other distractions that drivers choose to engage in, such as eating and drinking, personal grooming, reading, and talking to passengers. It addresses distractions associated with vehicle features only briefly. They have been studied extensively by automobile manufacturers, but states have little role in addressing them. Finally, it reviews the little that is known about distractions produced by external signs and displays.

References are provided to important recent research and to summaries of research on individual topics. For a comprehensive review of distracted driving, especially as it relates to vehicle features, readers should consult the book *Driver Distraction*, edited by Regan, Lee, and Young. (2009). *Distracted Driving: So What's the Big Picture?* (Robertson, 2011) provides a current overview of distracted driving causes and mitigation strategies.

2 // What is distracted driving?

Distracted driving definitions. Distracted driving immediately brings to mind cell phones and texting, and perhaps use of other electronic devices. But there are many more driving distractions: activities like eating, changing a CD, or talking to other passengers; billboards or other objects outside the car; even planning the day's work, rehashing an emotional moment from the previous night, or just daydreaming. It is useful to begin by defining what distracted driving means.

While several definitions have been proposed, a good definition is surprisingly elusive. All start by adapting a dictionary definition of distraction to driving:

> ***"Distraction occurs when a driver's attention is diverted away from driving by some other activity."***

This is too general and imprecise to be observed or measured, much less to be useful in suggesting effective countermeasures. To produce a working definition for state use and for this report, consider first what activities may distract drivers – distraction types – and where these activities originate – distraction sources.

Distraction types. There are four types of driver distraction:

- Visual – looking at something other than the road
- Auditory – hearing something not related to driving
- Manual – manipulating something other than the wheel
- Cognitive – thinking abut something other than driving

Most distractions involve more than one of these types. In particular, most distractions involve some thought – cognitive distraction – and many also involve some sensory distraction. Making a call on a hand-held phone involves all four types: holding the phone, looking at and touching the phone to dial, then listening to and thinking about the conversation.

Distraction sources. Driver distractions come from four general sources:

- Associated with the vehicle – controls, displays, driver aids such as GPS systems

- Brought into the vehicle – cell phones, computers, food, passengers, animals
- External to the vehicle – signs and displays, other roadside features or scenery
- Internal to the driver's mind – daydreaming, "lost in thought"

Distractions are almost too numerous to count, much less measure, or examine their effects on crashes, or consider countermeasures. Some are necessary for good driving, such as regular glances at the rear-view mirror. Some cannot be controlled or have little or no effect on crash risk. In many situations, drivers have considerable spare capacity in each dimension: drivers do not continually need to keep their eyes on the road, their hands on the wheel, and their attention firmly fixed on driving. As Regan, Young et al. observe (2009a, p. 6), "Distraction is an inevitable consequence of being human … driver distraction cannot be eliminated." The challenge is to identify and eliminate those distractions that increase crash risk substantially.

"Distraction is an inevitable consequence of being human ... driver distraction cannot be eliminated."

Distracted driving characteristics. Many distractions are very temporary, lasting less than a second or two: a quick glance at the roadside, an adjustment to the temperature controls. Other distractions can last for some time but can be interrupted at any moment: a conversation with a passenger can be halted in mid-sentence if a risky situation arises that requires the driver's concentration. Still others can persist for long periods: a driver conducting an emotionally-charged cell phone conversation may be oblivious to sudden changes in conditions on the road.

This transitory nature distinguishes distracted driving from other major driver behaviors that affect traffic safety. Alcohol impairment and fatigue persist for hours. Seat belts typically are used for all or none of a trip. Even speeding usually lasts for minutes, if not longer. But distractions can come and go in seconds or less. Distracted driving is not a "yes or no" characteristic of an entire trip but something that occurs many times during a trip, often in very short intervals.

Distracted driving ... is difficult to observe at the time it occurs and often almost impossible to reconstruct accurately after the fact.

Distracted driving also differs because it is difficult to observe at the time it occurs and often almost impossible to reconstruct accurately after the fact. After a crash, other important driver behaviors can be determined or estimated from hard evidence: alcohol impairment by chemical testing; fatigue by observation and interview information; speeding by crash reconstruction; even belt use by injury and belt wear patterns. But most distractions must be estimated from subjective reports from the driver or others.

Distracted driving reporting. Another way to help understand distracted driving is to examine how it is recorded. NHTSA's FARS, GES, and NMVCCS crash data systems can document an extensive list of visual, auditory, manual, and cognitive activities that may distract drivers, including using cell phones or other electronic devices, adjusting vehicle controls or radios, eating or drinking, applying cosmetics, picking up an object, distracted by other

occupants or animals in the vehicle, distracted by something outside the vehicle, or "lost in thought" or "daydreaming" (NHTSA, 2010a, p. 4-5; Ascone et al., 2009, Appendices A-C).

Distracted driving definition for this report. This report is addressed to State Highway Safety Offices and Departments of Transportation and Public Safety. It addresses distractions that are likely to affect crash risk and for which states can consider countermeasures. This helps narrow the scope. The report excludes, or mentions only in passing:

- Involuntary distractions from any source, such as animals or children in the vehicle or loud noises outside the vehicle. Countermeasures addressing these distractions are unlikely except in special circumstances, such as passenger restrictions for beginning drivers.
- Cognitive distractions such as daydreaming that are not produced by some external task. These distractions cannot be observed or measured and the only countermeasure is the standard and frequently ineffectual admonition to "pay attention while driving."

This produces a working definition for this report:

> ***"Distraction occurs when a driver voluntarily diverts attention away from driving to something not related to driving that uses the driver's eyes, ears, or hands."***

This report concentrates on distractions produced by driver use of cell phones, text messaging, and other electronic devices brought into the vehicle.

3 // How often are drivers distracted?

Three methods are used to estimate how frequently drivers are distracted: surveys, observations, and crash reports. Each has strengths and weaknesses; none provides a complete record of driver distraction.

- **Surveys:** Driver self-report surveys can estimate all the things drivers are conscious of doing, especially things that cannot be observed easily. But surveys depend on accurate recall and honest reporting. Surveys also can measure driver attitudes regarding the risks of various distractions and the acceptability of countermeasures such as cell phone laws. Well-designed, representative, and unbiased surveys of at least 1,000 drivers provide accurate information on non-controversial activities if drivers give honest answers. Surveys can estimate how often drivers do something only in broad subjective categories such as "never," "sometimes," or "frequently."
- **Observations:**
  - Direct observations from outside a vehicle can record only obvious distracting activities such as hand-held cell phone use or personal grooming, usually only in daylight hours at urban locations where vehicles are stopped or travelling slowly. Well-trained observers can record hand-held cell phone use in moderate traffic; observers using special equipment can record use at night. Observations are more difficult for vehicles with heavily-tinted windows. Observations at nationally-representative sites estimate the frequency of these distractions reasonably accurately.
  - Naturalistic studies put the observer inside the vehicle by means of a video camera that continually records driver actions. These studies can detect and measure when a driver's eyes are not on the road and when his or her hands are not on the wheel. Naturalistic studies are very expensive and consequently very small, and participants are volunteers. The only general-population naturalistic study to date followed 100 vehicles of volunteer drivers in northern Virginia for one year between January 2003 and July 2004 (VTTI, 2010; Dingus et al., 2006). Three specialized studies followed 40 teenage drivers and 203 commercial drivers,

respectively (Lee et al., 2011; Olson et al., 2009). A two-year naturalistic study of 1,950 drivers in six areas of the country began in 2010; the first data will be available in 2011 (www.trb.org/StrategicHighwayResearchProgram2SHRP2/Pages/The_SHRP_2_Naturalistic_Driving%20Study_472.aspx).

- **Crashes:** Crash reports may record driver distractions that the investigating officer believes caused or contributed to the crash (NHTSA, 2010a). Crash reports probably under-estimate distractions for two reasons. First, distraction is difficult to detect: drivers may not admit to being distracted before a crash and there may be no physical evidence of a distraction after the fact. Second, some state crash report forms do not specifically ask about driver distraction. In-depth crash investigations such as NMVCCS likely reduce but will not eliminate this under-reporting (Ascone et al., 2009).

Most drivers engaged in some distracting activities on at least some driving trips.

Surveys. The most recent overall estimates of a wide variety of distracting activities come from a 2002 NHTSA nationally-representative survey of 4,010 drivers. (Results from a fall 2010 NHTSA survey were not available in spring 2011.) Most drivers engaged in some distracting activities on at least some driving trips (Royal, 2003, p. 1):

- **81% talked to other passengers;**
- **66% changed radio stations or looked for CDs or tapes;**
- **49% ate or drank something;**
- **24% dealt with children riding in the rear seat.**

Other distracting activities were less frequent:

- **12% read a map or directions;**
- **8% engaged in personal grooming;**
- **4% read printed material.**

In 2002, only 25% of the drivers reported making cell phone calls and 26% answered calls. As the data presented below show, self-reported cell phone use has increased substantially since 2002. While no recent survey data are available on other distracting activities, they likely have not decreased in the past decade.

The more common the distracting activity, the less dangerous drivers believed it to be. The proportion of drivers who believed that activities made driving "much more dangerous" was:

- **4% - talking to other passengers;**
- **18% - changing a radio station or looking for CDs or tapes;**
- **17% - eating or drinking;**
- **40% - dealing with children in the rear seat;**
- **55% - reading a map or directions;**
- **61% - personal grooming;**
- **80% - reading printed material.**

Abut half the drivers surveyed in 2002 felt that making cell phone calls (48%) or taking calls (44%) made driving much more dangerous.

Three recent nationally-representative telephone surveys addressed the use of cell phones, texting, and other electronic devices while driving. AAAFTS (2010) surveyed 2,000 U.S. residents 16 years of age and older. IIHS (Braitman and McCartt, 2010; Farmer et al., 2010) surveyed 1,219 drivers ages 18 and older. TIRF (Vanlaar et al., 2007) surveyed 1,201 Canadian drivers.

The three surveys provide consistent estimates of drivers' self-reported cell phone use.

- **69% in the last 30 days; 34% "fairly often or regularly" (AAAFTS)**
- **65% sometimes; 40% "at least a few times per week" (IIHS)**
- **37% "in the last 7 days" (TIRF)**

CTIA reported that in June 2010 there were 292.8 million operational cell phones (or wireless connections) in the United States, more than one for each person in the United States aged 5 and above.

Across the three surveys, about two-thirds of all drivers reported they used cell phones while driving and about one-third used them regularly, substantially higher rates than were reported in the 2002 NHTSA survey. The IIHS survey found similar reported cell phone use rates for drivers aged between 18 and 60. The TIRF survey found higher reported use rates for drivers aged 16 to 34.

CTIA reported that in June 2010 there were 292.8 million operational cell phones (or wireless connections) in the United States (CTIA, 2010, #24), more than one for each person in the United States aged 5 and older (the Census Bureau estimates a total population of 308.7 million in 2010, with 93.1% aged 5 and older - www.census.gov). Almost every driver now has a cell phone available.

Drivers reported texting while driving less frequently than cell phone use.

- **24% in the last 30 days; 7% "fairly often or regularly" (AAAFTS)**
- **13% sometimes; 6% "at least a few times per week" (IIHS)**

The "last 30 days" and "sometimes" texting rates are similar to the cell phone use rates reported in NHTSA's 2002 survey.

Younger drivers reported texting while driving more frequently than older drivers. In the IIHS survey, 13% of drivers age 18-24 texted while driving daily compared to 2% of drivers aged 30-59. A survey of 1,947 teen drivers in North Carolina high schools found that 30% texted during their last driving trip (O'Brien et al., 2010). A survey of 348 drivers aged 18-30 in Kansas found that only 2% said they never texted under any circumstances while driving (Atchley et al., 2010). Overall, CTIA reported that 4.9 billion text messages were sent every day in the year June 2009 – June 2010 (CTIA, 2010, #27), or about 17 text messages daily for each cell phone connection.

The AAAFTS survey measured public support for laws restricting cell phone use or texting.

- **46% supported a total cell phone ban, hand-held and hands-free;**
- **69% supported a hand-held cell phone ban;**
- **80% supported a texting ban.**

The 46% of respondents to the AAFTS survey who supported a total cell phone ban can be compared to the 31% who reported they did not use a cell phone while driving in the past 30 days: at least 15% of the respondents supported a ban on their own actions.

In 2009, 5% of all sampled drivers were observed to be using hand-held cell phones and 0.6% were observed to be texting or otherwise manipulating hand-held devices.

Direct Observations. NHTSA observes cell phone use and texting each year as part of NOPUS, the National Occupant Protection Use Survey (NHTSA, 2010b). The survey is conducted between 7 a.m. and 6 p.m. and observes about 50,000 vehicles stopped at a representative sample of about 1,500 intersections across the country. In 2009, 5% of all sampled drivers were observed to be using hand-held cell phones and 0.6% were observed to be texting or otherwise manipulating hand-held devices. Both rates were higher in 2008, by a statistically significant amount: 6% for hand-held phone use and 1.0% for texting. A 2006 observation survey of nighttime cell phone use in Indiana, using night vision equipment, found use rates "similar to previous daytime studies" – 6% overall (Vivoda et al, 2008). Although hands-free cell phone use cannot be observed accurately, NHTSA estimated that about 9% of all drivers were using either a hand-held or hands-free phone in a typical daylight moment in 2009.

These observations are similar to the self-reported cell phone use in the IIHS survey, in which drivers estimated using cell phones about 7% of the time while driving in 2009 (Farmer et al., 2010).

Naturalistic studies. The VTTI 100-car study found that drivers engaged in some form of secondary task 54% of the time while driving (Klauer et al., 2006, p. x). It also found that drivers reduced secondary tasks in more risky driving situations, such as near intersections or in heavy traffic. Drivers were engaged in a secondary task 23% of the time in situations similar (at the same time of day, driving in a similar location) to those that produced a crash or near-crash (a situation that requires rapid evasive maneuver by the driver's vehicle, or any other vehicle, pedestrian, cyclist, or animal, to avoid a crash) (Klauer et al., 2010, p. vi).

The two commercial vehicle driver naturalistic studies together found that drivers were involved in a distracting task not related to driving 56% of the time while driving (Olson et al., 2009, p. xix, Table 2).

Crashes. NHTSA estimates that 16% of fatal crashes and 20% of injury crashes in 2009 involved at least one distracted driver (NHTSA, 2010a). Similarly, the more detailed investigations in NMVCCS found that in those crashes where the critical reason for the crash was attributed to a driver, 18% involved distraction (Ascone et al., 2009). Another study found that 29% of the passenger vehicle drivers in NMVCCS crashes and 20% of the large truck drivers in LTCCS crashes were distracted or inattentive (Craft and Preslopsky, 2010).

The 100-car study observed that in almost 80% of all crashes and 65% of near-crashes the driver was looking away from the forward roadway just before the incident.

The 100-car study observed that in almost 80% of all crashes and 65% of near-crashes the driver was looking away from the forward roadway just before the incident (Dingus et al., 2006, p. xxiii) and that secondary task distraction contributed to 22% of the crashes and near-crashes (Klauer et al., 2006, p. x; Ascone et al., 2009). The 100-car study had few crashes – 15 police-reported and 67 unreported – and most were very minor; there were 761 near-crashes (VTTI, 2010). The two commercial vehicle driver naturalistic studies found that 71% of drivers in the studies' 21 crashes and 46% of drivers in the 197 near-crashes were involved in a distracting non-driving task (Olson et al., 2009, p. xix, Table 2).

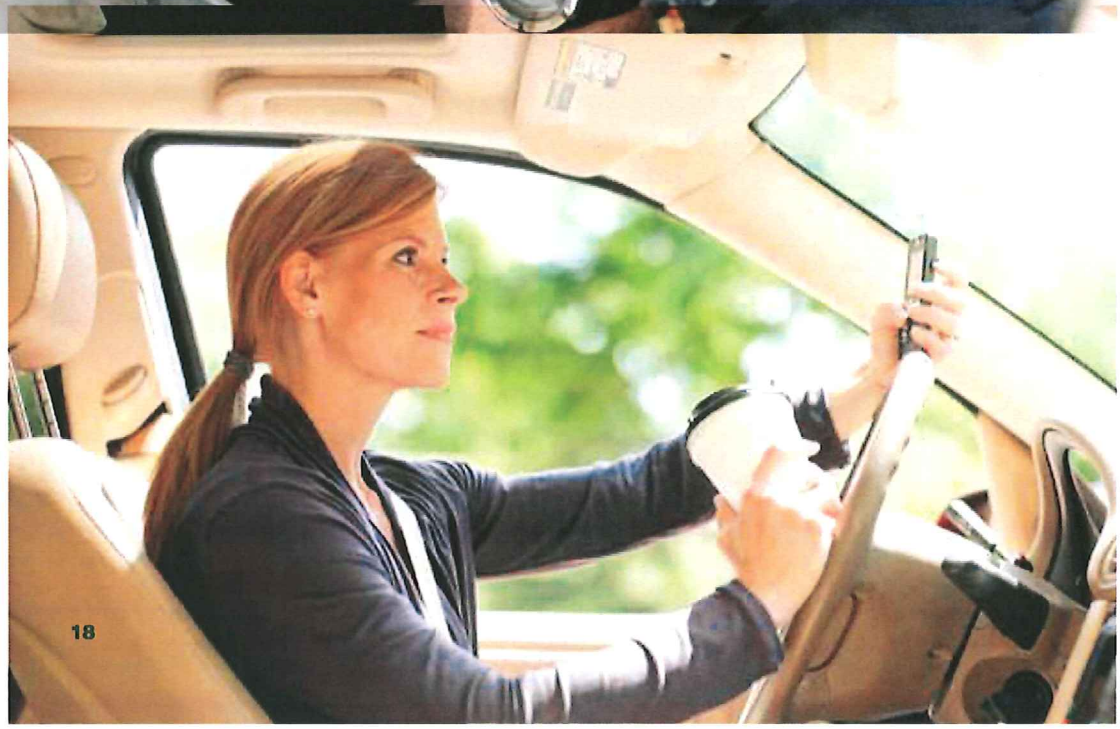
Taken together, these crash data studies conclude that drivers were distracted in 15% to 30% of crashes at all levels, minor to fatal, though the distraction may not have caused or contributed to the crash.

Summary and discussion //

Frequency of driver distraction. Driver distraction is common in everyday driving and in crashes.

- **Drivers on the road:** Most drivers in surveys reported that they sometimes engaged in distracting activities. The 100-car study's observations found that drivers engaged in a secondary task between one-quarter and one-half of the time while driving.
  - Cell phone use: In recent surveys, about two-thirds of all drivers reported using a cell phone while driving; about one-third used a cell phone routinely. In observational studies during daylight hours in 2009, between 7% and 10% of all drivers were using a cell phone.
  - Texting: In recent surveys, about one-eighth of all drivers reported texting while driving. Younger drivers reported texting more frequently than older drivers. In observational studies during daylight hours in 2009, fewer than 1% of all drivers were observed to be texting.
- **Drivers in crashes:** At least one driver was reported to have been distracted in 15% to 30% of crashes at all levels, minor to fatal. The proportion of distracted drivers may be greater because investigating officers may not detect or record all distractions. In many crashes it is not known whether the distractions caused or contributed to the crash.

At least one driver was reported to have been distracted in 15% to 30% of crashes at all levels, minor to fatal.



4 // How does distraction affect driver performance?

Measuring distraction with experiments. Distraction effects are studied in experimental settings. Experiments may be conducted in the laboratory, either in completely artificial situations or on driving simulators ranging from low-tech computer screens to high-tech full-vehicle mockups that imitate vehicle responses. Experiments also are conducted in cars on a test track or on the road. The tradeoff is between realism and control. Laboratory experiments are controlled, so they can compare distracted and undistracted drivers in identical situations, but they cannot study real-world driving behavior. On-road studies may be quite realistic but cannot control for events outside the vehicle.

The fundamental challenge with all experimental studies is that participating drivers know that they are in an experiment. They may not drive or react in the same way that they would naturally on the road.

Experiments measure quite accurately how distractions of various types affect reaction time and other driver performance features, but they do not measure directly how distractions affect crash risk.

The fundamental challenge with all experimental studies is that participating drivers know that they are in an experiment. They may not drive or react in the same way that they would naturally on the road. As McCartt et al. (2006, p. 97) observed in their review of experimental studies on cell phone effects, "The implications for real-world driving are unclear because experimental studies do not take into account how and when drivers use phones in their own vehicles and may not accurately reflect the effects of phone use on real-world driving performance." Ranney (2008, p. 6) generalized the conclusion to all distraction types: "It is virtually impossible to use experimental results to predict real-world risks associated with different secondary tasks."

Results from experimental studies. Distraction from cell phones has been studied most extensively. Caird et al. (2008) combined information from 33 high-quality studies in a meta-analysis. They concluded that cell phone conversations increase reaction time significantly and that hand-held and hands-free conversations have similar effects. Horrey and Wickens (2006) reached similar conclusions from their meta-analysis of 23 studies, as did McCartt et al. (2006) in their less formal review of 54 experimental studies

and Drews and Strayer (2009) in their overall review of the literature. Dula et al. (2010) found that emotional calls had larger effects than mundane calls. Chan and Atchley (2010) concluded that cell phones decreased performance even under monotonous driving conditions. Bellinger et al. (2009) found that cell phone conversations slowed response time while listening to music did not.

Drivers in some experimental studies attempted to compensate for cell phone distractions by slowing down or increasing their headway from the vehicle they were following (McCartt et al., 2006) while in others they did not (Caird et al., 2008). Horrey et al. (2008) found that drivers in experimental settings were not aware of how much the phone conversation affected their driving.

Text messaging has been studied less frequently than cell phone use, probably because text messaging has become common only recently. Four experimental studies found that text messaging increases the time that a driver's eyes are not on the road and also affects speed and lane-position variability (Crisler et al., 2008; Hosking et al. 2007; Hosking et al., 2009; and Owens et al., 2011). Hosking et al. (2007) also concluded that some drivers attempted to compensate by increasing their following distance while text messaging but they did not reduce their speed.

States have little role in improving or regulating distractions from features built into the vehicle to assist the driver, such as controls, displays, and navigation systems, so research on distractions from these sources was not reviewed in detail. Bayly et al. (2009) and Ranney (2008) summarize the available research. Navigation systems have been studied most extensively, with the conclusion that well-designed systems are less distracting than using paper maps.

Many other things inside a vehicle can distract, as noted in Chapter 2. They have not been studied extensively. Bayly et al. (2009) summarize several studies of the effects of radios, CD and MP3 players, iPods, DVDs, video systems, email, eating and drinking, smoking, reading and writing, and grooming. All these activities affected performance on driving-related tasks in some studies.

While the potential distracting effects of these activities are largely self-evident, there is little that states can or should do about them. Many, such as changing a radio station, eating, or drinking, are fairly common. But if done carefully, their distracting effects are minimal; states are not likely to prohibit listening to the radio or drinking coffee while driving. Both existing traffic laws and common sense already attempt to control truly blatant distracting activities such as watching a television program while driving.

A few studies have evaluated the distracting effects of fixed or variable message signs and billboards. Horberry and Edquist's summary (2009) concluded that, while billboards and signs can distract some drivers in some

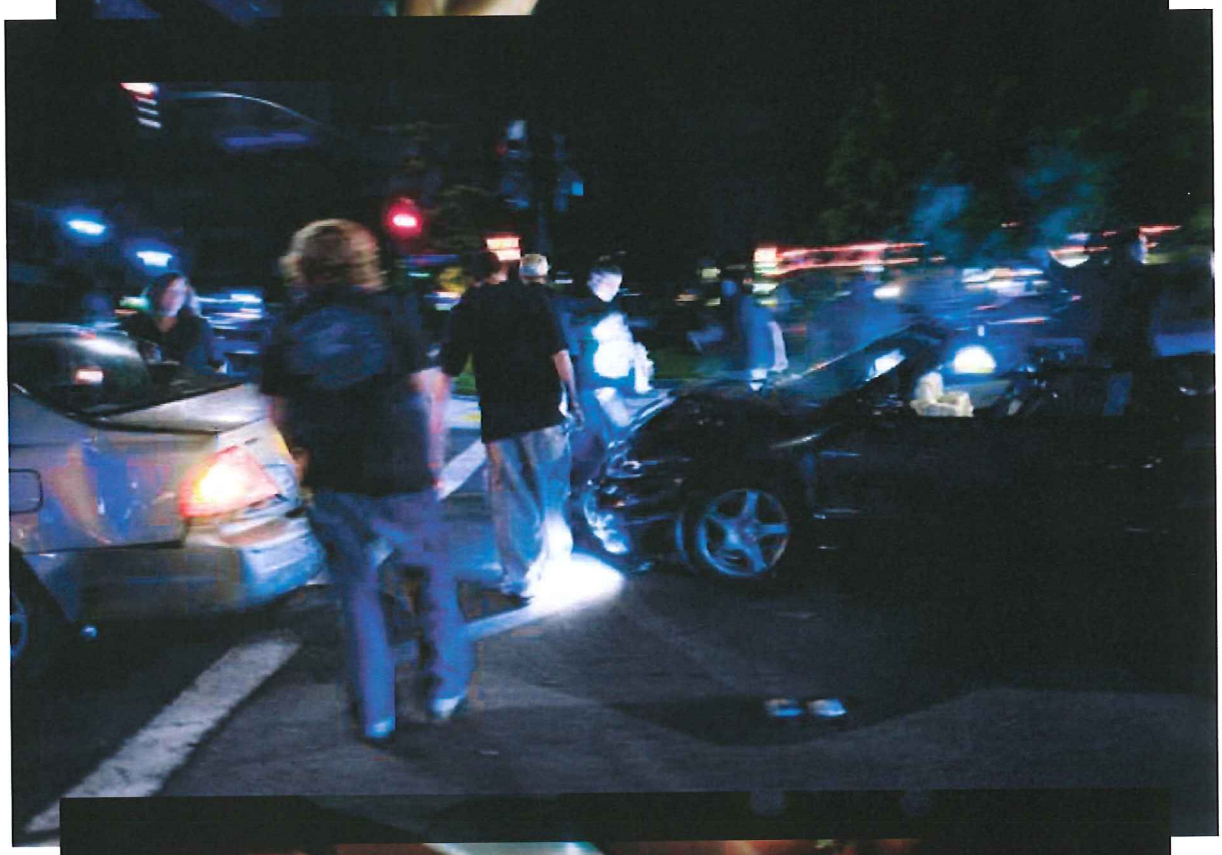
circumstances, there is not enough research evidence to form any guidelines or standards "about how much distraction from outside the vehicle is safe." Smiley et al. (2005) reached similar conclusions from their comprehensive assessment of the impact of signs in Toronto. They also concluded that, for the signs studied, the overall impacts on traffic safety are likely to be small. Three recent simulator studies show that billboards and signs can distract drivers in some circumstances (Bendak and Al-Saleh, 2010; Edquist et al., 2011; and Young et al., 2009).

Cognitive distractions by themselves – thinking about something other than driving, without any manual or visual distraction – can affect driving performance. Two recent studies reinforce the conclusion that distractions affect the mind, not just the eyes, ears, or hands (Harbluk et al., 2007; Liang and Lee, 2010).

Experimental studies show conclusively that distractions of all types affect performance on driving-related tasks. But these experimental results cannot predict what effect various distractions have on crash risk.

Summary and discussion //

Distraction effects on driver performance. Experimental studies show conclusively that distractions of all types affect performance on driving-related tasks. But these experimental results cannot predict what effect various distractions have on crash risk, for two reasons. First, drivers even in the best experiments may not perform in the same way that they would in real-world driving. Second, there is no way to predict how a change in some driver performance measure, such as reaction time, affects crash risk. The experimental studies suggest that distractions may increase crash risk, but studies of real-world driving and crashes are the only way to discover if they really do.



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5 // How does distraction affect crash risk?

To determine how distractions affect crash risk, crash data analyses must study a population of drivers and estimate crash rates while distracted and while not distracted. As discussed in Chapter 3, it is difficult to get accurate data on how frequently drivers on the road or in crashes are distracted in various ways.

Naturalistic studies can provide accurate data on distractions on the road and in crashes. The naturalistic studies conducted to date are small because they are expensive. The 100-car study contains about 2 million vehicle miles of driving but only 15 police-reported and 67 unreported crashes, most of which were very minor (VTTI, 2010). The two commercial vehicle driver naturalistic studies had only 21 crashes (Olson et al., 2009). Naturalistic studies also use volunteer drivers, who may not accurately represent all drivers.

Crash data studies. The best crash data studies directly compare crash rates of drivers who are distracted in some way with crash rates of similar drivers in similar conditions who are not distracted. Cell phone use and texting are the only distractions that have been studied using crash data in this way. The role of other distractions as contributing or causal factors sometimes can be recorded or estimated after the fact, but without data on how frequently these distractions occur in crash-free driving it is not possible to say whether they affect crash risk.

Cell phones should be easy to study because cell phone companies record each call down to the second, so that it should be possible to determine quite accurately when a driver is and is not using a phone. Unfortunately, cell phone records have not been available for research purposes in the United States (McCartt et al., 2006). Two studies, in Toronto, Canada (Redelmeier and Tibshirani, 1997) and in Perth, Australia (McEvoy et al., 2005), were able to review cell phone records directly linked to drivers involved in crashes. Both studies compared a driver's cell phone use in the 10 minutes before a crash with the same driver's cell phone use while driving at the same time of day during the week before the crash (a case-crossover design). They used the 10 minute interval because the time when a crash occurred may not be recorded as precisely as the times