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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.

3 // How often are drivers distracted?

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.**

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.

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.

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.

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.

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.

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

Both studies found that crash risk was about four times greater when using a cell phone.

when cell phone calls were made. Both studies found that crash risk was about four times greater when using a cell phone. Hands-free phones did not appear to be any safer than hand-held phones.

In the only other study to use phone records directly linked to driving, Young and Schreiner (2009) studied vehicles with OnStar equipment that included a hands-free phone. OnStar call centers record and store all hands-free calls and all airbag deployments. Airbag deployments per driver-minute were lower during hands-free call periods than during call-free periods. Young and Schreiner concluded that "for personal conversations using a hands-free embedded device the risk of an airbag crash is somewhere in a range from a moderately lower risk to a risk near that of driving without a recent personal conversation. … These results are not consistent with the large increase in crash risk reported in epidemiological studies using the case-crossover method [referring to the Redelmeier and McEvoy studies summarized above]".

A review of the Young and Schreiner study (Braver et al., 2009) noted several flaws that call these conclusions into question: driving with and without calls may have occurred under different conditions with differing crash risks; driver use of cell phones other than OnStar was not known; and driving time during no-call periods was only estimated from fleet-level data and not measured directly.

Two other studies (Violanti & Marshall, 1996; Laberge-Nadeau et al., 2003) combined cell phone records, crash records, and survey responses from drivers in New York and Quebéc, respectively. They did not have data to link cell phone use directly to crashes but instead compared overall crash rates of cell phone users and non-users. Both studies concluded that crash risks were higher for cell phone users than for non-users.

These crash data studies point out how difficult it is to reach definitive conclusions about the effect of cell phone use on crash risk. Braver et al. raise the key point regarding the Young and Schreiner study: driving with and without calls may occur under conditions with different crash risks. The Redelmeier and McEvoy studies present a similar issue. A crash-involved driver may have faced different crash risks while driving at the same time of day the week before the crash.

Naturalistic studies. The only evidence on the general-population crash risk produced by secondary task distractions other than cell phones and texting comes from two analyses of the 100-car study data (Klauer et al., 2006; Klauer et al., 2010). Both studies classified secondary tasks as simple (requiring at most one glance away from the forward roadway and/or at most one button press), moderate (at most two glances and/or two button presses, including talking on or listening to a cell phone), or complex (multiple glances and/or button presses, including dialing a cell phone). The two studies used different control groups with which to compare drivers involved in crashes

and near-crashes. The 2006 study used randomly chosen drivers and driving situations in a case-control study design. The 2010 study used the same drivers involved in crashes or near-crashes in previous driving at the same time of day in a similar location in a case-crossover design. Both studies found that complex secondary tasks increased the risk of crashes and near-crashes substantially: twice as high in the case-crossover study (odds ratio 2.1) and three times as high in the case-control (3.1). Moderate secondary tasks also increased risk: odds ratios of 1.3 and 2.1, respectively. Simple secondary tasks did not affect risk: odds ratios of 0.8 and 1.2, neither of which was significantly different from 1 (Klauer et al., 2010, p. iv).

Analyses of the two commercial vehicle naturalistic studies used the same classification of secondary tasks into simple, moderate, and complex. Using a case-control study design, they found that complex secondary tasks increased the risk of safety-critical events substantially, with odds ratios ranging from 4.0 for reading a book or newspaper to 23.2 for texting (the effects on crashes were not analyzed because there were only 21 in the combined data). Some moderate tasks increased risk, for example using or reaching for a 2-way radio (odds ratio 6.7) and personal grooming (4.5) while others did not, for example talking on a CB radio (0.6) and looking at something outside the vehicle (0.5). Dialing a cell phone increased risk (odds ratio 5.9) while talking on or listening to a hand-held cell phone had no effect (1.0) and talking or listening to a hands-free phone reduced risk (0.4) (Olson et al., 2009, p. xxi, Table 3).

Elvik (2011) conducted a meta-analysis of 12 crash data and naturalistic studies of cell phone effects on crash risk. He concluded that studies that do not have precise information on cell phone use at the time of a crash "are almost worthless as far as estimating the risk associated with using mobile phones" and even the best studies may not control adequately for other factors that may influence the results. From the best studies – those discussed above – he concluded that crash risk is about three times greater when using a cell phone.

Aggregate data studies. Several recent studies take a broad look at cell phone or text messaging influences on crashes overall, using aggregate data rather than cell phone and crash data from individual drivers. The challenge of these studies is to isolate the effects of cell phones or texting from the many other factors that affect crashes and crash rates.

Farmer et al. (2010) combined the fourfold increase in crash risk while using a cell phone from the McEvoy et al. and Redelmeier and Tibshirani studies with the 7% cell phone use rate while driving obtained in a telephone survey to conclude that cell phone use caused 1.3 million crashes in 2008, or about 22% of all crashes, 19% of all fatal crashes, and 23% of all injury crashes. The National Safety Council (NSC) (2010a, 2010b) used similar methods to produce a similar estimate: 25% of all crashes are caused by cell phones.

Flanagan and Sayer (2010) critiqued the National Safety Council's study. They noted that NHTSA (2010a) estimates that 18-22% of all crashes are associated with (but not necessarily caused by) all forms of distraction while NSC estimates that 25% are caused by cell phone use alone. Using different values than NSC for the risk of cell phone use, the frequency of use while driving, the presence of multiple causes for many crashes, and the extent to which drivers reduce their cell phone use in more risky driving situations, Flanagan and Sayer concluded that cell phones may be associated with 3% to 4% of crashes.

Wilson and Stimpson (2010) compared trends in distracted driving fatalities recorded in FARS with trends in cell phone subscriptions and text message volume. They observed that distracted driving fatalities and text messaging both increased substantially from 2005 to 2008. Their multivariate regression analysis estimated that increased texting since 2001 produced over 16,000 additional traffic fatalities.

Fowles et al. (2010) studied the effects of cell phones on fatality rates from a "classical econometric" and quite technical point of view. They considered the effects of broad social and economic variables such as beer consumption, proportion of young males, seat belt laws, and the number of cell phone subscribers on annual fatality rates from 1980 to 2004. They concluded that fatality rates increased as cell phones first began to be used, then decreased as cell phone use rose, and finally increased again more recently. They attributed the positive effect of cell phones in the middle period to their use to call for emergency assistance at a crash. Now that cell phones are almost universal, their negative effects in distracting drivers overcome these positive effects. "The bottom line is that cell phones now have an adverse effect on motor vehicle fatality rates."

Collision insurance claim study. As part of a study of the effect of cell phone laws on insurance claim frequencies, HLDI (2009) tracked collision claim frequencies for several states in the period 2000-2009 (different years for different states). During this period of rapid growth in cell phone use in the general population and by drivers, collision claim rates either were flat or decreased slightly, both in states with and without cell phone laws. Collision claims differ from crashes: some crashes may not produce a collision claim because the damage was slight or because a vehicle was not insured, and minor events that produce collision claims may not be reported to the police as crashes. So collision claim rates may differ from crash rates.

Drivers frequently are distracted, perhaps as much as half the time while driving.

Summary and discussion //

Distraction effects on crash risk. What does this all mean? A few things are certain, while others are more a matter of opinion.

What's certain:

- Distractions affect driving performance.
- Drivers frequently are distracted, perhaps as much as half the time while driving.

Distractions are estimated to be associated with 15% to 25% of crashes

- Drivers adapt to some extent: they pay more attention to driving and reduce their distracting activities (such as using cell phones) in more risky driving situations. The 100-car data provides some documentation: secondary task frequency was 54% in random situations but 23% in situations similar to those that produced a crash or near-crash.
- Distractions are estimated to be associated with 15% to 25% of crashes at all levels from minor property damage to fatal injury. The true role of distractions in crashes may be greater because some distractions may not be reported accurately.
- Distractions cause some unknown number of individual crashes: many officers who regularly write crash reports can cite specific examples.

What's far from certain is how much various distractions affect crash risk. While the crash risk varies for different driving situations, the first question to ask is how a specific distraction affects overall crash risk.

The cell phone studies provide the best evidence. The studies estimate that cell phone use increases crash risk by:

- About 4 times, in the two classic studies that used cell phone records (Redelmeier and Tibshirani, 1997; McEvoy et al., 2005);
- About 3 times, in a meta-analysis of all crash data and naturalistic studies (Elvik, 2011);
- 2 to 3 times, for crashes and near-crashes in the 100-car study, using random controls (Klauer et al., 2006);
- 1.3 to 2.1 times, for crashes and near-crashes in the 100-car study, using drivers in similar situations as controls (Klauer et al., 2010);
- Not enough to be detected, for collision claims (HLDI, 2009).

The truth probably lies somewhere in this range. Cell phone use cannot increase crash risk by a factor of four in all situations: if it did, then cell phones would have caused about one-quarter of all crashes (Farmer at al., 2010; NSC, 2010a and 2010b), while all forms of distraction are estimated to be involved in 15% to 25% of crashes. But cell phone use – certainly hand-held, and perhaps also hands-free – does increase crash risk in some situations for some drivers. The only definite conclusion is that hand-held cell phone use increases crash risk to some extent.

There is no conclusive evidence on whether hands-free cell phone use is less risky than hand-held use. The 100-car study analyses found that complex tasks such as dialing a cell phone were more risky than simpler tasks such as talking on a phone (Klauer et al., 2006 and 2010). Analyses of the two commercial vehicle naturalistic studies found that dialing a cell phone increased the risk of safety-critical events, talking on or listening to a hand-held cell phone had no effect, and using a hands-free phone reduced the risk (Olson et al., 2009). Dialing a cell phone requires only a few seconds and involves both eyes and hands while a cell phone conversation may last

Texting probably increases crash risk more than cell phone use because texting requires both visual and manual distraction for a longer period of time than dialing a cell phone.

for many minutes and either involves one hand or is hands-free. The 100-car results imply that dialing a cell phone increases crash risk more for a short time while a cell phone conversation increases crash risk less for a longer time. The commercial vehicle studies suggest that cell phone effects on crash risk are produced by looking at or holding the phone, not by talking or listening. But the crash studies found no difference between crash risks for hand-held and hands-free phones (Redelmeier and Tibshirani, McEvoy).

Texting probably increases crash risk more than cell phone use because texting requires both visual and manual distraction for a longer period of time than dialing a cell phone. The only data on the risk of texting come from analyses of the two commercial vehicle naturalistic studies. They found that texting increased the risk of safety-critical events substantially, with an odds ratio of 23.2 (Olson et al., 2009; no texting was observed in 100-car study because data were collected in 2003 and 2004, before texting became common). These results are based on a small sample of 31 safety-critical events involving texting by commercial vehicle drivers, so the results may not be accurate and may not apply to passenger vehicle drivers.

No other distraction has even this much evidence for its effect on crash risk.

6 // Are there effective countermeasures for distracted driving?

Distracted driving countermeasures attempt to do one of three things:

- Eliminate the distraction, for example by prohibiting or preventing cell phone use or convincing drivers not to use cell phones;
- Reduce the driver's attention needed for a distracting task, for example by requiring or convincing drivers to use hands-free instead of hand-held cell phones;
- Warn distracted drivers of an impending risky situation, for example by a lane departure warning in the vehicle or a rumble strip in the roadway.

Distracted driving countermeasures can address the driving environment (the roadway and other things outside the vehicle), the vehicle, the driver, or some combination of these.

Roadway environment countermeasures. Many things outside the vehicle – people, animals, scenery, buildings, objects, signs, other road users, and the like – can attract a driver's eyes and attention. Regulations or standards for road signs and commercial signs provide a potential opportunity to eliminate or reduce distraction. But, as discussed in Chapter 4, there is not enough research evidence on how much distraction from a sign is safe. Distracted driving considerations do not suggest any changes to the guidelines or standards for road and commercial roadside signage in place in most jurisdictions.

Some types of rumble strips are an effective and widely-used strategy to warn drivers as they are leaving their travel lane.

Several roadway countermeasures are directed at drivers who are fatigued, impaired, or inattentive in addition to those who are distracted. For example, some types of rumble strips are an effective and widely-used strategy to warn drivers as they are leaving their travel lane. Persaud et al. (2004) studied centerline rumble strips on rural two-lane roads in seven states and concluded that they reduced all injury crashes by 14% and frontal and sideswipe crashes by 25%. In a British Columbia study, Sayed et al. (2010) found that roads with both edgeline and centerline rumble strips reduced off-road and head-on crashes a combined 21%. For other effective roadway strategies, such as shoulder width and design, see the AASHTO guides #4, for head-on collisions, and #6, for run-off-road collisions (NCHRP, 2003a and 2003b).

Vehicle countermeasures. Measures to reduce the distracting effects that the vehicle imposes on driving, for example by managing the way vehicle-based information is presented to the driver, or to warn the driver of risky situations through forward collision or lane departure alerts, have been studied extensively. This report does not review these measures because states have little role in improving or regulating them. See Donmetz et al. (2009), Engström and Victor (2009), Regan, Victor et al. (2009), Smith et al. (2009), and Zhang et al. (2009) for summaries.

Driver countermeasures. States can attempt to reduce driver distraction by laws prohibiting certain distracting activities, with appropriate publicity and enforcement, or by communications persuading drivers to reduce or eliminate these activities. Both strategies have been debated and used extensively in recent years, especially for the distractions produced by cell phone use and texting.

General distracted driving laws. All states have provisions in their traffic laws requiring drivers to be competent and in control of their vehicles. These may be applicable to distracted driving: for example, some blatant forms of distraction may be considered reckless driving. Many states also prohibit specific distracting activities such as watching television while driving, which was illegal in 38 states as of 2005 (Kelderman, 2005). At least four states – Connecticut, Maine, New Hampshire, and Oklahoma – and the District of Columbia now have laws specifically directed at distracted driving (AAA, 2010). For example, Maine's 2009 law (Sec. 1. 29-A MRSA §2117) prohibits "operation of a motor vehicle while distracted" which in turn is defined as "an activity that is not necessary to the operation of the vehicle and that actually impairs, or would reasonably be expected to impair, the ability of the person to safety operate the vehicle." None of these distracted driving laws has been evaluated (Regan, Young et al., 2009b).

As of June 2011, 9 states and the District of Columbia prohibited talking on a hand-held cell phone while driving, 30 states and the District of Columbia prohibited the use of all cell phones by novice drivers, 34 states and the District of Columbia prohibited texting while driving, and 7 additional states prohibited texting by novice drivers.

Cell phone and texting laws. As of June 2011, 9 states and the District of Columbia prohibited talking on a hand-held cell phone while driving, 30 states and the District of Columbia prohibited the use of all cell phones by novice drivers (states use different definitions of novice driver), 34 states and the District of Columbia prohibited texting while driving, and 7 additional states prohibited texting by novice drivers (GHSA, 2011a).

McCartt et al. (2010) summarized several studies of the immediate and long-term effects of hand-held cell phone laws on cell phone use in New York, the District of Columbia, and Connecticut. All studies used roadside observers to record cell phone use. In each jurisdiction, cell phone use decreased substantially immediately after the laws became effective: by 47% in New York, 41% in the District of Columbia, and 76% in Connecticut. Use then increased, by different amounts in the three jurisdictions, but remained lower than might have been expected based on the experience of other nearby states without the laws. None of the jurisdictions enforced its law vigorously. The observers could not determine accurately whether drivers were using

hands-free cell phones so could not measure combined hand-held and hands-free cell phone use.

Foss et al. (2009) studied the effects of North Carolina's 2006 law banning all cell phone use by drivers younger than 18. Cell phone use by teenage drivers at high schools did not change from one to two months before the law to five months after the law. Two-thirds of teenagers interviewed post-law were aware of the law but fewer than one-quarter believed that the law was being enforced. About half of those who had driven on the day before the interview used their cell phones while driving.

Braitman and McCartt (2010) included questions on cell phone laws in their telephone survey of driver cell phone use. By comparing responses from states with and without laws, they concluded that "laws banning hand-held phone use seem to discourage some drivers from talking on any type of phone and motivate some drivers to talk hands-free. Laws banning texting while driving have little effect on the reported frequency of texting while driving in any age group."

Three studies have attempted to estimate the effects of hand-held cell phone laws on crashes. As discussed in Chapter 5, HLDI (2009) used data from insurance collision claims. They examined whether collision claims dropped when states implemented cell phone laws compared to claims in adjoining states without cell phone laws. HLDI found that cell phone laws had no effect on collision claims: claim rates either were flat or decreased slightly, both in states with and without cell phone laws.

Nikolaev at al. (2010) used county-level fatal and injury crash rates per licensed driver from 1997 to 2007 to study the effects of New York's 2001 hand-held cell phone law. After the law, injury crash rates were lower in all 62 New York counties and significantly lower in 46; fatal crash rates were lower in 46 counties and significantly lower in 10. The analysis did not control for other influences on crash rates over this time period, and both fatal and injury crash rates were decreasing in the pre-law period.

Kolko (2009) studied cell phone law effects using FARS data from 1997 to 2005. Cell phone laws during this period were in effect for more than 4 years in New York, 18 months in New Jersey and the District of Columbia, and 2 months in Connecticut. This limited experience suggested that the laws reduced traffic fatalities, but only in bad weather or wet road conditions, and the laws had no statistically significant effect on overall traffic fatalities.

In the only study of texting bans, HLDI (2010) studied their effect on collision claims using the same methods as their 2009 study of cell phone laws. They concluded that texting bans did not reduce collision claims. In fact, there appears to have been a small increase in claims in the states enacting texting bans compared to neighboring states. HLDI suggested two possible reasons for the increase. Texters may realize that texting bans are difficult to enforce,

so they may have little incentive to reduce texting for fear of being detected and fined. Alternatively, texters may have responded to the ban by hiding their phones from view, potentially increasing their distracting effects by requiring longer glances away from the road.

After the texting ban become effective in one of the states studied by HLDI, crashes decreased at the same time that collision claims increased (Marti, 2011).

Distracted driving law enforcement. Only one study has evaluated the effect of law enforcement directed specifically at distracted driving laws. Hartford, Connecticut, and Syracuse, New York, participated in a NHTSA demonstration program of cell phone and texting law enforcement. Three waves of high-visibility enforcement and publicity activities were conducted in 2010 and a fourth was conducted in spring 2011. Immediately after the second wave, observed cell phone use dropped 56% in Hartford and 38% in Syracuse; observed texting while driving dropped 68% in Hartford and 42% in Syracuse (Cosgrove et al., 2010). Experience with similar short-term high-visibility enforcement campaigns directed at impaired driving and seat belt use suggests that the effects often diminish over time unless the campaign is repeated periodically. Results from the full study are scheduled to be released in July 2011.

All 27 European Union member states except Sweden ban hand-held cell phone use.

Cell phone laws and enforcement in other countries. Janitzek et al. (2010) report on laws, enforcement, and behavior regarding cell phones and other portable electronic devices in Europe. All 27 European Union member states except Sweden ban hand-held cell phone use, as do Iceland and Switzerland. Enforcement strategies and levels vary. About half the European countries target cell phones in special enforcement activities such as one-day campaigns or special motorbike enforcement units. The number of citations issued for cell phone law violations varies considerably, but in some countries "they outnumbered in recent years some other traditional offences such as non use of seat belts or impaired driving" (ibid, p. 62).

Drivers in Italy, Poland, Spain, Sweden, and the United Kingdom were surveyed on their use of cell phones and other electronic devices while driving. About 25% to 45% of the drivers in the first four countries reported they used a hand-held or hands-free phone at least "sometimes" and about 10% used one "often" – use rates generally lower than those reported in the United States (Chapter 3). Seventy percent of United Kingdom drivers reported never using their phones while driving, and of those who do, 40% said they always used a hands-free phone (ibid, p. 81).

Australia and seven Canadian provinces also ban hand-held cell phone use and Japan bans all cell phone use while driving (ibid, Sec. 4.3). Harbluk et al. (2010) document Canadian distracted driving laws as of spring 2010. WHO (2011) provides a broad overview of how various countries are addressing cell phone use when driving.

Several manufacturers provide systems that attempt to block or filter a driver's cell phone while the vehicle is in motion.

Technology. Several manufacturers provide systems that attempt to block or filter a driver's cell phone while the vehicle is in motion. Some consist of software applications ("apps") loaded onto the cell phone. They are triggered when the phone's motion exceeds some threshold, so they work only on GPS-equipped "smartphones." Other systems are integrated into the vehicle and affect all cell phones in the vehicle through a small transmitter.

Different systems have different features to block or allow calls. Blocked incoming calls can be stored as voice or text messages; auto-reply responses can be sent. All systems allow emergency calls to 911. Some allow calls to a few other numbers set in advance. Some block all incoming calls, texts, and emails. Some allow calls when the vehicle is briefly stopped at a red light; others block calls for several minutes after stopping. Some allow geographic areas to be specified within which all calls are blocked. Some allow the user to allow or block calls from specified phone numbers. Each system has a different strategy for addressing the "passenger problem" – whether and how to allow calls by someone in motion who is not a driver, such as a passenger in a car or a rider on a bus or train.

This technology is developing very rapidly. Pogue (2010) provides a recent overview. The University of Michigan's Transportation Research Institute (UMTRI) is conducting a study in 2011 to evaluate these systems (GHSA, 2011b).

Distracted driving communications and education. Most states conduct distracted driving education and communication activities (GHSA, 2010).

- For beginning drivers: Twenty-three states have created special materials on distraction for teen drivers. Information on distracted driving is a required component of driver education in 18 states and the District of Columbia. There are distracted driving questions on the driver's license test in 17 states and the District of Columbia. Thirty-two states and the District of Columbia have distinct sections on distracted driving in their driver license manuals.
- For others: Thirty-seven states and the District of Columbia conducted a recent public communication or education campaign on distracted driving. Eight states provided training or technical assistance to the judiciary on distracted driving.

None of these communication and education activities has been evaluated to see whether they increased drivers' knowledge, changed their behavior, or reduced crashes.

U.S. Secretary of Transportation Ray LaHood has made distracted driving a top safety priority. The Department of Transportation has produced a variety of communication and education materials (see distraction.gov). Many other persons and organizations have publicized distracted driving or conducted specifically targeted campaigns, including Oprah Winfrey's *No Phone Zone* (www.oprah.com/packages/no-phone-zone.html), FocusDriven and the National Safety Council's *On the Road, Off the Phone* (www.focusdriven.org),

Many companies around the world have established and implemented policies for their employees regarding cell phone use.

and the American Academy of Orthopaedic Surgeons' *Decide to Drive* (www.decidetodrive.org). Some physicians are including distracted driving in their discussions with patients (Ship, 2010). While these activities undoubtedly have reached many drivers, their effects on driver knowledge, driver behavior, or crashes have not been evaluated.

Company policies and programs. Many companies around the world have established and implemented policies for their employees regarding cell phone use and other distractions (Regan, Young et al., 2009b). Speakers at the 2010 Department of Transportation Distracted Driving Summit provided examples (distraction.gov). The Network of Employers for Traffic Safety (NETS) reports that, of the 4,690 public and private organizations that downloaded the 2010 NETS Drive Safety at Work Week campaign materials, 3,067 have a cell phone policy in place, with 1,152 banning the use of all cell phones and another 1,915 prohibiting hand-held cell phones. Another 1,062 organizations plan to implement a policy in 2011 (trafficsafety.org).

Thirty-five states have worked with other state agencies and private employers to address distracted driving. Sixteen states and the District of Columbia have partnered with other state agencies or private companies to develop distracted driving policies (GHSA, 2010). Company policies can be a powerful influence on their employees' driving because companies can monitor their drivers' behavior and enforce their policies. However, no information on the effects of these policies is available.

Summary and discussion //

Distracted driving countermeasures. There are no roadway countermeasures directed specifically at distracted drivers. Many effective roadway design and operation practices that improve traffic safety in general, 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. These are key focus areas of research by vehicle manufacturers and NHTSA (distraction.gov). While some systems are beginning to be implemented in new vehicles, 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. Technological systems to block or limit a driver's cell phone calls are developing rapidly but have not yet been evaluated.

The limited research suggests that hand-held cell phone laws covering all drivers reduced cell phone use by about half when they were implemented, even though they were not vigorously enforced. Cell phone use then increased subsequently, but the laws appear to have had some long-term effect. The one study of high-visibility and heavily-publicized cell phone law enforcement suggests that it can reduce cell phone use at least temporarily.

There is no evidence that cell phone or texting laws have reduced crashes.

There is no evidence that cell phone or texting laws have reduced crashes. Two studies found no effects of these laws on collision insurance claims. The only study of a complete cell phone and texting ban for beginning drivers, who use text messages and cell phones more frequently than older drivers, found no effect on their texting.

Publicity and campaigns directed at cell phone use and texting while driving undoubtedly have reached many drivers but their effects have not been evaluated. Many companies have cell phone use policies and programs but these also have not been evaluated.

7 // Conclusions and recommendations

Distracted driving research thoroughly documents the frequency of distractions on the road and the effects of distraction in experimental settings. But there is little evidence on the two most important issues: the effect of distractions on crash risk (Chapter 5) and the effects of countermeasures on reducing distracted driving (Chapter 6). Research on cell phone use and texting, the distractions that have received the most attention, concludes 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.
- The influence of texting on crash risk in passenger vehicles has not been studied.
- 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 have not been evaluated.

Distraction while driving cannot be eliminated; rather, it's part of who we are, as humans and as drivers. The actions outlined below may help manage it.

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**.
    - **Pro:** Novices are the highest-risk drivers. Their attention should be focused on driving, not on cell phone conversations or other distractions. A ban reinforces this

message and 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 (states use different definitions of novice driver).
    - **Con:** There is no evidence that novice driver cell phone or texting bans are effective.

- **Enact texting bans.**
    - **Pro:** 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.
    - **Con:** Texting laws are difficult to enforce.

- **Enact hand-held cell phone laws.**
    - **Pro:** Hand-held cell phone use increases crash risk, probably more than hands-free. Laws reduce but will not eliminate hand-held cell phone use. Laws send a message that hand-held cell phone use while driving is unacceptable.
    - **Con:** Hand-held cell phone laws often are ignored. Hand-held cell phone laws send a message that hands-free cell phone use while driving is safe, which it may not be.

- **Enforce hand-held cell phone and texting laws.**
    - **Pro:** Enforcement will increase any law's effect. Enforcement can be targeted to specific high-risk locations or can be conducted in short high-visibility campaigns similar to those that have increased belt use and reduced impaired driving. Failing to enforce a law sends a message that the law is not important.
    - **Con:** Enforcing cell phone or texting laws will divert resources from other traffic law enforcement activities.

- **Implement distracted driving communication programs.**
    - **Pro:** 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.
    - **Con:** Distracted driving communication programs have not been evaluated. They will divert resources from other traffic safety communications activities.

- **Help employers develop and implement distracted driving policies and programs.**
    - **Pro:** Many companies have established and implemented cell phone policies for their employees. Company policies can be a powerful influence on employees' driving.
    - **Con:** Employer distracted driving programs have not been evaluated.

States can and should take three 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. The 4th Edition Model Minimum Uniform Crash Criteria (MMUCC) guidelines for state crash data systems, to be published in 2012, will address distracted driver coding (www.mmucc.us).
- Evaluate distracted driving laws and programs. Evaluation will provide the information states need on which countermeasures are effective and which are not.

Distracted driving is an important priority for employers, the automobile industry, and the federal government as well as for states. Key activities for each include:

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. These activities ultimately should lead to vehicles that work with drivers to prevent crashes.

Federal government.

- Help states evaluate the effects of distracted driving programs, especially cell phone and texting laws, enforcement campaigns, and communications.
- Continue tracking driver cell phone use and texting in NOPUS.
- Work with states to improve data collection on driver distractions involved in crashes. In particular, use the 4th Edition of MMUCC to improve how distraction is coded in crash reports.
- Continue to develop and conduct national communications campaigns on distracted driving.

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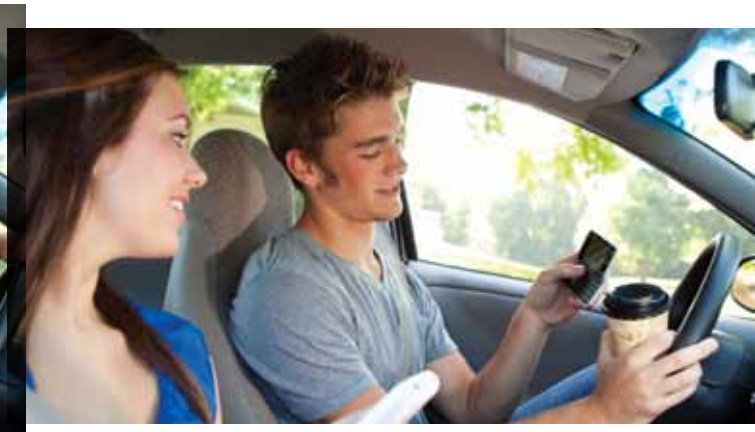

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