

# **Status Summary: Using Wireless Communication Devices While Driving**

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## Contents

I.	General Conclusion:	3
II.	Experimental Data:	3
A.	Hand-held vs. Hands-free mobile phones	3
B.	Cognitive Demand while Driving	4
C.	Epidemiological Data	5
III.	Other Laws, Policies and Recommendations from Around the World Against Cell Phone Use While Driving	5
IV.	Activity at the State Level	8
V.	Sample of Corporate Policies and Guidance	8
VI.	FMR Bulletin B-2 (Wireless Phone Use in U.S. Government Vehicles)	10
VII.	Summary of Positions Against Restrictions on Use of Wireless Communication Devices While Driving	11
VIII.	NTSB Safety Recommendations To the National Highway Traffic Safety Administration (June 3, 2003):	12
	Appendix: Detailed Summary -Using Wireless Communication Devices While Driving	13
	Research	14
	Policy Statements Against Cell Phone Use while Driving	74
	Policy Statements Against Restricting Cell Phone Use while Driving	85
	Company Policies and Guidance	98

## **Status Summary:**

### **Using Wireless Communication Devices While Driving**

#### **I. General Conclusion:**

The experimental data indicates that, with the exception of the consequences of manipulating a wireless communications device, there are negligible differences in safety relevant behavior and performance between using hand-held and hands-free communications devices while driving from the standpoint of cognitive distraction. Specifically, the experimental data reveal observable degradations in driver behavior and performance and changes in risk-taking and decision-making behaviors when using both hand-held and hands-free mobile phones, and the nature of those degradations and changes are symptomatic of potential safety-related problems.

#### **II. Experimental Data:**

##### **A. Hand-held vs. Hands-free mobile phones**

1. Evidence (e.g., Patten et al., in press; Consiglio et al., 2003; Greenberg et al., 2003; Direct Line Insurance, 2002; Ishida & Matura, 2001; Strayer & Johnston, 2001; Haigney et al, 2000; Lamble et al, 1999; RoSPA, 2002) of general delay in information processing and degradations in driving performance (e.g., variations in speed, decrement in driver responsiveness to traffic conditions and delayed reactions) regardless of mobile phone platform – hand-held or hands-free, and that those degradations are equivalent for hand-held and hands-free cell phone users.
2. Research (e.g., Briem & Hedman, 1995) suggests that a difficult conversation may have an adverse effect of driving, and any prolonged manipulation of a mobile phone is likely to impact driving performance, particularly under conditions that place heavy demands on the driver's attention and skill.
3. While it is not possible to make a direct connection to crash risk from experimental results, the nature of driving performance degradations measured in relation to the presence of a phone conversation task are associated with subjective risk manipulation and crash involvement and are symptomatic of potential safety-related problems associated with such things as mobile phone use while driving, even if such use does not involved physical manipulation of the device (ICBC, 2001; Haigney et al, 2000).
4. *Hands-free phones*
  - Evidence (e.g., Harbluk et al, 2002) of changes in driver behavior (narrowed visual scanning behavior and reductions in vehicle control) under real-world driving conditions due to increase in cognitive demands associated with mobile phone usage, including hands-free phones. Even simple conversation can disrupt attentive scanning and information processing of the visual scene. Researchers believe that changes in these behaviors are indicative of the extra demands placed on the driver by cell phone usage, and that these demands contribute to late detection, reduced situation awareness and a reduced margin of safety.
  - Evidence (e.g., ICBC, 2001) of increases in cognitive demand due to listening to complex messages via hands-free phone results in degraded driving performance (e.g., reductions in margin of safety and significantly riskier decision-making, such as shorter acceptor gaps), and that adverse driving conditions (i.e., slippery or wet road) aggravates the problems.

- Evidence from simulator studies (e.g., Parkes & Hooijmeijer, 2001) of significant deterioration in situational awareness (of the surround traffic environment) when drivers are engaged in cognitively demanding conversation using a hands-free phone. In addition, evidence of longer reaction times and increased mental workload associated with engaging in hands-free conversation, and that neither younger nor elderly drivers adapted headway (or following distance) to account for increase risk due to increased reaction time (Alm & Nilsson, 1995).

#### 5. *Hand-held phones*

- Evidence from simulator-based studies (e.g., Patten et al., in press; Graham & Carter, 2001; Strayer & Johnston, 2001) indicates that tracking performance and peripheral event detection are worse when using a mobile phone than when not, and that performance is worse when manually dialing a hand-held phone while driving than when using a voice-dialed hands-free phone.
- Evidence from on-road and closed-course studies (e.g., Tokunaga et al, 2000; Ishida & Matura, 2001) that both simple and complex conversations using a hand-held mobile phone are associated with greater reactions times than driving alone, that braking reaction times are longer than when not using a phone, and that delays are longer when using hand-held phones than when using hands-free phones.
- Evidence from closed-course and simulator-based studies (e.g., Ishida & Matura, 2001; Haigney et al, 2000; Parkes & Hooijmeijer, 2001) that driving speed tends to be lower and headway distance increases – suggesting a “process of risk compensation,” and that drivers are slower to react to specified speed changes.
- Evidence from simulator-based studies (e.g., McKnight & McKnight, 1991) of significant delays in response to or failure to respond to traffic events, a relative increase in chance of a highway-traffic situation going unnoticed ranging from 20% to 29% for placing a call in simple conversation to complex conversations, and that this behavior is twice as likely in older drivers. Greenberg et al. (2003) found that hands-free and hand-held dialing resulted in significantly more missed front events than the control condition, as did the hands-free incoming call and hand-held voicemail retrieval.

Researchers noted that while a cellular telephone conversation may be no more distracting than a conversation of the same intensity with a passenger, the availability of a cellular phone likely significantly increases the number of conversations in general and the more ‘distracting, intense, business conversation’ in particular. They also noted that older drivers in particular should be cautioned against using hand-held phones while driving. (McKnight & McKnight, 1991)

#### **B. Cognitive Demand while Driving**

- Evidence from closed-course and simulator-based studies (e.g., Irwin et al, 2000; Lee et al., 2001; Hancock et al., 2003) revealed longer reaction times when a driver is engaged in conversation using a mobile phone or other cognitively demanding task (e.g., simulated electronic mail).
- Evidence (McCarley et al, in press) that simple conversations can disrupt attentive scanning and representation of a visual scene (or situation awareness).

### C. Epidemiological Data

- Evidence (e.g., Laberge-Nadeau et al, 2001; Sagberg, 2001; Violanti & Marshall, 1996; Redelmeier & Tibshirani, 1997) of an increased risk of collision when using cellular telephones in a motor vehicle. Studies have found that:
  - Risk of all accidents and of accidents with injuries increases by 38% for cell phone users, and heavy cell phone users are exposed to more than twice the risk as normal users, taking into account age, exposure to risk and driving habits (Laberge-Nadeau et al, 2001).
  - While some crashes during telephone use are expected based on exposure to driving alone, the actual number of crashes is about 72% higher than the expected number, as estimated by the method of induced exposure. Increased risk is likely the consequence of telephone use per se and is not attributable to differences in risk-related behavior between users and non-users of mobile telephones (Sagberg, 2001).
  - Talking more than 50 minutes per month on cellular phones in a vehicle was associated with an increase of more than five times the risk of traffic collision (Violanti and Marshall, 1996).
  - It cannot be concluded from the data that hand-held phones lead to higher risk than hands-free phones (e.g. Sagberg, 2001; Redelmeier & Tibshirani, 1997).

*Authors of these epidemiological studies have stated that their data revealed statistical associations, not causal relationships, and that their data do not necessarily indicate that talking on cellular phones while driving is inherently dangerous.*

### **III. Other Laws, Policies and Recommendations from Around the World Against Cell Phone Use While Driving**

- At least 42 countries restrict or prohibit use of cell phones and other wireless technology in motor vehicles, and several more are considering legislation. Israel, Portugal and Singapore prohibit all mobile phone use while driving. Drivers in France and United Kingdom may use cell phones but can be fined if involved in crash while using the phone. Drivers in United Kingdom and Germany can lose insurance coverage if involved in crash while talking on the phone. Countries that prohibit the use of hand-held mobile phones while driving include:

Australia	Hong Kong, China	Malaysia	South Korea
Austria	Hungary	Netherlands	Spain
Belgium	India (New Delhi)	Norway	Switzerland
Brazil	Ireland	Philippines	Taiwan
Chile	Isle of Man	Poland	Thailand
Czech Republic	Italy	Romania	Turkey
Denmark	Japan	Russia	Turkmenistan
Egypt	Jersey	Slovak Republic	Zimbabwe
Germany	Jordan	Slovenia	
Greece	Kenya	South Africa	

- **Transport Canada** – “Recommends against using cell phones while driving. It is distracting and increases the risk of collision. Your primary concern is the safe operation of the vehicle. To avoid collisions arising from the use of cell phones: Turn the phone off before you start driving. Let callers leave a message. If there are passengers in the vehicle, let one of them take or make a call. If you’re expecting an important call, let someone else drive. If you have to make or receive a call, look for a safe opportunity to pull over and park.” [Transport Canada Fact Sheet RS200-06 (TP2436E, December 2001)]
- **United Kingdom – The Highway Code** – “You MUST exercise proper control of your vehicle at all times. Never use a hand held mobile phone or microphone while driving. Using hands-free equipment is also likely to distract your attention from the road. It is far safer not to use any telephone while you are driving – find a safe place to stop first.” (Department for Transport, Local Government and the Regions, 1999; Tunbridge, 2001).

The Department of the Environment, Transport and the Regions in the United Kingdom recommends to employers that they not ask staff to “carry out two demanding tasks at the same time” – that employees should not be expected to use a phone while driving. “If you or your customers need to contact staff while they may be driving, ensure that you provide hands-free equipment with voicemail or call divert facilities and encourage your staff to stop regularly to check for messages and return calls.”

- **National Safety Council** – “...a driver’s first responsibility is the safe operation of the vehicle and that best practice is to not use electronic devices including cell phones while driving. When on the road, drivers shall concentrate on safe and defensive driving and not on making or receiving phone calls, delivery of faxes, using computers, navigation systems, or other distracting influences.”

National Safety Council “supports restrictions that prohibit all non-emergency use of electronic devices including cell phones by teenage drivers during their graduated licensing period.”

National Safety Council recommends that employers assess whether to allow employees to use such devices while driving, and if so, what sensible restrictions should be followed.

- **Royal Society for the Prevention of Accidents (RoSPA, UK)** – “No driver should use a mobile telephone or any similar piece of telecommunications equipment (whether hand-held or hands-free) while driving.”

RoSPA recommends that employers “incorporate this policy within their own rules governing company drivers. Vehicles are intended to transport their occupants and good to their destination(s) and any temptation to turn vehicles into ‘mobile offices’ should be resisted.” RoSPA also recommends that employers “never ‘require’ staff to be available on mobile phones while they are driving” and to “consider carefully before fitting and requiring drivers to use ‘hands-free’ kits.”

- **Swedish National Road Administration (SNRA)** – "...the results of some 80 studies show that using a mobile phone in a car while driving impairs driving performance significantly. This is because a driver's attention to traffic and traffic information is impaired and the control of the car becomes less precise and smooth when talking over a phone. Not only the motor activities needed for phoning disturb driving, but also the conversation in itself and, in particular, demanding communications impair both attention and manoeuvring performance significantly. Therefore, hands-free mobile phones will not solve the safety problem of phoning and driving. Analyses of accidents have shown that the impairment of driving while phoning leads to an increased risk of having an accident both for hand-held and hands-free phones. One important characteristic of a phone conversation in relation to most other in-car activities is that the pace and content of the phone conversation cannot be controlled as well by the driver. This makes a phone conversation more distracting than other equally demanding in-car activities that can be distributed in time and adapted to prevailing traffic and driving conditions." [Swedish National Road Administration (Svensson, and Patten, in press)]

Some recent recommendations from the SNRA, as reported by Svensson, and Patten (in press), include the following:

1. "...it is not justifiable to introduce legislation that only forbids the use of mobile phone systems that require the use of the driver's hands" because research clearly shows that conversation and its complexity are a greater burden on the driver.
2. In the future study of fatal crashes, SNRA should look into the pre-crash phase for causes.
3. "The Police and SNRA's in-depth study programme be given the authority and opportunity to more easily check whether a mobile phone has been used in a fatal accident."
4. SNRA recommends that using a mobile phone while driving be defined in legal terms as an activity on par with the effects of tiredness or alcohol.
5. Drivers should be informed of the effects of mobile phone use on driving performance.

- **General Recommendations in the Literature**

- Governments should develop educational materials that cell phones should not be used while driving, to advise the public that hands-free phones are not risk-free, and to provide important safety tips for drivers to consider if they intend to continue their use of phones while driving (Harbluk et al, 2002). Driver-related safety measures should be encouraged, including training and education campaigns (LaBerge-Nadeau et al, 2001; National Safety Council, 2002; Joint State Government Commission, 2001).
- Need for further research to determine need for regulating original equipment (Harbluk et al, 2002).
- Need for further study into the nature and duration of typical car phone conversations (Parkes & Hooijmeijer, 2001).
- Need for further study on issue of using hands-free phones while driving (Direct Line Insurance plc, 2002).
- Use voice-activated hands-free cell phones in order to "minimize handling and keep both hands on the steering wheel" (LaBerge-Nadeau et al, 2001).
- Develop vehicle-related safety devices for improved hazard warning and driver assistance (LaBerge-Nadeau et al, 2001; Hahn et al, 2000).
- Government should contribute to consistent collection of reliable crash data nationally, which should include more detailed information regarding crashes associated with driver distraction (Joint State Government Commission, 2001; Jackman, 2000; Hahn et al, 2000).

#### **IV. Activity at the State Level**

As reported by the National Conference of State Legislatures, few states specifically regulate wireless phone use in motor vehicles. In particular (as of June 2003),

- New York prohibits drivers from talking on hand-held cell phones while driving.
- California requires that rental cars with cellular telephones must include written operating instructions for safe use of the phone.
- Florida and Illinois allow cell phone use in the car as long as sound to both ears of the driver is not impaired.
- Arizona, Illinois, Massachusetts, New Jersey, Rhode Island, and Tennessee have enacted legislation that prohibits the use of cell phones while operating a school bus.
- Massachusetts also requires that all drivers have at least one hand on the steering wheel at all times while using a cell phone.
- New Jersey enacted legislation in 2002 that prohibits the holder of a driver examination permit from using any interactive wireless device while operating a motor vehicle, with emergency use exceptions.
- Maine enacted legislation in 2003 that requires persons under 21 to obtain an instruction permit and receive education and training prior to obtaining a driver's license. This legislation also prohibits drivers with only an instruction permit from using a mobile telephone while driving.
- Legislation that would prohibit the use of hand-held cell phones while driving was passed by the California State Assembly on May 29, 2003, and has been passed to the State Senate for consideration.

In addition,

- Delaware, Louisiana, Virginia, New Jersey, New Mexico, and Pennsylvania have approved resolutions to study the risks associated with cell phones and driving.
- New Jersey passed a measure to provide for data collection and also prohibits drivers with learner's permits from using a cell phone while driving.
- Illinois allows the use of one-sided hands-free headsets with cell phones.
- Florida, Kentucky, Mississippi, Nevada, Oklahoma and Oregon are preventing local jurisdictions from enacting ordinances regarding cell phone use while driving.
- At least 16 states – California, Florida, Iowa, Maryland, Massachusetts, Montana, Michigan, Minnesota, Nebraska, New Jersey, New York, Oklahoma, Oregon, Pennsylvania, Tennessee, and Texas – collect information on crash report forms about cell phones and driver distractions.

#### **V. Sample of Corporate Policies and Guidance**

- **Direct Line Insurance plc** – “Putting safety first... Talking on the phone distracts your attention from the road and can lead to an accident. Never use a mobile phone. Even using a hands-free phone is distracting.”

Direct Line Insurance strongly believes that all employers have a responsibility to offer clear instructions to their staff not to use hand-held or hands-free phones when using company vehicles.



- **Farmers Insurance Group** – “While Farmers Insurance Group promotes the idea of drivers carrying a cell phone while in their car in case of emergencies, we don’t recommend people use a phone while they are driving.” (As quoted by the Auto Channel, 2000).
- **Praxair (Connecticut-based industrial gas maker)** - banned cell phone use while driving in 1999. (As noted by the Associated Press, 2001)
- **Wilkes Artis (Washington, D.C. -based law firm)** - “Our policy is that personnel are not to conduct business while using cell phones, unless they pull over and stop or use a hands free device.” (As quoted by the Associated Press, 2001)

## **VI. FMR Bulletin B-2 (Wireless Phone Use in U.S. Government Vehicles)**

General Services Administration (2002). FMR Bulletin B-2: Motor Vehicle Management.

To Heads of Federal Agencies

Regarding Use of Hand-held Wireless Phones while Driving Motor Vehicles Owned or Leased by the Federal Government

Effective March 1, 2002

*Recommended policy when issuing guidance on the use of wireless phones while driving motor vehicles owned or leased by the Federal Government*

Federal agencies should:

6. Discourage the use of hand-held wireless phones by a driver while operating motor vehicles owned or leased by the Federal government.
7. Provide a portable hands-free accessory and/or hands-free car kit for government owned wireless phones.
8. Educate employees on driving safely while using hands-free wireless phones.

Attachment A - Cellular Phone Safe Driving Tips (Source: NHTSA: *An Investigation of the Safety Implications of Wireless Communications in Vehicles November 1997*)

- Safe driving is your first priority. Always buckle up, keep your hands on the wheel and your eyes on the road.
- Make sure that your phone is positioned where it is easy to see and easy to reach. Be familiar with the operation of your phone, so that you're comfortable using it on the road.
- Use a hands-free microphone while driving. Make sure your phone is dealer-installed to get the best possible sound.
- Use the speed-dialing feature to program in frequently called numbers. Then you can make a call by touching only two or three buttons. Most phones will store up to 99 numbers.
- When dialing manually without the speed-dialing feature, dial only when stopped. If you can't stop, or pull over, dial a few digits, then survey the traffic before completing the call. (Better yet, have a passenger dial.)
- Never take notes while driving. Pull off the road to jot something down; if it's a phone number, many mobile phones have an electronic scratchpad that allows you to key in a new number while having a conversation.
- Let your wireless network's voicemail pick up your calls when it's inconvenient or unsafe to answer the car phone. You can even use your voice mail to leave yourself reminders.
- Be a cellular Samaritan. Dialing 9-1-1 is a free call for cellular subscribers; use it to report crimes in progress or other potential life-threatening emergencies, accidents or drunk driving.

## **VII. Summary of Positions Against Restrictions on Use of Wireless Communication Devices While Driving**

The information cited argues for sensible driving behavior relative to cellular phone use while driving and the use of hands-free phones (or speakerphones) if drivers feel compelled to engage in phone conversation while on the road. These organizations argue that while there is evidence that using a cellular phone while driving does pose risks to both the driver and other road users, however, the crash data are insufficient to necessitate an all out ban on phone use while driving. They encourage further research and educational campaigns to ensure responsible behavior on the road.

In particular, the National Conference of State Legislatures adopted a resolution in August 2001 that opposes restricting cell phone use while driving.

In addition, the National Association of Governors' Highway Safety Representatives (NAGHSR) opposes federal legislation that would penalize states for not restricting the use of cell phones or other electronic devices while driving. However, the NAGHSR discourages use of cell phones and other electronic devices while driving.

### **And related to the issue of crashes?**

A July 2000 article for Drivers.com quoted Csaba Csere, editor in chief of *Car and Driver* magazine, as saying, "The safety experts tell us that half the accidents are caused by drunk driving, 70 percent are caused by aggressive drivers, 30 percent are caused by speeding. All of a sudden, you know, we've got more causes than accidents, and it's very, very difficult to decide exactly what the causes are." Csere was further quoted as saying, "We currently have the safest driving in the United States we've ever had. That National Highway Traffic Safety Administration just released the preliminary statistics for 1999 that said that the traffic death rate was 1.5 deaths per 100 million vehicle miles traveled. That's one-third of what it was 30 years ago. So whatever problem we have with distracted drivers, it's can't be too bad." (Source: Drivers.com (2000). Distracted drivers: are car phones guilty? Online at [www.drivers.com](http://www.drivers.com))

However... "The crash death rate dropped or remained at the same level throughout the 1990s in response to a number of factors. Motor vehicles are now safer because of design improvements; air bags and seat belts provide greater crash protection; the driving population is more mature; and most states have enacted laws to restrict young drivers, screen elderly drivers, and deter drunk driving. Drivers have contributed to the reduction in fatalities by demanding vehicles with good safety ratings." (Source: Gastel, R. (2002). Auto Safety and Crashworthiness. In *III Insurance Issues Update* Insurance Information Institute. Online at [www.nexis.com/research/pnews](http://www.nexis.com/research/pnews))

### **Finally, from the Harvard Center for Risk Analysis**

The Harvard Center for Risk Analysis (Lissy, Cohen, Park, and Graham, 2000) reported that: "The weight of the scientific evidence to date suggests that use of a cellular phone while driving does create safety risks for the driver and his/her passengers as well as other road users. The magnitude of these risks is uncertain but appears to be relatively low in probability compared to other risks in daily life. It is not clear whether hands-free cellular phone designs are significantly safer than hand-held designs, since it may be that conversation per se rather than dialing/handling is responsible for most of

the attributable risk due to cellular phone use while driving." The authors concluded that "it may be premature to enact substantial restrictions at this time."

In an update of the analysis above, Cohen and Graham (2003) note that "Although the CE ratios for other injury prevention programs are also highly uncertain, they suggest that there are actions that could be taken that would save lives lost in motor vehicle crashes at a lower economic cost than a ban on cell phones. This finding is consistent with the conclusion reached by Redelmeier and Weinstein that *'Regulations restricting cellular telephone usage while driving are less cost-effective for society than other safety measures.'* The fact that the net benefits of the ban are close to zero and yet there are other more efficient motor vehicle safety measures that are not yet implemented indicates that as a society, we are under investing in motor vehicle safety."

### **VIII. NTSB Safety Recommendations To the National Highway Traffic Safety Administration (June 3, 2003):**

1. Develop in conjunction with The Advertising Council, Inc., a media campaign stressing the dangers associated with distracted driving.
2. Develop in conjunction with the American Driver and Traffic Safety Education Association a module for driver education curriculums that emphasizes the risks of engaging in distracting behavior.
3. Determine the magnitude and impact driver-controlled, in-vehicle distractions, including the use of interactive wireless communication devices on highway safety and report your findings to the United States Congress and the States.

**NTSB Safety Recommendations to the 49 States that do not have legislation prohibiting holders of learner's permits and intermediate licenses from using interactive wireless communication devices:**

4. Enact legislation to prohibit holders of learner's permits and intermediate licenses from using interactive wireless communication devices while driving.

**NTSB Safety Recommendations to the 34 States that do not have driver distraction codes on their traffic accident investigation forms:**

5. Add driver distraction codes, including codes for interactive wireless communication device use, to your traffic accident investigation forms.

**NTSB Safety Recommendations to the American Driver and Traffic Safety Education Association:**

6. Develop in conjunction with the National Highway Traffic Safety Administration a module for driver education curriculums that emphasizes the risks of engaging in distracting behavior.

**NTSB Safety Recommendations to the Advertising Council, Inc.:**

7. Develop in conjunction with the National Highway Traffic Safety Administration a media campaign stressing the dangers associated with distracted driving.

## **Appendix: Detailed Summary -Using Wireless Communication Devices While Driving**

Note: The following citations are listed in descending chronological order, and alphabetically by first author within each publication year.

## Research

Svensson, O., and Patten, C. (in press). Information Technology in the Car: Mobile Phones and Traffic Safety A Review of Contemporary Research. (Swedish National Road Administration)

Reviewed research on the effects of using a mobile phone when driving. Includes seven (7) recommendations.

- Results from some 80 studies show that using a mobile phone in a car while driving impairs driving performance significantly. This is because a driver's attention to traffic and traffic information is impaired and the control of the car becomes less precise and smooth when talking over a phone. Not only the motor activities needed for phoning disturb driving, but also the conversation in itself and, in particular, demanding communications impair both attention and manoeuvring performance significantly.
- Therefore, hands-free mobile phones will not solve the safety problem of phoning and driving.
- Analyses of accidents have shown that the impairment of driving while phoning leads to an increased risk of having an accident both for hand-held and hands-free phones.
- Recommendations:
  1. "it is not justifiable to introduce legislation that only forbids the use of mobile phone systems that require the use of the driver's hands" because research clearly shows that conversation and its complexity are a greater burden on the driver.
  2. In the future study of fatal crashes, SNRA should look into the pre-crash phase for causes.
  3. "The Police and SNRA's in-depth study programme be given the authority and opportunity to more easily check whether a mobile phone has been used in a fatal accident."
  4. SNRA recommends that using a mobile phone while driving be defined in legal terms as an activity on par with the effects of tiredness or alcohol.
  5. Drivers should be informed of the effects of mobile phone use on driving performance.
  6. Position equipment such as DVD, TV and other visual information be positioned where the driver cannot be visually distracted while driving.
  7. Further support for the development of intelligent driver-support systems.

Strayer, D., and Drews, F. (under review). Effects of cell phone conversations on younger and older drivers. Accessed on June 19, 2003 from: <http://www.psych.utah.edu/AppliedCognitionLab/Aging.pdf>

This study examined the effects of hands-free cell phone conversations on simulated driving performance for older and younger drivers. Participants then drove four ten-mile sections on a multi-lane highway. The participant's task was to follow a pace car that was driving in the right-hand lane of the highway. When the participant stepped on the brake pedal in response to the braking pace car, the pace car released its brake and accelerated to normal highway speed. The dual-task condition involved the participant and the research assistant discussing topics that were identified in the questionnaire as being of interest to the participant. Participants used a hands-free cell phone and the call was initiated before participants began the dual-task scenarios. Therefore, any dual-task interference that they observed must have been due to the cell phone conversation itself, because there was no manual manipulation of the cell phone during the dual-task portions of the study.

#### Context

- Driving simulator

#### Independent variables

- Age group (18-25 yrs vs. 65-74 yrs)
- Single vs. Dual task conditions (no conversation vs. conversation)

#### Dependent variables

- Brake onset time
- Following distance
- Speed
- Half-recovery time (time to recover 50% of speed lost during braking)

- We found that driving performance of both younger and older adults was impaired by cell phone conversations.
- Compared to single-task conditions, cell-phone drivers' reactions were 18% slower, their following distance was 12% greater, and they took 17% longer to recover the speed that was lost following braking.
- These cell-phone induced impairments were equivalent for younger and older adults, suggesting that older adults do not suffer a significantly greater penalty for talking on a cell phone while driving than their younger counterparts.
- Interestingly, the net effect of having younger drivers converse on a cell phone was to make their braking reactions equivalent to those of older drivers who were not using a cell phone.
- "In sum, our research found that the driving performance of both younger and older adults is significantly impaired when they are conversing on a hands-free cell-phone. These dual-task impairments were equivalent in magnitude for younger and older adults."
- Note: This report is still under peer review and therefore should be considered with caution.

Glassbrenner, D. (in press). Cell Phone Use on the Roads in 2002 (Technical Report DOT HS 809 580). Washington, DC: NHTSA.

NHTSA 2002 NOPUS results relevant to the cell phone issue.

- In 2002, the portion of drivers estimated to be using a hand-held phone at any given time during daylight hours increased to 4%.
- An estimated additional 2% use hands-free equipment.
- In total, at least 6% of drivers are using some kind of wireless phone at any given time
- Significant increase in urban areas from 2000

Lesch, M., and Hancock, P. (in press). Driving performance during concurrent cell-phone use: are drivers aware of their performance decrements? *Accident Analysis and Prevention*.

This study examined the extent to which different driver groups are aware of their associated performance decrements. Subjects' confidence in dealing with distracters while driving and their ratings of task performance and demand were compared with their actual driving performance in the presence of a cell-phone task.

Context

- Test track

Independent variables

- Age group (25-36 yrs vs. 55-65 yrs)
- Gender

Dependent variables

- Confidence ratings
- Brake response time
- Stopping time
- Stopping distance
- Stopping accuracy

- For males, as confidence ratings increased, the effect of the cell phone task on BRT and stopping distance was diminished.
- This trend was also true for older males, despite a general decrease in confidence with age.
- For older females, as confidence increased, performance decreased
- When drivers were matched in terms of confidence level, brake responses of older females were slowed to a much greater extent (0.38 s) than were brake responses of any other group (0.10 s for younger males and females and 0.07 s for older males).
- Females rated the driving task as less demanding than males, despite the fact that their performance was more greatly affected by distraction.
- "These results suggest that many drivers may not be aware of their decreased performance while using cell-phones and that it may be particularly important to target educational campaigns on driver distraction towards female drivers for whom there tended to be a greater discrepancy between driver perceptions and actual performance."
- CAUTION: The authors note that because of the relatively small number of participants (36) the results should be taken with caution. There was also some acknowledgement of differences in cell phone ownership and how this may or may not have affected the data.



Patten, C., Kircher, A., Östlund, J., and Nilsson, L. (in press). Using mobile telephones: cognitive workload and attention resource allocation. *Accident Analysis and Prevention*.

Forty participants completed an on-road driving course characterized by a low level of road complexity in the form of vehicle handling and information processing. A peripheral detection task (PDT) was employed to gauge mental workload. They compared effects of conversation type (simple versus complex) and telephone mode (hands-free versus handheld) to baseline conditions. The simple conversation was repeating single digits, whereas the complex conversation involved adding another digit to the second of a pair of presented digits.

Context

- On-road driving

Independent variables

- Conversation type (simple vs. complex)
- Phone architecture (hands-free vs. hand-held)
- Baseline condition (no phone)

Dependent variables

- Peripheral detection task reaction times
- Vehicle speed

- **Reaction times increased significantly when conversing but no benefit of hands-free units over handheld units on rural roads/motorways were found.**
- The reaction times for the simple and complex conversations were both significantly longer than the no-conversation baseline condition, and the complex conversations resulted in significantly longer reaction times than the simple conversation.
- The content of the conversation was far more important for driving and driver distraction than the type of telephone when driving on a motorway or similar type of road. The more difficult and complex the conversation, the greater the possible negative effect on driver distraction.
- Whereas phone architecture had no effect on peripheral detection performance, it did have an effect on mean speed. Mean speed for hand-held condition was slower than the hands-free and baseline conditions. The authors note that further research is required to explain this effect.
- **CONCLUSIONS:** "When driving on motorways and larger rural roads, the mobile telephone modality would appear to be of little consequence when solely considering the conversational aspect of telephoning. Far more important for driver distraction, in regard to mobile telephones, is the content and the complexity of the conversation per se. Note that even simple conversations may distract the driver, however, the more difficult and complex the conversation, the greater the negative affect on the drivers' ability to allocate or direct their attention."

Cohen, J.T., and Graham, J.D. (2003). A revised economic analysis of restrictions on the use of cell phones while driving. *Risk Analysis*, 1, 5-17.

Revised estimate of previous Harvard study (Lissy et al., 2000). They updated estimated number of cell phones users, revised the assumed amount of time spent on the phone while driving based on 2000 NOPUS results, and increased assumed consumer surplus value of the calls made while driving from \$25 billion to \$43 billion annually.

- They conclude a best estimate of zero for the net benefit of cell phone use while driving.
- "Although the CE ratios for other injury prevention programs are also highly uncertain, they suggest that there are actions that could be taken that would save lives lost in motor vehicle crashes at a lower economic cost than a ban on cell phones. This finding is consistent with the conclusion reached by Redelmeier and Weinstein that '*Regulations restricting cellular telephone usage while driving are less cost-effective for society than other safety measures.*' The fact that the net benefits of the ban are close to zero and yet there are other more efficient motor vehicle safety measures that are not yet implemented indicates that as a society, we are under investing in motor vehicle safety."
- Note: the authors acknowledge that both the "benefit cost estimate and the CE ratio are very uncertain (net benefits ranging from a loss of \$142 billion annually to a gain of \$175 billion annually, and CE ratio ranging from as high as \$13 million per QALY saved to negative values indicating savings of both resources and QALYs)."

Consiglio, W., Driscoll, P., Witte, M., & Berg, W. (2003). Effect of cellular telephone conversations and other potential interference on reaction time in a braking response. *Accident Analysis and Prevention*, 35, 495-500.

Study compared the effects of cell phone conversations and passenger conversations on driver braking response time.

Context

- Lab response time part-task simulation

Independent Variables

- Conversation with hands-free, hand-held, passengers vs. no-conversation

Dependent Variables

- Braking response time

- A simple reaction time experiment similar to Irwin, Fitzgerald, and Berg (2000) showed that braking responses to a brake-light signal were significantly longer when engaged in conversations (passenger, hand-held, and hands-free headset) than a control condition (no conversation or task) and a radio listening condition.
- The conversations were scripted questions intended to simulate naturalistic 'getting to know you' type questions. The passenger conversation condition resulted in significantly longer reaction times than the control condition, but the phone-based conversation conditions (hand-held and hands-free) resulted in even longer reaction times. Subjects were instructed not to look at the passenger during their conversation.
- There was no difference in reaction times between the hand-held and hands-free conditions.
- **LIMITATIONS:** This was a lab-based study where subjects simply made a braking foot pedal response to the onset of a red light, the sole focus of attention. There was no attempt to simulate any other aspect of the driving task, including steering (or the presence of a steering wheel).

**Glaze, A.L., and Ellis, J.M. (2003).**  
Pilot Study of Distracted Drivers.  
Richmond, VA: Virginia  
Commonwealth University, Center for  
Public Policy.

A statewide pilot study to test a standard list of distracted driving behaviors used in crash investigations was conducted for the Virginia Department of Motor Vehicles by Virginia Commonwealth University in 2002 to investigate driver distraction. The study involved completion of a supplemental survey for each distraction crash; the surveys were submitted for review as a part of this study.

All seven VA state police divisions, four selected counties, and 14 independent cities were requested to participate in the pilot study of distracted drivers. All localities participated in the study with varying degrees of success. State troopers submitted the majority of the surveys received (75%). All counties in Virginia were represented in the pilot study data with the exception of Alleghany County, Cumberland County, and Lunenburg County.

The survey contained questions regarding the MAIN driver distraction and did not address other additional contributing factors.

- Of the crashes reported, 63% occurred in rural areas.
- Surveys were received on 2,792 crash scenes that involved 4,494 drivers including 2,822 distracted drivers.
- Half of the crashes that were reported involved only a single driver and of all the crashes reported, 98% involved a single distracted driver.
- Troopers and officers wrote over 1,400 open-ended responses to indicate the MAIN distraction in each crash. Approximately 250 of the open-ended responses were coded into existing categories. The remaining open-ended responses were classified into new categories.
- Overall, the results indicated that 13% of traffic crashes in Virginia are due to driver distraction. Various distractions inside the vehicle accounted for 62% of the distractions reported, distractions outside the vehicle accounted for 35% of the distractions reported, and 3% of the distractions were unknown or not marked on the survey form.
- Driver fatigue or a driver that was asleep accounted for 17% of the specific distractions reported. Looking at crashes, other roadside incidents, traffic, or other vehicles accounted for 13% of the distractions reported. Looking at scenery or landmarks accounted for 10% of the distractions reported. A distraction caused by passengers or children in the vehicle accounted for 9% of the distractions reported. No other cause accounted for more than 7% of the distractions reported.
- Cell phones accounted for about 5% of the reported distractions associated with these distraction crashes.

*General recommendations from the Virginia Pilot Study:*

- Collect information at the driver level rather than the crash level.
- Reconsider and standardize the framework and terminology used to categorize distractions and driver inattention
- Conduct focus groups and training for troopers and officers regarding collection of distraction and inattention-related crash information.

**Continued –**

**Glaze, A.L., and Ellis, J.M. (2003).**  
Pilot Study of Distracted Drivers.  
Richmond, VA: Virginia  
Commonwealth University, Center for  
Public Policy.

**Notes:**

- Only police-reportable crashes were included in the survey. 75% of data came from State Troopers, and only 24% of data came from city or county police departments. In addition while the survey was statewide, law enforcement agencies responded with varying levels of success.
- One main distraction was listed as cause of the crash. Phone use was only cited in the survey if identified as main cause of the crash, and information was not generally collected regarding whether phones were otherwise present or in use by involved parties (or if phone was an additional contributing factor).
- 63% of the reported crashes occurred in rural areas. The report notes that implementation problems may have contributed to the low number of urban crashes because the locations of the agencies reporting implementation difficulties were urban.
  - Recall that data from North Carolina show cell phone crashes to be mostly rear-end crashes and that more than two-thirds of cell phone crashes occur on local streets.

Greenberg, J., Tijerina, L., Curry, R., Artz, B., Cathey, L., Grant, P., Kochhar, P., Kozak, K., and Blommer M. (2003). Evaluation of driver distraction using an event detection paradigm. In *Proceedings of the TRB 2003 Annual Meeting CD-ROM*. Washington, DC: National Academies of Science, Transportation Research Board.

The effects of eight in-vehicle tasks (hand-held and hands-free versions of phone dialing, voicemail retrieval and incoming calls were compared to manual radio tuning and climate control adjustment) on driver distraction were measured in Ford's VIRTTEX simulator. During the drive the participants were asked to respond to an event detection task where the vehicle in front of the lead vehicle swerved to the left or right. Similar events occurred to the rear of the vehicle, requiring participants to monitor the forward and rear views of the vehicle.

Context

- High fidelity motion-base driving simulator

Independent variables

- Eight in-vehicle tasks

Dependent variables

- Proportion of events detected

- Hands-free and hand-held dialing resulted in significantly more missed front events than the control condition, as did the hands-free incoming call and hand-held voicemail retrieval.
- Curiously, incoming hand-held calls corresponded with very few missed front events (same control). This effect was dramatically pronounced for the teen drivers who missed 54% of the front events when dialing with the hand-held phone.
- Overall, the number of missed rear events was much greater than the front events, but the hand-held dialing, hand-held incoming calls, hands-free incoming calls, and hvac adjustments resulted in significantly more missed rear events than the control condition.
- This study has additional value because it included a teenage driver condition (16-18 yrs). Compared with the adults, the teens were found to choose unsafe following distances, have poor vehicle control skills and to be more prone to distraction from hand-held phone tasks.
- **CONCERN:** the rear event detection task probably artificially increased the amount of mirror checking, which also may have affected the front event detection task. There were some curious patterns in the data that invites caution when interpreting the results of this study. For example, the hand-held incoming calls task actually resulted in fewer missed front events than the control (no task) condition. However, the authors report that an analysis of the video data shows that some front detection events were missed despite forward visual fixations, thus supporting the inattention blindness phenomenon discussed in Strayer et al. (2003).

Hancock, P., Lesch, M., and Simmons, L. (2003). The distraction effects of phone use during a crucial driving maneuver. *Accident Analysis and Prevention*, 35, 501-514.

Hancock et al. performed a test-track study on the effects of phone use while encountering a critical event while driving. They compared younger (25-36 yrs) and older drivers (55-65 yrs) and gender for brake response behavior when using a phone in coincidence with a critical driving maneuver. Subjects were required to maintain a consistent speed throughout a test-track lap and to brake to a stop as quickly as possible before the intersection line in one third of the trials. The trials included a number memorization and recall loading task, a cell phone task on one third of the trials (answering with digit recognition task on phone display – no conversation), and the stopping task on one third of the trials.

Context

- Test track

Independent variables

- Age group (25-36 yrs vs. 55-65 yrs)
- Gender

Dependent variables

- Brake response time
- Stopping time
- Stopping distance
- Stopping accuracy

- Without the distraction, the overall compliance rate to stopping task was very close to 95%. However, when the phone distraction task was added, compliance rate dropped to 80%, a highly significant 15% reduction in stopping response.
- Older subjects had a lower compliance rate with the distractor task present.
- There was also an interaction with the gender of the driver. Female drivers are more compliant than their male peers in the baseline (non-distraction) situation. However, with the distractive phone task, female drivers were complied less than their male counterparts.
- BRT was slower in the presence of the distraction as compared to its absence. However, like the measure of compliance, there was an interaction with the age of the individual.
- Consistent with the compliance findings, older drivers were at a greater disadvantage in the presence of the distractive phone task compared to their younger counterparts who were little affected by such distraction.
- Drivers exhibited a 24% decrease in safety margin stopping distance when driving with the distractor task.
- Study postulates that use of cell phones would increase the number of rear-end collisions by forcing drivers behind the cell phone user to react faster, however this would be difficult to determine because, according to Dr. Hancock, "rear end is the no. 1 form of accident, and it has a lot of different causes."

Kircher, A., Tornros, J., Vogel, K., Nilsson, L., Bolling, A., Patten, C., Malmstrom, T., and Ceci, R. (2003). Mobile telephone simulator study. VTI/Swedish National Board and Transport Research Institute.

Four experiments investigating the effects of mobile phones (hand-held and hands-free), DVD players, and SMS on simulated driving performance in the VTI driving simulator in Sweden. The different distractions were tested separately, resulting in four experiments (with the fourth being a dialing study). The DVD and SMS studies had small sample sizes (low n's) and are to be interpreted with caution. This summary focuses on the phone studies.

#### Context

- Driving Simulator

#### Independent Variables

- Mobile phone (hand-held vs. hands-free)
- DVDs
- SMS
- Traffic environment (rural, urban simple, urban medium, urban complex)

#### Dependent Variables

- Speed and speed variance
- Peripheral detection task (PDT)
- Lateral position variance
- Traffic event (stop lights, bus, cyclist)

- For both phone conditions, speed was reduced while talking on the phone. This could be a compensatory strategy to deal with additional workload resulting from conversations.
- Across all four traffic environments, hand-held phone use led to greater slow-down effect than hands-free.
- The speed variability results were difficult to interpret because speed variability was smaller for hand-held phones in some traffic conditions and smaller for hands-free phones in other conditions.
- The PDT performance was reduced significantly (slower reaction time and higher miss rates) for both hand-held and hands-free mode in all traffic environments.
- For the rural environment, the lateral position variance decreased as an effect of phone use for both hands-free and hand-held phones.
- For the dialling study, the results for hand-held and hands-free phones were similarly negative in terms of PDT performance. Speed reduction was greater for the hand-held condition, though.



Matthews, R., Legg, S., and Charlton, S. (2003). The effect of cell phone type on drivers' subjective workload during concurrent driving and conversing. *Accident Analysis and Prevention*, 35, 451-457.

Study that compared the subjective workload for hand-held, speaker-based hands-free, and headset-based hands-free phone architectures during real-world driving. Subjects drove a familiar route during non-rush hour traffic in a clear daytime rural setting. Subjects completed trials in the modified rhyming task (MRT) where they repeated back a list of aurally presented words that had alternative interpretations (e.g., tip could be repeated as lip, sip, dip, rip or hip). They completed the NASA-TLX subjective workload index after each set of MRT trials.

Context

- On-road driving study

Independent Variables

- Hand-held, speaker-based hands-free, and headset-based hands-free phones.

Dependent Variables

- NASA-TLX subjective workload ratings.

- The authors found that the headset hands-free phone was "associated with the lowest total subjective workload, followed by the hand-held phone, while the hands-free speaker phone was associated with the highest total subjective workload."
- All phone conditions resulted in significantly higher workload ratings than the no-phone control condition. Phone intelligibility and frustration were significant sources of variance.
- **CONCLUDED** that "drivers using a [hands-free] phone will be rewarded with the benefits of hands free and high intelligibility, making for safer driving while conversing."
- **LIMITATION:** this is strictly a subjective workload study; no driving performance measures were collected.

Royal, D. (2003). *National Survey of Distracted and Drowsy Driving Attitudes and Behaviors: 2002, Volume 1 - Findings Report* (NHTSA Research Note, DOT HS 809 566). The Gallup Organization.

The data come from two surveys undertaken by National Highway Traffic Safety Administration (NHTSA) to better understand drivers' behaviors and attitudes regarding speeding, unsafe driving, distracted (including cell phone use) and drowsy driving, each conducted among nationally representative samples of drivers during the Spring of 2002. Interviews were conducted with a total of 4,010 drivers in the U.S.

- A reported mean of 4.5 minutes per call while driving
- 58% report they rarely or never make outgoing calls
- 18% report they make calls on 25% of trips per week (5-6 trips per week)
- 10% report they make calls on 50% of trips (11 trips per week)
- 13% report they make calls on 75% or more trips (20-30 trips per week)
- 88% of all drivers support increased public awareness of the risks of wireless phone use while driving.
- 57% of all drivers support a ban on all wireless phone use while a car is moving (except for 911 calls). About one-fourth of drivers who use cell phones support such a ban compared to 69% of drivers who do not use cell phones.
- 62% support increased fines for traffic violations involving cell phone use. About 40% of drivers who use cell phones support such fines compared to about 70% of drivers who do not use cell phones.
- **NOTE:** This data should be interpreted with caution.

Strayer, D., Drews, F., & Johnston, W. (2003). Cell phone-induced failures of visual attention during simulated driving. *Journal of Experimental Psychology: Applied*, 9(1), 23-32.

Study to investigate potential for inattention blindness as a result of cell phone conversations while driving a driving simulator.

Context

- Driving simulator

Independent Variables

- Naturalistic casual conversation vs. no conversation

Dependent Variables

- Recognition memory for targets on billboards
- Eye-tracking data

- In a series of four experiments, the authors replicated findings from Strayer and Johnston (2001) that conversations impaired driver reactions to lead vehicle braking in a driving simulation context.
- They also demonstrated that explicit recall of billboard information is reduced when engaged in naturalistic casual conversation (hands-free).
- In addition, eye-tracking data showed that this recall is diminished regardless of whether or not the target information was fixated or not. In other words, it isn't only the narrowing of visual attention that is responsible for reduced recognition and signal detection, but the interference of the conversation task on the processing of the fixated information (look but did not see phenomenon).
- In addition, they showed that hands-free conversations impaired implicit perceptual memory for items presented at fixation.
- Together, this series of experiments provides compelling evidence that naturalistic casual conversation while driving significantly interferes with attention to external visual inputs.
- **NOTABLE:** Previous research has shown that visual attention narrows with cell phone use (Recarte & Nunes, 2000; Harbluk, Noy, & Eizenman, 2002), but this study also demonstrates that in addition to the reduction of scanning behavior, people experience inattention-blindness for the objects that they do attend to. In other words, cell phone conversations result in increased "looked-but-did-not-see" type phenomena.

Stutts, J.C., Hunter, W.W., and Huang, H.F. (2003). Cell Phone Use While Driving: Results of a Statewide Survey. In *Proceedings of the TRB 2003 Annual Meeting CD-ROM*. Washington, DC: National Academies of Science, Transportation Research Board.

A statewide telephone survey of licensed North Carolina drivers, ages 18 and older, was conducted during the summer of 2002. The purpose of the survey was to provide current information on cell phone use while driving and to learn drivers' perceptions of cell phone safety and their opinions regarding regulation. The survey targeted 500 users and 150 non-users of cell phones.

- Estimated that 58.8 percent of the state's licensed drivers have used a cell phone while driving.
- Use levels were highest among younger drivers.
- 1 in 4 users reported having a hands-free device, although they did not always use the device.
- Users generally perceived talking on cell phones while driving to be less distracting and less of a safety concern than did non-users.
- Users were also less likely to support legislation that would prohibit anything other than use of a hand-held phone, and less likely to support stricter penalties for cell phone users involved in crashes.

Wilson, J., Fang, M., Wiggins, S, and Cooper, P. (2003). Collision and violation involvement of drivers who use cellular telephones. *Traffic Injury Prevention*, 4, 45-52.

Observational study designed to "measure and understand the relationship between the use of cellular telephones while driving and collision risk." Cell phone users [hand-held] were compared to non-users for a variety of "indices of driving risk" including: at-fault collisions (as identified by insurance claim records), traffic violations associated with inattention, and contributing factors to crashes. After the observation stage, the license numbers were used to retrieve driving records for the observed phone users and non-users. Appropriate screening and matching of vehicle registrations and observed drivers was undertaken to result in a sample of 3,869 cases with matched driving records (for the preceding 5 years).

- **"Drivers that have been observed using cell phones while driving have a higher risk of an at-fault collision than do drivers observed not using cell phones."**
- The risk was found to be higher for females than males.
- The relationship between cell phone use and violations such as red light running, failure to yield right-of-way, disobeying traffic signals, and improper turning is unclear.
- Cell phone users (while driving) take more risks than non-users (or low-frequency users), including more violations for speeding, impaired driving, seat belt nonuse, aggressive driving, and nonmoving violations.
- Analysis of police reported crashes indicated that cell phone users may have been over represented in rear-end collisions, relative to other collision type; "however, this finding is very preliminary due to the small number of cases and the lack of adjustment for sample differences."
- Results indicated that the increase in risk associated with cell phone use while driving was 1.16 for all drivers; 1.12 for males; and 1.31 for females.
- NOTE: It is likely that there were actual users among the non-user group that were not observed using a cell phone while driving during the observational phase. This underestimation of users is a flaw in the study (acknowledged), but it does not completely invalidate the findings.

**Wisconsin State Patrol. (2003). Cell Phone Use in Motor Vehicle Crashes (Data from Wisconsin Motor Vehicle Accident Report Form MV4000, May - October 2002).** Wisconsin Department of Transportation, Division of State Patrol, Division of Motor Vehicles, and Bureau of Transportation Safety.

"The Wisconsin State Patrol (State Patrol), in conjunction with the Department of Transportation's Division of Motor Vehicles (DMV) and Bureau of Transportation Safety (BOTS) and at the request of Wisconsin State Representative Jerry Petrowski, surveyed a limited number of crashes in Wisconsin in an attempt to determine if there was any relation between the use of cell phones by drivers involved in crashes and the crashes themselves."

"The survey conducted by the Wisconsin State Patrol for six months during the summer and autumn of 2002 [May 1, 2002, and October 31, 2002] focused on the use of cell phones during motor vehicle crashes. Information was obtained at the crash site by noting motorist cell phone use by the drivers involved in the crash. The data collected was recorded as driver "self-reporting" responses and categorized on the Wisconsin Motor Vehicle Accident Report form known as the "MV4000" in the data fields titled "Special Study"."

"The State Patrol completed 2,691 MV4000 reports (i.e. 2,691 crashes) during the six-month survey time period. Over 96% of the completed reports included the required cell phone use information."

The authors noted that "Within the State Patrol's 4% of the statewide crashes that occurred between May and October of 2002, the State Patrol's survey does not indicate a *definable* relationship between cell phone use and motor vehicle crashes. The total survey numbers reporting cell phone use are not significant enough to make a determination that cell phone use is a *major* contributing factor in motor vehicle crashes, or if hands-free cell phones are safer to use than hand-held cell phones."

The authors concluded that "While the Department of Transportation and Wisconsin State Patrol survey did not provide a definitive conclusion on the relationship of cell phone use to motor vehicle crashes, it did provide a first step in a review of the issue. The lack of striking data that points unquestionably at cell phone use as the cause of crashes leads us to believe that there are many more variables that must be discussed before any decisions are made on how best to either limit motorist cell phone use or enhance safety for cell phone users. The data indicates that cell phone use is indeed a contributing factor to motor vehicle crashes, as are other reasons for "inattentive" or "distracted" driving, and that, in itself, is an important finding."

They also stated, "...taking into consideration the limited scope of the survey and after reviewing the studies conducted by other agencies and institutions on cell phone use, it is clear that there are many variables involved and alternative approaches for alleviating the problem. The Wisconsin legislature, law enforcement community and safety professionals must take this "first step" survey data and use it to encourage further consideration of alternative ways to ensure the safe, and perhaps limited, use of cell phones on Wisconsin's highways."

Some limitations of the study:

- "The results of this survey are limited by the detail of the queries, the number of the crashes queried, and the types of highways on which the crashes occurred, as well as the fact that just one law enforcement agency, the Wisconsin State Patrol, conducted the survey. Those limitations do not diminish the reliability of importance of the survey data, but they do caution the overall applicability of the results."
- "It is important to note that the results of the survey may have

**Continued -**

**Wisconsin State Patrol. (2003). *Cell Phone Use in Motor Vehicle Crashes* (Data from Wisconsin Motor Vehicle Accident Report Form MV4000, May - October 2002). Wisconsin Department of Transportation, Division of State Patrol, Division of Motor Vehicles, and Bureau of Transportation Safety.**

lower total numbers for cell phone use than previously expected. That may be partially due to the fact that the survey relied on a "self-reporting" procedure that gave the motorists at the crash site the responsibility to answer questions posed by the State Patrol officer about her/his cell phone use rather than relying on the officer's own observations. Similar to questions about seat belt use, the answers to questions about cell phone use rely on the honesty and memory of the motorists involved."

**Burns, P.C., Parkes, A., Burton, S., Smith, R., and Burch, D. (2002).** How dangerous is driving with a mobile telephone? Benchmarking the impairment to alcohol. TRL Report TRL547, Crowthorne, UK.

This study aimed to quantify the impairment from hands-free and handheld phone conversations in relation to the decline in driving performance caused by alcohol impairment. Twenty healthy experienced drivers were tested in the TRL Driving Simulator on two separate occasions. The drivers were aged 21 to 45 years (mean = 32, SD = 7.8) and were split evenly by gender. Before starting the test drive, participants consumed a drink, which either contained alcohol or a similar looking and tasting placebo drink. The quantity of alcohol was determined from the participant's age and body mass using the adjusted Widmark Formula (the UK legal alcohol limit 80mg/100ml). There were four conditions on the test route: 1) motorway with moderate traffic, 2) car following, 3) curving road 4) and dual carriageway with traffic lights. During each condition the drivers answered a standard set of questions and conversed with the experimenter over a mobile phone.

#### Context

- Driving simulator

#### Independent Variables

- Normal driving, alcohol impaired driving, and driving while talking on Hands-free or Hand-held phone.

#### Dependent Variables

- Driving performance measures such as lane position variability and speed
- Reaction time to traffic event
- Subjective workload ratings
- Conversation task performance

- Results showed a tendency for drivers to slow down when talking on handheld or hands-free phones, even when they were specifically instructed to maintain a set speed.
- Alcohol tended to have the opposite effect such that drivers drove faster than normal when under the influence of alcohol.
- The standard deviation of speed and speed error measures indicated that drivers' had significantly poorer speed control when using the handheld phone than during the other three conditions.
- When drivers were under the influence of alcohol, they were significantly worse at driving smoothly.
- Reaction times were significantly slower for drivers using phones in comparison to when they had alcohol.
- Drivers missed significantly more warnings when they were using a phone.
- Drivers found driving while using a hand-held phone to be the most difficult. The easiest task was the normal driving without any phone conversations. Hands-free was easier than handheld.
- Drivers found it easier to drive drunk than to drive while using a phone, even when it was hands-free.
- Hands-free phones were worse than handheld phones for the repeating sentence tasks (time and number of pauses). Hand-held phones were worse than hands-free phones for the verbal puzzles (errors) and monologues (number of pauses).
- "Driving while intoxicated is clearly dangerous and this study further confirmed that alcohol impairs driving performance. However, this study also found that certain aspects of driving performance are impaired more by using a phone than by having a blood alcohol level at the legal limit (80mg/100ml)."

**California Highway Patrol (2002).**  
Driver distractions and inattention data  
summary. Sacramento, California:  
Assembly Bill 770, Chapter 710.

**California Highway Patrol (2002).**  
*Provisional 2001 Statewide Collision  
Totals and Selected Inattentions.*  
Sacramento, California: CHP Office of  
Public Affairs.

Department of California Highway Patrol (CHP)  
recently completed a special study of crash data from  
April 1, 2001, to June 30, 2002.

A 2001 state law requires that the CHP note  
distractions that may have contributed to a crash.  
California crash statistics were examined for cell  
phone involvement for the six-month period between  
January 1, 2000 and June 30, 2000.

- CHP reported the following:
  - 491,083 reported parties involved in traffic collisions
  - 2,952 crashes that resulted in Fatalities
  - 190,701 crashes that resulted in Injuries
  - 297,430 crashes that involved Property Damage Only
  - 5,677 of these drivers were classified as "inattentive" in one of several categories (eating, smoking, cell phone, etc.)
  - Of these 5,677 inattentive drivers, 11% were attributed to cell phone use
 

Status	Parties
○ Cell phone in use	3,927
○ Cell phone not in use	98,876
○ Cell phone None/Unknown	175,790
○ Total Parties	278,593

The CHP analysis does not include all crashes in which cell phones may have been in use and a contributing factor. The report noted, "officers statewide often failed to document on the [crash] report whether a cellular telephone was in use, present, or unknown."

**LIMITATIONS:** There was potential confusion of where on the reporting form the Officers should indicate distraction sources. Also, Officers were only allowed to select one distraction source when more than one is commonly encountered.

Of the 13,637 inattention-related crashes, cell phone use accounted for 11% of inattention-related crashes, more than any other specific inattention factor ("Other" accounted for 66%). The results also indicated that cell phones accounted for 11% of fatalities and total inattention crashes between April 1, 2001, and June 30, 2002.

While cell phone use accounted for 11% of total inattention crashes between January 1, 2002, and June 30, 2002, cell phones use while driving contributed to 20% of inattention-related fatalities during that period. This data revealed that a cell phone was known to be in use by at least 12,733 parties involved in crashes during the 18-month period.

The CHP concluded that driver distraction is the issue, not the particular device, and it suggested, given the crash data collected, that any action regarding cell phones should also address issues related to other distracting activities (e.g., car radio/CD player).

**Recommendations from the California Highway Patrol:**

- Continue collection and reporting of collision data related to driver distraction.
- Consider whether to require use of the hands-free option when using a cellular telephone while driving.
- Improve consumer education.
- Add an "Inattentive Driving" section to the Vehicle Code.
- Continue training law enforcement agencies statewide on the proper documentation of inattention factors, if the requirement for inattentive driver data collection is extended.

It is also important to note the following about the Traffic Collision Coding form: Information on whether driver inattention contributed to the crash is only collected under "Other Associated Factors" for the involved party cited for having caused the crash. Officers check the box "F" indicating "Inattention" and note the cause next to it (e.g., officer must write in "P-Cell Phone").

Information on Cell Phone Use by involved parties is specifically requested under the section entitled, "Special Information." Use or non-use is indicated for all parties involved. No distinction is made between condition in which no phone is present and condition in which the officer is unable to determine presence/use of phone.

**Direct Line Insurance plc (2002).**  
*The Mobile Phone Report: A report on the effects of using a 'hand-held' and 'hands-free' mobile phone on road safety.* (Online at [www.directlinegroup.com](http://www.directlinegroup.com)). Surrey, UK.

Study to quantify the impairment from hands-free and hand-held mobile phone conversations in relation to the decline in driving performance caused by alcohol impairment. Included 20 drivers aged 21 to 45 years.

Context

- Driving simulator featuring a standard road layout. Study employed a modified grammatical reasoning test to replicate demands of verbal comprehension.

Independent Variables

- Hands-free vs. handheld phone compared to Alcohol vs. placebo condition.

Dependent Variables

- Driving performance measures such as speed and headway
- Reaction time to traffic event

- Found that drivers' reactions times were significantly slower (up to 0.5 sec) when using a mobile phone versus normal driving.
- Found that use of hands-free phones was "safer" than use of hand-held mobile phones. However, the conversation itself was a major [mental] distraction "carrying hidden dangers" regardless of hand-held or hands-free mode.
- Found that using a mobile phone when driving significantly impairs the driver's attention to potentially hazardous situations, including a greater lack of judgment in the use of speed, an inability to recognize hazards on the road and difficulty maintaining headway.
- Authors emphasize the need for further [Government] research on the issue of using hands-free phones while driving.



**Hahn, R.W., and Dudley, P.M.**  
(2002). *The Disconnect Between Law and Policy Analysis: A Case Study of Drivers and Cell Phones (Working Paper 02-7)*. Washington, DC: The AEI-Brookings Joint Center for Regulatory Studies.

Purpose of the working paper is to "assess the policy response to the use of cellular phones while driving from a legal, economic and political perspective." The authors argue, "there is a fundamental disconnect between law and policy analysis. The disconnect arises largely because the political process is more responsive to the public's perception of risk than the scientists' risk assessments and the economists' policy analyses."

The authors reviewed epidemiological studies, experimental studies, and data on the possible cause of automobile crashes. They state (p. 14) that, taken together, "the evidence clearly shows that using a cell phone while driving increases the risk of an accident." "The primary reason hands-free phones will not reduce risk significantly is because conversation, on any type of device, is a significant distraction. Conversation impairs driving performance, apparently by reducing the driver's ability to fully comprehend visual information. Since hands-free phones will still allow conversation, a major part – if not the major part – of the risk associated with calling and driving will remain." (p. 35)

The authors noted (p. 1) that there are over 135 million cellular subscribers in the United States today, compared to fewer than 100,000 subscribers in 1985. The authors also noted that current industry revenues were almost \$60 billion in 2001, compared to less than \$1 million in 1985.

The authors noted study (p. 3) estimates ranging from 10 to 1000 fatalities per year in cell phone-related crashes in the United States. Estimates cited from:

- Redelmeier & Weinstein (1999): estimates 730 annual fatalities. A cell phone ban would cost \$300,000 [range \$50k - \$700k] per quality-adjusted life year saved. 600,000 collisions annually due to cell phone use. 115,000 injuries annually. \$1.8 billion in health care costs and property damage annually. Estimate the annual costs of a ban at \$12 billion of "foregone welfare."
- Hahn & Tetlock (1999): estimates 100 annual fatalities
- Hahn, Tetlock & Burnett (2002): calculates 10 to 1000 annual fatalities with a best estimate of 300 annual fatalities. No cell phones at all => \$25 billion in cost - \$4.6 billion in net benefit = \$20 billion in net costs annually. A hands-free policy would still result in negative net benefits under most circumstances -- Estimates \$1.4 Billion in cost - \$690 Million in net benefit = \$710 Million In net costs annually
- Harvard Center for Risk Analysis (Lissy, Cohen, Park, and Graham, 2000): estimated \$23 billion annually in net cost. A cell phone ban would cost \$700,000 per quality-adjusted

Continued -

Hahn, R.W., and Dudley, P.M.  
(2002). *The Disconnect Between Law  
and Policy Analysis: A Case Study of  
Drivers and Cell Phones (Working  
Paper 02-7)*. Washington, DC: The  
AEI-Brookings Joint Center for  
Regulatory Studies.

life year saved.

The authors stated that a review of recent economic analyses suggests that a ban on cell phone use while driving "would not be appropriate at this time." They also noted that "...the current literature strongly suggest that a total ban on using cell phones while driving would be a rather expensive way to save lives."

"A good policy should pass a broadly defined benefit-cost test. (When the economic benefits of a policy exceed the economic costs, that policy is said to increase efficiency or economic efficiency.) In this case, that means analyzing the benefits of a ban, which includes the reductions in fatalities and property damage, and the costs of a ban, which means measuring how much drivers value the unregulated use of their phones while driving." (p. 18)

Authors state that there is "no strong empirical justification at present for the enactment of a policy or legislation that differentiates between the use of hand-held and hands-free sets in motor vehicles." (p. 38) "All the evidence suggests that hands-free devices are barely, if at all, safer than hand-held ones. The experimental and epidemiological studies show that manual dialing is distracting, but no more so than conversation. Other physical distractions, such as holding the phone, do not appear to be significant." (p. 40)

Author Footnote #260: "...there are positive externalities associated with driving and calling, such as reporting accidents and drunk drivers. These benefits, which have not been adequately studied or quantified, may be lost if drivers carry their phone less often or fear being ticketed."

Authors suggest consumer information campaign, stricter enforcement of reckless driving laws, and stricter penalties for crashes when a cell phone is involved.

Harbluk, J.L., Noy, Y.I., and Etzenman, M. (2002). *The Impact of Cognitive Distraction on Driver Visual Behaviour and Vehicle Control* (TP# 13889 E). Transport Canada.

Study to examine the impact of internal distraction created by the processing of information in the course of interacting with or conversing over a hands-free in-vehicle device. Also documents recommendations to the Canadian Federal government.

Subjects were asked a series of questions over the cell phone; responses were made verbally. The phone task consisted of easy and difficult arithmetic operations. Study included 21 drivers – 9 women and 12 men ages 21 to 34 yrs old (Mean = 26.5 yrs)

Context

- On-Road, conducted in the city under normal traffic conditions.

Independent Variables

- Level of complexity of cell-phone interactions (cognitive operations).

Dependent Variables

- Visual scanning patterns
- Driving performance measures such as braking and longitudinal deceleration.
- Subjective evaluations of workload, safety and distraction

- Concluded that significant changes in driver behavior (narrowed visual scanning behavior and reductions in vehicle control) under real-world driving conditions may result due to the cognitive distraction associated with the use of in-vehicle, hands-free devices, and that these changes support the idea that these extra demands on the driver contribute to late detection, reduced situation awareness and a reduced margin of safety.
- Recommend that "during a casual conversation drivers can adapt by pausing during the conversation or ending the call should the demands of driving increase."
- Notes that "business is commonly conducted using cell phones... however, an intense business conversation could divert a driver's attention away from the task of driving."
- Recommends that the Canadian Federal Government develop public education materials to recommend to the public that cell phones should not be used by drivers while driving, to advise the public that hands-free phones are not risk-free, and to provide important safety tips for drivers to consider if they intend to continue to use their phones while driving.
- Concluded that there is a need continued research to determine the need for regulating original equipment.

Jennes, J., Lattanzio, R., O'Toole, M., and Taylor, N. (2002). Voice-activated dialing or eating a cheeseburger: which is more distracting during simulated driving? In the *Proceedings of the Human Factors and Ergonomics Society 46<sup>th</sup> Annual Meeting* (pp. 592-596). Santa Monica, CA: HFES.

Twenty-six participants drove a fixed distance while continuously eating a cheeseburger, operating an automobile CD player, reading directions, or using a voice-activated dialing system to place calls on a mobile phone. Performance was measured while participants drove without doing other tasks (baseline).

Context

- Part-task driving simulation (lab)

Independent Variables

- Type of distraction (eating, CD player, reading directions, voice-activated dialing).

Dependent Variables

- Driving errors
- Driving times
- Glances away from the road

- Participants made the most lane-keeping errors, minimum speed violations, and glances away from the road while reading and while operating the CD player.
- They made significantly fewer driving errors and glances while voice-dialing the mobile phone or eating, although in both of these conditions they made more driving errors and glances than they did when driving without doing any other activity (baseline).
- **CONCLUSIONS:** "We conclude that for simulated driving, placing calls using a voice-activated dialing system is as distracting as eating a cheeseburger, but both of these activities are less distracting than continuously operating a CD player or reading directions."
- Authors acknowledge that two factors may have influenced the voice-activated dialing performance: signal problems with the phone and participants' lack of experience with the voice-activated system. Indeed, 10 of the 26 participants had difficulty with the voice-activated interface.

Lyda, L., Osborne, V.M., Coleman, P., and Rienzi, B. (2002). Age and distraction by telephone conversation in task performance: Implications for use of cellular telephones while driving. *Perceptual and Motor Skills*, 94(2), 391-394.

A laboratory experimental was conducted to investigate the performance by age group on a simple automatic task with no distraction and on the same task during a telephone conversation. Participants were timed as they pointed to letters in alphabetical sequence on one of two matrix conditions (alphabetized and random ordering). Two factors were predicted to diminish task performance: distraction by telephone conversation and older age. Participants included 38 subjects (23 Females and 15 Males), ages 18 to 75 years, divided into three age groups.

Context

- Lab experiment, desk telephone.

Independent Variables

- No-distraction and Distraction (i.e., telephone conversation with open-ended questions)

Dependent Variables

- Performance times (sec)

- Found that presence of the distraction task led to significant increases in the alphabet matrix performance times for both the alphabetized and random ordering conditions.
- Reported that "telephone conversation as a limited distraction is consistent with previous studies (e.g., Redelmeier & Tibshirani, 1997; Jones, 1999). However, our results are inconsistent with findings that cellular telephone conversations do no affect motor activity (e.g., Redelmeier & Tibshirani, 1997)."
- Authors noted that "A variety of factors associated with cellular telephones and driving performance were not addressed" – conversation intensity (simple & casual versus emotional and problem solving), equipment variables, important situations that are experienced by drivers (e.g., "dire consequences for errors"), phone type (cellular phone versus desk telephone). Authors also noted small sample size in this study.

McCartt, A.T., Braver, E.R., and Geary, L.L. (2002). *Drivers' Use of Hand-Held Cell Phones Before and After New York State's Cell Phone Law*. Arlington, Virginia: Insurance Institute for Highway safety.

Reports the findings of an observational study to examine the rate of hand-held cellular telephone use among drivers of passenger vehicles in New York (and compared with drivers in Connecticut) prior to and following the implementation of a 2001 state law banning the use of such phones.

Daytime cell phone use was observed at controlled intersections in four metropolitan areas in New York and two metropolitan areas in central Connecticut, an adjacent state when no such ban was in place.

The law:

Apprehended violators received warnings beginning Nov 1, 2001 and could receive fines beginning Dec 1, 2001.

Until March 1, 2002, violators could have fines waived if the court was shown proof of purchase of hands-free accessories.

Observations included 37,462 vehicles in four New York metropolitan areas – 11,768 at baseline (pre-law); 12,732 in Dec 2001; and 12,962 in Mar 2002. Observations included 21,315 vehicles in two Connecticut metropolitan areas – 7,110 at baseline; 6,817 in Dec 2001; and 7,388 in Mar 2002.

- Found that "Cell phone use decreased significantly in New York but not in Connecticut during the first few months after the law became effective."
- Found that Hand-held cell phone rate in New York decreased significantly, from 2.3% one month before the warning period took effect to 1.1% immediately after the fine-with-waiver phase took effect on December 1, 2001.
- Found that Hand-held cell phone rate in New York remained at 1.1% following the expiration of the waiver provision of the law on March 1, 2002.
- Found that Hand-held cell phone rate in Connecticut was 2.9% and that use did not change significantly during the observation periods.
- Found that in both states, cell phone use was higher among drivers of sport utility vehicles.
- Found that in both states, cell phone use was virtually nonexistent among drivers estimated to be age 60 and older.
- Found that in New York, cell phone use declined significantly for both males and females, for drivers estimated to be younger than 25 or ages 25-59, and for drivers of cars, SUVs, and vans/minivans.

Concluded that "Results from this study suggest that passing a law restricting use of hand-held cell phones while driving, even in the absence of vigorous enforcement campaigns, has a strong effect on driver behavior when accompanied by publicity about the law."

Nowakowski, C., Friedman, D., and Green, P. (2002). An Experimental Evaluation of Using Automotive HUDs to Reduce Driver Distraction while Answering Cell Phones. In the *Proceedings of the Human Factors and Ergonomics Society 46th Annual Meeting*. Santa Monica, CA: Human Factors and Ergonomics Society, CD-ROM

To examine strategies for reducing driver distraction while answering the phone, 24 participants answered calls while driving in a simulator. Calls were answered using a center-console-mounted phone or one of several phone designs that utilized a HUD to display the caller ID and steering-wheel-mounted buttons to activate the phone. Driving workload was manipulated by varying the curve radius and by varying the timing of the call, either 1 second before or 5 seconds after the start of a curve.

Context

- Driving simulator

Independent variables

- Phone interface type and location (HUD center with ring, HUD center without ring, HUD right, and console)

Dependent variables

- Call answering response time
- Lane position variability
- Line-crossing rate
- Speed loss

- The HUD-based phones resulted in response times that were 39 percent faster than the conventional center-console phone, and they resulted in up to 62 percent fewer line crossings.
- When using the center-console phone, road curvature had a large influence on response times and driving performance; however, the HUD-based phone were less sensitive to increased road curvature or driving workload.
- The mean response times favored the HUD-based phones by 1.46 seconds over the head-down, center-console location.
- Additionally, the driving performance measures indicated that there was significantly more variability in lane keeping and more line crossings while answering the head-down, center-console-mounted phone as compared to the HUD-based phones.
- "Admittedly, by requiring the driver to read the caller ID before answering, the task favored the use of the HUD and response times increased as HUD eccentricity increased."
- There was no indication that the presence or absence of a ring had any influence on driving performance. There was evidence that some drivers may have waited for the completion of a ring before answering.

Nunes, L. and Recarte, M. (2002).  
Cognitive demands of hands-free-  
phone conversation while driving.  
Transportation Research Part F, 5, 133-  
144.

In a series of four on-road eye-glance experiments, the authors replicated the pattern of reduced visual scanning behavior found in Recarte and Nunes (2000). Participants drove an instrumented car provided with a hands-free phone and performed several cognitive tasks while driving including phone conversations. The study focused the cognitive component of the conversations, excluding dialing. The cognitive demands of the conversations were varied and in two of the experiments the same tasks had two versions: by phone and in live conversation with the experimenter in the car.

Context

- On-road

Independent variables

- Hands-free phone conversation vs. passenger conversation

Dependent variables

- Eye-glance behavior
- Visual search behavior
- Driving speed
- Visual detection and response selection capacities

- Claim to show that wireless phone conversations (hands-free) were no different than live [passenger] conversations in terms of visual attention reduction, but it was the content and complexity of the conversation that caused the effects. They used a detection task where subjects responded when seeing flashing lights in their visual field (implementation of this method is unclear). They also collected eye-tracking data.
- **PROBLEMS:** No description of the driving task or routes other than "real traffic and normal daylight conditions." Also, in the first experiment, the tasks for the phone and live conversations were different, which is a serious methodological confound. The subsequent three experiments seem to eliminate this problem, but overall there is not enough detail (any detail for that matter) given regarding the 27 cognitive tasks used in these studies.
- The results of the third and fourth experiments may be noteworthy, as they show that visual behavior for both phone and live conversation conditions were narrowed, but there was no difference between these two conditions.
- Because so little methodology information is presented, it is not recommended that these results and conclusions be cited.

Reimer, B., Sodhi, M., and Llamazares, I. (2002). Glance Analysis of Driver Eye Movements (Report Dated March 15, 2002). Kingston, RI: The University of Rhode Island.

See also...

Sodhi, M., Reimer, B., and Llamazares, I. (2002). Glance Analysis of Driver Eye Movements to Evaluate Distraction. *Behavior Research Methods, Instruments and Computing*, 34(4), 529-538.

Study investigating drivers' eye movements and glance patterns (via eye tracking methods) when performing secondary tasks while driving. Presents some metrics on the impact of secondary tasks occurring separately on driver performance. The tasks were radio tuning, answering a hand-held call and completing a computational task, describing vehicle through rear-view mirror, answering a hands-free call and completing a memory task, reading the odometer, responding to a startling phone ring, and noting the gas prices of approaching fuel stations.

Context

- Unspecified driving task

Independent variables

- Different secondary tasks (hands-free vs. hand-held phone answering and conversation tasks).

Dependent variables

- Eye-glance behavior

- **NOTE: the description of the methods is incomplete. The driving task and context are not specified in the write-up.**
- Eye movements for the radio, rearview mirror, and odometer tasks all showed a time-sharing pattern where visual attention was divided between the driving scene and the secondary task.
- The often-cited 1.6-second single glance duration upper bound was corroborated by this data as only 4 glances in 208 were over 1.6 seconds (however this is a small sample).
- Glance data between the tasks didn't differ much, but both the hand-held and hands-free phone conditions were significantly different from the control in terms of task performance.
- **NOTE: the hand-held and hands-free conditions had different conversation tasks, which was a confounding factor within this study.**

Salvucci, D. D., & Macuga, K. L. (2002). Predicting the effects of cellular-phone dialing on driver performance. *Cognitive Systems Research*, 3, 95-102.

This paper demonstrates how cognitive modeling can aid in understanding these effects by predicting the impact of cell-phone dialing in a naturalistic driving task. Working within the ACT-R cognitive architecture, the authors developed models of four methods of cell-phone dialing and integrated these models with an existing driver model of steering and speed control. By running this integrated model, they generated a priori predictions for how each dialing method affects the accuracy of steering and speed control with respect to an accelerating and braking lead vehicle. They attempted to validate several of the model's predictions with an empirical study in a fixed-based driving simulator.

- The model predicted that the largest effects on driver performance arose for dialing methods with high visual demand rather than methods with long dialing times.
- "The model's predictions suggested that total dialing time does not seem to be a good indicator of the effects of a given dialing method on driver performance (as measured by lateral and speed deviations): although voice dialing required the most time, it produced the smallest deviations, while two faster methods, speed and menu dialing, produced larger deviations. Instead, visual demand as measured by phone gazes *does* seem to be a good indicator of the effects of a method on driver performance: the methods with the least visual demand resulted in the smallest deviations and vice-versa."



**Saltzberg, P. (2002).** Cell Phone Use by Motor Vehicle drivers in Washington State. Olympia, Washington: Washington Traffic safety Commission.

Presents the results of an observational study to examine the incidence of cell phone use by drivers in Washington State in 2001.

Observational study of 18 counties in the state of Washington; nine from western Washington and nine from eastern Washington. The observations were made in 80-minute blocks at 402 roadway sites between the hours of 8AM and 5PM. Observations were made only for hand-held phones used by drivers of passenger vehicles.

- 2,781 out of 78,754 observed drivers were using a hand-held phone, which makes for an overall state rate of 3.53%.
- The rate was higher for the western Washington counties, especially those along the Interstate 5 corridor.
- The rate also tended to be higher for the more urban counties (e.g., King (Seattle), Pierce (Tacoma), and Snohomish (Everett) counties).
- The highest cell phone rate was in Whatcom County, which borders BC, Canada (5.27%).
- SUVs and vans had the highest rate (4.59% and 4.23%, respectively), whereas the lowest rate was for passenger cars (2.91%).
- The authors note that these results are limited to drivers of passenger vehicles during daytime hours in the state of Washington.
- "The findings of this study (3.53% use rate) indicate that at any given time during daylight hours approximately 3 or 4 out of every 100 drivers of passenger vehicles will be using a cell phone while traveling on Washington roadways."

**Sodhi, M., and Cohen, J. (2002, work in progress).** Kingston, RI: University of Rhode Island Transportation Center.

Study investigating "tunnel vision" effects when using cell phone while driving.

Context

- Instrumented vehicle with head-mounted, eye-tracking device

Independent Variables

Dependent Variables

- Eye movements

- Preliminary results of analysis of the eye movements of automobile drivers using cell phones found that the drivers have a reduced field of view – tunnel vision.
- Concluded that the alertness of drivers decreased considerably when they were conducting cognitive tasks, such as remembering a list of items, calculating in one's head, or using a cell phone.
- Found that the tunnel vision caused by cell phone use continues well after the conversation ends, perhaps because drivers are still thinking about the conversation.
- Found that even when drivers do tasks that require brief glances away from the roadway, like adjusting the radio, wide-ranging eye movements suggest a higher level of alertness than when speaking on a cell phone.
- Found that most drivers seldom look away from the road for more than about 1.6 seconds when doing such tasks, a result that corresponds with previous research.

**Wilson, J., et al. (May 2002).**  
Collision and Violation Involvement of  
drivers Who Use Cellular Telephones.  
As cited on page 8 of Safety Canada  
(Vol. XLVI No. 3, July 2002), the  
member newsletter of the Canada  
Safety Council.

- "According to a British Columbia study, individuals who use cell phones while driving are inherently riskier drivers. They have more violations for speeding, impaired driving, seat-belt non-usage, aggressive driving and non-moving violations than drivers who refrain from cell phone use in vehicles, or have low usage. This indicates differences in lifestyle, attitude and personality that need to be considered in the design and targeting of public awareness campaigns."

**Boyle, J.M., and Vanderwolf, P. (2001).** *2000 Motor Vehicle Occupant safety Survey Volume 4 Crash Injury and Emergency Medical Services Report* (DOT HS 809 459). Washington, DC: NHTSA.

As part of the Motor Vehicle Occupant Safety Survey's volume on crash injury and emergency medical services, respondents were asked about cellular telephone use while driving.

- The proportion of drivers who have a car or cellular phone with them when they drive has continued to increase in all community types (urban, suburban and rural).
- Having a car or cellular phone was related to education level with 39% of those who did not graduate from high school, 48% of high school graduates, 58% of those with some college, and 62% of college graduates having a car or cellular phone.
- Nearly three-quarters (73%) of those who usually have a car or cellular phone in their vehicle reported a tendency to hold the phone with their hand. 22% reported a tendency to use hands-free phones.
- More than half reported talking on the phone during fewer than half of their trips. In total, 73% reported using their phone, at least on occasion, while driving. 26% said they never talk on the phone while driving.

**Crawford, J.A., Manser, M.P., Jenkins, J.M., Court, C.M., and Sepúlveda, E.D. (2001).** Extent and effects of handheld cellular telephone use while driving (Report No. SWUTC/01/167706-1). College Station, TX: Texas A&M University System, Texas Transportation Institute

This research assessed handheld cellular telephone use among drivers on highways during the afternoon peak period in Dallas County, Texas. Use was measured through visual data collection methods.

- 5% of drivers were observed using a handheld cellular telephone.
- Use was lower in less dense urban areas than in more dense urban areas.
- The maximum proportion observed was slightly over 8% – driving in the peak direction in a dense urban area.
- Interactions were found among site location, time of day, and travel direction.
- These estimates are conservative in nature because they do not include the use of either handheld cellular telephones with hands-free adapters, or in-vehicle, installed hands-free cellular telephone systems

Graham, R., and Carter, C. (2001). Voice dialing can reduce the interference between concurrent tasks of driving and phoning. *International Journal of Vehicle Design*, 26(1), 30-47.

A laboratory experiment was conducted to test two variations of speech interface against a standard manual telephone interface. Participants carried out driving-related tasks while simultaneously dialing familiar telephone numbers. The primary hypothesis of this study was that speech recognition would reduce the interference between concurrent tasks of driving and phone dialing, compared to manual input. The level of interference was assessed through measures of tracking-task (driving) error, "collisions", reaction times to peripheral targets, phone transaction times, number of dialing errors, and perceived mental workload with NASA-TLX.

#### Context

- Part-task driving simulation (tracking task)

#### Independent Variables

- Phone interface (manual, speech recognition with auditory feedback, speech recognition with auditory and visual feedback)
- Concurrent task (driving only, phoning only, driving and phoning)
- Increased speech recognition error (0%, 3%, 6%)

#### Dependent Variables

- Tracking performance error – mean RMS of "lane" position
- Reaction time (RT) to peripheral targets
- "Collisions" – defined as lane departures
- Phone performance (task times, errors)
- Perceived mental workload (NASA-TLX)

- Overall, tracking performance, "crashes", and peripheral target detection were worse when dialing and driving compared to driving alone.
- Tracking performance was significantly worse in the manual dialing condition than the two speech recognition conditions.
- There were significantly more "crashes" in the manual dialing condition compared to the two speech recognition conditions.
- Peripheral target detection was significantly slower in the manual dialing condition compared to the two speech recognition conditions.
- Note: the location of the phone in the manual dialing condition was NOT controlled: some participants kept it in the cradle, some held it in the air, some leaned it against the steering wheel, etc.
- Speech recognition dialing required significantly more time than did the manual dialing interface.
- Dialing accuracy was also significantly more accurate in the manual condition.
- Participants felt that speech recognition dialing was less mentally demanding than the manual dialing.
- There were significantly more tracking errors and "crashes" when the speech recognition dialing included visual feedback in addition to auditory feedback, compared to the auditory feedback alone.
- The speech recognition had little effect on performance (dialing time was the only factor affected).
- Authors concluded "The present study lends some support to the previous findings that hand-held mobile phone use while driving has the potential to adversely affect driving safety. Voice dialing may be considered as an extension to the hands-free concept. There are, however, a number of reasons why we should not recommend that legislation be changed to allow the use of voice-activated phone functions while driving."

**Green, P. (2001).** Safeguards for on-board wireless communications. Presentation at the 2<sup>nd</sup> Annual Plastics in Automotive Safety Conference. Troy, Michigan.

According to Green, in contrast to the optimistic market projections the safety picture is less positive for telematics as these systems could distract drivers to a significant degree, making driving less safe rather than safer. This paper identified (1) the problems associated with telematics use (especially for navigation systems and phones), (2) the factors contributing to driver overload (visual demand, cognitive demand, immediacy), (3) why safety initiatives are needed, (4) ongoing safety rulemaking (by organizations such as SAE and ISO) and (5) why a workload manager may be the best solution to safety concerns.

- "Recognizing the crash risk due to visual demands, cognitive demands, and the immediacy of in-vehicle tasks, numerous bodies are developing guidelines, recommended practices, and safety standards affecting interface design. [Then] current activities of SAE and ISO are most important."
- "Some believe that rather than focusing on regulations, simply making all driver interfaces voice based will solve the overload problem and provide the desired levels of safety. Voice interfaces can be beneficial, but only in some circumstances."
- "In the long run, the ultimate solution is to develop workload managers that regulate information flow to the driver in response to the driving situation. However, both short-term activities to develop standards and long-term activities, such as the development of workload managers, are hampered by a lack of a research basis for decisions."
- "There are no signs that the funding necessary, an order of magnitude increase over the current situation, will occur, and this should be a significant concern to organizations that see a future in telematics."

Haigney, D., and Westerman, S.J. (2001). Mobile (cellular) phone use and driving: a critical review of research methodology. *Ergonomics*, 44(2), 132-143.

**Abstract:**

"Studies have examined possible effects of concurrent mobile phone use on driving performance. Although interference is often apparent, determining the implications of such findings for 'real-world' driving is problematic. This paper considers some relevant methodological issues including the definition of procedures and terms, operationalization of task elements, sampling of task components, and the provision of experimental controls. Suggestions are made about how methodological rigor could be improved."

**Topics include:**

- Models of time-sharing performance
- Mobile phones and accident reports
- Influence of mobile phone type
- Influence of vehicle transmission type
- Measuring distraction
  - Eye movements
  - Comparison with radio use
  - Comparison with passenger conversation
- Ethical and legal considerations

**The authors concluded:**

"It is argued here that there is a need for greater operational clarity in experimental reports in order to facilitate comparisons between studies. In many instances, more detailed description of phone type, task demands and vehicle transmission would be useful. In the UK consideration of driver performance while using a manual transmission is a particularly important and generally neglected area of research.

The ecological validity of tasks used during laboratory-based studies is a matter of some concern. It is debatable whether the range of tasks investigated accurately reflects the range and balance of cognitive processes involved when concurrently using a mobile phone and driving.... In summary, the demands of driving and phone use are varied, and a more detailed understanding of the ways in which mobile phones are used in this context is required in order to improve estimates of interference.

**Insurance Corporation of British Columbia (2001).** *The Impact of Auditory Tasks (as in hands-free cell phone use) on Driving Performance.* (Online at [www.icbc.com](http://www.icbc.com)). North Vancouver, British Columbia: ICBC.

Investigated the impact of in-vehicle telephone use on driving performance using closed course driving experiments. Simulated hands-free cell phone use using a sequence of verbal messages to which the driver would respond. Included 41 subjects – 30 men and 11 women. Seven were aged 19-24, 25 were aged 25-44, and 9 were aged 45-70.

Context

- On-road, conducted on a closed-course test track.

Independent Variables

- Presence or absence of messages.
- Traffic event (traffic signal light, pop-up target, left turn task)

Dependent Variables

- Driving performance variables such as braking and acceleration behavior
- Reaction time to traffic event

- Found that listening and responding to relatively complex messages resulted in significant degradation of driving performance in a series of driving tasks. Results indicated a relationship between extent of degradation and the complexity of the required driving maneuver.
- Authors concluded that study provides evidence that the problems associated with divided attention (driving and message attention/response) were aggravated by adverse driving conditions, such as slippery road conditions.
- Authors concluded that "While it was not possible to make a direct connection to crash risk from the experimental results, the nature of the driving performance degradations measured in relation to the presence of the message task clearly point to potential safety related problems associated with such things as phone use while driving – even if such use does not involved physical manipulation of the device."

**Ishida, T., and Matsuura, T. (2001).** The effect of cellular phone use on driving performance. *IATSS Research*, 25(2), 6-14.

The purpose of this study was to investigate the influence of operating a cellular phone and of the phone call itself on driving performance during a controlled on-road experiment, and to examine whether hands-free phones are an effective safety countermeasure. The location of the hands was an important factor in this study, with a single hand on the steering wheel condition for the hand-held phone, and both hands on the steering wheel for all other conditions. Participants followed a lead car on a test track while performing the in-vehicle tasks as cued. They performed addition problems while driving.

Context

- Test-track study

Independent Variables

- Hands-free vs. Handheld phone, car radio

Dependent Variables

- Driving performance measures such as braking, headway distance, and lanekeeping
- Eye movements

- The mean glance duration when manipulating the hand-held phone was longer than when manipulating a hands-free set or car stereo.
- Braking reaction time delay increased in the following order: driving only, car radio, hands-free phone, and hand-held phone.
- Driving speed was lowest when drivers used the hand-held phone, and the headway distance was the longest.
- Some indication that processing of the addition task was worse for the hand-held condition compared to the hands-free condition.
- Despite the different in-vehicle device modalities, a general delay in information processing was found when using the in-vehicle devices while driving compared to driving only.
- Conclusion: use of hands-free phones is effective to an extent (as compared to hand-held phones), but that driving performance was worse when using a phone (either type) than when only driving.

**Just, M.A., Carpenter, P.A., Keller, T.A., Emery, L., Zajac, H., and Thulborn, K.R. (2001).**  
Interdependence of Nonoverlapping Cortical Systems in Dual Cognitive Tasks. *NeuroImage*, 14, 417-426.

(Center for Cognitive Brain Imaging,  
dept of Psychology, Carnegie Mellon  
University)

Describes a study that used functional magnetic resonance imaging (fMRI) to measure cortical activation during the concurrent performance of two high-level cognitive tasks that involve different sensory modalities and activate largely nonoverlapping areas of sensory and association cortex.

Involved participation of 18 right-handed native English speakers (6 females), aged 18-32

Context

- Two tasks performed both alone and concurrently
  - Auditory sentence comprehension task combined with mental rotation of visually depicted 3-D objects.

- Found that the behavioral measures indicated that the dual tasks were performed without compromising accuracy in either task. Although both tasks were performed at a high absolute level of accuracy, the behavioral performance was reliably poorer in the dual task conditions.
- Found that in the dual task, the activation in association areas (primarily temporal and parietal areas of cortex) was substantially less than the sum of the activation when the two tasks were performed alone, suggesting some mutual constraint among the association areas. In other words, the activation volume in the cortical systems underlying the two tasks is not independent, but decreases relative to the single task conditions. A similar result was obtained for sensory areas as well.
- One interpretation of results – “there is a limit on how much attention is available to distribute over more than one task.” In this context, the word *attention* refers to a limited cognitive commodity that can be distributed over tasks, such as divided attention.
- Concluded that if either task had imposed more computational demand per unit time, then deterioration in accuracy would probably have been more noticeable in the dual task. In other words, the constant co-processing may apply not to the number of tasks that can be performed simultaneously, but to the amount of computation performed per unit time in each task.
  - Suggests that this may explain why it is increasingly possible to concurrently perform multiple tasks, such as driving and conversing, as one or both become automated and less resource demanding.
  - “However, even for an experienced driver, a sudden, computation-demanding complexity in traffic events can put an end to conversation, and a complex conversation may put an end to careful driving.”

Laberge-Nadeau, C., Maag, U., Bellavance, F., Desjardins, D., Messier, S., and Saïdi, A. (2001). *Wireless telephones and the risk of road accidents (Final report, CRT-2001-16)*. Montreal, Canada: Laboratoire sur la sécurité des transports, Université de Montreal.

See also

Bellavance, F., Bourhattas, M., Lapierre, S., Laberge-Nadeau, C., and Messier, S. (2003). Misclassification bias in the case-crossover design applied to wireless telephones and the risk of road crashes. Presentation at the Statistical Society of Canada 2003 Annual Meeting. Retrieved on June 12, 2003 at : [http://www.ssc.ca/main/meetings/halifax\\_e.html](http://www.ssc.ca/main/meetings/halifax_e.html)

See also

Angers, J.-F., Courchesne, S., Poirier, L.-F., Bellavance, F., and Laberge-Nadeau, C. (2003). Cell phone and car accidents: a Bayesian approach. Presentation at the Statistical Society of Canada 2003 Annual Meeting. Retrieved on June 12, 2003 at : [http://www.ssc.ca/main/meetings/halifax\\_e.html](http://www.ssc.ca/main/meetings/halifax_e.html)

An epidemiological study that attempted to "verify whether an association exists between cell phone use and accidents, with a distinction made between accidents with injuries and accidents with property damage only."

Considered survey data from 36,079 respondents. Collected data on driver demographics, cell phone usage, driving and crash history in recent 24 months. Also obtained cell phone activity records.

- Found that relative risk of all accidents and of accidents with injuries is higher for users of cell phones than for non-users – relative risks for accidents is 38% higher for cell phone users than for non-users.
- Found that relative risks calculated in this study are "much lower than those described by Redelmeier and Tibshirani (1997)," and that the method used in the previous study is "responsible for overestimation."
- Found an association between the risks of accidents with property damage only and risk of accidents with injuries for cell phone users compared with nonusers.
- Found that heavy cell phones users are exposed to twice the risk as normal users, taking into account age, exposure to risk and driving habits.
- **Recommendations:** Concluded that driver-related safety measures should be encouraged, including training and education campaigns. Encouraged use of voice-activated hands free cell phones in order to "minimize handling and keep both hands on the steering wheel." Encouraged development of vehicle-related safety devices for improved hazard warning and driver assistance.
- Suggested that future road safety perspectives should consider "the association between frequency of calls and the risk of accident."

Recommendations to the driver:

- Avoid intensive and unnecessary phone use, keep conversations short and avoid this form of communication, especially in situations requiring that they pay particular attention to the road.
- When using the phone while driving is unavoidable, drivers should remain at a considerable distance from other vehicles and driver at moderate speeds, preferably in the slow lane.
- The use of voice-activated or hands-free cell phones is encouraged in order to minimize handling and to keep both hands on the steering wheel.
- If manual dialing is necessary, the driver should safely move towards the shoulder of the road or dial the number while the vehicle is stopped.



Continued...

Laberge-Nadeau, C., Maag, U.,  
Bellavance, F., Desjardins, D.,  
Messier, S., and Saïdi, A. (2001).  
*Wireless telephones and the risk of  
road accidents (Final report, CRT-  
2001-16)*. Montreal, Canada:  
Laboratoire sur la sécurité des  
transports, Université de Montreal.

- *The telephone should always be firmly attached and located within the driver's field of vision, making it unnecessary to search for the phone.*

*Other recommendations:*

- *Cell phone companies could intensify information campaigns, which now include advertising and advice provided with products and bills. Cell phone companies should be supportive and assist in other technical, ergonomic and epidemiological research efforts.*
- *The automobile industry could work to reduce the risk of crashes linked to cell phones by developing technology to provide the driver with information or to help the driver remain at an optimal distance from other vehicles.*

Lee, J.D., Caven, B., Haake, S., and Brown, T.L. (2001). Speech-based interaction with in-vehicle computers: The effect of speech-based e-mail on drivers' attention to the roadway. *Human Factors*, 43(4), 631-64.

This study used a car-following task to evaluate how a speech-based e-mail system affects drivers' response to a periodically braking lead vehicle. A baseline condition with no e-mail system was compared to a simple and a complex e-mail system in both simple and complex driving environments. The e-mail system was simulated and an experimenter, who gave the system 100% speech recognition accuracy, simulated speech recognition. The simple e-mail system consisted of three levels of menus with two options for each menu. The complex system consisted of four to seven options for each menu. Traffic density, intersection density, and the scenery (houses, barns, fences, and animals) defined the complexity of the driving environment. The e-mail system was either available or not. Sample e-mail task: "Read a new message from your boss concerning the project budget. Also, read messages containing vendor estimates for the project. Correctly reply to your boss. The task is completed when you have gone through all messages and you have exited the system."

#### Context

- Driving simulator (Hyperion)

#### Independent Variables

- E-mail system availability (available or not)
- E-mail system complexity (simple vs. complex)
- Driving environment

#### Dependent Variables

- Driving performance (RT to lead vehicle slow-down)
- Subjective workload (NASA-TLX)
- Perceived distraction (subjective rating modeled after NASA-TLX)

- Overall, drivers responded more slowly when the e-mail system was available versus not, with a mean Reaction Time (RT) of 1.32 seconds compared to 1.01 seconds (a 30% increase).
- The driving environment complexity also increased reaction time from 1.00 to 1.32 seconds.
- The complexity of the e-mail system did not have an effect on RTs.
- The availability of the e-mail system had a large impact on the NASA-TLX scores, a rating of 47.0 when the system was available and 27.1 when it was not.
- The subjective ratings were greater for the complex e-mail system (53.3) compared to the simple system (40.7).
- The complexity of the driving environment did not have an effect on subjective ratings of workload.
- The authors conclude with a discussion how a RT latency of 310 msec in a crash situation does in fact impact driving safety.

McCarley, J.S., Vais, M., Pringle, H., Kramer, A.F., Irwin, D.E., and Strayer, D.L. (2001). Conversation disrupts visual scanning of traffic scenes. Presented at *Vision in Vehicles* 9.

Investigated the effects of naturalistic conversation on observers' scanning and consequent representation of traffic scenes. Utilized a *change detection* task. Observers were required to perform the change detection task while conversing with a confederate. The confederate was located in a separate room to discourage discussion of the stimulus or modulation of behavior. Conversations "were casual, covering topics such as television shows and hobbies." The authors equate this task to hands-free wireless phone use.

Context

- Lab: Observed traffic scene images

Independent Variables

- Conversation vs. no conversation, older (mean of 68 yrs) vs. younger (mean of 21 yrs)

Dependent Variables

- RTs and accuracy for reported change detection in traffic scenes
- Eye-movement data with an eye-tracker.

- Error rates were significantly higher for older observers than younger ones.
- Error rates were significantly higher under the conversation condition. The majority of the errors were misses, where the observer failed to notice the change at all.
- RTs for older observers were significantly longer than for younger observers.
- There was no difference in RT between the conversation and no-conversation conditions, nor did it interact with the age factor.
- Observers made significantly more eye fixations per trial under the conversation condition compared to the no-conversation condition, but the fixation durations were also significantly shorter than in the no-conversation condition. This may be the reason for the lack of difference in RT.
- They interpret this to indicate less efficient visual search while conversing.
- Concluded that even simple conversations can disrupt attentive scanning and representation of a visual scene.

**Parkes, A.M., and Hooijmeljer, V. (2001).** *Driver Situation Awareness and Carphone Use* (paper submitted for publication in July 2001). Crowthorne, England: Transport Research Laboratory.

Examined the influence of hands-free cell phone use on driver situational awareness while driving on a simulated route. Driving performance of 15 subjects, aged 22-31, (both with and without a hands-free telephone) was assessed while conversing on a cell phone. Subjects were asked a series of questions over the cell phone; responses were made verbally. The phone task consisted of memory, arithmetic and reasoning operations. Unexpected events (presentation of visual stimuli) requiring choice reactions were also included in the scenario.

Context

- Static simulator study featuring a motorway with low traffic volume, varied weather conditions and curves in the road.

Independent Variables

- Access to hands-free cell phone (with vs. without phone conversation)
- Location of unexpected events in relation to tasks and environment.

Dependent Variables

- Situational awareness measured using probe questions (e.g., describe traffic around you, color of car in rearview mirror, relative speed of car in rearview mirror compared to your car)
- Reaction time to unexpected events.
- Lane keeping
- Speed and braking behavior

- Found significant deterioration in situational awareness across the phone and no-phone conditions. Drivers engaged in phone conversations had significantly fewer correct answers in response to situational awareness questions. In other words, drivers demonstrated decreased awareness of traffic movements around them (i.e., could not report on presence of actions of traffic around them) due to level of concentration demanded by the carphone conversation.
- Some evidence suggests that drivers are slower to react just after the start of the conversation, but the effect is minimized over time.
- Drivers were found to be slower to adapt to a change in speed from 80 to 50 km/h when engaged in a conversation.
- Authors highlight the need for further study into the nature and duration of typical car phone conversations.
- Authors noted, "This experiment has attempted to focus on those elements that can reasonably be addressed in a medium fidelity simulator: speed choice, lane tracking, reaction times and situation awareness. All of these measures have shown that the concurrent engagement in a hands-free carphone task directly influence performance in a direction associated with a decrease in safety."

**Reinfurt, D.W., Huang, H.F., Feaganes, J.R., and Hunter, W.W. (2001).** *Cell Phone Use While Driving in North Carolina*. Chapel Hill, NC : University of North Carolina Highway Safety Research Center.

Describes a study that: (1) reviewed recent research – epidemiological studies, case analyses of cell-phone-related crashes, and driver performance studies; (2) reports on recent legislative activity regarding the use of cell phones while driving; (3) analyzed data from an observational study of cell phone use while driving in North Carolina; (4) pilot-tested the use of a supplemental data form by the N.C. Highway Patrol to report additional information on crashes when a cell phone was involved; and (5) analyzed police narratives for crashes where the use of a cell phone by the driver was indicated by the investigating officer.

- Observational Study in North Carolina to determine characteristics of drivers who use hand-held phones while driving revealed that:
  - 1,070 drivers were using cell phones among the 14,059 vehicles observed;
  - Cell phone usage was associated with front seat occupancy, vehicle type, and driver age, ethnicity and restraint usage;
  - Drivers who were using a cell phone while driving were more likely to be driving without a front seat passenger, driving a sport utility vehicle, younger, white, and using seat belts;
  - Cell phone prevalence rate is 3.1%, which is consistent with recent studies carried out nationally by NHTSA (3.0%) and by researchers in Texas (~5%).
- The results of a pilot study with the NC State Highway Patrol where investigating Troopers completed a special cell phone-related form for crashes where a cell phone was being used indicated that about one in 600 crashes appeared to involve the use of a cell phone while driving.
- Analysis of crash narratives for crashes occurring in North Carolina between 1/1/96 and 8/31/00 revealed that there has been “exponential growth” in frequency with which cell phone is mentioned in police narratives.
  - 22 in 1996; 35 in 1997; 53 in 1998; 111 in 1999; and 231 in first eight months of 2000
  - Most common driver action was “talking on the phone” (46%) followed by “answering the phone” (15%) and “reaching for the phone” (10%).
- Concluded that there is a “critical need for better information if the risk of crashing while talking on a cell phone is to be appropriately estimated.”

Sagberg, F. (2001). Accident risk of car drivers during mobile telephone use. *International Journal of Vehicle Design*, 26(1), 57-69.

Describes a survey study of 9000 Norwegian drivers who had recently reported a crash to their insurance company. Drivers responded to questionnaires about mobile telephone use and other distractors during the latest crash incident.

- Found that 0.66% of guilty drivers and 0.30% of innocent drivers reported using the mobile telephone during the accident. Found that mobile telephones were used in 0.86% of accidents, which is 72% higher than expected proportion based on "induced exposure."
- Found that the number of accidents during telephoning was too low for significant differences between hands-free and hand-held telephones to appear.
- Found that rear-end collisions were the most frequent accident type when mobile phones were involved during an accident.
- Found that both radios and CD players cause more accidents than the mobile telephone.
- Found that about 50% of drivers reported using a mobile phone in the car at some time. Found that 28.6% of those drivers use hand-held phones, 11.2% use dash-mounted telephones (dialing without holding phone but hand-held conversation), and 10.8% of drivers used hands-free telephones.
- Found that 27.4% of drivers with hands-free telephones receive or place calls more than three times per day, whereas 9.7% of those with hand-held telephones receive or place calls more than three times per day.
- Found that mobile telephone use during driving is a "significant risk factor."
- Found that while some accidents during telephone use are expected based on exposure [to driving] alone, the actual number of accidents is about 72% higher than the expected number, as estimated by the method of induced exposure. Concluded that increased risk most likely is the consequence of the telephone use *per se*, and is not attributable to differences in risk-related behavior between users and non-users of mobile telephones.
- Found that the risk increase was statistically significant only for hand-held phones, however, it cannot be concluded from the data that hand-held phones entail a higher risk than hands-free phones, since no statistically significant difference was demonstrated.

Strayer, D.L., and Johnston, W.A. (2001). Driven to distraction: Dual-task studies of simulated driving and conversing on a cellular phone. *Psychological Science*, 12 (6), 462-466.

A set of two experiments designed to contrast the effects of hand-held and hands-free wireless phone conversations on a simulated driving task (visual pursuit tracking). While performing the tracking task, a green or red light would appear at points. Subjects were to respond to the red light by pressing a "brake" button on a joystick as quickly as possible. They performed the tracking task alone, and while engaged in a naturalistic conversation task with a confederate using either a hand-held or hands-free phone. The authors performed an "additional control condition" where they required subjects to listen to a book on tape as the dual-task. The second experiment incorporated differences in the difficulty of the simulated driving task, as well as verbal tasks for two dual-task conditions (no naturalistic conversations). One task was a shadowing task where subjects were required to repeat aloud words they heard read from a list at a rate of one word for every 3 seconds. The second dual-task was a word generation task, where subjects were required to respond with a new word beginning with the last letter of the word read by the experimenter.

#### Context

- Part-task driving simulation (tracking task only) - dual-task study

#### Independent Variables

- Two types of phones: Hand-held vs. hands-free
- Conversation vs. no-conversation
- Exp. 2: the two dual-tasks vs. the single task

#### Dependent Variables

- Response times
- Probability of a miss

- "Principle findings are that (a) when participants were engaged in cell-phone conversations, they missed twice as many simulated traffic signals [response cues] as when they were not talking on the cell phone and took longer to react to those signals that they did detect; (b) these deficits were equivalent for handheld and hands-free cell phone users; and (c) tracking error increased when participants used the cell phone to perform an active, attention-demanding word-generation task but not when they performed a shadowing task."
- The largest performance decrements were associated with the word-generation conversation task, but there were also decrements under the listening condition.
- Listening to radio broadcasts or listening to a book on tape did not disrupt simulated driving performance.
- Continuous shadowing of a verbal list using a handheld phone was also not disruptive, ruling out the dual-task interpretations associated with holding the phone, listening, or speaking.
- Concluded that cellular phone conversation - handheld or hands-free - leads to significant degradation of simulated driving performance.

Stutts, J.C. (2001). *Testimony for Presentation at the Subcommittee on Highways and Transit hearing on Driver Distractions: Electronic Devices in the Automobile* (May 9, 2001). Online at [www.aaafoundation.org](http://www.aaafoundation.org)

*See Also*

Smith, E. (2001). *University of North Carolina Highway Safety Research Center Study on Distracted Driving : Outline of Results, Methodology, and Data Limitations* (May 8, 2001). Online at [www.aaafoundation.org](http://www.aaafoundation.org)

Describes highlights and recommendations of study, awarded to be University of North Carolina Highway Safety Research Center by the AAA Foundation for Traffic Safety, to examine the role of driver distraction in traffic crashes. The goal was to identify (using both crash and field data) the major sources of distraction to drivers and the relative importance of the distractions as potential causes of crashes.

Work included analysis of five years of Crashworthiness Data System (CDS) data, made available by NHTSA's National Center for Statistics and Analysis. Also included analysis of crash narrative data from two years of both CDS and North Carolina data.

**Limitations of the study:**

- The study analyzed data from the CDS. "This data includes only information on crashes in which at least one vehicle was damaged severely enough to require towing from the scene.... It is important to note that the CDS data for this study was vehicle-based rather than crash-based, and thus almost certainly understates the role of driver distraction in crashes."
- **Missing data:** The CDS data has a high percentage if either missing, unknown, or other data. Driver attention status is unknown for almost 36% of the drivers, and the exact nature of distracted for 34% of the distracted drivers was not recorded. Thus, present estimates for *known* distracting events probably understate their true magnitude.
- **Limited Sample Size:** data may have large standard errors when weighted to reflect national estimates. The estimates for cell phone use are based on only 42 reported cases.
- **Exposure Data:** Cannot determine relative risk since it is unknown how much time drivers

- Found that while 8.3% of drivers were identified as distracted at the time of the crash. Of that number, found that 1.5% of distracted drivers were using or dialing a cell phone.
- Found that younger drivers (under 20 years of age) were the most likely to be involved in distraction-related crashes.
- Note "Our analysis was not intended to provide definitive answers as to which distractions pose the greatest risk to drivers."
- "It is also important to consider the limitations of the CDS data. Despite the in-depth nature of the data collection activities, there is potential underreporting of distracted driving in general, as well as differential underreporting of specific distracting events. Crashes involving cellular phones offer a good example. Given the huge increase in reported ownership and use of cellular phones nationwide, one might expect an increase in the reported number of crashes involving cell phones over the five years covered by the analysis. No such increase occurred, however. The actual recorded number of cases involving cellular phones was 8 in 1995, 10 in 1996, 8 in 1997, 10 in 1998, and 6 in 1999. It may be that as more attention has been drawn to the potential role of cellular phone in unsafe driving and crashes, drivers have become less willing to reveal this information when involved in a crash. People may believe that admitting to cell phone use at the time of their crash put them in more legal or financial (insurance) jeopardy than admitting to spilling a cup of coffee or dropping a CD."

*Recommends "better crash data are needed to clarify and quantify the magnitude of the driver distraction problem and the relative contributions of different sources of driver distraction. Equally important, however, are empirical data on how often drivers engage in potentially distracting behaviors and what it is about these behaviors that increases crash risk. For example, does a particular distraction lead to reduced vehicle control (in the form of lane wandering, reduced headways, lower speeds, braking, etc.), reduced situational awareness (measured by eye gaze direction, longer response times, fewer mirror checks to monitor surrounding traffic, etc.), or both? To date, these kinds of data have primarily been collected in laboratory settings, but there is growing recognition that they also need to be collected in real-world driving environments,*



Continued...

engage in various distracting activities.

with people driving their own vehicles."

Stutts, J.C. (2001). *Testimony for Presentation at the Subcommittee on Highways and Transit hearing on Driver Distractions: Electronic Devices in the Automobile* (May 9, 2001). Online at [www.aaafoundation.org](http://www.aaafoundation.org)

Recommends that "More research is needed to document frequency, intensity, and consequences of real-world driver distraction. Understanding driver distraction is especially important in light of new in-vehicle technologies."

See Also

Stutts, J.C., Reinfurt, D.W., Staplin, L., and Rodgman, E.A. (2001). *The role of driver distraction in traffic crashes. Phase I Final Project Report*. Chapel Hill, NC : University of North Carolina Highway Safety Research Center.

- Found that for the overall 1995-1999 CDS data, 8.3% of the drivers were identified as distracted, 5.4% as "looked but did not see," and 1.8% as sleepy or asleep. 35.9% were coded as either unknown or no driver present. The remainder was classified as attentive at the time of their crash. Without the unknowns, 12.9% of drivers were identified as distracted, and the percentage of actual crashes involving distractions would be higher.
- Found that among the specific sources of distraction among distracted drivers, 1.5% of crashes were caused specifically by Using/Dialing a cell phone. Another 34.2% of distracted drivers were classified as "other" or "unknown" distraction.
- Found that younger drivers (under 20 years of age) were the most likely to be involved in distraction-related crashes.

Utter, D. (2001). *Passenger Vehicle Driver Cell Phone Use Results from the Fall 2000 National Occupant Protection Use Survey* (NHTSA Research Note DOT HS 809 293). Washington, DC: NHTSA.

This Research Note presents results based on the Controlled Intersection Study conducted in the Fall (October - November) 2000.

Data collection for the Controlled Intersection Study consists of observing shoulder belt use in passenger motor vehicles. Observers were stationed for 45 minutes at each observational site. Shoulder belt use and other demographic information (age group, sex, and race) were obtained for drivers and passengers in passenger cars, pickup trucks, vans, minivans, and sport utility vehicles (SUVs). Additionally, the driver's use of a cell phone at the time of observation was also recorded. Only use of hand-held cell phones was included. Commercial and emergency vehicles were excluded. Every day of the week and all daylight hours (8 a.m. to 6 p.m.) were covered.

- Nationally, overall hand-held cell phone use by drivers of passenger vehicles (Table 1) was estimated at 3 percent. This means that at any given time during daylight hours, about 3 percent of drivers of passenger cars, vans, SUVs, and pickups are actively using a cell phone.
- The 2000 Motor Vehicle Occupant Safety Survey also estimated that 73% of drivers who said they usually have a wireless phone in their vehicle with them use a hand-held cell phone and an additional 22% use "hands-free" equipment. Extrapolating this result to the NOPUS hand-held cell phone observations results in an additional 0.9 percent of drivers using "hands-free" cell phones for a total of 3.9 percent (or more than 600,000) of drivers actively using cell phones at any one time.

Woo, T.H., and Lin, J. (2001). Influence of mobile phone use while driving. *IATSS Research*, 25(2), 15-19.

A study initiated by the Ministry of Transportation and Communications in Taiwan to examine and investigate the influence of mobile phone use while driving in order to determine the legislation needs. Data were collected in four areas: driving reaction test using a simulator, accident reports, questionnaires to drivers involving an accident, and a general public opinion survey.

The authors reported the following:

- Results from the driving simulator test indicated that reaction times for drivers using mobile phones are significantly longer. Age and gender were found to affect reaction time.
- Results from the analysis of accident reports revealed:
  - 3,075 accident reports, of which either driver involved in the crash carried a mobile phone in 676 cases, and either driver involved in the crash was using the phone in 133 cases.
- Results from the questionnaires and public opinion surveys show that drivers who do not own mobile phones are more inclined to support the ban of using mobile phones while driving. However, whereas the majority of the general public is aware of the adverse effects of using a mobile phone while driving, only 44.2 percent of the responders supported a legislative ban.

"Based on the conclusions from this study, the Legislative Yuan of Taiwan passed a law to ban the use of handheld mobile phones while driving in January 2, 2001. For a compulsory three-month campaign, the regulation will be in force from September 1, with a violation fine of NT\$3,000 (approximate to US\$90) for drivers and NT\$1,000 for motorcyclists."

**Hahn, R.W., Tetlock, P.C., and Burnett, J.K. (2000).** Should you be allowed to use your cellular phone while driving? *Risk*, 23(3), 46-55.

**See Also**

**Hahn, R.W., and Tetlock, P.C. (1999).** *The Economics of Regulating Cellular Phones in Vehicles (Working Paper #99-9)*. Washington, DC: The AEI-Brookings Joint Center for Regulatory Studies.

Economic analysis of regulatory options for addressing cellular phone usage by drivers.

- Concluded "banning drivers from using cellular phones is a bad idea." Also concluded that less intrusive regulation, such as requiring the use of a hands-free device that would allow a driver to use both hands for steering, is unlikely to be economically feasible. Authors base these conclusions on the following:
  - Estimate that costs of a ban are likely to exceed benefits.
  - Estimates of accidents and fatality reductions do not take into account how drivers would alter their behavior in response to regulation, which has implications for net reductions in accidents and fatalities.
  - Technology is moving toward voice activation, which is likely to reduce risks.
- Recommends further research and collection of more systematic information regarding relationship between cellular phone use and crashes.
- Also recommends research into how new technologies could reduce crash risks associated with drivers' using cellular phones.

Haigney, D.E., Taylor, R.G., and Westerman, S.J., (2000). Concurrent mobile (cellular) phone use and driving performance: task demand characteristics and compensatory process. *Transportation Research Part F*, 3, 113-121.

**See Also**

Haigney, D., and Taylor, R.G. (1998). *Mobile Phone use Whilst Driving: Phone Operation vs. Vehicle Transmission*. (Online at [www.rosppa.co.uk](http://www.rosppa.co.uk)). Birmingham, UK: Royal Society for the Prevention of Accidents.

Investigated the effects of mobile phone use (handheld vs. hands-free) on driving performance in a simulator-based study with simulated vehicles featuring *manual* and *automatic* transmissions. Included 30 drivers – 13 men and 17 women. Mean age was 26.93 yrs old. Sixty-three percent of the subjects had previous experience using a mobile phone. The conversation task consisted of a modified version of the Baddeley grammatical reasoning test in which the subject is presented with 5 stimulus letters, followed by a statement regarding the relative ordering of two pseudo-randomly selected letters. The subjects were then asked to indicate if the statement was true or false.

**Context**

- Driving simulator featuring a standard road layout. Study employed a modified grammatical reasoning test to replicate demands of verbal comprehension.

**Independent Variables**

- Handheld vs. hand-free phone
- Manual vs. Automatic transmission

**Dependent Variables**

- Driving performance measures including acceleration, speed, braking, steering, following distance, number of gear changes, number of overtakes, number of off-road excursions, and number of collisions. In this study, as in other referenced research, speed and acceleration measures were associated with “risk acceptance” behaviors.
- Physiological measures such as heart rate.

- Found that changes in heart rate indicated increase in cognitive demand experienced by drivers when using mobile phones. Authors argue that the increases in cognitive demand lead to reductions in safety margins.
- Concluded that participants engaged in a “process of risk compensation, with driving speed being slower at times of mobile phone conversation while the number of off-road excursions (OFFS) and collisions remained stable.”
  - Found that using a phone, either hands-free or handheld – leads to variations in driver behaviors, which are strongly associated with subjective risk manipulation and crash involvement. Results showed significant variations in vehicle speed, decrement in driver responsiveness to traffic conditions, and decreased driver responsiveness following a phone call.
- Found no perceptible difference in attention deficit generated by drivers using handheld or hands-free phones – both seriously affected the driver’s ability to consistently attend to the driving task.
- Found no identifiable difference in attention deficit between use of mobile phones with manual or automatic cars.
- Concluded that “Whilst the emergency use of mobile phones is recognized as a significant benefit, the position stated in RoSPA (1997b) is maintained – namely that such calls do not need to be made whilst actively engaged in the driving task – and that it can only be recommended that drivers do not engage in polychronic phone use.” Authors concluded that it is impossible to use a mobile phone while driving without being significantly distracted and without increasing the risk of a crash.

Irwin, M., Fitzgerald, C., and Berg, W.P. (2000). Effect of the intensity of wireless telephone conversations on reaction time in a braking response. *Perceptual & Motor Skills*, 90, 1130-1134.

Using a laboratory based driving buck to mimic the foot activity in driving, 16 adults were instructed to release the accelerator pedal and depress the brake pedal as quickly as possible following the activation of a red brake light. The mean response time (RT) was measured for five (5) conversation conditions, ranging in conversation intensity, conducted on a wireless phone. The five conditions were: (1) no conversation (control); (2) listening to a weather report; (3) responding to questions with simple one or two word responses (e.g., what is your name); (4) responding to questions of greater depth of thought and use of memory (e.g., describe the rout to your residence from your current location; (5) responding to inquiries of personal opinions regarding emotionally charged issues (e.g., what are your views about abortion rights?).

#### Context

- Simulated driving foot controls in a Lab

#### Independent Variables

- Five conversation conditions listed above, including a control no-conversation condition.

#### Dependent Variables

- RTs for foot-brake pedal response to a red-light stimulus onset while conversing.

- The mean RTs for the four conversation conditions was 98msec longer than the control condition.
- There were no significant differences for RT between the four conversation intensity conditions
- However there was a slight trend for longer RTs under the two more demanding conditions compared to the two less demanding conditions.
- The lack of an effect for the conversation intensity may reflect an inadequate manipulation of naturalistic conversations, or the laboratory setting.

**Lissy, K.S., Cohen, J.T., Park, M.Y., and Graham, J.D. (2000).** *Cellular Phone Use While Driving: Risks and Benefits*. Boston, MA: Harvard Center for Risk Analysis, Harvard School of Public Health.

Study to assess the risks and benefits associated with cell phone use while driving.

- The weight of the scientific evidence to date suggests that use of a cellular phone while driving does create safety risks for the driver and his/her passengers as well as other road users. The magnitude of these risks is uncertain...
- Found that "It is not clear whether hands-free cellular phone designs are significantly safer than hand-held designs, since it may be that conversation *per se* rather than dialing/handling is responsible for most of the attributable risk due to cellular phone use while driving.
- Found multiple benefits of using this communications device while driving – to users, households, social networks, businesses and communities. Benefits include public health and safety considerations.
- Found that while cellular phone use while driving should be a concern of motorists and policymakers, and that there is evidence that using a cellular phone while driving poses risks to both the driver and others, it may be premature to enact substantial restrictions at this time.
- Their review of international, state, and local legislative activity revealed uncertainty among policymakers about whether legislation should be passed to restrict or prohibit use of cellular phones while driving. Claim that the scientific evidence regarding risks is weak, and that benefits outweigh the risks. Claim that compared to other highway safety policies, a prohibition on the use of cellular phones while driving does not appear to be a relatively efficient way to save lives and prevent injuries. Note that this finding is preliminary since underlying database on costs, risks and benefits is weak and uncertain.
- Recommended better crash data collection and education public programs on the prudent use of cellular phones while driving in order to enhance transport safety.

**NHTSA Driver Distraction  
Internet Forum (2000).**

The site remains available as an  
information repository and can be  
accessed at

[http://www-  
nrd.nhtsa.dot.gov/driver-  
distraction/Welcome.htm](http://www-nrd.nhtsa.dot.gov/driver-distraction/Welcome.htm)

The National Highway Traffic Safety Administration (NHTSA) sponsored a virtual conference on the Internet (held July 5- August 11, 2000) to understand the risks from distraction associated with the explosive growth of in-car electronics. The Internet Forum provided an opportunity for technical experts and the public (both in the U.S. and internationally) to download research papers, ask questions, and share experiences regarding the use of in-vehicle devices (cell phones, navigation systems, wireless Internet, information & entertainment systems, night vision systems, etc.). Content on the site was organized into two basic areas: (1) Experience with technologies, and (2) Technical issues. The former provided opportunities for the driving public to share their experience with specific technologies in the context of driving and to provide their perspectives on basic issues related to their use. Discussions emphasized use of cell phones, navigation systems, night vision systems, wireless Internet, and information and entertainment systems. The "Technical Issues" section was devoted to general cross-cutting issues related to the safety impacts of in-vehicle technologies; five separate discussion areas were provided: Defining benefits and safety risks, Technical challenges associated with measuring distraction, Equipment design features and design solutions, Regulations, guidelines, and enforcement, and Safety campaigns and public education surrounding the safe use of in-vehicle technologies.

- In all, the site received over 23,000 hits with over 9,500 unique users and 2,600 registered guests. Discussions emphasized use of cell phones, navigation systems, night vision systems, wireless Internet, and information and entertainment systems. General crosscutting issues related to the safety impacts of in-vehicle technologies (benefits & risks, measuring distraction, equipment design features, regulations, guidelines and enforcement, safety and educational campaigns) were also discussed.
- Informal polls addressing a variety of issues were also used to stimulate discussion on key topics and provide a sense of the general feelings of Forum participants – results are not scientific and should not be interpreted as representatives of drivers in general.
- Nearly half of the comments posted on the site (46%) related to cell phones. Comments reflected perspectives from drivers impacted by others using cell phones, as well as from technology users themselves describing their own experiences with operating cell phones while driving. According to poll results, the overwhelming majority of participants (75%) felt it was not safe to talk on a cell phone while driving; indeed 74% of the poll respondents felt local governments should enact laws to restrict the use of these devices while driving. Even a majority of experienced cell phone users agreed that some form of restriction or regulation governing cell phone use while driving was needed.
- Many also felt that hands-free technology is not sufficient to address the safety concerns while driving, arguing that the conversation itself (or cognitive distraction) contributes to the underlying problem. Some even felt that hands-free technology could exacerbate the problem by encouraging cell phone use while driving.
- There was considerable disagreement, however, on what particular actions or steps are needed in order to preserve the benefits of cell phones without causing unsafe driver distraction. Education and safety campaigns, better equipment designs, standards, requirements for hands-free devices, bans on cell phone use while driving, and enforcement of existing laws were among the solutions proposed to address the distraction problem.
- Similar poll results are available for navigation systems, night vision systems, and other telematics.

**Recarte, M., & Nunes, L. (2000).** Effects of verbal and spatial-imagery tasks on eye fixations while driving. *Journal of Experimental Psychology: Applied*, 6 (1), 31-43.

Recarte and Nunes (2000) performed an on-road study that looked at the distribution of visual attention while performing verbal and spatial-imagery tasks. Recarte and Nunes (2000) used a head-free eye-tracker to measure visual attention, which they assumed reflected attentional states and changes. The verbal task was a word generation task and the spatial-imagery task involved mental rotation of letters and decisions about those rotated letters.

- The results showed that the spatial-imagery task resulted in longer fixation durations, or an 'eye-freezing' effect. Fixations were longest in the spatial task, followed by the no-task condition, and finally the verbal task condition.
- The key result of the Recarte and Nunes (2000) study was the reduction of gaze variability with the spatial and verbal tasks. In other words, the 'attentional window' defined by the range of gaze fixations (both horizontally and vertically) was smaller when performing the secondary tasks. These reductions were on the order of 25% to 60%.
- Recarte and Nunes (2000) also found a sharp reduction in mirror checking with the verbal and spatial tasks.
- Recarte and Nunes (2000) conclude that the differences between the verbal and spatial tasks support the multiple resource model of attention (Wickens, 1984).
- **CONCLUSIONS:** Recarte and Nunes (2000) found a reduction in the 'visual inspection window' when drivers performed a verbal or spatial task while driving.

**Tokunaga, R.A., Hagiwara, T., Kagaya, S., and Onodera, Y. (2000).** Cellular telephone conversation while driving: Effects on driver reaction time and subjective mental workload. *Transportation Research Record*, 1724, 1-6.

Investigated effects of handheld cellular telephone conversation on driver reaction time and subjective mental workload while following a lead car. Thirty-one Japanese drivers. Nineteen were young (mean age, 23.95 years; 16 male, 3 female) and 12 were elderly (mean age, 62.75 years; all male). All had a minimum of three years of driving experience, and experience using a cellular phone.

#### Context

- On-Road, conducted on an expressway in Japan.

#### Independent Variables

- Conversation Complexity (Simple vs. complex)
- Age (old vs. young)

#### Dependent Variables

- Reaction time to lead car activating its hazard lights
- Subjective mental workload as determined by the NASA Task Load Index

- Both simple & complex conversation while driving was associated with greater reaction times than driving alone.
- No differences were found between age groups in terms of reaction time.
- Subjective mental workload was higher when receiving a call than when solely driving
- Subjective mental workload was similar for receiving a call and engaging in simple phone conversation, and was higher for complex vs. simple conversation.
- Subjective mental workload interacted with age and conversation complexity. For complex conversation, young drivers indicated a larger increase in workload than did older drivers.



Reed, M. and Green, P. (1999).

Comparison of driving performance on-road and in a low-cost driving simulator using a concurrent telephone dialing task. *Ergonomics*, 42(8), 1015-1037.

The primary purpose of the Reed and Green (1999) study was to compare the driving performance results of the UMTRI driving simulator with those of an instrumented vehicle. Subjects drove on a route in the Ann Arbor area and then drove a simulation of the same route several weeks later, both while dialing a phone number and listening to a message. Therefore, the results of this study pertain more to the manual act of dialing than the cognitive load of conversation.

Context

- Driving simulator and on-road

Independent Variables

- Manual dialing vs. no-dialing (control)
- Age (old vs. young)

Dependent Variables

- Lane-keeping
- Speed
- Steering measures (variability)

- In general, subjects exhibited greater mean lateral speed and steering variability when dialing a phone compared to simply driving.
- This effect was even greater for older compared to younger subjects.
- The comparison of the simulation to the on-road conditions revealed that the simulator results were much more variable in the phone condition compared to the on-road condition.
- CONCLUSIONS: lane keeping and speed control were less precise when dialing a phone compared to driving without dialing. These effects were amplified with older subjects and in the simulator compared to the instrumented vehicle.
- This study is the only one to directly compare cell phone and driving performance in a simulator and on-road.

Hancock, P., Simmons, L., Hasemi, L., Howarth, H., & Ranney, T. (1999). The effects of in-vehicle distraction on driver response during a crucial driving maneuver. *Transportation Human Factors*, 1 (4), 295-309.

Test-track study on the effects of phone use while encountering a critical event while driving. There were four tasks in this study, the first was a number memorization and recall task where subjects were required to memorize a seven-digit phone number presented on a simulated phone and then recall the number at the end of the trial (a lap on the track). This task was used to load working memory. Regarding the driving task, subjects were to maintain a consistent speed throughout the test-track lap (trial). Subjects were required to brake to a stop as quickly as possible before the intersection line in one third of the trials. Finally, subjects were required to perform a distractor task that involved responding to digits displayed on the phone as either a match or mismatch with the first number of the seven-digit number memorized before the trial. All combinations of driving without tasks, the distractor task, and the stopping tasks were included to constitute four conditions. There were two different track speed conditions as well, 20mph and 30mph.

Context

- Test track

Independent variables

- Distractor task (cell phone task) vs. control
- Track speed (20mph and 30mph)

Dependent variables

- Brake response time
- Stopping time
- Stopping distance
- Stopping accuracy

- Found that subjects responded later when driving in the presence of the distractor task, but sooner when driving 30mph compared to 20mph.
- Subjects were able to stop faster when driving in the higher speed condition.
- Drivers exhibited a 24% decrease in safety margin stopping distance when driving with the distractor task.
- **CONCLUSIONS:** Hancock et al. (1999) found that in the presence of a working memory distractor task, drivers braked harder and faster than when driving without the distractor task.

Lamble, D., Kauranen, T., Laakso, M., and Summala, H. (1999). Cognitive load and detection thresholds in car following situations: safety implications for using mobile (cellular) telephones while driving. *Accident Analysis and Prevention*, 31, 617-623.

Evaluated drivers' abilities to detect lead vehicle deceleration while engaged in distraction tasks. After a desired headway of 50 m was attained, both vehicles proceeded on cruise control at 80 km/hr. Deceleration of the lead vehicle, at about  $0.47 \text{ m/s}^2$ , was achieved by releasing the cruise control, so presumably no brake signal was presented. The three in-vehicle tasks were a control task (watch vehicle ahead), a numeric keypad entry task (divided visual attention), and a cognitive task involving mental addition of verbally presented digits (non-visual attention). Nineteen subjects, aged 20-29 years old, drove a 30 km roadway section near Helsinki, Finland, while engaging in the three tasks (30 repetitions of each, in blocks of 10). The subject drove with the foot positioned over the brake and was to hit the brake as soon as deceleration of the lead vehicle was detected.

#### Context

- On-Road study

#### Independent Variables

- Distraction task: control (watch vehicle ahead), "phone dialing" (keypad entry), cognitive (mental arithmetic)

#### Dependent Variables

- Response time (brake response) to detect lead vehicle deceleration
- Time-to-collision at detection of lead vehicle deceleration
- Lateral lane position (standard deviation of lateral acceleration)
- Performance on distraction tasks

- Both the visual/motor task of "dialing" (keypad numeric entry) and the non-visual cognitive task (mental arithmetic with a memory component) significantly delayed recognition of the lead vehicle slowing.
- The magnitude of the effects for the two distraction tasks did not significantly differ from each other. Recognition time (brake response time) increased by about 0.5 seconds and TTC at recognition decreased by 0.67 s for phone dialing and 0.95 s for the cognitive task (not significantly different).
- There was no significant effect of either task on lateral lane position. However, some "very noticeable" lateral movements occurred for some subjects; the authors suggest that individual differences may be important and should be studied regarding lane position.
- The authors conclude that neither a hands-free phone option nor a voice-controlled interface would remove the impairment (or safety problems) when using a mobile phone in a car.

Goodman, M., Bents, F.D., Tijerina, L., Wierwille, W., Lerner, N., and Benel, D. (1997). *An Investigation of the Safety Implications of Wireless Communications in Vehicles* (DOT HS 808-635). Washington, DC: NHTSA.

Comprehensive review of the cellular phone use while driving literature up to its publication. The report addressed four specific questions as follows:

- Does use of cellular telephone technology while driving increase the risk of a crash?
- What is the magnitude of the traffic safety problem related to cellular telephone use while driving?
- Will crashes likely increase with increasing numbers of users of cellular telephone technology in the fleet?
- What are the options for enhancing the safe use of cellular telephones by drivers?

- "Based on the information collected it can be concluded that in some cases, the inattention and distraction created by the use of a cellular telephone while driving is similar to that associated with other distractions in increasing crash risk. Both the research studies and crash data reviewed in this report highlight several factors by which cellular telephone use while driving can increase the risk of a crash. Among these, conversation appears to be most associated with the crashes reviewed."
- "Furthermore, it is clear that at this time there are insufficient data to indicate the magnitude of any safety-related problem associated with cellular telephone use while driving."
- "The data also suggest that as the use of in-vehicle wireless communications technology increases there will be an associated increase in related crashes if little changes. However, the accuracy of this prediction in either direction (i.e., increase or decrease in crashes) is uncertain, given the pace at which cellular telephone designs and the functions they can perform are changing. Such changes, along with state legislative initiatives and changes in wireless subscriber characteristics, virtually ensure that usage patterns will change over time and thus influence associated crash trends."
- The report offers a number of recommendations for addressing the broad range of issues identified:
  - Improving data collection and reporting.
  - Improving consumer education.
  - Initiating a broad range of research to better define and understand the problem.
  - Addressing issues associated with use of cellular phones from vehicles to access emergency services.
  - Encouraging enforcement of existing state laws to address inattentive driving behavior.
  - Working with states on legislative options.
  - Using the National Advanced Driving Simulator (NADS) and instrumented vehicles to study optimal driver/vehicle interfaces.
  - Developing a sound basis for carrying out cost benefit analyses.

Redelmeier, D.A., and Tibshirant, R.J. (1997). Association between cellular-telephone calls and motor vehicle collisions. *The New England Journal of Medicine*, 336(7), 453-458.

An epidemiological study that attempted to determine "whether using a cellular telephone while driving increases the risk of a motor vehicle collision." Considered survey data from 669 drivers who had cellular telephones and suffered substantial damage but no personal injury from a motor vehicle collision occurring between 1994-1995 in Ontario. Over the 14-month study period a total of 26,798 cellular-telephone calls were examined. They collected data on use of cellular phones, time of motor vehicle collisions, driver demographics, and recent history of cell phone activity.

NHTSA found substantial flaws in the case-crossover analysis methodology used, including the implication of causality based on relative risk metrics. It is also noted that their study did not account for crashes involving injuries or fatalities, nor did their study account for drivers who had never experienced a crash while talking on a cellular telephone.

- Study reported an association between the use of cellular telephones in a motor vehicle and a quadrupled risk of collision during the call (i.e., relative risk of crash for users when on the phone versus not on the phone was reported to be 4.3).
- Authors "observed no safety advantage to hands-free as compared to hand-held unit telephones."
- Authors concluded that the associated, increased risk "appeared to be stronger for collisions on high-speed roadways than for collisions in ... low-speed locations..."
- Report suggested that one possible explanation for collisions was result of driver's limitations with regard to attention rather than dexterity.
- Authors suggested that existing evidence supports policies that restrict use of both hand-held and hands-free telephones while driving, however, authors cautioned against interpreting their data as "showing that cellular telephones are harmful and that their use should be restricted."

Violanti, J.M., and Marshall, J.R. (1996). Cellular phones and traffic accidents: An epidemiological approach. *Accident Analysis and Prevention*, 28(2), 265-270.

Study that used epidemiological case-control design and logistic regression techniques to examine the association of cellular phone use in motor vehicles and motor vehicle crash risk. Data were obtained from 100 randomly selected [New York State] drivers involved in crashes within last 2 years and from a control group of 100 randomly selected [New York State] drivers not involved in crashes in last 10 years.

Context

- Epidemiological case-control design, including use of official driving records and mail surveys – focus on presence or absence of factors rather than outcomes.

Independent Variables

- Amount of time per month spent talking on the phone and 18 other driver inattention factors

Dependent Variables

- Risk factors such as frequency of attention-diverting driving behaviors and other factors that might affect the association between cellular phone use and crashes.

- Found that talking more than 50 minutes per month on cellular phones in a vehicle was associated with an increase of 5.59 times the risk of traffic collision (i.e., odds ratio = 5.59).
- Found that the combined use of cellular phones and motor (e.g., drinking a beverage) and cognitive (e.g., watching the scenery) activities while driving were also associated with increased risk of traffic collision.
- Found that subjects who had been in crashes had spent twice the number of minutes per month talking on their cellular phones while driving, and that they appeared to engage in considerably more business and intense business calls.
- Found that “cellular phone use as a single behavior may affect accident risk to a greater degree than many other in-car activities while driving.”
- Authors caution that study consists of small sample size, reveals statistical associations but not causal relationships, and does not conclude that talking on cellular phones while driving is inherently dangerous.

Alm, H., and Nilsson, L. (1995). The effects of a mobile telephone task on driver behavior in a car following situation. *Accident Analysis and Prevention*, 27(5), 707-715.

Study to investigate the effects of hands-free mobile telephone use on driver behavior in a car-following situation. Included 40 drivers – 30 men and 10 women. Two age groups - younger drivers (<60 years of age) with mean age of 29.3 yrs and elderly drivers (>60 yrs of age) with mean age of 67.6 yrs.

Context

- Simulator (with moving base) study using a two-lane straight, asphalt road.

Independent Variables

- With or without Conversation (Baddeley et al, 1985, Working Memory Span Test)
- Age (old vs. young)

Dependent Variables

- Reaction time to lead car activating its brake lights
- Driver performance measures such as headway and lateral position
- Subjective mental workload as determined by a modified NASA Task Load Index
- Communication measures based on the telephone conversation

- Found that drivers experienced longer reaction times and increased mental workload when using a hands-free mobile phone.
- Found that the headway (or following distance) of both younger and elderly drivers was not large enough to account for the increased risk caused by an increased reaction time.
- Found that using a hands-free mobile telephone while driving in a car-following situation may increase the risk of an accident if something unexpected happens.

**Briem, V., and Hedman, L.R. (1995)**  
Behavioral effects of mobile telephone  
use during simulated driving.  
*Ergonomics*, 38(12), 2536-2562.

The effects on driving performance of using a hands-free telephone were investigated in a pursuit-tracking task that simulated driving. Subjects drove for 20 min in each of three secondary task blocks with (1) a simple phone conversation about a familiar topic, (2) a difficult conversation incorporating a test of working memory, and (3) car radio tuning and listening. Half of the driving was performed with a slippery road surface for the simulation dynamics; the other half was on with a firm surface simulation. Driving behavior was classified into four activities: (1) driving on a clear road; (2) driving with obstacles; (3) driving with a secondary task - conversation; and (4) driving with a secondary task - device manipulation (both the radio and hands-free phone).

Context

- Low-fidelity driving simulation (tracking task)

Independent Variables

- Secondary task (radio, simple phone conversation, difficulty conversation)
- Road surface (firm and slippery)
- Activity (driving only, obstacles, communication, manipulation)
- Gender and age groups (19-26 and 40-51)

Dependent Variables

- Road position (tracking accuracy)
- Number of collisions with obstacles (barriers off the path)
- Driving speed

- Overall, the slippery surface resulted in lower driver performance than any other factor.
- For driving on the slippery surface, driving performance deterioration was especially marked during device manipulation, the radio in particular compared to the hands-free phone.
- Driving during an easy phone conversation was associated with the least performance decrement.
- In general, male drivers exhibited better control while driving under difficult conditions.
- Age was not a contributing factor to any results.
- The authors conclude that "simply conversing over a hands-free telephone while driving does not in itself impair performance. However, a difficult conversation may affect the driving adversely, and any prolonged manipulation of the telephone is liable to produce a performance decrement, particularly under conditions that put heavy demands on the driver's attention and skill."



McKnight, A.J., and McKnight, A.S. (1991). *The effect of cellular phone use upon driver attention*. Online at [www.aaafoundation.org](http://www.aaafoundation.org).

**See Also**

McKnight, A.J., and McKnight, A.S. (1993). *The effect of cellular phone use upon driver attention*. *Accident Analysis & Prevention*, 25(3), 259-265.

Examined the effect of cellular phones on driver performance in a simulator study using a 25-minute video driving sequence containing 47 situations to which drivers would be expected to respond. Included 151 subjects who performed three cell phone tasks (placing a call, carrying on simple and complex conversations), as well as a radio tuning task and a baseline-driving task.

Context

- Simulator study.

Independent Variables

- Type of phone task
- Age - younger drivers aged 17-25, middle drivers aged 26-49, and older drivers aged 50-80

Dependent Variables

- If driver responded and Response time

- Found that all of the distractions led to significant increases in both the number of situations to which the drivers failed to respond and the time it took to respond to them.
- Found that greatest level of distraction due to complex conversation.
- Found that smallest level of distraction due to simple conversation.
- Found that there were no significant differences in performance between placing a phone call and carrying on simple conversation, but placing a call resulted in delayed responses to the same degree as carrying on complex conversation.
- Found that relative increase in chances of a highway-traffic situation going unnoticed ranged from approximately 20% for placing a call in simple conversations to 29% for complex conversations.
- Found that older drivers were twice as likely to fail to notice some highway-traffic situation while calling or conversing on a cellular phone.
- Concluded "while a cellular telephone conversation is no more distracting than a conversation of the same intensity with a passenger, the availability of a cellular phone is almost certain to increase significantly the number of conversations in general and the more distracting, intense, business conversation in particular. Older drivers should be cautioned against placing calls."

**Transport Canada (2002).** Strategies for Reducing Driver Distraction from In-Vehicle Telematics Devices: A Discussion Document. Report No. TP 14133 E, Ontario, Canada. Retrieved on June 19, 2003:  
<http://www.tc.gc.ca/roadsafety/tp/tp14133/en/menu.html>

Report discussion the telematics issue (including other telematics than just cell phones) and potential regulatory and non-regulatory approaches to dealing with the issue. The focus was to obtain detailed information on what industry is currently doing or planning and to understand what federal interventions are feasible, appropriate and expected by Canadians.

*"A number of complementary efforts are envisioned, including the publication of this discussion document defining the problem and outlining possible regulatory and nonregulatory responses. The status quo may not be viable since there appears to be insufficient effort on the part of the industry to manage the risk."*

**Alberta Motor Association. (2002).** Hands-free cell phones as dangerous as hand-held for drivers (News Release dated 8 April 2002). Available at <http://www.ama.ab.ca>.

Press release citing dangers of cell phone use while driving, whether hand-held or hands-free. Includes brief summary of policy statement of the Alberta Motor Association regarding use of cell phones while driving.

"Non-regulatory approaches could include public awareness initiatives and a Memorandum of Understanding (MOU) between government jurisdictions and industry. An MOU might require manufacturers to implement a driver-system integration design process to minimize the potential adverse safety consequences of in-vehicle telematics. Alternatively, the Department could publish an advisory outlining the driver-system integration design process that manufacturers should adopt."

"Regulatory initiatives could include requiring the disabling of access to entertainment systems (e.g., DVDs), telecommunication or other telematics devices in moving vehicles, having safer limits on visual distraction, and prohibiting open-architectures that would allow the use of untested after-market 'plug-and-play' type applications."

"AMA policy recommends that you pull off the road to a safe place such as a parking lot or roadside turnout to take or make a call. Leave your cell phone turned off while driving and use a messaging service to ensure important calls are not missed. Check for calls the next time you stop."

*Notes that the AMA has not taken a position on a legislated ban.*

National Safety Council (2002).  
Multitasking Statement. Online at  
[www.nsc.org/news/policy/multitasking.  
htm](http://www.nsc.org/news/policy/multitasking.htm)

Policy and recommendations regarding cell phone  
use while driving.

The policy of the National Safety Council regarding multitasking  
while driving:

"The National Safety Council acknowledges that states have laws  
that prohibit distracted driving and that no one has a right to put  
others at risk."

"The Council recognizes that electronic devices such as cell  
phones provide extraordinary benefits to public safety and  
productivity. However, a driver's first responsibility is the safe  
operation of the vehicle and that best practice is to not use  
electronic devices including cell phones while driving. When on  
the road, drivers shall concentrate on safe and defensive driving  
and not on making or receiving phone calls, delivery of faxes,  
using computers, navigation systems, or other distracting  
influences. When a driver decides that it is safe to use such a  
device while driving, it should be with the understanding that  
negligent drivers be held accountable when distracted driving  
results in the injury or death of others."

"Furthermore, the National Safety Council supports restrictions  
that prohibit all non-emergency use of electronic devices including  
cell phones by teenage drivers during their graduated licensing  
period."

"The National Safety Council calls on producers and providers of  
electronic devices and services to undertake a substantial  
educational campaign to inform the public of the safe operation of  
electronic devices, emphasizing both the risks and the benefits. The  
Council also recommends that employers assess whether to allow  
employees to use such devices while driving, and if so, what sensible  
restrictions should be followed."

"The driver of a mechanically propelled vehicle that is in a public  
place, shall not hold or have on or about their person, a mobile  
phone or other similar apparatus while in the said vehicle, except  
when it is parked."

Department of the Environment and  
Local Government (2002). *Statutory  
Instruments No. 93 of 2002: Road  
Traffic (Construction, Equipment and  
Use of Vehicles) (Amendment) (No. 2)  
Regulations, 2002.* (Online at  
[www.environ.ie/press/si93of2002.pdf](http://www.environ.ie/press/si93of2002.pdf)).  
Republic of Ireland: Government  
Supplies Agency.

Regulation on use of mobile phone while driving --  
bans use of mobile phones while driving in Ireland.  
Applies to handheld mobile phones and does not  
extend to fixed hands-free mobile phones.

NHTSA - For Internal Use Only

**Direct Line Insurance plc (2002).**  
*The Mobile Phone Report: A report on the effects of using a 'hand-held' and 'hands-free' mobile phone on road safety.* (Online at [www.directlinegroup.com](http://www.directlinegroup.com)). Surrey, UK.

Provides policy statement.

**Direct Line 'Drive Safely' policy – putting safety first**

- “Although you may think that a hands-free phone allows you to keep in control of your vehicle your mind may not be fully on driving. It is not like talking to a passenger who will be more aware of traffic conditions and can see what is happening while you are driving.”
- “Talking on the phone distracts your attention from the road and can lead to an accident. Never use a mobile phone. Even using a hands-free phone is distracting.”

Direct Line strongly believes that all employers have a responsibility to offer clear instruction to their staff not to use hand-held or hands-free phones when using company vehicles.

**Illinois Department of Transportation (2002).** *May I have your attention please: The dangers of distracted driving and how to prevent them.* State of Illinois: Division of Traffic Safety, Illinois Department of Transportation.

[www.cyberdriveillinois.com](http://www.cyberdriveillinois.com)

Recommendations to driver.

**Recommendations to driver.**

*If you need to use your cell phone when driving, pull off the road and stop in a safe place before using your phone.*

*How to avoid being distracted – Stay focused, Pay attention.*

*Limit interaction with passengers: avoid talking while driving; avoid taking your eyes off the road; and keep both hands on the wheel.*

*Don't drive when angry or upset – Emotions can interfere with safe driving. Wait until you have cooled down or resolved problems to drive.*

**Insurance Information Institute (2002).** Cell Phones & Driving. New York, NY. Online at [www.iii.org/individuals/auto/lifesaving/cellphones/](http://www.iii.org/individuals/auto/lifesaving/cellphones/).

Recommendations to driver.

**Recommendations to driver.**

*“If you must talk while you drive, the safest way is to have a hands-free cell phone cradle installed in your car so you can speak while driving with two hands. Even so, remember to stay aware of what is going on around you on the road. It's easy to get so engrossed in conversation that you miss exists or don't notice what other drivers are doing. Better yet, wait until you have arrived at your destination or pull over to the side of the road to begin your cell phone conversations.”*

Royal Society for the Prevention of Accidents (RoSPA, 2002). *Mobile Phones and Driving Fact Sheet*. (Online at [www.rospace.co.uk](http://www.rospace.co.uk)). Birmingham, UK: RoSPA.

Describes current RoSPA policy and recommendations for drivers and employers regarding cell phone use while driving and 1997 RoSPA international review of research about effects of using mobile phones while driving.

#### **"RoSPA Policy"**

**"No driver should use a mobile telephone or any similar piece of telecommunications equipment (whether hand-held or hands-free) while driving."**

**"Such use is likely to distract the driver from the main task of managing the vehicle in a safe and competent manner and be prejudicial to road safety. Calls should not be made or received while on the move. Ideally, an interlock should be integral in all such equipment so that it is rendered inoperable while the vehicle is moving. Where this is not possible, it is recommended that all telecommunications equipment is switched off while the driver is driving."**

**"Employers are recommended to incorporate this policy within their own rules governing company drivers. Vehicles are intended to transport their occupants and goods to their destinations(s) and any temptation to turn vehicles into "mobile offices" should be resisted."**

**Recommends that employers should**

- **"Never 'require' staff to be available on mobile phones while they are driving"**
- **Provide clear guidelines about how, when and where it is appropriate (and safe) to use mobiles (this should include the elements detailed below under 'drivers')**
- **Make sure all equipment issued by the company has 'message facilities'**
- **Consider carefully before fitting and requiring drivers to use 'hands-free' kits**
- **Carry out regular checks to ensure compliance with company policies and practices**
- **Risk-assess driving and vehicle use; and check for and limit the tendency toward the 'mobile-office.'**"

**Recommends that drivers**

- **Make sure you have activated the 'message facility' on you mobile phone**
- **Switch off the phone before you start the engine**
- **Never make or receive calls while driving**

Continued -

Royal Society for the Prevention of Accidents (RoSPA, 2002). *Mobile Phones and Driving Fact Sheet*. (Online at [www.rospace.co.uk](http://www.rospace.co.uk)). Birmingham, UK: RoSPA.

**See Also**

Royal Society for the Prevention of Accidents (RoSPA, 1999). *Mobile Phones and Road Safety*. Birmingham, UK: RoSPA.

- *Check for messages and deal with any calls once you are parked*
- *Asks questions about safety and risk before accepting and using a 'hands-free' phone*
- *Guard against the distraction of your vehicle becoming a 'mobile office'*

RoSPA states that it has "never suggested that mobile phones should be banned from vehicles, that they should never be used in vehicles, nor that passengers should not use them. The only caveat to this last element is the degree of driver distraction which the passenger's use of the phone might generate. The Society's stance is, and has always been, that they should never be used by the driver when driving."

The 1997 RoSPA review revealed that when using either a hands-free or handheld phone, drivers "fail to maintain touch with traffic conditions and

- Significantly vary their road speeds - out of sync with prevailing traffic,
- Fail to maintain headway, and
- Wander in their lane."

Review also indicated "while making or receiving a call, drivers attempt to maintain a 'normal telephone conversation' to the detriment of their driving. They frequently do not admit that they are driving, and the caller may not realize where they are or what they are doing."

In addition, review found that "even using a hands-free phone while driving an automatic car significantly distracted the driver."

Transport Canada (2002). *Fact Sheet*  
RS 2001-06 (TP 2436E, Dec 2001).  
Online at [www.transportcanada.com](http://www.transportcanada.com).

Describes current Transport Canada policy and recommendations for drivers regarding cell phone use while driving.

**Policy** - "Transport Canada recommends against using cell phones while driving. It is distracting and increases the risk of collision. Your primary concern is the safe operation of the vehicle."

**Recommendations to drivers:**

- Turn the phone off before you start driving. Let callers leave a message.
- If there are passengers in the vehicle, let one of them take or make the call. If you're expecting an important call, let someone else drive.
- If you have to make or receive a call, look for a safe opportunity to pull over and park.

If for some reason you have no alternative but to use a cellular phone while driving, here are some tips:

- Use only a speakerphone or a hands-free phone. Make sure you put on the hands-free accessories before you start driving. But be aware: hands-free is not risk-free.
- If you must use a hand-held phone, place it where it will be readily accessible. Trying to retrieve a phone from a briefcase, handbag or pocket can be especially dangerous.
- Don't answer the phone until you have checked that it is safe to do so.
- Use speed dial options. If you know you will need to call an unprogrammed number, dial the number before starting off and send the call at your convenience.
- Driving and talking on a phone at the same time is difficult. Don't make it worse by trying to read or take notes. Do pull over and stop.
- Keep calls short and factual. Emotional or thought-provoking conversations are distracting. Recent research suggests that decisions made while driving and talking on a cell phone are not always good decisions.
- It's good etiquette to ask a caller to hold until you can park, or to say you'll return the call as soon as it's safe to do so.
- Stay in the right-hand lane, where driving may be less demanding.
- When reporting an emergency situation from a cell phone, pull over and ensure you are not in the flow of traffic. If you must keep driving, remember your primary concern is to avoid causing another emergency.

Canada Safety Council (2002). *Driven to Distraction* (on CD-ROM). Ontario, Canada: Canada Safety Council. (Available on-line from [www.safety-council.org](http://www.safety-council.org))

See also  
Burns, P.C. (2003, May). Driver Distraction from Cell Phones and Other Devices. Presented at AIM 2003 – Emerging Trends (Automotive Insurers and Manufacturers Forum), Toronto, Canada.

CD-ROM with 10-minute video message providing guidance to drivers on driving and driver distraction.

Discusses “driver inattention” and “distraction or distractibility.”

Identifies three types of distractions – Environmental, Situational, and Psychological.

“Driven to Distraction reminds all drivers – novice to experienced – that behind the wheel, safety is the number one priority.”

The goal of the program is to help people avoid traffic collisions. “By recognizing when they are distracted, they can better manage and minimize potential distractions.”

“*Driven to Distraction* is designed to draw attention to one of the major causes of traffic collisions – driver inattention or distraction. The program has been reviewed by a technical advisory panel made up of leading experts and researchers in the field of highway safety and is designed to help drivers:

- Recognize when and how frequently they are distracted while driving;
- Identify sources of routine driver distractions;
- Understand that behind the wheel, safety is the first priority;
- Develop techniques and strategies to manage distractions.”

#### Environmental Distractions: Passengers

“Any passenger can be a distraction for a driver, especially for novice drivers. For them, everything about the driving task is distracting because it is new.”

“In the case of more experienced drivers, however, passengers can either be a distraction or a help, i.e., assisting with directions or placing phone calls. The trick is to realize when the passenger – any passenger is a distraction and do something about it.”

#### Situations Distractions: Talking on a cell phone

“...using cellular phones can be as distracting as other activities while driving. However, many may not be aware that the mechanical issues of cell phone use – i.e., dialing, holding a phone, etc. – are not the only element of distraction. The nature of the conversation is also an issue. Intense, complex, and emotional conversations take the driver’s mind off the road. Drivers should learn to use their cell phone’s safety features such as voice-activated dialing and hands-free devices, and also to use sound judgment on when to make or take a call.”



Continued -

Canada Safety Council (2002).  
*Driven to Distraction* (on CD-ROM).  
Ontario, Canada: Canada Safety  
Council. (Available on-line from  
[www.safety-council.org](http://www.safety-council.org))

See also

Canada Safety Council (March 7,  
2002). *Opinion Letters - Banning cell  
phones would be irresponsible* (signed  
Emile-J. Therien, President).  
(Available on-line from  
[www.therecord.com](http://www.therecord.com))

Opposes ban on cell phone use while driving.

Psychological Distractions: Coping with Anxiety and Mental Stress  
"... as they [drivers] get stressed, they are less likely to pay attention  
to even the basic steps of driving."  
"The greater the levels of anxiety and stress, the more likely we are to  
become aggressive behind the wheel or to take shortcuts."  
"In each instance, letting stressful activity control your actions  
increases the risk of an accident."

Guidance to the driver:

- *Keep your focus on driving and don't let passengers become a distraction;*
- *Postpone intense, emotional or complicate cell phone calls until the car is stopped. If you need to use your cell phone while driving, make sure conditions are safe and keep your conversations brief;*
- *By recognizing and eliminating common distractions, we can better manage and minimize the potential for collisions;*
- *Driver distractions affect everyone. This is not something that happens with new or "reckless" drivers.*

"The inappropriate use of cell phones by drivers is part of a serious traffic safety problem - distractions can be dangerous for anyone behind the wheel. Some say the solution is to ban drivers from using cell phones. The Canada Safety Council disagrees."

"A cell phone ban would be counterproductive, irresponsible and unenforceable."

**Canadian Wireless Telecommunications Association (2002).** *Safety: Your most important call.* (Online at [www.driverresponsibly.ca](http://www.driverresponsibly.ca))

Pamphlet to provide guidance on driving and using a wireless phone.

Also packaged with the *Driven to Distraction* CD-ROM available from the Canada Safety Council.

**Guidance to the driver:**

- Safe driving is your first priority.
- Use a hands-free device to make it easier to keep both hands on the wheel.
- When dialing manually, dial only when stopped. Or, have a passenger dial for you.
- Do not engage in stressful or emotional conversations that may divert your attention from the road.
- Program frequently called numbers into the speed dial feature of your phone for easy, one-touch dialing, or use auto answer or voice-activated dialing services (when available).
- Never take notes while driving.
- Let voice mail pick up your calls when it's inconvenient, unsafe to answer the phone or driving conditions become hazardous.
- Be a Wireless Samaritan. Call 9-1-1 to report any crimes, life-threatening emergencies, accidents or drunk drivers.

**Tunbridge, R. (2001).** Mobile phones and driving – the UK perspective on government policy. *International Journal of Vehicle Design*, 26 (1), 96-99.

Overview of a 1998 review study conducted by the Transport Research Laboratory (TRL) in the UK to look at the evidence for any road safety risk of the use of mobile phones within vehicles, with special attention to the comparison of hand-held and hands-free equipment. The article also includes a discussion of the Great Britain Policy on the use of mobile phones and driving.

- The 1998 TRL study concluded, "The use of hand-held mobile phones whilst driving was widely regarded as unsafe. Studies into the road safety implications of using hands-free phones whilst driving suggested that the distraction effect reduced as they were made easier to use. However, distraction caused by the mental effort of the telephone was present."
- The GB policy states: "Never use a hand-held phone while driving" and "It is safer not to use a hands-free phone while driving."

Department for Transport, Local Government and the Regions (1999). *The Highway Code* (Online at [www.roads.dlttr.gov.uk/roadsafety/hc](http://www.roads.dlttr.gov.uk/roadsafety/hc)). United Kingdom.

Department for Transport as cited in Farrell, N. (2002). *Drivers face mobile phone ban*. Available on [www.aaafoundation.org](http://www.aaafoundation.org). Original source VNUNet.com.

Describes the rules for all road users in the United Kingdom: pedestrians, horseriders and cyclists, as well as motorcyclists and drivers.

General rules, techniques and advice for all drivers and riders:  
General Advice

127. "You MUST exercise proper control of your vehicle at all times. Never use a hand held mobile phone or microphone when driving. Using hands free equipment is also likely to distract your attention from the road. It is far safer not to use any telephone while you are driving – find a safe place to stop first. *Laws RTA 1988 sects 2 & 3 & CUR reg 104.*

*"The UK Government is considering banning motorists from using mobile phones while driving.*

*The Department for Transport may permit the use of hands-free kits, as well as the use of mobile phones by passengers, but drivers would not be able to use hand-held phones even while stopped at a traffic light or in a traffic jam.*

*Although drivers who use hand-held phones can already be prosecuted for failing to have proper control of their vehicle, the Government believes that a specific law against using a cell phone while driving should be introduced.*

*Road safety minister David Jamleson is seeking views from interested parties before 25 November."*

Department of the Environment,  
Transport and the Regions (1998).  
*Mobile Phones and Driving* (online at  
[www.dtlr.gov.uk/campaigns/mobile/index.htm](http://www.dtlr.gov.uk/campaigns/mobile/index.htm)). United Kingdom.

Provides guidance to the driver and employers  
regarding use of mobile phones while driving.

**Guidance to the driver:**

- "It is unsafe for a driver to use a hand-held mobile phone."
- "Making or receiving a call, even with a hands-free phone, can distract your attention from driving and could lead to an accident."
- "Responsibility for the safe control of a vehicle always rests with the driver."
- "Never use a hand-held phone while driving."
- "It is safer not to use a hands-free phone while driving. Conversations using hands-free equipment can distract your attention from the road."

**Guidance to the employer:**

- "Do not ask your staff to carry out two demanding tasks at the same time – your employees should not be expected to use a phone while driving."
- "If you or your customers need to contact staff while they may be driving, ensure that you provide hands-free equipment with voicemail or call divert facilities and encourage your staff to stop regularly to check for messages and return calls."
- "The emergency services, taxi drivers and couriers often need to be contacted while on the road. Where contact is unavoidable, it is safer if the vehicle is fitted with hands-free equipment and communication is kept to a minimum."

**AAA (2002).** AAA promotes cellular phone safety. Online at [www.aaamidatlantic.com/](http://www.aaamidatlantic.com/)

**Recommendations regarding cell phones while driving.**

*"Cellular phones provide a wide range of safety benefits for travelling motorists. Whether requesting emergency road service or reporting a dangerous driver, cellular phones provide a large measure of safety and security, comfort and convenience.*

*"But with that convenience comes added responsibility. Safe driving requires caution, courtesy, common sense, and alertness under any conditions.*

*"For most drivers, anything that is a distraction – a passenger, the radio, or your cellular phone – can get in the way of your concentration," said Melissa O'Neill Walczak, spokesperson, AAA Mid-Atlantic. 'But there are ways to minimize the distraction.'*

*"To help increase concentration while driving with a cellular phone:*

- *Place calls while stopped or have someone dial for you.*
- *Use the cell phone in the 'hands-free' mode.*
- *Avoid intense or complicated conversations.*

*"Some other useful safety tips for cellular phone users:*

- *Always buckle up.*
- *Always assess traffic conditions before placing a call.*
- *Give driving your full attention.*
- *Ensure that the phone is within easy reach.*
- *Use 'memory dial' to minimize dialing time."*

**Curry, D.G. (2002).** In-Vehicle Cell Phones: Fatal Distraction? Real or potential problem? *Transportation Safety*, March 2002. Available online at [www.asse.org/cellfatal.htm](http://www.asse.org/cellfatal.htm).

Article that proposes alternative solution to the problem, and cites publicly available facts and figures in order to place the problem in perspective.

- Concludes that "while some degree of risk is associated with in-vehicle cell phone use, the current state of knowledge regarding its level does not indicate that it is significantly greater than that experienced during the course of normal driving while performing other socially acceptable in-vehicle tasks."
- Further research comparing spectrum of distracting activities.
- Suggests caution in considering legislation, especially in light of developing technologies such as adaptive cruise control, lane departure warning systems, and forward collision warning systems. Notes that such devices address the primary effects of driver distraction – lane position variability, speed variance, and failure to detect forward obstacles. Questions whether it is "reasonable" to "forbid drivers to operate cellular or other devices in vehicles that are equipped to compensate for driver distraction regardless of its cause".
- Suggests program of education combined with vigorous enforcement of existing laws in order to combat distracted driving.

Verizon Wireless (2002). *Safety Tips*.  
Online at [www.verizonwireless.com](http://www.verizonwireless.com).

**Recommendations for cell phone use while driving. Your safety is our first priority.**

*For your well-being and the well-being of those around you, please follow these simple safety recommendations while driving. Some of these safety tips are not only sensible, but mandatory. Before using your wireless phone, please familiarize yourself with the regulations in your area.*

1. *When behind the wheel, safe driving is always your first responsibility.*
2. *Dial your phone when your car is not in motion.*
3. *Always use hands-free when driving and talking. When you turn your phone on, make sure your hands-free device is on and working.*
4. *Pre-program important and frequently-dialed numbers, including home and babysitter, so you can dial them by pressing only a few buttons.*
5. *Never take notes or write down phone numbers while driving. Rather, pull off the road to a safe spot or leave yourself a message on your voice mail system.*
6. *Know your wireless phone number so emergency personnel can call you back. You may want to write it down and keep it in your car for quick reference.*
7. *If traffic conditions warrant your undivided attention, turn your phone off, and let calls go to Voice mail or activate Call Forwarding.*

American Society of Safety Engineers. (2001). *American Society of Safety Engineers Position Statement on the Use of Electronic Devices in Motor Vehicles and Safe Driving Practices* (October 25, 2001). Online at [www.asse.org/ngposi9.htm](http://www.asse.org/ngposi9.htm).

ASSE's position on legislating the use of cellular phones while driving.

"The Society's view is that operating a vehicle while using a cellular phone is a potentially unsafe act. All drivers should be cognizant of the hazards associated with such behaviors."

"ASSE's view is that specifying cellular phones in legislation and regulation may not be the best route to take in addressing this issue. For example, the same argument against cellular phones also holds true for a vehicle operator who drives in an unsafe manner while eating, drinking, putting on makeup, reading a newspaper, operating any other electronic device, or some other type of distracting activity where the driver's mind, eyes, and hand(s) are engaged elsewhere than the road ahead and the steering wheel."

"Clearly better crash data are needed to clarify and quantify the magnitude of the driver distraction problem and the relative contributions of different sources of driver distraction."

Makes following recommendations:

- "More public outreach to reinforce to the public that a driver's first responsibility is the safe operation of a vehicle. This includes school-based driver education."
- "Examination of state driver licensing processes to ensure all applicants understand the tenets of safe driving in addition to understanding state driving regulations."
- "Evaluation of employers' current practices; creation and enforcement of written guidelines addressing employee use of electronic devices while driving."
- "Proactive training of employees about appropriate operation of electronic devices."
- "Increased research by the automotive industry and the manufacturers of electronic and other devices that are routinely used in vehicles to improve designs and functions to eliminate driver distractions."
- "One of the tenets of the ASSE position for traffic safety is the need for improved driver education. This is a significant component in securing safety on the highways and in addressing the hazards of using cell phones while driving. Driver education should include training about elimination, or at least minimizing, driver distractions."



**Cellular Telecommunications & Internet Association (2001).**  
*Testimony of Tom Wheeler before the U.S. House of Representatives Transportation and Infrastructure Highways and Transit Subcommittee (May 9, 2001).* Washington, DC.CTIA.

CTIA's position on reinforcing the responsible use of wireless phones while driving.

"Wireless phones are the greatest safety tools invented since the creation of 911 itself."

"A wireless phone out of all potential driver distractions is the only one that could possibly save your life or the life of another."

"Today in the United States there are over 100 million wireless users making over 120,000 emergency calls a day. That's one every 1.4 seconds."

"These calls ensure that emergency responses to life-threatening accidents are expedited and that drunk, impaired and aggressive drivers are reported to the police and taken off of America's streets and highways."

"The wireless telephone industry believes that education is key in addressing the issue."

*"CTIA encourages Congress to take a three-pronged approach in addressing the inattentive driving issue: 1) additional [crash] data collection [on any in-vehicle distraction], 2) enforcement of current reckless and careless driving laws, and 3) education."*

See Also  
CTIA (2001). CTIA's position on reinforcing the responsible use of wireless phones while driving. Online at [www.wow-com.com/consumer/issues/driving](http://www.wow-com.com/consumer/issues/driving)

**Cellular Telecommunications & Internet Association (2001).** *The wireless telephone industry recognizes that drivers face many distractions in the car; Please don't let your wireless phone be one of them (pamphlet).* Online at [www.wow-com.com](http://www.wow-com.com).

#### **Tips for drivers**

#### ***The Cellular Telecommunications & Internet Association's Ten Tips to using Your Phone Responsible and Safely While Driving***

*Safe driving is your first responsibility. Always buckle up and keep your hands on the wheel and your eyes on the road. The wireless industry encourages callers to use a hands-free device or speakerphone while driving. Users are also encouraged to keep their calls brief and to employ the memory dialing function on their phones to minimize the potential distraction. Remember that state laws already prohibit distracted driving!*

- 1. Get to know your wireless phone and its features such as speed dial and redial.*
- 2. When available, use a hands-free device.*
- 3. Position your wireless phone within easy reach.*
- 4. Let the person you are speaking with know you are driving if necessary; suspend the call in heavy traffic or hazardous weather conditions.*
- 5. Do not take notes or look up phone numbers while driving.*
- 6. Dial sensibly and assess the traffic; if possible, place calls when you are not moving or before pulling into traffic.*
- 7. Do not engage in stressful or emotional conversations that may divert your attention from the road.*
- 8. Dial 9-1-1 or other local emergency numbers to report serious emergencies – it's free from your wireless phone!*
- 9. Use your wireless phone to help others in emergencies.*
- 10. Call roadside assistance or a special non-emergency wireless number when necessary.*

Joint State Government Commission,  
General Assembly of the  
Commonwealth of Pennsylvania  
(2001). *Driver Distractions and Traffic  
Safety* (2000 Senate Resolution No.  
127, Printer's No. 1935). Harrisburg,  
PA: Joint State Government  
Commission

Study into recent research surround issue of driver  
distraction and traffic safety, includes  
recommendations to the General Assembly.

- Cites statistics that indicate "Of all distractions identified as primarily or contributorily causing a crash in Pennsylvania during 1999 and 2000, cell phones represented 5.2 percent of those distractions."
- Suggests "According to crash statistics from Pennsylvania during 1999 and 2000, other occupants caused approximately twice as many distractions leading to crashes as cell phones so that a ban of wireless conversations doesn't seem promising when personal conversations with other occupants would presumably remain unabated."
- Based upon it's review of the current state of research, the Joint State Government Commission for the General Assembly of Pennsylvania made the following recommendations:
  - "A statutory or regulatory restriction on specific driver distractions does not yet appear to be warranted based upon available data. Should future data demonstrate the necessity of a restriction, its application and enforcement should be uniform statewide."
  - "To contribute to consistent collection of reliable crash data nationally, Pennsylvania's Department of Transportation should adopt the voluntary criteria known as Model Minimum Uniform Crash Criteria, which are expected to be revised next year."
  - "Pennsylvania's Department of Transportation should routinely collect and annually publish data specifying distractions that contributed to motor vehicle crashes in our Commonwealth. A corrective policy has the best chance to succeed if it is based upon reliable data to best assure that any regulatory response actually increases safety."
  - "The public and private sectors should continue to increase drivers' awareness of distractions through training, educational materials and publicity designed to emphasize the importance of suitably attentive driving."
  - "While the public and private sectors must encourage and require safe driving, there is no substitute for a suitably attentive and cautious driver. Ultimately, motorists are individually responsible to carefully attend to their primary task, driving."

**National Association of Governors'  
Highway Safety Representatives  
(2001). Membership Adopts New  
Policies at Annual Meeting (October  
14, 2001) – N.6 Distracted Driving.  
Online at [www.naghsr.org](http://www.naghsr.org)**

***Policy statement and recommendations.***

***"NAGHSR opposes federal legislation which would penalize states for not restricting the use of cell phones or other electronic devices, particularly since many have life-saving benefits. Rather, the federal government should fund considerably more research to determine the scope and nature of the distracted driving problem and the effect of telematics on driving behavior. Further, the federal government should fund a comprehensive media campaign to educate the public about the dangers of distracted driving and the way to manage driver distractions."***

***"Producers and providers of electronic devices should also undertake a major public educational campaign to inform the public about the proper use of these devices."***

***"As part of a company or agency's employment policies, employers should discourage the use of cell phones and other electronic devices when driving except in emergency situations."***

***"As part of a state's graduated licensing law, young drivers should be discouraged from using cell phones and other electronic devices for non-emergency purposes while driving until they are fully licensed."***

***"NAGHSR believes that, when on the road, drivers should not use cell phones, faxes, computers, or other distracting devices except to report a crash to emergency responders. If a driver must use such devices, he/she should drive into a parking lot or other protected area."***

National Conference of State Legislatures (2001). Federal Mandates on Cell Phones While Driving. Action Resolution from the Commerce and Communications Committee & Energy and Transportation Committee. Washington, DC: NCSL. Online at [www.ncsl.org/statefed/cellphonerest.htm](http://www.ncsl.org/statefed/cellphonerest.htm)

Resolution regarding legislation on cell phone use while driving; adopted August 15, 2001.

Whereas, according to the Cellular Telecommunications Industry Associated (CTIA), more than 120 million Americans subscribe to wireless telephone service; and

Whereas, the National Highway Traffic Safety Administration (NHTSA) estimates that 83 percent of those subscribers use their phones while driving to report emergencies, conduct business, stay in touch with family and friends, call for assistance, and report aggressive or drunk driving; and

Whereas, the proliferation of cell phones in cars and their potential for distracting drivers has attracted the attention of state and local policy makers, media, the federal government and the general public; and

Whereas, state and local policy makers are weighing the advantages of wireless technology against potential problems; and

Whereas, in 2001, state legislatures proposed approximately 140 bills regarding cell phones and driving in 43 states, the District of Columbia and Puerto Rico; and

Whereas, these 140 bills included measures to prohibit the use of hand-held cell phones while driving, improve data collection about cell phone involvement in auto accidents, increase the penalties or responsibilities of drivers who crash while using a cell phone; to prohibit school bus drivers from using cell phones while operating a school bus; restrict or prohibit phone use by teenage drivers; and

Whereas, eight states this year passed legislation regarding cell phone use while driving; and

Whereas, legislation has been introduced in Congress to mandate that states restrict cell phone use while driving or face the loss of a portion of the \$30 billion in federal highway funds allotted to the states;

Whereas, if a state fails to enact the federal mandate contained in S. 927 or H.R. 1837, that state would lose five percent of its highway trust funds allotment the first year and ten percent for each year after;

Continued ...

National Conference of State Legislatures (2001). Federal Mandates on Cell Phones While Driving. *Action Resolution from the Commerce and Communications Committee & Energy and Transportation Committee.* Washington, DC: NCSL. Online at [www.ncsl.org/statefed/cellphones.htm](http://www.ncsl.org/statefed/cellphones.htm)

See Also  
National Conference of State Legislatures (2002). *Along for the Ride: Reducing driver distractions - Final Report of the Driver Focus and Technology Forum.* Washington, DC: NCSL.

Final Report of the Driver Focus and Technology Forum

Now, therefore be it resolved, that the National Conference of State Legislatures does not advocate any position with regard to state legislative consideration of cell phone use while driving; and

Be it further resolved, that NCSL believes the decision with regard to cell phone use while driving is best decided by policymakers at the state and local level in response to unique state and local issues; and

Be it further resolved, that the National Conference of State Legislatures will oppose any congressional legislation, such as S. 927 and H.R. 1837, that mandates states to restrict cell phone use while driving or preempts state laws and regulations, which place restrictions on cell phone use while driving, as a preemption of state sovereignty and as an unfounded mandate on the states; and

Be it further resolved, that copy of the resolution be forwarded to all members of the 107<sup>th</sup> Congress and the President of the United States.

- States that driver behavior is a state issue, and that states should decide whether to regulate the use of wireless telephones and other communications, information and entertainment technology in motor vehicles.
- States that no regulation should prevent a driver's use of hand-held and hands-free wireless telephones in emergency situations. Emergency situations are circumstances where the driver is using a mobile telephone or other telematic device for the sole purpose of communicating with an emergency response operator; a hospital, physician's office or health clinic; an ambulance company or corps; law enforcement personnel; or a fire department, district or company. Emergency situations also include communications by police officers or peace officers; members of a fire department, district or company; or operators of an authorized emergency vehicle in the performance of official duties.
- States that any restrictions on wireless communication use should not impede emergency response technology.
- Recommends driver education, better crash data collection and further research.

Network of Employers for Traffic  
Safety (2001). Campaign Targets  
Distracted Driving & safety Belt Use.  
In *NETS Factsheet September 10,*  
2001. Washington, DC: NETS. Online  
at  
[www.trafficsafety.org/newsroom/091001](http://www.trafficsafety.org/newsroom/091001)  
1.

#### Brief Recommendations to Employers/Employees.

"The U.S. department of Transportation estimates that driver distraction is a factor in 25 to 50 percent of all crashes or 4,000 to 8,000 crashes per day. Yet, motor vehicles crashes that are a result of inattentive behavior are predictable, preventable and within the driver's control. NETS advises employers that distracted driver crashes are no accident."

"The latest [NETS] survey results emphasize the need for employers to take a more proactive approach and implement workplace traffic safety programs for all employees."

"...the survey found that drivers who routinely engage in distracting activities view these activities as less dangerous than the general public. Only 46% of the adults who have prepared for work while driving believe this is a dangerous activity compared to 79% of the general public."

As part of the Drive Safely Work Week campaign, NETS recommends that employees manage distractions safely. The only specific advice regarding cellular phones while driving is to "pre-program cell phones with commonly called number."

Network of Employers for Traffic Safety (2001). Programs: Distracted driver. Washington, DC: NETS. Online at [www.trafficsafety.org/distracted.asp](http://www.trafficsafety.org/distracted.asp)

NETS survey – poll of 1013 drivers surveyed August 16-19, 2001, by Pacific Data Development Corporation.

Based on the 94% of Americans who ever drive distracted...

96% have talked with a passenger while driving;  
89% have adjusted vehicle's stereo/climate control while driving;  
74% have eaten a meal/snack while driving;  
51% have used a cell phone while driving;  
41% have tended to children while driving;  
34% have read a road map/publication while driving;  
19% have applied makeup, shaved, or combed hair while driving; and  
11% have prepared for work while driving.

The survey results indicated that 56% of the Total Public believes that using a cell phone while driving is "very dangerous."  
The survey results indicated that only 38% of those who have engaged in the use of cell phones while driving actually believe that using a cell phone while driving is "very dangerous."

The survey results indicated that only 4% of the Total Public believe that talking with a passenger while driving is "very dangerous," whereas only 2% of those who have engaged in conversation with a passenger while driving actually believe that engaging in that activity is "very dangerous."

Network of Employers for Traffic Safety (2001). Safety NETS Newsletter (Fall 2001, A quarterly newsletter of the Minnesota Network of Employers for Traffic Safety). Minnesota: Minnesota Safety Council, State of Minnesota Department of Public Safety, and the Network of Employers for Traffic Safety.

Presents "Tips to Manage Potential Distractions"

*Pull off the road to make calls. Pre-set your cellular phone with commonly called numbers and allow voicemail to handle your calls when possible.*

Notes that, "Drivers to Distraction" include "Engaging in intense or emotional conversations with other passengers or on the phone."

Notes that, "Driver instructors estimate that a driver makes an average of 200 decisions during every mile they drive. This leaves no room for multi-tasking while behind the wheel."

Network of Employers for Traffic Safety (2000). Leading Employers Join to Combat Distracted Driving. In *NETS Factsheet June 27, 2000*. Washington, DC: NETS. Online at [www.trafficsafety.org/newsroom/06272000](http://www.trafficsafety.org/newsroom/06272000).

NETS survey – poll of 1026 respondents conducted June 16 - 19, 2000 by Wirthlin Worldwide.

"Just under a fifth (19 percent) of drivers say they talk on the phone [while driving]..."



**Jackman, K.W., III. (2000).**

Warning: using a cellular phone while you drive may be hazardous. *Hinckley Journal of Politics*, 2(1), 41-46.

Discusses the association between cellular phones and motor vehicles accidents (including a review of the relevant literature to date), analyzes the steps that have been taken by lawmakers, and makes strategy recommendations for lawmakers to follow as they attempt to deal with the increasing complex problem of cellular phone use while driving.

- Concluded that, based on the research and evidence available, cellular phone use while driving is hazardous.
- Concluded that more data is needed in order to determine the magnitude of the problem.
- Concluded that relevant information is too limited and that lawmakers should not ban all cellular phone use by people while they are driving.
- Recommended that lawmakers should mandate accurate police reporting and assist researchers as they develop a better understanding of the safety implications of cellular phone use.

**Alston, H. (1999). A Risky Call: Employer Limitation of Employee Cell Phone Use. Management Update, 22(1).** Atlanta, GA: Ford & Harrison LLP. Online at [www.fordharrison.com](http://www.fordharrison.com).

Ford & Harrison  
Atlanta, GA

"Companies that rely on wireless communication should heed the warning of the Smith Barney settlement. Management might consider implementing policies that prohibit cellular phone use while driving on company business. If the company provides employees with wireless communication devices, it could require, as a condition of receipt, that the employee sign an acknowledgement that these devices are not to be used while operating automobiles or other equipment. Company owned cell phones could carry a sticker warning expressing that using the phone while driving is dangerous and should be done only in an emergency. Even those companies that do not provide wireless communication devices but support or promote use of cell phones may wish to study dependence on this technology in order to avoid claims that dangerous behavior was tacitly approved."

**Farmers Insurance Group as cited in The Auto Channel (May 4, 2000).** New survey shows drivers have had 'close calls' with cell phone user. Online at [www.autochannel.com](http://www.autochannel.com).

Farmers Insurance  
Los Angeles, CA

- Kenneth Adams – "While Farmers Insurance Group promotes the idea of drivers carrying a cell phone while in their car in case of emergencies, we don't recommend people use a phone while they are driving."
- Farmers Insurance offers the following safety tips:
  - If possible, use a hands-free device.
  - Do not take notes or look up numbers while driving.
  - Place calls when you are not moving or before pulling into traffic.
  - Keep conversations short and sweet. Don't use the phone for social visiting while you drive.
  - Suspend the call in heavy traffic, hazardous weather conditions or stressful situations. You can explain later, because you will still be alive.

**Praxair, a \$5-billion industrial gas maker (Associated Press, Aug 26, 2001).** Firms craft cell phone policies. Online at [www.wired.com](http://www.wired.com).

Praxair, Inc., Worldwide Headquarters  
39 Old Ridgebury Road, Danbury, CT 06810 USA

Banned cell phone use on 1999

State Farm Insurance Cos. as cited in  
The Journal Star, Peoria, Illinois  
(August 13, 2002) on the AAA  
Foundation for Traffic Safety Website  
under Traffic Safety News. Some  
Illinois Companies Create Policies on  
Cell Phone Usage while Driving at  
[www.aaafoundation.org](http://www.aaafoundation.org)

State Farm Insurance Cos.  
Bloomington, Illinois

"Since using a cellular phone, two-way radio or wireless device may become a distraction while driving, using any of these devices is discouraged when the car is in motion. If it is absolutely necessary to use one of these devices while driving, the vehicle should be equipped with equipment that allows the individual's hands to remain on the steering wheel."

U.S. Cellular Co. as cited in The  
Journal Star, Peoria, Illinois (August  
13, 2002) on the AAA Foundation for  
Traffic Safety Website under Traffic  
Safety News. Some Illinois Companies  
Create Policies on Cell Phone Usage  
while Driving at  
[www.aaafoundation.org](http://www.aaafoundation.org)

U.S. Cellular Co.  
Chicago, Illinois

Mandates hands-free equipment for employees who drive on company business.

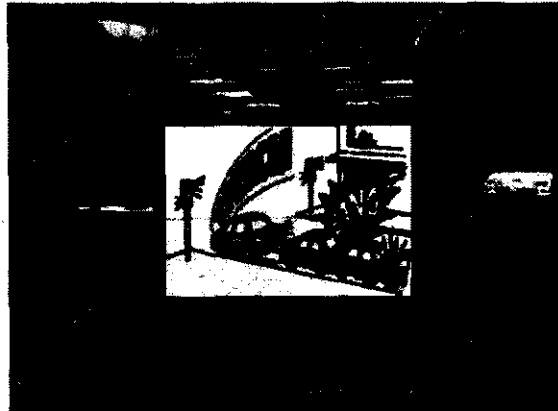
From the company's cell phone policy statement: "Stopping on the side of the road is not acceptable. It is encourage that associates exit the roadway and find a proper parking space prior to using their cellular phone."

Wilkes Artis, Washington DC-based  
law firm (Associated Press, Aug 26,  
2001) Firms craft cell phone policies.  
Online at [www.wired.com](http://www.wired.com).

Wilkes Artis  
1150 18th St, NW, Suite 400, Washington, DC  
20036-3841

David Fuss - "Our policy is that personnel are not to conduct business while using cell phones, unless they pull over and stop or use a handsfree device."

## **The Relationship Between On-Road Wireless Phone Use and Crashes**



**DRAFT 07/07/03**

**Office of Advanced Safety Research**

**Michael Goodman / NHTSA  
Julie Barker / NHTSA  
Christopher A. Monk / SAIC**



### **Note**

**The material contained herein is a working document, currently under revision, and as such should not be disseminated.**

**This document has not yet undergone full, internal Agency review.**

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NHTSA Issues the Only, Working Document to States (2005)

3

## ***Introduction***



Over the past 10 years there has been considerable research and comment on the nature and magnitude of the problems as well as the benefits associated with cell phone use while driving. The various positions, interpretations and perspectives expressed are often in response to highly publicized studies. The conclusions from such studies are often characterized as being definitive or applicable to the population as a whole, and may sometimes serve as a basis for making policy decisions. Close examination of these studies, however, sometimes reveal shortcomings in terms of methodology, sampling, and assumptions, which can restrict the comparability of findings and the ability to generalize the results. These issues bear directly on our ability to determine the magnitude of the problem, the costs and the benefits. This document represents an update to NHTSA's 1997 report on the subject, and is intended to highlight the enormous complexities that surround this issue and to present what we currently know about the relationship between on-road wireless phone use and traffic crashes.

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4

## ***Presentation Outline***



- **Definitions**
- **History at NHTSA**
- **Questions – What Do We Need to Know?**
- **The Technology**
- **Legislation and Corporate Policies**
- **Cell Phone Crashes – How They Happen**
- **Hands-Free vs. Hand-Held**
- **Sources of Data and Limitations**
- **Estimating Fatalities**
- **Strategies For Addressing the Issue**
- **Summary & Conclusions**
- **Recommendations**

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5

## ***What is Distraction? Background***



- **There is great variation in how the terms inattention and distraction are defined and applied to issues involving crash causation, driver behavior, driver performance and driver error.**
- **Use of these terms revolves around the particular aspects of driving that are studied, the taxonomy of driving that is used, and the nature of the data that is available.**
- **NHTSA has typically separated distraction out as a component of inattention as a matter of convenience in partitioning the data that it collects since the crash records with which we deal best fit this strategy.**

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6

## ***What is Distraction?***



**Distraction refers to the diversion of attention away from the primary task of driving due to other visual, cognitive, auditory or biomechanical activities.**

- At least 25% of crashes are distraction related.
- Examples of sources of distraction include:

<b>Animals</b>	<b>Eating/Drinking</b>	<b>Reading</b>
<b>Cell Phone</b>	<b>Passengers</b>	<b>Rubber-necking</b>
<b>Children</b>	<b>Radio</b>	<b>Smoking</b>
- It is not necessary for such activities to result in adverse consequences to be considered a distraction.

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7

## ***Cell Phones: Definition & Applicability***



The issues discussed in the material that follows relate to all forms of wireless communications that are typically used for voice communications, but may be used for other functions as well (e.g., instant messaging, access to email). In an effort to simplify the language we have elected to use the more familiar phrase "cell phone" throughout the presentation. It should be noted, however, that the issues addressed here are independent of the underlying technology, service or carrier and apply to all wireless devices (regardless of protocol), and associated systems that are capable of voice communications. It should also be noted that because the demands of the cell phone are similar to the demands of other distracting activities, some consider it to be a surrogate of other distractions and thus, many of the issues discussed may be relevant to other devices not involving voice communications (e.g., navigation) as well as other non-technological distractions (e.g., eating).

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8

## Abbreviated NHTSA History 1989-2003 (Cell Phones & Distraction)



- 1989 - NHTSA receives first documented Letter of Concern about the potential for cell phones to result in distraction related motor vehicle crashes
- 1991 - cursory review of motor vehicle crash data reveals crashes due to cell phone use
- 1992 - NHTSA initiates cell phone safety overview research program
- 1995 - NHTSA incorporates distraction/cell phone data into FARS and NASS
- 1997 - NHTSA publishes report on the issue of wireless communications while driving
- 2000 - NHTSA holds Distraction Public Meeting, Internet Forum, and Subject Matter Expert Workshop
- 2000-2001 - NHTSA conducts on-road research on cell phones and navigation devices, and on-road naturalistic study on hand-held and hands-free cell phone architectures
- 2001 - NHTSA Executive Director L. Robert Shelton presents testimony before the Subcommittee on Highway and Transit, Committee on Transportation and Infrastructure, U.S. House of Representatives on May 9, 2001
- 2001 - NHTSA publishes results of 2000 Motor Vehicle Occupant Safety Survey (MVOSS), including questions on driver distractions and cell phone use
- 2001 - NHTSA publishes results of 2000 National Occupant Protection Use Survey (NOPUS), including observed use of hand-held cell phones while driving
- 2002 - NHTSA conducts MVOSS, NOPUS, and National Survey of Distracted and Drowsy Driving Attitudes and Behaviors. Surveys include issues related to driver distraction and cell phone use while driving
- 2003 - NHTSA initiates distraction/cell phone research program on National Advanced Driving Simulator (NADS)

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9

## What Constitutes a Cell Phone Problem Requiring Formal Action



Whereas the specifics of such a determination are vague, any formal action should be founded on a valid and complete set of data and associated analyses. Lacking such information, decisions must be based on careful consideration of available data and any actions must be evaluated as to consequences.

It is clear that there are at least three fundamental considerations that must be factored into determining the nature and scope of any action. These include:

- The magnitude of the problem
- The costs and benefits of cell phone use from vehicles
- The risks associated with cell phone use while driving

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10



## Primary Questions



- What is the magnitude of the problem?
  - Fatalities?
  - Injuries?
  - Property damage only crashes?
  - Non-police reported crashes?
- What are the costs, and what are benefits?
  - Economic?
  - Social Network?
  - Community?
  - Personal?
  - Family/Household?
  - Safety?
  - Congestion?
  - Medical?
- What is the relative risk?
  - How do cell phone crashes compare with other distraction related crashes?
  - How do cell phone crashes compare with other crashes in general?

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11

## Can We Examine Costs Relative to Benefits?



The difficulties in determining the costs and benefits of cell phone use while driving have already been highlighted. Potential costs along with a host of potential benefits have been identified throughout the literature. Inherent in a series of notable analyses (Brookings Joint Center for Regulatory Studies and Harvard Center for Risk Analysis) are a number of assumptions that attempt to address a subset of these benefits and costs. Careful analysis of these assumptions and their implications for the analyses associated with these efforts raise significant questions as to the validity of the conclusions. Many of these assumptions are "soft" in that there is no easy way to gauge the true magnitude or monetary value for the elements discussed (e.g., convenience). Furthermore, the tendency to characterize a ban on cell phones as "complete" may be viewed as unrealistic. Certainly emergency calls would be permitted and any degree of restriction that reduces calls from a moving vehicle does not imply that the calls would not be made at all.

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12

## Secondary Questions



- What is the nature of the problem?
  - Who?
  - What?
  - When?
  - Where?
  - How?
- What contribution does exposure make to risk?
  - Frequency of use?
  - Duration of use?
  - Calls per unit time?
  - Calls per unit distance?
  - Calls per trip?

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13

## Wireless Technology



Over the past 15 years wireless technology has undergone a dramatic change in capability, architecture, and availability.

This evolution has had a significant impact on in-vehicle use and the potential risks associated with such use.

Unlike the situation for other in-vehicle distractions, the high rate of change in cell phone technology, associated changes in usage, and the uncertain influence of these factors on driver behavior and performance, have made the determination of safety impact difficult to assess, and contributes to the inherent instability of the available distraction related crash data from year to year.

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14

## Some Specific Changes in Wireless Technology



- Transition from fixed to portable devices
- Smaller, more portable size
- Flip-phones
- Hands-free devices – headsets, earpieces\*, and speakerphones
  - Some with voice dialing
  - Some with both voice dialing and voice command
- Lower service rates with more free minutes
- Phones with increased functionality
  - Voice messaging, short text messaging, electronic mail, internet access, address/contact info,
  - Phones that can receive and transmit digital images
- PDA based phones

\*Other names include Portable HF, Earset, EarWrap, EarLife, EarGlove, Ear Bud, & Ear Boom Mic

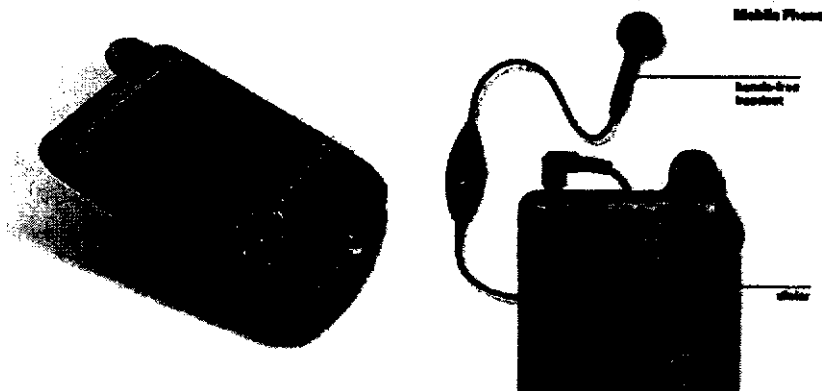
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13

## Advancing Technology



**"It's a phone, it's a Web browser, it's a Palm!"\***



\* from Federal Computer Week, April 14, 2003

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15

## Changes in Wireless Technology and Associated Risks



Many of the changes that have taken place suggest safer use (e.g., hands-free), but to the extent that conversation itself contributes to increased risk, and given the manner in which the different architectures appear to be used, the expectations may not be valid.

However, these changes can reduce the risks associated with certain actions or populations. For example hands-free, voice dialing reduces manual/visual demand and in so doing may reduce the risks associated with manual operation of the cell phone while driving. This is particularly important for older drivers.

Nevertheless, to the extent that improving usability will increase in-vehicle use (exposure), any net safety benefit will be reduced and may in fact, result in a decrease in overall safety.

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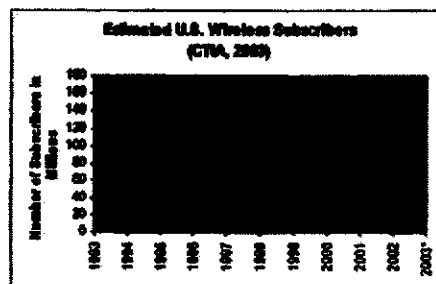
17

## Dramatic Growth in Cellular Subscribers



There has been tremendous growth in the number of cellular subscribers in the United States since the introduction of cellular phones in 1983.

The greatest increase to date occurred between 1998 and 2002, when the number of subscribers more than doubled from over 60 million subscribers in 1998 to over 137 million subscribers in 2002. <sup>43</sup>



At the current pace, there will be more than 150 million U.S. subscribers by the end of 2003.

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18

## Dramatic Growth in Overall Use



The amount of cellular phone usage in the United States has increased significantly in recent years.

Overall, Cellular Telecommunications & Internet Association (CTIA) data indicate that wireless minutes of use and the number of wireless calls have increased by a factor of 5 since 1999.

**Notes:**

1. Starting with the June 1999 CTIA market survey, estimates of local billable calls and local minutes of use data include prepaid minutes and calls.<sup>43</sup>
2. The estimates of monthly minutes of use are based on estimates of billable prepaid, local and roaming minutes of use.
3. The estimates of monthly calls are based on estimates of billable prepaid, local and roaming calls.

**Total Estimated Wireless Minutes Used, All U.S. Subscribers (CTIA, 2003)**



**Total Estimated Billable Local and Roaming Wireless Calls, All U.S. Subscribers (CTIA, 2003)**



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19

## Dramatic Growth in Minutes of Use



The average amount of time that subscribers use their cell phones on a monthly basis has increased from an estimated 140 minutes per subscriber per month in 1999 to more than 350 minutes per subscriber per month in 2002.

Overall, monthly use continues to climb with increasing access to affordable service, and the monthly average will likely exceed 400 minutes per subscriber by the end of 2003.

**Estimated Average Wireless Minutes Used Per Month Per U.S. Subscriber**



**Notes:**

1. Estimates derived from CTIA data.<sup>43</sup> Average monthly minutes of use calculated from annual total minutes of use averaged over 12 months and divided by annual total estimated U.S. subscribers. (CTIA, 2003)
2. Starting with the June 1999 CTIA market survey, estimates of local billable calls and local minutes of use data include prepaid minutes and calls. (CTIA, 2003)
3. The estimates of monthly minutes of use are based on estimates of billable prepaid, local and roaming minutes of use.

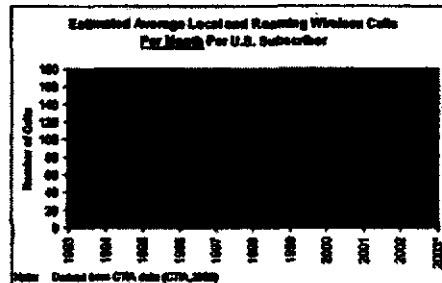
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20

## Dramatic Growth in Frequency of Use



On a monthly per subscriber basis, this translates to an increase from an estimated 47 local (including prepaid) and roaming wireless calls per month in 1999 to an estimated average of more than 120 calls per subscriber per month in 2002.



**Notes:**

1. Estimates derived from CTIA data.<sup>68</sup> Average monthly calls calculated from annual total local and roaming calls averaged over 12 months and divided by annual total estimated U.S. subscribers. (CTIA, 2003)
2. Starting with the June 1999 CTIA market survey, estimates of local billable calls and local minutes of use data include prepaid minutes and calls. (CTIA, 2003)
3. The estimates of monthly calls are based on estimates of billable prepaid, local and roaming calls.

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21

## U.S. Subscribership Total Population, States, Metro Areas



A quarterly online survey by Telephia, Inc. and Harris Interactive (i.e., Telephia Attitude and Behavior Survey) revealed that 53% of the total U.S. population in major metropolitan areas subscribed to mobile phone service in December of 2002, and confirmed that subscribership rates in metropolitan areas are significantly greater than the statewide estimates.<sup>69</sup>

City Subscription Rate	Statewide Subscription Rate
Boston, Massachusetts: 63%	Massachusetts: 51%
Atlanta, Georgia: 64%	Georgia: 49%
Raleigh, North Carolina: 65%	North Carolina: 53%
Orlando, Florida: 65%	Florida: 49%
St. Louis, Missouri: 69%	Missouri: 40%
Greenville, South Carolina: 71%	South Carolina: 42%
Washington, DC: 64%	

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22

## U.S. Mobile Phone Use Young Adults, SMS messaging



- Results from 2002 quarterly Telephia surveys indicate the following:
  - About 35% of young adults (ages 18-24) use their wireless service for more than 500 minutes per month, compared to 20% of all users.<sup>69</sup>
  - Use of SMS and other 2-way messaging services has increased from 12% in 2001 to 20% in 2002.<sup>70</sup>
  - 45% of young adults say they frequently use wireless data services, including SMS and the wireless internet, compared with 22% of all users combined.<sup>68</sup>
- A 2000 study by market research firm Cahners In-Stat Group predicted that the wireless market for young people ages 10 to 24 would experience tremendous growth, and suggested that half of all teenagers will own of cell phone by 2004.<sup>64</sup>

Note: SMS refers to Short Message Service more commonly know as Instant Messaging

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23


## Estimates of Exposure While Driving in 2002



Percent of Daylight Driving Time Spent Using a Cell Phone (2002 NOPUS)	6%
Number of Drivers Using Cell Phones During the Average Daylight Moment (2002 NOPUS)	801,000 drivers per moment
Daylight Hours of Cell Phone Use While Driving Per Day (derived from 2002 NOPUS data)	7,440,000 hours per day
Daylight Miles Driven Using a Cell Phone Per Day (derived from 2002 NOPUS data)	243,600,000 miles per day
Trips While Taking Incoming Cell Phone Calls Per Day	113,000,000 trips per day
Trips While Making Outgoing Cell Phone Calls Per Day (derived from National Survey of Distracted and Drowsy Driving Attitudes and Behaviors 2002)	111,000,000 trips per day

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24


<h1>Estimates of Exposure While Driving in 2002</h1> <h2>Compared to Overall Wireless Phone Use</h2>		
<b>Total Hours of Wireless Phone Use in 2002, all wireless use regardless of whether user was driving or not</b> (from CTIA 2003 data <sup>43</sup> )	10,329,000,000 hrs for 2002	
<b>Total Hours of Wireless Phone Use during Daylight (8AM-6PM), all wireless use regardless of whether user was driving or not</b> (Recent data extracted from the University of Montreal's 2001 epidemiological study indicates that ~75% of all wireless calls were made between 8AM and 6PM. <sup>44</sup> Assume that Total Hours of Wireless Phone Use During Daylight Hours is 75% of Total Hours of Wireless Phone Use in 2002.)	7,746,700,000 hrs during daylight for 2002	
<b>Total Hours of Daylight (8AM-6PM) Wireless Cell Phone Use Per Day, all wireless use regardless of whether user was driving or not</b> (Total Hours of Daylight (8AM-6PM) Wireless Cell Phone Use Per Day is average of Total Hours of Wireless Phone Use during Daylight (8AM-6PM) over 365 days.)	21,200,000 hours per day for 2002	
<b>Daylight Hours of Cell Phone Use While Driving Per Day</b> (from previous slide)	7,440,000 hours per day	
<b>How Much Daylight Wireless Phone Use Takes Place While Users Are Driving?</b> (Daylight Hours of Cell Phone Use While Driving Per Day) divided by (Total Hours of Daylight (8AM-6PM) Wireless Cell Phone Use Per day, all wireless use regardless of whether user was driving or not) = 7,440,000 hrs per day use while driving / 21,200,000 hrs per day total use	35%	

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25

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25

<h1><b><i>Legislative Update: Public Opinion</i></b></h1>	
<p>Surveys of public opinion confirm the driving public's concern over the safety of using cell phones while driving and willingness to accept some restrictions. However, there are clear differences in the opinions of users and non-users. For example, data from a 2002 national survey<sup>44</sup> indicate that:</p> <ul style="list-style-type: none"><li>• 88% of all drivers support increased public awareness of the risks of wireless phone use while driving.</li><li>• 57% of all drivers supports a ban on all wireless phone use while a car is moving (except for 911 calls). About one-fourth of drivers who use cell phones support such a ban compared to 69% of drivers who do not use cell phones.</li><li>• 62% support increased fines for traffic violations involving cell phone use. About 40% of drivers who use cell phones support such fines compared to about 70% of drivers who do not use cell phones.</li></ul>	

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26

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26



## **Legislative Update: State Activity**



- NY is the only state to restrict use of hand-held phones while driving by general public.
- On May 29, 2003, the California State Assembly voted in favor of legislation that would prohibit the use of hand-held cell phones while driving, and that legislation is currently being considered by the State Senate.
- Several local jurisdictions have also restricted hand-held cell phone use while driving.
- Several states have restricted use of cell phones by novice drivers and/or school bus operators.
- Several states have established task forces and/or have set up special data collection activities on this issue.
- A few states have prohibited local restrictions.
- More than 30 states have considered legislation on the issue in the last year.

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27

## **Legislative Update: States Restricting Novice Drivers & School Bus Operators**



- New Jersey enacted legislation in 2002 that prohibits the holder of a driver examination permit from using any interactive wireless device while operating a motor vehicle, with emergency use exceptions.
- Maine enacted legislation in 2003 that requires persons under 21 to obtain an instruction permit and receive education and training prior to obtaining a driver's license. This legislation also prohibits drivers with only an instruction permit from using a mobile telephone while driving.
- Arkansas, Illinois, Massachusetts, New Jersey, Rhode Island, and Tennessee have enacted legislation that prohibits the use of cell phones while operating a school bus.

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28

## Legislative Update: Activity in Other Countries



At least 42 countries restrict or prohibit use of cell phones and other wireless technology in motor vehicles, and several more are considering legislation.

Israel, Portugal and Singapore prohibit all mobile phone use while driving.

Countries that prohibit the use of hand-held mobile phones while driving:

Australia	Czech Rep.	India (New Delhi)	Kenya	Russia	Taiwan
Austria	Denmark	Ireland	Malaysia	Slovak Rep.	Thailand
Belgium	Egypt	Isle of Man	Netherlands	Slovenia	Turkey
Brazil	Germany	Italy	Norway	South Africa	Turkmenistan
Canada (Newfoundland)	Greece	Japan	Philippines	South Korea	Zimbabwe
Canada (Labrador)	Hong Kong	Jersey	Poland	Spain	
Chile	Hungary	Jordan	Romania	Switzerland	

Drivers in France and United Kingdom may use cell phones but can be fined if involved in crash while using the phone. Drivers in United Kingdom and Germany can lose insurance coverage if involved in crash while talking on the phone.

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29

## Legislative Update: Laws in Japan



Japan banned drivers from using hand-held cell phones and discouraged use of hands free phones while in the car in November, 1999.

- Advertisement of hands-free devices as a solution to distraction is discouraged.
- Reported cell phone-related crashes before and after institution of ban

	6 months Before Law Enactment	6 months After Law Enactment	Decrease
Number of Crashes	1,473	580	-893 (-60.6%)
Deaths	12	7	-5 (-41.7%)
Injuries	2,174	846	-1,328 (-61.1%)

- Decrease in reported crashes may be due to reduction in use, greater care when using, and (or) failure to admit a phone was being used.

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30

## Corporate Issues



Wireless communication is increasingly being applied in the corporate environment to improve productivity and efficiency. Such utilization has sometimes resulted in crashes where drivers were confirmed to be using a cell phone at the time of the crash. The resulting lawsuits have heightened corporate awareness of the potential liability whether the driver was using the phone for business or personal reasons. In some cases the corporate response resulted in formal policies regarding the use of cell phone while on company time or while using a company vehicle.

NTSB Internal Use Only, Working Document in Review (2002)

31

## Corporate Views



- **Wilkes Artis, Washington DC-based law firm (2001)** <sup>72</sup>
  - "Our policy is that personnel are not to conduct business while using cell phones, unless they pull over and stop or use a hands-free device."
- **U.S. Cellular Co. (2002)** <sup>73</sup>
  - From the company's cell phone policy statement: "Stopping on the side of the road is not acceptable. It is encouraged that associates exit the roadway and find a proper parking space prior to using their cellular phone."
  - Mandates hands-free equipment for employees who drive on company business.

NTSB Internal Use Only, Working Document in Review (2002)

32

## Corporate Views



- **State Farm Insurance Co. (2002) <sup>73</sup>**
  - "Since using a cellular phone, two-way radio or wireless device may become a distraction while driving, using any of these devices is discouraged when the car is in motion. If it is absolutely necessary to use one of these devices while driving, the vehicle should be equipped with equipment that allows the individual's hands to remain on the steering wheel."
- **Farmers Insurance Group (2000) <sup>16</sup>**
  - "While Farmers Insurance Group promotes the idea of drivers carrying a cell phone while in their car in case of emergencies, we don't recommend people use a phone while they are driving."

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33

## GSA (2002)



- **Recommended policy (FMR Bulletin B-2 <sup>58</sup>) on the use of wireless phones while driving motor vehicles owned or leased by the Federal Government.**  
Federal agencies should:
  - Discourage the use of hand-held wireless phones by a driver while operating motor vehicles owned or leased by the Federal government.
  - Provide a portable hands-free accessory and/or hands-free car kit for government owned wireless phones.
  - Educate employees on driving safely while using hands-free wireless phones.

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34

## Industry Guidelines



- **CTIA's "Guide to Safe and Responsible Wireless Phone Use" <sup>3</sup>**

1. Get to know your phone and its features, such as speed dial and redial.
2. When available, use a hands free device.
3. Position your phone within easy reach.
4. Let the person you are speaking to know you are driving; if necessary, suspend the call in heavy traffic or hazardous weather conditions.
5. Do not take notes or look up phone numbers while driving.
6. Dial sensibly and assess the traffic; if possible, place calls when you are not moving or before pulling into traffic.
7. Do not engage in stressful or emotional conversations that may divert your attention from the road.
8. Dial 9-1-1 to report serious emergencies -it's free from your wireless phone!
9. Use your phone to help others in emergencies.
10. Call roadside assistance or a special non-emergency wireless number when necessary.

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35

## How Do Cell Phones Contribute to Crash Causation?



- Review of cell phone related crashes provides insight into how driver actions and responses associated with cell phone use lead to crashes.
- For simplicity we identify four categories of distraction:
  - Visual – e.g., Looking away from road to dial a number
  - Biomechanical (manual) – e.g., Manipulating a device
  - Cognitive – e.g., Lost in conversation or thought
  - Auditory – e.g., Startled by ringing phone
- These forms of distraction may occur independent of one another or in combination depending upon the specific activity (e.g., trying to remember a number, looking at a phone, dialing the number).

NTSA Internal Use Only, Working Document to Review (2002)

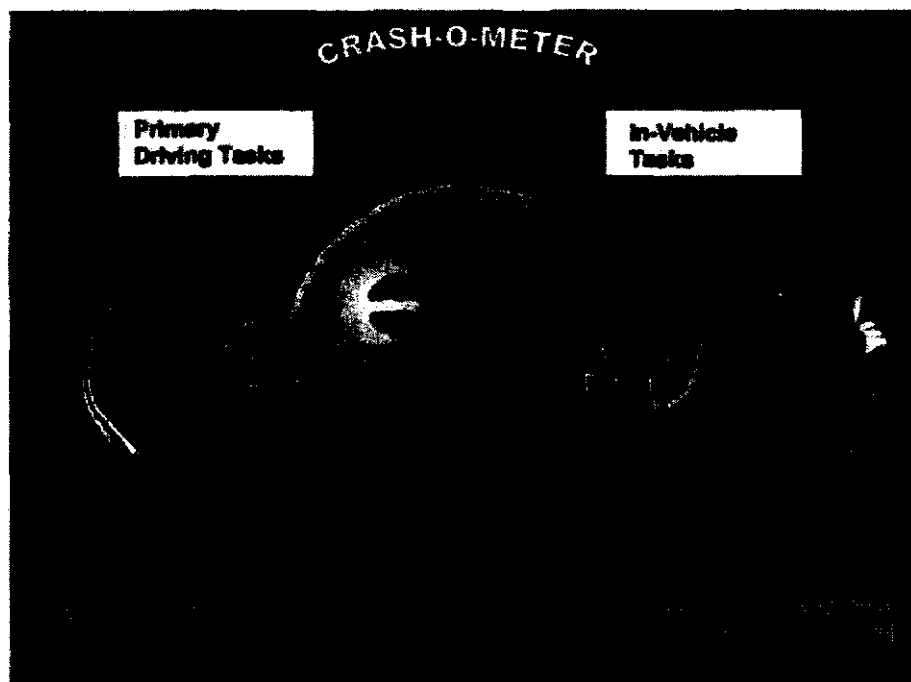
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## Some Factors Influencing Crash Risk



- Individual differences (e.g., in skill, abilities, experience, personality)
- Learning / Behavioral Adaptation
- Device demand
- Context (e.g., traffic, weather, roadway)
- Willingness to engage
- Perceived urgency
- Driver state (e.g., emotional, sick, drugs)
- Other concurrent distracting activities
- Exposure (duration, frequency)

The relationship of these factors to the risk of a crash while using a cell phone is very complex as illustrated in the diagram that follows.

NTSA present this Only, Working Document to Surface (7/00)37

## Factors Influencing Crash Risk



- **Individual Differences**

Individual factors such as skills and abilities, experience, risk taking, and aggressiveness can significantly influence the potential for a driver to be involved in a cell phone related crash. Driver decisions about willingness to use and conditions of use are a key to understanding how these factors influence risk.

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39

## Factors Influencing Crash Risk



- **Learning / Behavioral Adaptation**

An analysis of crash data reveals that drivers of new vehicles are at increased risk of a crash for some period of time. As they gain experience with the vehicle, this risk is reduced. Likewise, drivers who use new technologies may, over time, develop techniques for adjusting their behavior to improve usability and efficiency. It is the increased confidence that it safe to use a particular technology that can get drivers into trouble. This *behavioral adaptation* may take the form of complacency, may result in increased use, and may extend the driving conditions (context) in which the device is used (e.g., in heavy traffic rather than just light traffic). Since most distraction related crashes occur when a distracted driver encounters an unanticipated event, any increase in exposure (i.e., frequency, duration or context) may ultimately place the driver at greater risk.

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40

## **Factors Influencing Crash Risk**



- **Device Demand**

Device demand is determined by a large number of device design features (e.g., legibility, button size, display size, color) that determine the degree of (e.g., how difficult it is to read a display), and nature of (e.g., requiring visual attention) distraction.

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41

## **Factors Influencing Crash Risk**



- **Context**

Context refers to the conditions that exist at the time of distraction. These include, for example, traffic conditions, time of day, weather, roadway type/ characteristics, and visibility. Context can have a significant impact on the willingness of a driver to engage in distracting activities and hence, on the risk of engaging.

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42



## **Factors Influencing Crash Risk**



### **• Willingness to Engage**

The willingness of a driver to use a particular device is closely related to the demands of the device, the context of the driving situation (e.g., traffic and weather conditions), the urgency of the task, and driver characteristics. For example, there may be situations and contexts when a driver is willing to answer an incoming call, and other situations when he or she is not.

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## **Factors Influencing Crash Risk**



### **• Perceived Urgency**

Urgency refers to the motivation of the driver to engage in a distracting activity. Thus, drivers may not normally carry out a task under certain circumstances, but will if there is a perceived urgency (e.g., running late and there is a need to notify someone, a need to adjust a mirror for better visibility under adverse conditions, need to answer a call or make a call for business deadline).

NTSB Internal Use Only, Working Document in Review (2009)44

## **Factors Influencing Crash Risk**



### **• Driver State**

The state or condition of the driver at any given time (e.g., drowsiness, emotional) can have a significant influence on the risks associated with operating a device. These effects may simply be in terms of degrading performance further, influencing willingness to engage, or influencing driver judgment. Some of these effects may be transient (e.g., emotional call) or continuous (effects of a drug).

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## **Factors Influencing Crash Risk**



### **• Other Concurrent Distracting Activities**

Other concurrent distracting activities refer to concurrent performance of multiple distracting activities that divert the driver's attention from the road. For example, the driver may be concurrently talking on the phone and eating while driving, sometimes leaving both hands off of the wheel. Concurrent activities while driving can have a significant impact on risk.

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## **Factors Influencing Crash Risk**



- **Exposure**

Exposure refers to the frequency and duration of involvement with a distraction, whether it be visual, cognitive, auditory, manual, or some combination thereof. It is exposure, combined with individual differences, device demand, context, willingness to engage and urgency that determines the degree of risk associated with a particular activity.

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47

## **Factors Influencing Crash Risk Transactional Risk vs. Exposure**



Each task (transaction; e.g., dialing a phone, talking on a phone, adjusting the volume) associated with an activity (e.g., using a phone) is also associated with some degree of risk based on the demands of that task. This risk is further influenced by the duration and frequency with which we engage in the task. While some tasks may produce less demand than others, their greater frequency and duration of use may result in greater overall risk. For example, dialing a phone vs. conversation.

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48

## ***What Is a Hands-free Phone?***



The sensitivity of driver behavior and performance to device demands has already been highlighted. In the case of hands-free phones in particular, this is a potentially significant issue since not all hands-free phones are created equal, taking into account the specific features of the phone, the accessories used and manner in which the "system" is used. Generally these differences are associated with the degree to which the phone must be manipulated (e.g., to dial, open), the method of communications (e.g., speaker/mic vs. earphone/mic), the nature of the connection (e.g., wired vs. wireless), the location of the phone (e.g., cradle vs. on driver), whether the phone has a voice command capability (e.g., "dial 555-5555"), and when the "system" is set up (e.g., vehicle moving or stationary). Since the distribution and manner of use of these different system architectures is unknown, they are considered in aggregate as "hands-free" phones in the discussion that follows. Thus, any phone that does not require the driver to hold the phone for dialing or conversation is considered "hands-free."

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49

## ***Hands-Free vs. Hand-Held***



Over the past several years there has been tacit acceptability of hands-free phones for mobile use by state (through legislation) and federal (GSA) authorities. That hands-free phones are somehow safe or safer has been promoted by elements of the wireless industry for some time ("hands-free lets you keep your hands on the wheel and eyes on the road"). It appears that this is generally believed by users as reflected by the growing use of hand-free devices. Nevertheless, this expectation does not appear to be supported by either experimental or epidemiological research, both of which indicate little if any difference between the architectures in terms of risk or safety relevant behavior and performance. This is not to say that hands-free and hand-held devices adversely influence driving in the same way, but rather that beyond the common cognitive demand of conversation itself, the use of each architecture may be associated with unique attributes that have the potential to increase crash risk. The following slides summarize empirical evidence suggesting the lack of clear distinction in risk associated with the two architectures.

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50

## ***Hands-Free vs. Hand-Held***



- **Studies that compared Hands-free (HF) and Hand-held (HH) phones found that both architectures resulted in:**

- Delayed reaction times 12, 15, 24, 29, 38, 50, 75
- Missed events 20, 50
- Speed variations 24

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51

## ***Hands-Free vs. Hand-Held***



- **Studies have shown that the cognitive aspects of conversation seem to be the greater source of distraction (regardless of HH or HF):**

- Delayed reaction times 12, 15, 24, 29, 38, 50
- Missed events 20, 50
- Reduced situation awareness 37
- Narrowing of visual field 26, 40, 48
- Reduced visual scanning 10, 34
- Inattention blindness 49
- Higher subjective mental workload 4, 33, 53

} These refer to the same general phenomenon but reflect the terminology of the reporting authors.

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52

## ***Hands-Free Is Not Risk Free***



Complicating the issue is the lack of clear understanding of how these hands-free and hand-held devices are used in the real world. For example, it is not at all clear that drivers using hands-free phones drive with both hands on the wheel or attend more to the road, nor can it be said that they always use the phone in a hands-free mode while driving. As will be seen later, this latter point is supported by survey data. Similarly, while the act of dialing with a hand-held may place a driver at greater risk, a hands-free phone on the console may actually require more visual attention where manual dialing is used. In addition, there is evidence that hands-free calls are longer than hand-held calls, which would increase exposure and hence risk. Finally, use of hands-free phones may involve using an earpiece. Drivers have been observed putting on these devices while driving, an activity that can require two hands and would clearly increase the risk of crash. Survey data specifically indicates that one in five headset/earpiece users place the headset on while driving (2003 MVOSS <sup>30</sup>). Clearly, hands-free is not risk free.

Note: 2003 MVOSS data is preliminary.

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53

## ***Sources of Information and Data on Cell Phone Use, Consequences of Use, and Association with Crashes***



- **Anecdotal**
- **Survey and Focus Group Data**
- **Experimental Research**
- **Crash Data**
- **Cost-Benefit and Risk Analyses**

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54

## **Sources of Information and Data on Cell Phone Use, Consequences of Use, and Association with Crashes**



### **❖ Anecdotal**

- Survey and Focus Group Data
- Experimental Research
- Crash Data
- Cost-Benefit and Risk Analyses

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55

## **Sources of Anecdotal Information**



- Media reports and articles
- Letters to NHTSA
- Various internet sources
- Discussions with researchers and conversations with callers to NHTSA
- Noted observations and interview comments from researchers
- Observations from law enforcement officers

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56

## ***Anecdotal Information***

***Some of What We Have Learned***



- Drivers will not readily admit to being distracted.
- There are differences in the willingness of drivers to report different distractions; they may be more willing to admit to one form of distraction rather than another.
- Many cell phone users gesture with their free hand when they speak, sometimes leaving no hands on the wheel for short periods of time.

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57

## ***Anecdotal Information***

***Some of What We Have Learned***



- Cell phone drivers are perceived to drive like intoxicated drivers (e.g., slow speed, excessive, and slow lane motion, reduced situational awareness).
- Other drivers are involved in crashes caused by cell phone users who themselves are not involved.
- Anecdotal data, not unlike survey data, reveal that the public is very concerned about this problem behavior. They have witnessed or experienced the adverse effects and were concerned enough to pass that information along to the media, police or NHTSA.

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58



## ***Examples from the Media***



- **2002 – An Arkansas woman talking on a cell phone was killed after driving into the path of an Amtrak train.**
- **2001 – Supermodel Niki Taylor was critically injured in a crash that resulted when her driver lost vehicle control while reaching for a ringing cell phone.**
- **2000 – A Virginia attorney conducting business using cell phone while driving struck and killed a teenage girl.**
- **1999 – An investment firm employee ran a red light while searching for dropped cell phone and struck a motorcyclist.**

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59

## ***Sources of Information and Data on Cell Phone Use, Consequences of Use, and Association with Crashes***



- **Anecdotal**
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- **Crash Data**
- **Cost-Benefit and Risk Analyses**

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60

## Survey Data



- **NHTSA-sponsored surveys**

- BI-Annual Motor Vehicle Occupant Safety Survey (MVOSS) 8, 38
- 2002 National Survey of Distracted and Drowsy Driving Attitudes and Behaviors 44

- **NHTSA-sponsored Focus Groups**

- VTI Study 2002 9

- **Other independent surveys**

- North Carolina Statewide Survey 2002 61, 63
- Montreal Study 2000 30
- CTIA market survey 43
- Other Public Opinion Surveys 18, 39, 54, 71

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61

## Survey Data: User Characteristics



- **The following are estimates based on several surveys and do not reflect the full ranges of values reported.**

- About two-thirds of drivers have cell phones.
- Over half with phones keep phones on for all trips, and two-thirds for most or all trips.
- About three-fourths of those with phones report having used phones while driving; this translates to about one-third to one-half of all drivers.
- About one quarter of those with phones report *never* talking on phones while driving.

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62

## Survey Data: Phone Use & Driving



### Average Duration of Calls Or Daily Talk Time While Driving

- **CTIA** <sup>43</sup>
  - length of average local cellular call in 2002 was 2.73 min (compared with average of 2.74 min in 2001)
- **2002 National Survey of Distracted and Drowsy Driving Attitudes and Behaviors** <sup>44</sup>
  - Mean 4.5 minutes *per call* while driving
- **North Carolina Statewide Survey 2002** <sup>51</sup>
  - Mean 14.5 min *per day* while driving (Median = Mode = 5 min per day while driving)

Note: NVDSS data is preliminary

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63

## Survey Data: Phone Use & Driving, Monthly vs. Daily Use



- **1999 PCIA poll** <sup>39</sup>
  - 10% no MONTHLY use
  - 40% less than 10 min per Month
  - 20% said 10-30 min per Month
  - 30% said 30 min or more per Month
- **North Carolina Statewide Survey 2002** <sup>51</sup>
  - 18.4% less than one min per DAY
  - 29.6% said 1-4 min per Day
  - 20% said 5-9 min per Day
  - 32% said 10 or more min per Day

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64

## Survey Data: Phone Use & Driving



### Answering the Phone

- **NHTSA 2003 Motor Vehicle Occupant Safety Survey (MVOSS)** <sup>38</sup>
  - Of drivers who report having a wireless phone turned on at least some of the time when they drive
    - 40% also report that they *always* answer an incoming call while driving
    - 31% report that they *usually* answer the call
    - Less than 10% report that they *never* answer the incoming call while driving

Notes: It is not clear what proportion of drivers have voicemail as an option.  
MVOSS data is preliminary.

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65

## Survey Data: Phone Use While Driving



### per Trip Use

- **NHTSA MVOSS, 2003** <sup>38</sup>
  - 23% report they never talk on phone while driving
  - 47% report they talk on phone for less than half of trips
  - Nearly 18% report they talk on phone for half of trips
  - 13% report they talk on phone for most or all trips.
- **NHTSA Distracted Driving Survey 2002** <sup>44</sup>
  - 58% report they rarely or never make outgoing calls
  - 18% report they make calls on one-quarter of trips per week (5-6 trips per week)
  - 10% report they make calls on one-half of trips (11 trips per week)
  - 13% report they make calls on three-fourths or more trips (20-30 trips per week)

Note: 2003 MVOSS data is preliminary

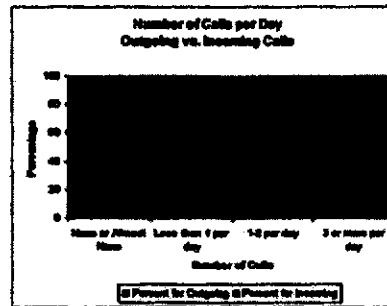
NHTSA Internal Use Only. Working Document in Review (F03)

66

## Survey Data: Phone Use & Driving Calls per Day



- About one-half of cell phone users surveyed in the North Carolina Statewide Survey in 2002 reported making or answering at least 1-2 calls daily while driving. <sup>41</sup>
- Overall, cell phone users were more likely to make outgoing calls than to answer incoming calls while driving.
- 24.5% reported making none or almost no daily outgoing calls while driving.
- 34.9% reported answering none or almost no daily incoming calls while driving.



(Source: Stutts et al., 2003)

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67

## Survey Data: Phone Use & Driving - Trends



Estimated Average Calls per Week While Driving



(Sources: Laberge-Hadeneau, et al., 2001; Stutts, et al., 2003; Stutts, 2003)

- Canadian survey data, collected in 2000, indicate that drivers are more likely to make and receive fewer (<6) calls weekly. Data for drivers in North Carolina, collected in 2002, indicate that more drivers are making and receiving more calls. <sup>38, 51, 63</sup>
- The data also indicate that males are more likely to make more calls while driving than females.

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68

## Survey Data: Hand-Held vs. Hands-Free



- For drivers who reported usually carrying a wireless phone in the vehicle:
  - The 2000 NHTSA MVOSS <sup>38</sup> data showed that:
    - Hand-held phone use rate was about 73%
    - Hands-free phone use rate was about 22%
- For drivers who reported talking on the phone while driving:
  - The 2002 North Carolina Statewide Survey <sup>51</sup> suggested that the hand-held usage rate is about 72%
  - The NHTSA 2002 Distracted Driving Survey <sup>44</sup> and the NHTSA 2003 MVOSS <sup>38</sup> data showed that:
    - Hand-held phone use rate is between 60-63%
    - Hands-free phone use rate is between 34-38%

Note: 2003 MVOSS data is preliminary

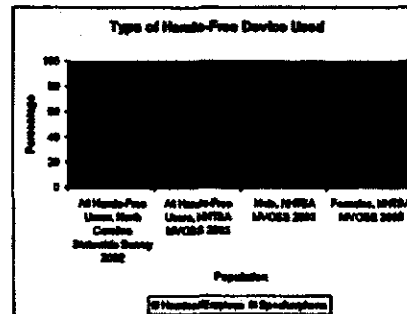
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69

## Survey Data: Use of Hands-Free Systems



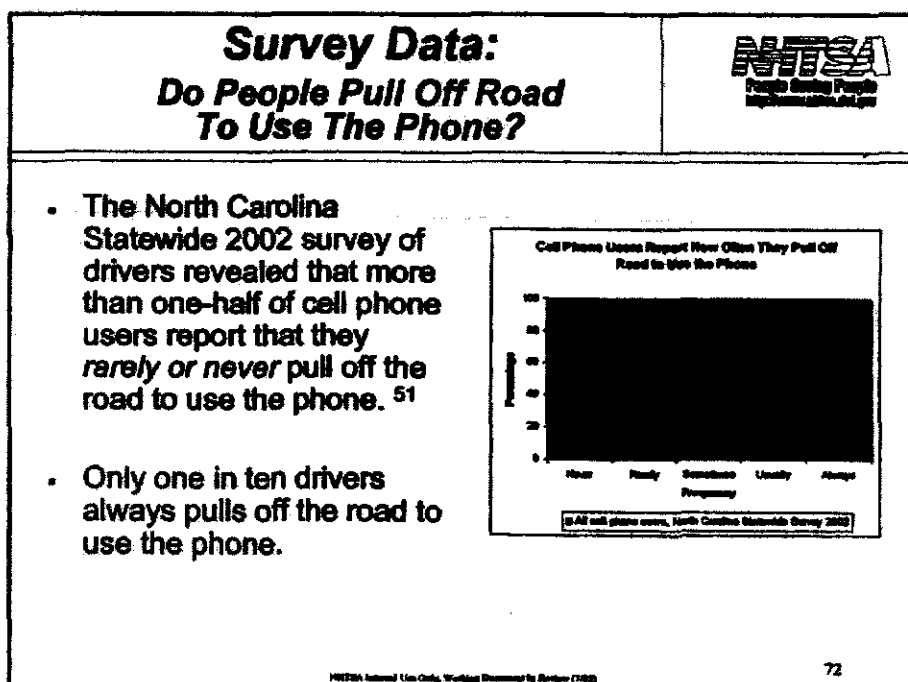
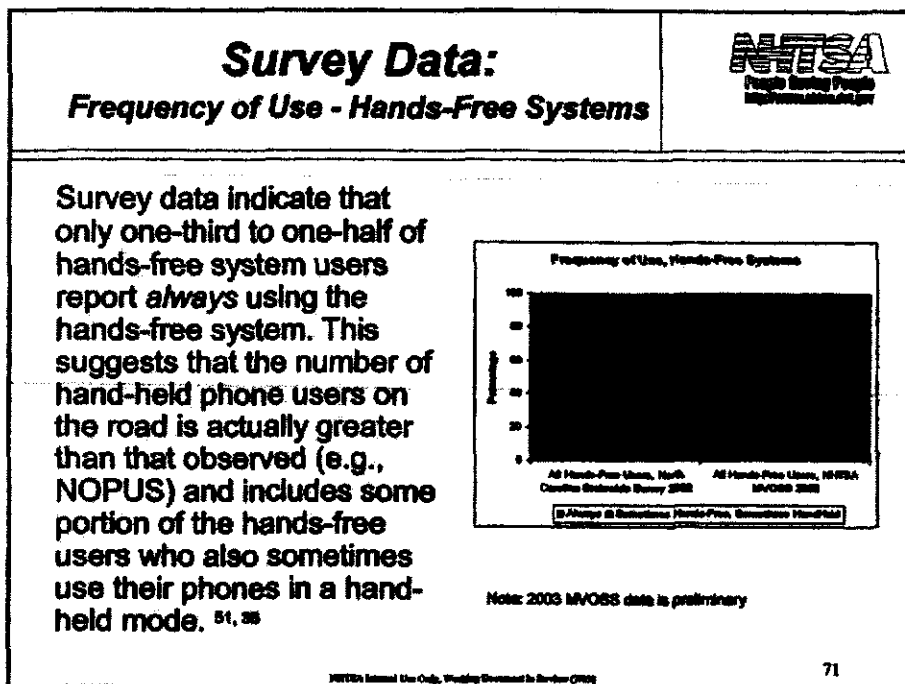
- Survey data show that about two-thirds of drivers who "usually" use hands-free systems report use of a headset or earpiece. <sup>51, 38</sup>
- Survey data also indicate that female users are more likely to use the headset or earpiece, whereas male users are more likely than the females to use the speakerphone feature. <sup>51, 38</sup>



Note: 2003 MVOSS data is preliminary

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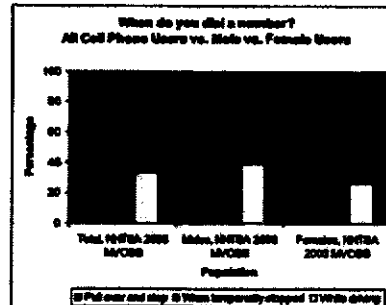
70



## Survey Data: Where Do People Dial A Number?



- NHTSA 2003 MVOSS data show that about one-third of drivers who reported using a cell phone on at least some trips also reported a tendency to dial phone numbers while driving.<sup>36</sup>
- The male drivers were more likely to dial while driving.
- The female drivers were more likely to dial while temporarily stopped, though they were equally likely to dial after pulling over to stop.



Note: 2003 MVOSS data is preliminary

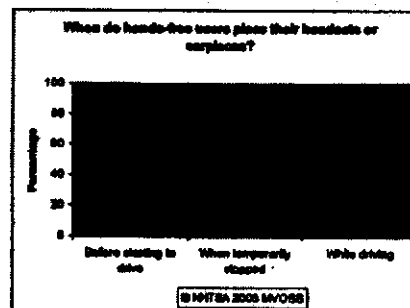
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73

## Survey Data: When Do People Place The Headset/Earpiece On For Use?



- According to the NHTSA 2003 MVOSS data, four out of five hands-free users of a headset / earpiece report that they place the device on prior to driving or when stopped temporarily.<sup>36</sup>
- But one out of five users reported that they do this while driving.



Note: 2003 MVOSS data is preliminary

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74

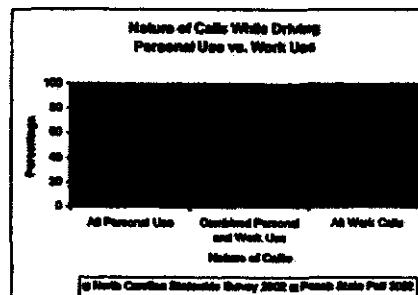


## Survey Data: Reported Reasons For Calls While Driving



Recent survey data (NC <sup>50</sup>, GA <sup>71</sup>) show:

- 6-10% reported work use only while driving.
- 40-54% of cell phone users reported a combination of personal and work calls while driving.
- 34-53% of cell phone users reported personal use only while driving.



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75

## Survey Data: Reports Of Real Problems W/ Vehicle Control



- In 2000, more than 22% of male and 22% of female cell phone users in the Montreal study reported having experienced difficulty staying in their lane when using a phone while driving at some time in the last 24 months. <sup>30</sup>
- In 2003, more than 10% of drivers polled in the NHTSA MVOSS reported having had to take sudden quick action to avoid another vehicle or to avoid some object at some time in the past 12 months when talking on the phone while driving, and about 4% have had to act quickly to move back onto the roadway at some time in the past 12 months. <sup>36</sup>

Note: 2003 MVOSS data is preliminary

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76

### **Survey Data: Reports Of Close Calls Or Near Misses**



- In 2000, more than 40% of drivers polled by Farmers Insurance reported having experienced a close call or near miss situation at some time with another driver who was using a cell phone. <sup>16</sup>
- In 2000, about 6% of male and 4% of female drivers, respectively, in the Montreal study reported having experienced a close call or near miss situation at some time when they were using the phone while driving. <sup>30</sup>

NTSA Internal Use Only, Working Document to Review (2003)

77

### **Survey Data: Other Messaging Features and Functions While Driving**



- NHTSA 2003 MVOSS data <sup>36</sup> show that drivers who usually have a wireless phone of some type in the vehicle report also having access to additional phone features that include:

Voice Mail (75%)	Address/Phone Book (20.9%)
Internet Access (28%)	Short Messaging (23%)
E-mail (20.9%)	

Note: 2003 MVOSS data is preliminary

NTSA Internal Use Only, Working Document to Review (2003)

78

## ***Limitations of Survey Data***



Many of the lessons learned from anecdotal data apply to survey data.

Whereas much data is available, there are significant variations in the manner in which the data is collected and reported.

For example, multiple surveys ask about frequency with which driver uses phone while driving. Question has been asked in terms of: daily use, weekly use, per trip use, percentage of trip use, often vs. rarely, calls per day, calls per week, calls per trip, and so on.

This makes data comparison difficult and limits the ability to draw definitive conclusions on exposure and relative risk.

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## ***Limitations of Survey Data***



Survey data is subjective, and is vulnerable to a multitude of factors that contribute to inconsistencies in recalled data. As a result these data may not be completely reliable. For example:

- The excitement that results from a collision may cause a driver to forget what distracted him/her just prior to the collision.
- A driver may want to hide the true reason for his/her distraction prior to a collision to avoid consequences.
- A driver may not realize the relationship between what distracted him/her and the resulting collision, so he/she does not know to report it in the survey.
- A driver may have difficulty recalling exact details of crash from several years past.

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## **Sources of Information and Data on Cell Phone Use, Consequences of Use, and Association with Crashes**



- Anecdotal
- Survey and Focus Group Data
- ♦ **Experimental Research**
- Crash Data
- Cost-Benefit and Risk Analyses

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81

## **Experimental Research**



- **Large body of independent and NHTSA-sponsored studies (dozens of studies since the early 1990s) directed at issues associated with cell phone use while driving and traffic safety**
  - In the laboratory
  - Using driving simulators
  - On-the-road research (controlled and naturalistic)
  - Observational research such as NHTSA's National Occupant Protection Use Survey (NOPUS)

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82

### **Prominent Driver Performance Effects: Experimental Research Findings**



- Narrowing of visual field or "tunnel vision" 26, 40, 48
- Failure to process visual information despite fixations "inattention blindness" 49
- Delayed reactions to traffic events 12, 15, 24, 29, 38, 50
- Failure to respond to events or targets 20, 50
- Delayed braking and more intense braking 25, 28
- Reduced lane position stability (e.g., lane excursions) 37, 60
- Increased headway variability (reduced safety margins) 4
- Increased speed variability 24, 29, 37, 38
- Reduced situation awareness 26, 37, 75
- Reduced capability for vehicle control 26, 37, 60

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83

### **Driver Performance: Results from an On-Road Study**



- Harbluk, Noy, and Elzenman (2002) 26
  - Conducted an on-road study to examine the impact of distraction when using a hands-free phone while driving.
  - Concluded that significant changes in driver behavior (narrowed visual scanning behavior and reductions in vehicle control) under real-world driving conditions may result due to the cognitive distraction associated with the use of in-vehicle, hands-free devices, and that these changes support the idea that these extra demands on the driver contribute to late detection, reduced situation awareness and a reduced margin of safety.

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84

## ***Driver Performance: Results from a Simulator Study***



- **Strayer and Johnston (2001)** <sup>50</sup>

- Conducted a set of experiments using a part-task driving simulation to contrast the effects of hand-held and hands-free wireless phone conversations on a simulated driving task.
- Results showed that cell phone users missed more traffic signals and had longer reaction times to those signals they noticed, with users of hands-free devices performing no better than those using hand-held phones.

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85

## ***Driver Performance: Results from a Simulator Study***



- **Haigney, Taylor, and Westerman (2000)** <sup>24</sup>

- Conducted a study using a driving simulator to investigate the effects of hand-held and hands-free mobile phone use on driving performance.
- Found that changes in heart rate indicated an increase in cognitive demand experienced by drivers when using mobile phones.
- Found that using a phone, either hands-free or handheld – leads to variations in driver behaviors, which are strongly associated with subjective risk manipulation and crash involvement.
- Results showed significant variations in vehicle speed, decrement in driver responsiveness to traffic conditions, and decreased driver responsiveness following a phone call.
- Both handheld or hands-free phones seriously affected the driver's ability to consistently attend to the driving task.

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86

## **Driver Performance: Other Important Factors**



### **• Hand-held vs. hands-free phones**

- Whereas hands-free phones may have some performance benefits, evidence indicates that drivers who use hands-free phones use them more frequently and for longer durations <sup>29, 69</sup>
- In addition, there is a growing body of evidence that the complexity of the conversation task is a far greater contributor to the deleterious effects on driver performance <sup>12, 15, 34, 35, 38, 53</sup>
  - Even when hands-free phones result in better performance than hand-held, both are usually significantly worse than a no-phone condition <sup>29</sup>

### **• Conversation complexity**

- Strong evidence that complex conversation tasks contribute significantly to reduced driver performance <sup>12, 34, 35, 38, 53</sup>
- Even simple conversation results in some decrements <sup>28, 35, 37, 38, 53</sup>

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87

## **Driver Performance: Other Important Factors**



### **• Driver Characteristics**

- Nearly all effects are much worse for older drivers, but research has shown that they can benefit from voice-interface designs. <sup>34, 35</sup>
- In one study, teens (16-18 yrs) were found to choose unsafe following distances, have poor vehicle control skills and to be more prone to distraction from hand-held phone tasks. <sup>20</sup>

### **• Other distractions**

- Some evidence that radio tuning, HVAC operation, and listening to books on tape result in fewer decrements than phone conversations. <sup>20, 29, 50</sup>
- CD case manipulations and map reading have been shown to be more detrimental to driving performance than cell phone use.

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88

## **Observational Research**



**In addition to driver performance data, observational data plays an important role in our understanding of cell phone use while driving.**

**NHTSA's National Occupant Protection Use Survey (NOPUS) and other observational studies are essential for determining current levels of cell phone use by drivers.**

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89

## **Observational Research**

***NHTSA's Bi-Annual National Occupant Protection Use Survey (NOPUS)***



**NOPUS is a probability-based observational survey that focuses on seat belt use in the United States. As a part of this data collection effort, use of hand-held cell phones was also captured. For 2002, approximately 38,000 drivers were observed at 1,141 randomly selected road sites involving controlled intersections (i.e., stop sign or signal). Data was collected during daylight hours between 8:00 AM and 6:00 PM.**

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90



## **Observational Research NHTSA's Bi-Annual NOPUS**



- In 2000, at any given time during daylight hours, 3% of drivers are using a hand-held phone. <sup>53</sup>
  - Higher rate for vans and SUVs (4.8%)
  - Additional 0.9% use hands-free equipment (estimated)
- In 2002, the portion of drivers estimated to be using a hand-held phone at any given time during daylight hours increased to 4%. <sup>17</sup>
  - Additional 2% use hands-free equipment (estimated)
  - In total, at least 6% of drivers are using some kind of wireless phone at any given time
  - Significant increase in urban areas from 2000

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91

## **Observational Research Other Studies**



- The observed rate of cell phone use by drivers was 3.1% in a 2001 University of North Carolina study. <sup>42</sup>
  - Cell phone users were more likely to be without a front-seat passenger, driving a SUV, younger, white, and wearing a safety belt.
- In 2000, five percent (5%) of all drivers observed on Dallas area highways were using a hand-held cell phone during the afternoon peak period. <sup>13</sup>
  - Ranged from 3% (rural) to 7% (urban)
- At any given time during daytime hours in 2001, 3.5% of drivers in the state of Washington were observed to be using a hand-held phone. <sup>48</sup>
  - Sport Utility Vehicle and Van drivers had the highest rate at 4.59% and 4.23%, respectively

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92

## **Observational Research**



### **Conclusions**

- The most recent evidence (2003) shows that, at any given time during daylight hours (8 am-6 pm), 6% of drivers are talking on a wireless device while driving, on average
- The observed use varies depending on road type (rural or urban) and vehicle type
  - Higher percentage in urban areas
  - Higher percentage for SUV and van drivers

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93

## **Epidemiological Research**



### **1996 Rochester Study <sup>55</sup>**

- Talking more than 50 minutes per month on cell phone in a vehicle was associated with 5.59-fold increased risk of a traffic crash.
- Combined use of cell phones and motor and cognitive activities while driving were also associated with increased traffic crash risk.

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94

## ***Epidemiological Research***



- **1997 Toronto Study** <sup>41</sup>
  - Reported an association between the use of cellular telephones in a motor vehicle and a quadrupled risk of crash during the call.
  - Authors "observed no safety advantage to hands-free as compared to hand-held unit telephones."
- **2003 Montreal Study** <sup>62</sup>
  - Results from a 2003 Montreal Study that examined the case-crossover design used in the 1997 Toronto Study suggest that the resulting estimated relative risk factor reported in the Toronto Study was two to three times larger than the true relative risk when randomness of the time of collision in the police report was introduced.

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95

## ***Epidemiological Research***



### **2001, 2003 Montréal Studies** <sup>30, 61</sup>

- Relative risk of all traffic crashes and of crashes with injuries is 38% higher for cell phone users than for non-users.
- Heavy cell phones users (defined in terms of frequency of use and duration of individual calls) are exposed to twice the risk compared with those who make minimal use of their phones or are non-users, taking into account age, exposure to risk and driving habits.

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96

## **Epidemiological Research**



### **2001 Norwegian Study <sup>45</sup>**

- Reported an overall relative risk of 2.2 of driver being involved as responsible party in an accident while using a mobile phone as compared to driving without using the phone.
  - RR=1.8 for Hands-free users
  - RR=1.2 for dash-mounted users
  - RR=3.6 for hand-held users
- Increased risk is most likely a consequence of the telephone use *per se* and is not attributable to differences in risk-related behaviors between users and non-users of mobile telephones.

\*Not statistically significant difference in RR between HF and HH.

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97

## **Epidemiological Research: Limitations**



- **Nature of crash data**
  - Vehicle-based vs. Crash-based
  - Crashes that involve Property Damage Only vs. Injury and/or Fatality
- **Missing data**
- **Limited sample sizes**
- **Methodological issues related to**
  - Comparisons of phone users vs. non-users
  - Comparisons of those who have had prior crashes vs. those who have not
- **These studies showed statistical associations but did not establish causal relationships.**

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98

## ***Epidemiological Research: Limitations of Existing Data***



**Lack of exposure data and details on phone use that would be helpful to link crash risk with specific user behavior and cell phone architecture. In particular, it would be useful to know:**

- Length of calls
- Frequency of calls
- Number of calls in a trip
- Device configuration information

**It should be noted that in the 2001 Montreal Study, the finding of a dosing effect (the greater the use of cell phones, the greater the risk), added credibility to the findings.** 30, 61

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99

## ***Limitations of Research Studies***



- Research studies have varying objectives and experimental circumstances, and employ a range of dependent measures. This variety provides much information, but can limit comparability.
- Research often involves commanded tasks in situations which may not represent the conditions under which a particular subject would actually carry out the task. This may bias the results against the technology if task demands are such that the subject would not normally carry out the task in the experimental context used.
- There is a need to understand behaviors in naturalistic settings; the research rarely uses benign conditions, which are most often associated with distraction related crashes.
- Observational surveys are snapshots in time. Information is gathered about population exposure at a point in time, but not necessarily the overall amount of exposure.

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100

## **Issues with Research Studies Behavioral Adaptation**



Within the context of driving, *behavioral adaptation* refers to the changes in behavior and performance that take place over time as we gain experience with various aspects of our environment or vehicle.

Such adaptation may involve, for example, learning, strategy changes, complacency or other changes that take place in response to our experience, perceptions, and beliefs. These changes may be conscious or unconscious.

As indicated earlier, behavioral adaptation is a potentially important phenomenon in assessing risk. We know that drivers are at increased risk in unfamiliar vehicles. Likewise, when subjects are asked to use unfamiliar technology they are likely placed at greater risk while using it. With time they will adapt to using the technology while driving, and may develop specific time-sharing strategies. Research that provides very little exposure to a new technology may not address the long-term changes that may occur with experience using that particular technology.

NTSA Issues with Cell Phone Use, Working Document to Board (2002)

101

## **Sources of Information and Data on Cell Phone Use, Consequences of Use, and Association with Crashes**



- Anecdotal
- Survey and Focus Group Data
- Experimental Research
- ❖ **Crash Data**
- Cost-Benefit and Risk Analyses

NTSA Issues with Cell Phone Use, Working Document to Board (2002)

102

## ***Crash Data***



**Objective, well-documented and complete crash data can help to identify and characterize the role of cell phones in crash causation and the magnitude of the problem. The challenge is to determine how "good" and complete the data are, how it can best be utilized to answer the questions at hand and how to improve it where it falls short.**

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103

## ***Crash Data***



**In reviewing crash data it is also important to recognize that the reporting of distraction as a causal factor appears to be conservative (the greater the depth of investigation, the greater involvement discovered) and may be biased by differences in reporting associated with the severity of a crash. In addition, the data have a very high level of "unknowns" associated with both general crash data and distraction related crash data.**

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104

## Crash Data



- Available NHTSA data sources
  - FARS
  - GES
  - CDS
- NHTSA special investigations and analyses of state crash data
- State-initiated analyses of crash data and special investigations <sup>14, 18, 77</sup>
- Other independent analyses and epidemiological studies

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105

## General Trends in Distraction-Related Crash Data, 1997-2001



According to both FARS and GES, distraction related crashes most frequently occurred under the following conditions:

Road Characteristic	FARS <sup>1</sup>			GES <sup>2</sup>		
	Straight	Curved	—	Straight	Curved	Other
Alignment	76%	24%	—	83%	9%	8%
Environment	Rural	Urban	—	—	—	—
	66%	34%				
Profile	Level	Grade	Other	Level	Grade	Unknown
	72%	24%	4%	50%	13%	36%
Surface Condition	Dry	Wet	Other	Dry	Wet	Other
	86%	12%	2%	82%	14%	4%
Atmospheric Condition	Normal	Rain	Other	None	Rain	Other
	90%	7%	3%	88%	9%	3%
Light Condition	Daylight	Dark	Other	Daylight	Dark	Other
	56%	26%	18%	75%	7%	17%

Note: distraction includes: emotional, inattentive, cell phone, fax machine, computer, on-board navigation system, 2-way radio, HUD

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106



## North Carolina Crash Data



The following crash data was drawn from the Huang & Stutts (2003) analysis of North Carolina data covering the period 1996-2000 <sup>27</sup>

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107

## Characteristics of Cell Phone-Related Crashes – Crash Severity



	Crash Severity		
	More Severe Injury	Possible Injury	No Injury
Cell Phone Crashes	9.0%	36.2%	54.8%
Non-Cell Phone Crashes	14.3%	27.3%	58.4%

North Carolina data, 1996-2000 (Source: Huang & Stutts, 2003)

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108

## Characteristics of Cell Phone-Related Crashes – Crash Types



	Crash Type		
	Rear-end	Run-off-road	Angle Impact
Cell Phone Crashes	45.1%	18.5%	18.3%
Non-Cell Phone Crashes	25.6%	20.5%	14.6%

North Carolina data, 1996-2000 (Source: Huang & Stults, 2003)

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109

## Characteristics of Cell Phone-Related Crashes – Vehicle Maneuver



	Most Frequent Vehicle Maneuver		
	Going-Straight	Slowing/Stopping	Left Turn
Cell Phone Crashes	76.1%	8.8%	5.3%
Non-Cell Phone Crashes	54.5%	20.1%	9.7%

North Carolina data, 1996-2000 (Source: Huang & Stults, 2003)

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110

## Characteristics of Cell Phone-Related Crashes – Prior Traffic Violations



- 92.5% of cell phone drivers in crashes had prior traffic violations
- 50.6% of non-cell phone drivers\* in crashes had prior traffic violations

\* "non-cell phone drivers" refers to drivers in crashes that did not involve cell phones.

North Carolina data, 1996-2000 (Source: Huang & Stutta, 2003)

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111

## Characteristics of Cell Phone-Related Crashes – Prior Traffic Violations



	Prior Traffic Violations			
	Safe movement & other	Failure to reduce speed	Traffic Signal	Following too close
Cell Phone Crashes	42.1%	23.5%	9.6%	3.5%
Non-Cell Phone Crashes	18.3%	12.5%	1.8%	1.3%

North Carolina data, 1996-2000 (Source: Huang & Stutta, 2003)

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112

## Possible Significance of Prior Violation History



Examination of violation data for cell phone involved crashes suggests that these drivers tend towards more aggressive driving behavior. It is not clear how such behavior relates to the willingness of drivers to use the phone, the conditions under which they use the phone or the degree to which their aggressive behaviors contributed to the cell phone related crashes. It is also unknown how many cell phone related crashes were characterized in terms of an aggressive driving behavior or vice-versa. Nevertheless, use of cell phones by aggressive drivers may heighten the crash risk.

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113

## Characteristics of Cell Phone-Related Crashes – Time of Day



For time of day, there are no differences between cell phone users and non-users

	Time of Day					
	10pm – 1:59am	2am – 5:59am	6am – 9:59am	10am – 1:59pm	2pm – 5:59pm	6pm – 9:59pm
Cell Phone & Non-Phone Users	7.8%	4.3%	16.8%	21.6%	32.0%	17.4%

North Carolina data, 1996-2000 (Source: Huang & Stults, 2003)

NTSA Internal Use Only, Working Document to Review (7/02)

114

## Characteristics of Cell Phone-Related Crashes – Roadway Classification



The North Carolina crash data revealed that over two-thirds (69.8%) of crashes involving cell phone users occurred on local streets, compared with slightly more than one-third (37.9%) of crashes involving non-users.

North Carolina data, 1996-2000 (Source: Huang & Stults, 2003)

NTSA Shared Use Only, Working Document to NHTSA (2003)

115

## Characteristics of Cell Phone-Related Crashes – Roadway Feature



	Roadway Feature		
	No Special Feature	Intersection	Other
Cell Phone Crashes	64.4%	29.3%	6.3%
Non-Cell Phone Crashes	55.7%	28.0%	16.3%

North Carolina data, 1996-2000 (Source: Huang & Stults, 2003)

NTSA Shared Use Only, Working Document to NHTSA (2003)

116

## Where Are These Crashes In The Crash Record?



Given the dramatic increase in cell phone use and the preponderance of observed cell phone related traffic events reported, it is often asked why we do not see a dramatic increase in the fatality rate if, in fact, cell phones represent a major crash problem. Noting that the fatality rate has remained relatively stable for a number of years, there are many safety relevant changes that have taken place in the vehicle/highway system during the same period of time. The consequence of these changes may tend to decrease or increase crash rates. Examples expected to improve safety would include improvements to roadways (e.g., rumble strips, traffic calming), air bag improvements (e.g., side airbags), brake improvements (ABS), vehicle stability improvements (ESC), and greater vehicle conspicuity and visibility (reflectors and lighting). On the other hand, increased vehicle speeds, availability of in-vehicle technology and the growing number of SUVs might be expected to decrease safety. Any change in cell phone related crashes might therefore be masked by other contributing factors.

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117

## Issues In Establishing Crash Involvement



- There is no post-crash test for distraction.
- Crashes may have multiple contributing factors that make it difficult to isolate the primary cause.
- Cell phone distracted drivers may cause crashes in which they themselves are not involved.
- There is often uncertainty about the role of cell phone use in crashes "caused" by other drivers.
- Data collection difficulties include:
  - Inconsistent and underreporting of contributing factors is problematic.
  - Drivers may be unwilling to admit to being distracted.
  - Phone records are not easily accessible.
  - Not all states require law enforcement officers to collect information specifically related to distraction in general, and cell phone use in particular, at time of crash.

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118

## Recent Special Studies: California



- Department of California Highway Patrol (CHP) recently completed a special study of crash data from April 1, 2001, to June 30, 2002. <sup>14</sup>
- Of the 13,637 inattention-related crashes, cell phone use accounted for 11% of inattention-related crashes, more than any other specific inattention factor ("Other" accounted for 66%).
  - The results also indicated that cell phones accounted for 11% of fatalities and total inattention crashes between April 1, 2001, and June 30, 2002.
  - While cell phone use accounted for 11% of total inattention crashes between January 1, 2002, and June 30, 2002, cell phones use while driving contributed to 20% of inattention-related fatalities during that period.
- This data revealed that a cell phone was known to be in use by at least 12,733 parties involved in crashes during the 18-month period.

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119

## Recent Special Studies: California



- The CHP concluded that driver distraction is the issue, not the particular device, and it suggested, given the crash data collected, that any action regarding cell phones should also address issues related to other distracting activities (e.g., car radio/CD player).
- Recommendations from the California Highway Patrol <sup>14</sup>
  - Continue collection and reporting of collision data related to driver distraction.
  - Consider whether to require use of the hands-free option when using a cellular telephone while driving.
  - Improve consumer education.
  - Add an "Inattentive Driving" section to the Vehicle Code.
  - Continue training law enforcement agencies statewide on the proper documentation of inattention factors, if the requirement for inattentive driver data collection is extended.

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120

## Recent Special Studies: California – Limitations of Study



- The CHP analysis does not include all crashes in which cell phones may have been in use and a contributing factor. The report noted that "officers statewide often failed to document on the [crash] report whether a cellular telephone was in use, present, or unknown."<sup>14</sup>
- It is also important to note the following about the Traffic Collision Coding form:
  - Information on whether driver inattention contributed to the crash is only collected under "Other Associated Factors" for the involved party cited for having caused the crash. Officers check the box "F" indicating "Inattention" and note the cause next to it (e.g., officer must write in "P-Cell Phone").
  - Information on Cell Phone Use by involved parties is specifically requested under the section entitled, "Special Information." Use or non-use is indicated for all parties involved. No distinction is made between condition in which no phone is present and condition in which the officer is unable to determine presence/use of phone.

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121

## Recent Special Studies: Virginia



- A statewide pilot study to test a standard list of distracted driving behaviors used in crash investigations was conducted to provide data for the Virginia State Legislature. The study was conducted for the Virginia Department of Motor Vehicles by Virginia Commonwealth University in 2002 to investigate driver distraction.<sup>16</sup> The study involved completion of a supplemental survey for each distraction crash; the surveys were submitted for review as a part of this study.
- The survey contained questions regarding the MAIN driver distraction and did not address other additional contributing factors.
- The results indicated that 13% of traffic crashes in Virginia are due to driver distraction, and 62% of distractions reported as factors in these crashes were inside the vehicle.
- Cell phones accounted for about 5% of the reported distractions associated with these distraction crashes.

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122



## Recent Special Studies: Virginia



- General recommendations from Virginia's Pilot Study of Distracted Drivers <sup>18</sup>
  - Collect information at the driver level rather than the crash level.
  - Reconsider and standardize the framework and terminology used to categorize distractions and driver inattention
  - Conduct focus groups and training for troopers and officers regarding collection of distraction and inattention-related crash information.

NTSA issued the Only, Working Document to Review (2009)

123

## Recent Special Studies: Virginia – Limitations of Study



- Only police-reportable crashes were included in the survey. 75% of data came from State Troopers, and only 24% of data came from city or county police departments. In addition while the survey was statewide, law enforcement agencies responded with varying levels of success.
- One main distraction was listed as cause of the crash. Phone use was only cited in the survey if identified as main cause of the crash, and information was not generally collected regarding whether phones were otherwise present or in use by involved parties (or if phone was an additional contributing factor).
- 63% of the reported crashes occurred in rural areas. The report notes that implementation problems may have contributed to the low number of urban crashes because the locations of the agencies reporting implementation difficulties were urban.
  - Recall that data from North Carolina show cell phone crashes to be mostly rear-end crashes and that more than two-thirds of cell phone crashes occur on local streets.<sup>27</sup>

NTSA issued the Only, Working Document to Review (2009)

124

## ***NHTSA Ongoing and Planned Research***



NHTSA has carried out research related to drivers' use of technology since 1991. Past efforts have focused on developing methodologies, tools and techniques for assessing driver workload and device demand within the context of safety. More recent efforts have focused on the application of these methods, tools and techniques to specific technologies, including cell phones. These cell phone studies have typically focused on issues associated with device architecture (e.g., hand-held vs. hands free). Three of these programs of research are briefly described in the material that follows.

NHTSA Internal Use Only, Working Document to Review (2002)125

## ***Small-Scale Naturalistic Driving Study***



NHTSA researchers at the Vehicle Research & Test Center (VRTC) in Ohio completed a small-scale naturalistic driving study comparing three phone architectures. Participants drove instrumented vehicles equipped with hand-held, hands-free and totally hands-free phones over the course of several weeks. Although preliminary analyses have not yielded driver performance differences between the phone architectures, the lessons learned from this effort were invaluable to the development of the larger scale naturalistic driving study currently underway. In addition, NHTSA is conducting a separate analysis on the conversation content to identify any associations between high demand conversations and driving performance.

NHTSA Internal Use Only, Working Document to Review (2002)126

## **Long-Term Naturalistic Driving Study**



This effort is currently underway and has deployed 100 instrumented vehicles in the Northern Virginia area to record driver behavior and performance over a period of one year. Data collected will detail driver distractions in general and the use of cell phones in particular. Of particular interest will be the role these distractions play prior to crashes. Because the instrumented vehicles record both performance and video data, the effects of distractions will be quantified in a more ecologically valid context than ever before. This study will also produce much needed objective data for cell phone use patterns that have thus far relied on surveys and observational studies.

NHTSA Internal Use Only, Working Document In Review (200)

127

## **National Motor Vehicle Crash Causation Survey**



NHTSA is planning a research effort that will enable us to determine the factors responsible for the most frequent causes of crashes on the Nation's roads. The last update of crash causation data was generated comprehensively in the 1970s. Vehicle design, traffic patterns, numbers and types of vehicles in use, on-board technologies and lifestyles have changed dramatically in the last 30 years. Old assumptions about the causes of crashes may no longer be valid. Updating the crash causation data will allow NHTSA to focus our efforts on the factors that are most frequently associated with crashes, and will provide additional insights into the relationship between distraction and crashes.

NHTSA Internal Use Only, Working Document In Review (200)

128

## **Driver Distraction Research on the National Advanced Driving Simulator (NADS)**



Three studies specific to cell phones are planned for NADS. A fourth study will focus on cognitive driver distraction covering cell phones and other in-vehicle technologies. The first study is currently underway.

**Study 1** - Examine effects of different interfaces (hands-free, hand-held, & command-based) on dialing, talking and answering phone in driving situations that vary in driving task demand.

**Study 2** - Examine whether dimensions of conversation affects distraction potential while driving.

**Study 3** - Assess drivers' willingness to make/receive calls under a variety of traffic conditions and situations.

**Study 4** - Develop assessment techniques for evaluating cognitive driver distraction.

NTSA's Second Use Only, Working Document in Review (2/00)

129

## **Sources of Information and Data on Cell Phone Use, Consequences of Use, and Association with Crashes**



- Anecdotal
- Survey and Focus Group Data
- Experimental Research
- Crash Data
- ♦ **Cost-Benefit and Risk Analyses**

NTSA's Second Use Only, Working Document in Review (2/00)

130

## **Using Crash Data to Assess the Magnitude, Costs, and Benefits of the Problem**



While the magnitude, costs, and benefits associated with cell phone use can theoretically be assessed in terms of relevant fatality, injury, property damage only and non-police reported crashes, it is becoming increasingly clear that obtaining a complete and accurate set of data to support this determination is not practical using traditional data sources and techniques. Nevertheless, available crash data is useful in characterizing the nature of the problem and documenting trends that take place over time.

Attempts at estimating problem magnitude, costs and benefits have been made using epidemiological studies and industry data that provide estimates of relative risk and exposure, respectively. In the material that follows, these efforts are reviewed and summarized, associated risk analyses are explored and, using the most recent information, estimates of problem magnitude are calculated.

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131

## **Cost-Benefit and Risk Analyses**



- **Includes:**
  - Efforts to understand the degree of increased risk that results from cell phone use while driving, and
  - Efforts to establish an empirical basis for determining the impact of regulating use of cell phones while driving in terms of costs and benefits.

NTSA Internal Use Only, Working Document to Review (WDR)

132

## Risk Comparisons



- **Harvard researchers (2000, 2003) describe two types of risk:** <sup>11, 32</sup>
  - The risk of fatality to the driver who chooses to use the cell phone ("voluntary risk") (primary focus of the present analysis)
  - The risk of fatality to other road users (e.g., occupants of other vehicles, pedestrians, bicyclists) that is associated with cell phone use. This "involuntary risk" accounts for:
    - Number of individuals using a cell phone while driving,
    - Annual probability of being in a collision while driving and using a cell phone, and
    - Average number of fatalities per collision to individuals not riding with cell phone user.
  - *Risk estimates omit risks incurred by passengers traveling with driver who uses cell phone because the nature of the risk to those passengers is unclear (i.e., is risk exposure voluntary or involuntary)*

NTSA Internal Use Only, Working Document to Review (7/03)

133

## Magnitude of the Problem As A Basis for Cost-Benefit Analysis



- Studies by the Harvard Center for Risk Analysis and the AEI-Brookings Joint Center for Regulatory Studies have attempted to weigh the many costs and benefits of cell phone use while driving, and to examine the relative risks associated with this behavior.
- Inherent in each of these analyses are fundamental issues involving the assumptions made and methodology used.
- It should be noted that estimates of fatalities based on each of these approaches are at the extremes (given a relative risk factor of 4.3, which will be discussed in more detail later).
 

• AEI-Brookings 1999:	78 fatalities per year (range 10-1000) <sup>20</sup>
• Harvard 2000:	900 fatalities per year (calculated)
• Harvard 2003:	2,800 fatalities per year
	( <i>estimates cited from various studies</i> )
- The disparity and changes in fatality estimates reflects the sensitivity of this issue to variances in the underlying assumptions, the data that is referenced, and the analytical techniques that are utilized. Note also that both Harvard estimates include fatalities associated with both voluntary and involuntary risks related to cell phone use while driving.<sup>11, 32</sup> The AEI-Brookings estimates "assume that all accidents and fatalities associated with cellular phone use are caused by cellular phones" (p. 12).<sup>21</sup>

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134

## **Cost-Benefit Analyses**



### **• 2000 AEI-Brookings <sup>22</sup>**

- Estimated that costs of a ban are likely to exceed benefits.
- Claim that estimates of accidents and fatality reductions do not take into account how drivers would alter their behavior in response to regulation, which has implications for net reductions in accidents and fatalities.
- Technology is moving toward voice activation, which they claim is likely to reduce risks.

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135

## **Cost-Benefit Analyses**



### **• 2000 Harvard Study <sup>32</sup>**

- "The weight of the scientific evidence to date suggests that use of a cellular phone while driving does create safety risks for the driver and his/her passengers as well as other road users."
  - However, they note that the magnitude of this risk is unknown
- Acknowledged that hands-free may not be the best solution because of evidence that conversation per se may be responsible for the risk.
- Note multiple public health and safety considerations as benefits to using cell phones while driving.

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136

## **Cost-Benefit Analyses**



- **2002 AEI-Brookings** <sup>23</sup>

- Disconnect between Policy and Data (synthesis report)
  - "The economics and science on this issue are fairly clear: a total ban does not seem to be justified on economic grounds and the effectiveness of hands-free devices in reducing phone-related crashes is unclear."
  - However, states and local jurisdictions continue to enact laws prohibiting hand-held phone use while driving.
- Unintended consequences of a ban should be considered (e.g., drivers may use paper maps while driving if a call for directions was to be banned).
- Any legislation should extend beyond cell phones as they are just one example of advanced technologies available to the driver.

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137

## **Cost-Benefit Analyses**



- **2002 Harvard Study** <sup>11</sup>

- Revised estimate of previous Harvard study (2000) <sup>32</sup>
  - Updated estimated number of cell phones users.
  - Revised the assumed amount of time spent on the phone while driving based on 2000 NOPUS results.
  - Increased assumed consumer surplus value of the calls made while driving from \$25 billion to \$43 billion annually.
- Best estimate of zero for the net benefit of cell phone use while driving.

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138



## ***Analysis of the Crash Risks and Societal Costs***



The following slides contain information related to studies attempting to establish the relationship between cell phone use while driving and the associated increase in crash risk.

The analysis is based on existing studies and the assumptions made therein.

The goal of this effort is to illustrate the range of crash risks that have been associated with this issue and the potential implications of those risks. It must be recognized, however, that the results of this analysis do not provide definitive answers and are based on a very incomplete and sometimes undefined dataset.

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139

## ***Defining Exposure Time ( $\Delta T$ )***



### **Exposure Time ( $\Delta T$ )**

Percentage of driving time spent using a cell phone (time on phone while driving divided by driving time), or approximate percentage of driving population on cell phone at any given daylight moment. The higher the exposure time, the greater the overall risk.

Note that neither definition accounts for the frequency or duration of calls during a single trip or over a daily number of trips. There is evidence suggesting that both frequency and duration of calls influence crash risk. These factors may also interact with other factors, such as traffic density, to influence actual risk.

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140

## Other Relevant Risk Definitions



### Relative Risk (RR)

- Defined as the amount of increase in crash risk (i.e., an *incremental* crash risk) for cell phone users in comparison to non-cell phone users, specifically the ratio of the risk of a crash for cell phone users compared to the risk of a crash for non-cell phone users.
  - If  $RR > 1$ , then the risk of a crash for cell phone users is greater than risk of a crash for non-cell phone users.
  - If  $RR = 1$ , then the risk of a crash is the same for cell phone users and non-users.
  - If  $RR < 1$ , then the risk of a crash is less for cell phone users than for non-users.

### Odds Ratio (OR)

- Defined as the amount of increase in crash risk for cell phone users in comparison to non-cell phone users, specifically the ratio of the odds of a crash for cell phone users compared with the odds of a crash for non-cell phone users.
  - If  $OR > 1$ , then the odds of a crash for cell phone users is greater than the odds of a crash for non-cell phone users.
  - If  $OR = 1$ , then the odds of a crash is the same for cell phone users and non-users.
  - If  $OR < 1$ , then the odds of a crash is less for cell phone users than for non-users.

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141

## Defining a Model of Total Risk



$$\text{Total Risk} = (1 - \Delta T) * R_0 + \Delta T * RR$$

Where  $R_0$  = general crash risk ( $R_0=1$ ),  $\Delta T$  = Exposure Time, and  $RR$  = relative risk.

Total Risk is a measure of the risk for all crashes, and includes users and non-users of cell phones. Total Risk is defined here as a function of the amount of exposure time (phone time/drive time) and of the relative risk of a crash event.

The increase over a risk value of 1 represents how much the total risk increases when the driver uses a cell phone while driving. For example, a calculated total risk of 1.05 represents a 5% risk increase over normal conditions. Thus Total Risk is the risk of a crash for drivers not using cell phones plus the additional risk of a crash for drivers using cell phones.

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142

## Example Using the Model of Total Risk



- Given the following model:  

$$\text{Total Risk} = (1 - \Delta T) \cdot R_0 + \Delta T \cdot RR$$
- Example:
  - Assume that, on average, drivers are using phone 6% of driving time (i.e.,  $\Delta T = .06$ )
  - Suppose that the relative risk of a crash while driving and using a cell phone is 1.2 (i.e.,  $RR = 1.2$ , where the incremental risk is thus 20%)
  - Total Risk =  $(1 - .06) \cdot 1 + (.06 \cdot 1.2)$   

$$0.94 + 0.072 = 1.012$$
  - Thus the Total Risk is increased by approximately 1.2%

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143

## Plotting General Estimates of Total Risk



The following slides provide an explanation and a graphical representation of general estimates of total risk for all drivers based on exposure time and relative risk values. The exposure time is determined from estimated "one-way" driving trips for all drivers<sup>44</sup>, one-way trips in which the driver used a cell phone<sup>44</sup>, time-on-phone per call while driving<sup>43,44</sup>, and average trip time<sup>74</sup>. The total risk is calculated using the model described in the previous slides.

It is important to note that these figures do not account for call frequency, which has been found to influence the magnitude of the increase in crash risk.

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144

## Assumptions Used to Estimate Total Risk: Estimating Exposure Time - Background



Estimates of Exposure Time ( $\Delta T$ ) are based on:

Estimated total number of one-way driving trips in a typical week for all drivers in 2002<sup>22</sup>: 4,200,000,000 trips/week

Average vehicle trip duration according to 2001 National Household Travel Survey <sup>23</sup>: ~20 min/trip

Minimum estimated number of calls made or received while driving based on estimated number of one-way trips involving such calls (translate trips involving phone use to number of calls while driving)

- Estimated number of one-way driving trips in a typical week in 2002 in which a driver receives at least one wireless phone call (this is included within the total 4,200,000,000 trips per week)<sup>24</sup>: 792,000,000 trips/week
- Estimate number of one-way driving trips in a typical week in 2002 in which a driver makes at least one wireless phone call (this is included within the total 4,200,000,000 trips per week)<sup>25</sup>: 778,088,008 trips/week
- If we assume 1 call per trip of the specified call type (incoming or outgoing; there is overlap in number of trips for each type of call so we translate into number of calls rather than trips), then combined number of trips equals minimum number of calls. So, Minimum Estimated Number of Calls Made or Received While Driving = 792,000,000 + 778,088,008 = 1,568,000,000 calls/week

Estimates of exposure will be shown for the following range of call lengths:

- 1 min/call (minimum included for comparison)
- 2.73 min/call (average CTIA local call length, 2002)<sup>26</sup>
- 4.5 min/call (average self-reported call length while driving, 2002 National Survey of Distracted and Drowsy Driving Attitudes and Behaviors)<sup>27</sup>
- 8 min/call (hypothetical call length included for comparison and indicative of increasing exposure given dramatic growth in cell phone use as noted earlier)

Estimates of Total Risk (and the corresponding risk increases) will be shown for relative crash risks (RR) from 1.0 to 4.5

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145

## Assumptions Used to Estimate Total Risk: Estimating Exposure Time - Example



**Example - Estimating Total Exposure Time in 2002:**

Given the average call length while driving is 4.5 minutes per call for drivers who use cell phones <sup>24</sup> (average time per call for drivers who use cell phones, not average call time across all drivers)

From previous slide:

Estimated total number of one-way driving trips in a typical week for all drivers: 4,200,000,000 driving trips in a typical week

Average vehicle trip duration, all drivers: 20 min/trip

Minimum Estimated number of calls made or received while driving based on estimated number of one-way trips involving such calls: 1,568,000,000 calls made or received while driving in a typical week

Estimated total driving time for all drivers in a typical week (convert trips to time in minutes)

= Number of driving trips in a typical week \* average number of minutes per driving trip  
= 4,200,000,000 trips \* 20 min/trip = 84,000,000,000 min total driving time in a typical week

Estimated time using phone while driving in a typical week (convert phone calls while driving to time in minutes)

= Number of calls made or received while driving in a typical week \* average call length while driving  
= 1,568,000,000 calls \* 4.5 min/call = 7,056,000,000 min total phone use while driving in a typical week

**Total Exposure Time ( $\Delta T$ )**

= Estimated time using phone while driving in a typical week in 2002 (based on drivers who use phones while driving) divided by Estimated total driving time in a typical week in 2002 (based on all drivers)

= 7,056,000,000 min total phone use while driving / 84,000,000,000 min total driving time  
= 8.4% Estimated Total Exposure Time when average call length is 4.5 minutes per call

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146

## Estimates of Risk as a Function of Exposure Time and Relative Risk of Crash



Percentage Increase in Total Risk of Crash

Average Call Length (min)	Exposure Time, $\Delta T$	RR=1.5	RR=2.0	RR=3.0	RR=4.3
1.0 min	1.9%	1.0%	1.9%	3.8%	6.3%
2.74 min	5.1%	2.6%	5.1%	10.2%	16.8%
4.5 min	8.4%	4.2%	8.4%	16.8%	27.7%
8.0 min	14.9%	7.5%	14.9%	29.8%	49.2%

Example - 2002 (cont'd):

If the exposure time ( $\Delta T$ ) is 8.4% given an average call time while driving of 4.5 min and given the estimated trip and call information as detailed on the previous slides, then the resulting Total Risk (TR) of a crash for all drivers is increased by 1.7% if RR=1.2 (TR=1.017), by 3.2% if RR=1.38 (TR=1.032), by 4.2% if RR=1.5 (TR=1.042), and so on. As indicated by the data shown in the table above, the Total Risk of a crash increases with both exposure time and the relative risk of a crash.

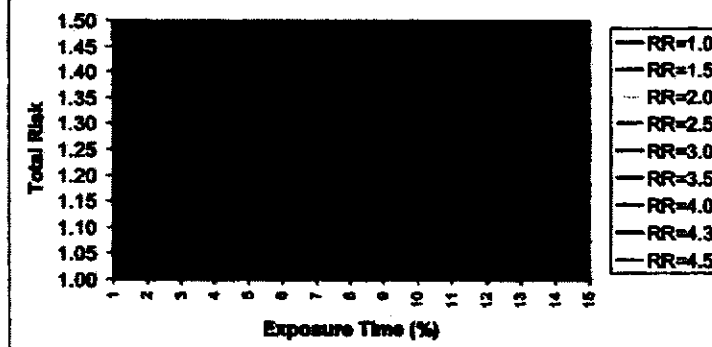
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147

## General Estimates of Total Risk



Total Risk as a Function of Exposure Time  
(Total Phone Use Time While Driving / Total Driving Time)  
and Relative Risk, Relative Risk = 1.0 to 4.5



Total Risk of a crash increases with both exposure time and the relative risk of a crash.

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148

## Attempts to Assess the Relative Risk and Societal Costs of Cell Phone Use While Driving



Several recent studies, including those already mentioned, have examined the relative risks associated with cell phone use while driving. Some studies have focused on determining societal costs assuming a given relative risk. The results of these studies have been employed in the analyses that follow to explore potential societal costs associated with cell phone use while driving. Some of the underlying assumptions made by the researchers, as well as some additional assumptions for the purpose of this analysis, are presented on the following slide.

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149

## Summary of the Bases for Determination of Relative Crash Risks in Relevant Studies



- **AEI-Brookings 1999**
  - Given a sample population of cell phone users who were involved in traffic collisions, risk of a collision when using a cellular phone was four times higher for the user than risk when the same user was not using a cell phone (RR=4.3, i.e., incremental risk is 330%). Does not account for risk of injury or fatal crashes.
- **Harvard 2000**
  - Same as above (RR=4.3)
- **Harvard 2003**
  - Same as above (RR=4.3)
- **Violanti and Marshall 1996**
  - Talking more than 50 minutes per month on cellular phones in a vehicle was associated with 5.58-fold increased risk of a traffic crash. Study compared random sample of drivers involved in recent crashes versus random sample of drivers not involved in crashes; included some crashes not reported to authorities.
- **Laberge-Nadeau et al, 2001**
  - Relative risk of all crashes and of crashes with injuries is 1.38 (i.e., incremental risk is 38%) for users of cell phones when compared to non-users.
- **Sagberg 2001**
  - Relative risk of a driver being involved as a responsible party in a crash while using a mobile phone is two times greater than when driving without using the phone.
- **ICBC 2002**
  - Relative risk of crash involvement is 1.18 for drivers observed using handheld phones compared to drivers observed not using handheld phone.

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150

## Assumptions Based on Relevant Studies of Crash Risks Cell Phone Use While Driving



- **AEI-Brookings 1998**
    - $8.4 \times 10^{12}$  min annual driving time, all drivers;  $5.9 \times 10^{10}$  min annual time on phone while driving; 0.7% of driving time on phone; 1200 min talk in car / yr per user; 60 million driver/users
    - RR=4.3
  - **Harvard 2000**
    - $4 \times 10^{12}$  min annual driving time, all drivers;  $1.9 \times 10^{10}$  min annual time on phone while driving
    - 318 minutes of talk in car / yr per user (or ~26 min talk in car / month per user); 60 million driver/users\*
    - RR=4.3
  - **Harvard 2003**
    - $4 \times 10^{12}$  min annual driving time, all drivers;  $3.8 \times 10^{10}$  –  $1.5 \times 10^{11}$  min annual time on phone while driving (use central estimate of  $7.7 \times 10^{10}$  min)
    - 300 to 1200 min talk in car / yr per user (use central estimate of 600 min); 125 million driver/users
    - RR=4.3
  - **Violanti and Marshall 1996**

(Note: Estimated values derived for 1992-1993 timeframe used in study)

    - $3.2 \times 10^{12}$  min annual driving time, all drivers\*;  $4.8 \times 10^{10}$  min annual time on phone while driving\*; 50 min talk in car per month per user\*
    - 6 million driver/users\*
    - Odds Ratio = 5.69

(Note: Authors associated 50 minutes of talk in car per month with odds ratio of 5.69)
  - **Laberge-Nadeau et al, 2001**
    - RR = 1.36 overall
  - **Sagberg 2001**
    - RR=2.2, risk of a driver being involved as a responsible party in an accident while using a mobile phone as compared to driving without using the phone.
  - **ICBC 2002**
    - RR = 1.16
- \* Assumption made for present comparison

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151

## Estimating the Risks Using the Preceding Studies: What Data is Presented



- The following table and graph present a summary of estimated total risk as a function of exposure time and relative risk.
- The table and graph contain data points for studies from the United States, Canada and Norway, as well as for exposure rates obtained from NHTSA's 2000 and 2002 NOPUS efforts.
- NOPUS estimates yield higher exposure times than other studies.
- Most of the studies are based on a relative risk factor of 4.3, as calculated by Redelmeier & Tibshirani (1997). This is risk of crash when using phone compared to when not using phone, for same set of drivers. Note again that the most recently reported analysis by the University of Montreal (2003),<sup>62</sup> which examined the methodology employed by Redelmeier & Tibshirani, suggests that the reported relative risk of 4.3 is 2 to 3 times larger than the actual relative risk value.
- Thus, it is likely that the actual relative risk values are lower than those predicted by these studies.

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152

## Graph Summary: Increase in Crash Risk Based on Some Recent Studies



	Increase in Total Crash Risk	Exposure Time, $\Delta T$	RR	Estimated Fatalities/yr as Reported by Author
Violanti & Marshall 1996	0.9%	0.2%*	5.6 <sup>2</sup>	No Estimate Given
AEI-Brookings 1999	2.3%	0.7%	4.3	78 (range 16-1000)
Harvard 2000	1.7%	0.5%*	4.3	1200
Laberge-Nadeau, et al 2001	(Range 0.4-3.8%) <sup>3</sup>	(Range 1-10%) <sup>4</sup>	1.38	No Estimate Given
Sagberg 2001	(Range 1.3-12%) <sup>3</sup>	(Range 1-10%) <sup>4</sup>	2.2	No Estimate Given
Harvard 2003	6.3% <sup>1</sup> (Range 2.5-12.7%)	1.9% <sup>1</sup> (Range 0.75-3.94%)	4.3	2000
ICBC 2002	(Range 0.2-1.8%) <sup>3</sup>	(Range 1-10%) <sup>4</sup>	1.16	No Estimate Given

\*Derived for the present analysis using assumptions as shown earlier.

<sup>1</sup>Based on central estimate of time on phone while driving.

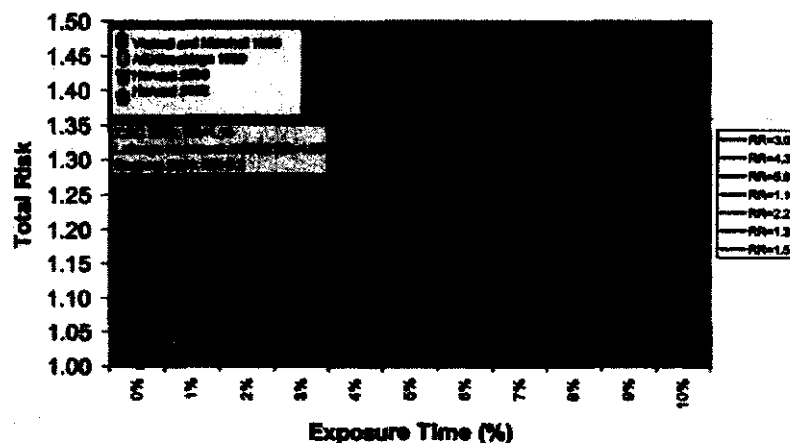
<sup>2</sup>Odds Ratio used here as approximation of relative risk.

<sup>3</sup>Derived from plot.

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153

Summary of Estimated Total Risk as Function of Exposure Time and  
Relative Risk Based on Results from Recent Studies



The concern is that as exposure time ( $\Delta T$ ), device functionality and complexity increase, the slope of the line corresponding to the actual relative risk (and corresponding incremental risk) will increase accordingly, leading to greater total risk.

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154



## **Summary of Findings: Increased Crash Risk Based on Recent Studies**



The range of results illustrated in the preceding graph and table reflects their reliance on a limited set of assumptions and associated "soft" values. It would appear that the capability for characterizing and determining, with confidence, the magnitude of any increase in either total crash risk or relative risk associated with using a cell phone while driving continues to be elusive.

Furthermore, estimates of the crashes, injuries and fatalities associated with cell phone use while driving appear to be even more difficult to determine.

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155

## **Best Estimate of Crashes as a Function of Relative Risk**



In an effort to use available information to estimate crashes across a range of relative risks, an analysis was carried out using the recent NOPUS <sup>17</sup> results as a basis for establishing exposure.

The approach outlined represents one method for approximating the number of property damage only (PDO), injury, and fatal crashes associated with cell phone use given a base set of relative risks as well as those associated with known studies.

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156

# **Framework for Calculating An Estimate of Expected Crashes in 2002 in Which Cell Phone Use Was Contributing Factor**



## **Assumptions:**

1. From NIPUS 2002, 6% of drivers are using a cell phone at any daytime moment (this is exposure time,  $\Delta T = .06$ ).
2. This leaves 94% (or  $1 - \Delta T = .94$ ) of drivers not using a cell phone at any given daytime moment.
3. NHTSA estimates 6,279,356 police reported crashes in 2002.
4. If the risk of a crash is equal for cell phone users and non users, Total Risk = 1.0

## **Example:**

For condition in which Relative Risk (RR) = 1.2 (i.e., incremental risk = 20%)  
 Total Risk (TR) =  $0.94 + 0.06 \cdot RR = 0.94 + 0.06 \cdot 1.2 \Rightarrow TR = 1.012$

Estimated Police Reported Crashes in 2002 if no one was on cell phone:

Crashes = Total Crashes  $\cdot R_0 / TR$ ,  
 so  $6,279,356 \cdot 1.000 / 1.012 = 6,204,897$  crashes in 2002 (no cell phone involved)

Estimated Number of Police Reported Cell Phone Crashes if Relative Risk = 1.2:

$6,279,356$  total crashes -  $6,204,897$  crashes if no driver was using a cell phone  
 =  $74,459$  police-reported crashes where cell phone use was contributing factor

The table and graph that follows provide estimates of crashes across a range of relative risks.

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157

# **2002 Estimates of Police-Reported Crashes Cell Phone Use Was Contributing Factor: 6% Exposure Time ( $\Delta T = .06$ )**



Relative Risk (RR)	Total Risk (TR), $TR = 0.94 + RR \cdot 0.06$	Estimate of Police-Reported 2002 Crashes in which Cell Phone Use <u>Was Not</u> a Contributing Factor to the Crash	Estimates of Police-Reported Crashes in 2002 in which Cell Phone Use <u>Was</u> a Contributing Factor to the Crash
1.00	1.000	6,279,356	0
1.20	1.012	6,204,897	74,459
1.38*	1.023	6,139,378	139,978
1.50	1.030	6,096,462	182,894
2.20**	1.072	5,857,608	421,748
4.30***	1.198	5,241,533	1,037,823

\*Laberge-Nadeau et al 2001; <sup>30</sup> \*\*Sagberg, 2002; <sup>45</sup>

\*\*\*Harvard, 2000, <sup>32</sup> 2003; <sup>11</sup> AEI-Brookings, 1999 <sup>21</sup>

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158

## NHTSA Data Underlying Estimates of Crashes Where Cell Phone Use Was Contributing Factor



Description	2000	2001*	2002
Persons Killed	41,821	42,118	42,856
Persons Injured	3,188,000	3,033,000	2,914,000
Total Crashes (Fatal + Nonfatal)	6,306,400	6,322,795	6,279,358
Fatal Crashes	37,469	37,795	38,356
Nonfatal Crashes	6,306,000	6,285,000	6,241,000
Injury Crashes	2,970,000	2,884,000	2,834,000
PDO Crashes	4,288,000	4,282,000	4,287,000
Portion of Total Crashes that are Fatal	0.6%	0.6%	0.6%
Ratio of Nonfatal Crashes to Fatal Crashes	170	168	163
Ratio of Injury Crashes to Fatal Crashes	85	83	80
Ratio of PDO Crashes to Fatal Crashes	115	113	112
Ratio of Persons Killed to Fatal Crashes	1.12	1.11	1.12

\*Shown for comparison purpose only.

Note: Unreported PDO crashes account for an estimated 48% of all PDO crashes.  
Unreported injury crashes account for an estimated 21.42% of all injury crashes. \*

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159

## Calculating Estimates of Crashes in 2002 Where Cell Phone Use Was Contributing Factors



### Example:

For condition with 6% exposure time ( $\Delta T = .06$ ), RR = 1.2 and resulting Total Risk = 1.012

Estimated Total Police-reported crashes in 2002 where no one on cell phone = 6,204,897

Estimated Total Police-reported crashes where cell phone use was contributing factor

= 6,279,358 - 6,204,897 = 74,460 total police-reported crashes

Estimated Number of Fatal Crashes where cell phone use contributed (About 0.6% of Total Police-Reported Crashes)

Fatal Crashes = Total police-reported crashes \* 0.006 = 465 total crashes

Estimated Number of Injury Crashes where cell phone use contributed (Assume - 50 Injury crashes : 1 Fatal crash)

Police Reported Injury Crashes = Fatal Crashes \* 50 = 22,933 (This is the 78.68% of injury crashes that are police-reported)

Non-reported Injury Crashes = 22,933 \* 0.21420.7868 = 6,251 (This is the 21.42% of injury crashes that are not reported to/by police)

Total Injury Crashes = 22,933 + 6,251 = 29,184 injury crashes

Estimated Number of PDO crashes where cell phone use contributed (Assume - 112 PDO : 1 Fatal crash)

Police-Reported PDO Crashes = Fatal Crashes \* 112 = 51,071 (This is the 52% of PDO crashes that are police-reported)

Non-reported PDO crashes = 51,071 \* 0.480.52 = 47,143 (This is the 48% of the PDO Crashes that are not reported to/by police)

Total PDO Crashes = 51,071 + 47,143 = 98,214 PDO crashes

Total Number of Crashes = Fatal crashes + Total Injury crashes + Total PDO crashes

= 465 + 29,184 + 98,214

= 127,863 total crashes where cell phone use was contributing factor

Note that calculations assume distribution of crash severity (fatal, injury, PDO) is same for total police reported crashes and for crashes in which cell phone use was a contributing factor to the crash. Equivalence in relative risk is assumed across all levels of crash severity (fatal, injury, PDO), and for daytime and nighttime.

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160

## NHTSA 2000 Crash Estimates Given 4% Exposure Time ( $\Delta T=0.04$ )



Year 2000	RR=1.0	RR=1.2	RR=1.38	RR=1.5
Total Risk	1.0000	1.0078	1.0148	1.0195
Estimated Total Police Reported Crashes in which Cell Phone Use <u>Was Not</u> a Contributing Factor to the Crash	6,308,409	6,343,928	6,300,042	6,271,122
Estimated Police Reported Crashes in which Cell Phone Use <u>Was</u> a Contributing Factor to the Crash	0	48,483	93,367	122,287
Estimated Total Crashes (*CP) (Reported plus Non-reported)	0	84,470	186,383	208,752
Estimated PDO Crashes (*CP) (Reported plus Non-reported)	0	63,792	120,367	157,851
Estimated Injury Crashes (*CP) (Reported plus Non-reported)	0	20,388	38,470	50,388
Estimated Fatal Crashes (*CP)	0	290	548	716
Estimated Fatalities (*CP)	0	324	811	888

\*CP = Cell Phone Was a Contributing Factor to the Crash

Note that calculations assume distribution of crash severity (fatal, injury, PDO) is same for total police reported crashes and for crashes in which cell phone use was a contributing factor to the crash; and equivalence in relative risk is assumed across for daytime and nighttime.

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161

## NHTSA 2002 Crash Estimates Given 6% Exposure Time ( $\Delta T=0.06$ ) ~50% increase from Year 2000 estimates



Year 2002	RR=1.0	RR=1.2	RR=1.38	RR=1.5
Total Risk	1.0000	1.0120	1.0228	1.0300
Estimated Total Police Reported Crashes in which Cell Phone Use <u>Was Not</u> a Contributing Factor to the Crash	6,279,359	6,204,897	6,136,378	6,086,462
Estimated Police Reported Crashes in which Cell Phone Use <u>Was</u> a Contributing Factor to the Crash	0	74,459	139,978	182,894
Estimated Total Crashes (*CP) (Reported plus Non-reported)	0	127,853	240,355	314,046
Estimated PDO Crashes (*CP) (Reported plus Non-reported)	0	98,214	184,838	241,243
Estimated Injury Crashes (*CP) (Reported plus Non-reported)	0	29,184	54,864	71,885
Estimated Fatal Crashes (*CP)	0	455	855	1,117
Estimated Fatalities (*CP)	0	508	955	1,248

\*CP = Cell Phone Was a Contributing Factor to the Crash

Note that calculations assume distribution of crash severity (fatal, injury, PDO) is same for total police reported crashes and for crashes in which cell phone use was a contributing factor to the crash; and equivalence in relative risk is assumed across for daytime and nighttime.

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162

## **Apportioning the National Fatality Estimate by State: Introduction**



Given the wide diversity in the distribution and use of cell phones nationally, and the differences in population statistics, roadway systems and a number of other state specific factors, it is reasonable to expect a wide range of differences in fatalities associated with cell phone crashes in each state. Using available information along with the preceding analyses, the material that follows uses three approaches for estimating the distribution of state fatalities for crashes in which cell phones were a contributing factor. Since relevant state data is not complete for the year 2002, estimates for this year are based on an assumed 50 percent increase in total fatalities (as reflected in the previous analysis) over the 2000 estimate in conjunction with the more complete set of 2000 state data. Each set of calculations is preceded by a detailed example presenting the methodology. Multiple approaches were used to establish a sense of confidence that the estimated distributions appropriately reflect state cell phone related fatal crashes as represented by the ranges across the different approaches for each state.

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163

## **Methodology for Calculating State Estimates of Expected Fatalities in Which Cell Phone Use Was Contributing Factor (1)**



### **Methodology #1**

This method employs the same framework for Total Risk and Estimated Crashes described previously to calculate national estimates of traffic fatalities in which cell phone use was a contributing factor (recall that this framework accounts for the influence the relative risk of a crash when using a cellular phone on the total risk of a crash). In estimating state fatalities this framework was applied to the overall traffic fatality estimate reported for each State in NHTSA's *Traffic Safety Facts 2000*. Estimated fatalities were then calculated for 2002.

This methodology, on which the earlier national crash estimates are based, takes the following information into account in estimating fatalities for each state in which cell phone use was a contributing factor:

- Number of estimated traffic fatalities within each state in 2000 (based on NHTSA Traffic Safety Facts 2000).
- A range of relative risks factors and the associated total risk values.

A sample calculation is provided.

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164

## Methodology for Calculating State Estimates of Expected Fatalities In Which Cell Phone Use Was Contributing Factor (1)



### Assumptions and NHTSA data:

1. From NHTSA 2000, 4% of drivers are using a cell phone at any daytime moment ( $\Delta T = .04$ ). Assume this is true for all States.
2. This leaves 96% (or  $1 - \Delta T = .96$ ) of drivers not using a cell phone at any given daytime moment.
3. If the risk of a crash is equal for cell phone users and non users, Total Risk = 1.0
4. The calculation of 2002 fatality estimates that follows is based on a 50% increase assumed from the earlier calculation of national fatalities.

### Example - California:

NHTSA estimates 3,753 traffic fatalities in California in 2000.

For condition in which Relative Risk (RR) = 1.2 (i.e., incremental risk = 20%)

Total Risk (TR) =  $0.96 + 0.04 \cdot RR = 0.96 + 0.04 \cdot 1.2 \Rightarrow TR = 1.008$

Estimated California Traffic Fatalities in 2000 if no one was on cell phone:

Fatalities = Total Fatalities  $\cdot R_0 / TR$

so  $3,753 \cdot 1.000 / 1.008 = 3,723$  CA fatalities in 2000 (no cell phone involved)

Estimated Number of California Fatalities in 2000 if Relative Risk = 1.2:

$3,753$  total fatalities -  $3,723$  fatalities if no driver was using a cell phone

=  $30$  fatalities in California where cell phone use was contributing factor in 2000

Estimated Number of California Fatalities in 2002 if Relative Risk = 1.2:

$2002$  fatalities =  $2000$  Fatalities  $\cdot 150\%$

so  $30 \cdot 150\% = 45$  fatalities in California when cell phone was contributing factor in 2002

The table that follows provides estimates of fatalities for each State across a range of relative risks using the methodology outlined above.

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165

## NHTSA 2000 & 2002 State Estimates of MV Fatalities (1a) Cell Phone Use was Contributing Factor



State	2000	2001	2002	2003	2004	2005
United States	26,000	26,000	26,000	26,000	26,000	26,000
Alabama	8	16	20	12	22	29
Alaska	1	2	2	1	2	3
Arizona	8	16	20	12	22	30
Arkansas	5	10	13	8	16	19
California	3,753	3,753	3,753	4,504	4,504	4,504
Colorado	8	16	13	8	16	20
Connecticut	3	6	7	4	8	10
Delaware	1	2	2	1	2	3
District of Columbia	0	1	1	1	1	1
Florida	24	48	50	28	56	66
Georgia	12	24	30	18	36	45
Hawaii	1	2	3	2	3	4
Idaho	2	4	5	3	6	8
Illinois	11	22	28	17	34	42
Indiana	7	14	17	10	20	26
Iowa	4	8	10	6	12	15
Kansas	4	8	10	6	12	15
Kentucky	7	14	18	10	20	24
Louisiana	7	14	18	11	22	28
Maine	1	2	3	2	4	5
Maryland	5	10	12	7	14	17
Massachusetts	3	6	8	5	10	13
Michigan	11	22	27	16	32	41
Minnesota	9	18	22	13	26	33
Mississippi	8	16	20	12	24	30

Note: The calculation of 2002 fatality estimates is based on a 50% increase assumed from the earlier calculation of national fatalities.

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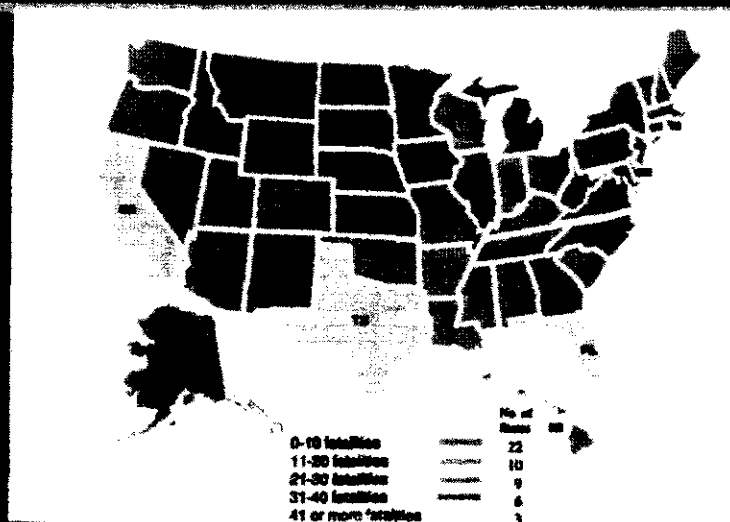
166

# NHTSA 2000 & 2002 State Estimates of MV Fatalities Cell Phone Use was Contributing Factor



State	2000 Total	2000 Cell Phone Factor	2002 Total	2002 Cell Phone Factor	2000 Total	2000 Cell Phone Factor	2002 Total	2002 Cell Phone Factor
Alabama	17	4	17	4	17	4	17	4
Alaska	4	1	4	1	4	1	4	1
Arizona	4	1	4	1	4	1	4	1
Arkansas	4	1	4	1	4	1	4	1
California	11	2	11	2	11	2	11	2
Colorado	6	1	6	1	6	1	6	1
Connecticut	11	2	11	2	11	2	11	2
Delaware	6	1	6	1	6	1	6	1
District of Columbia	26	5	26	5	26	5	26	5
Florida	26	5	26	5	26	5	26	5
Georgia	1	1	1	1	1	1	1	1
Hawaii	26	5	26	5	26	5	26	5
Idaho	11	2	11	2	11	2	11	2
Illinois	26	5	26	5	26	5	26	5
Indiana	11	2	11	2	11	2	11	2
Iowa	6	1	6	1	6	1	6	1
Kansas	4	1	4	1	4	1	4	1
Kentucky	11	2	11	2	11	2	11	2
Louisiana	6	1	6	1	6	1	6	1
Maine	11	2	11	2	11	2	11	2
Maryland	26	5	26	5	26	5	26	5
Massachusetts	11	2	11	2	11	2	11	2
Michigan	26	5	26	5	26	5	26	5
Minnesota	11	2	11	2	11	2	11	2
Mississippi	6	1	6	1	6	1	6	1
Missouri	11	2	11	2	11	2	11	2
Montana	6	1	6	1	6	1	6	1
Nebraska	11	2	11	2	11	2	11	2
Nevada	6	1	6	1	6	1	6	1
New Hampshire	11	2	11	2	11	2	11	2
New Jersey	26	5	26	5	26	5	26	5
New Mexico	11	2	11	2	11	2	11	2
New York	26	5	26	5	26	5	26	5
North Carolina	26	5	26	5	26	5	26	5
North Dakota	11	2	11	2	11	2	11	2
Ohio	26	5	26	5	26	5	26	5
Oklahoma	11	2	11	2	11	2	11	2
Oregon	6	1	6	1	6	1	6	1
Pennsylvania	26	5	26	5	26	5	26	5
Rhode Island	11	2	11	2	11	2	11	2
South Carolina	6	1	6	1	6	1	6	1
South Dakota	11	2	11	2	11	2	11	2
Tennessee	26	5	26	5	26	5	26	5
Texas	26	5	26	5	26	5	26	5
Utah	11	2	11	2	11	2	11	2
Vermont	6	1	6	1	6	1	6	1
Virginia	26	5	26	5	26	5	26	5
Washington	11	2	11	2	11	2	11	2
West Virginia	6	1	6	1	6	1	6	1
Wisconsin	11	2	11	2	11	2	11	2
Wyoming	6	1	6	1	6	1	6	1
Total	111	22	111	22	111	22	111	22

## Distribution of Estimated Fatalities in which Cell Phone Use was Contributing Factor By State for 2002, RP-133



## Methodology for Calculating State Estimates of Expected Fatalities In Which Cell Phone Use Was Contributing Factor (2)



### Methodology #2

This method apportions the national fatality estimate among the States based on the number of licensed drivers, within each state, who reported using the phone while driving, at least some times, based on year 2000 survey data <sup>8</sup>, and the vehicle miles traveled by those drivers as reported for each state in NHTSA's *Traffic Safety Facts 2000* <sup>97</sup>. These state data were compared against the respective national totals to determine how the national estimate of fatalities in which cell phone use was a contributing factor was to be apportioned between the States in 2000. Estimated fatalities were then calculated for 2002.

This methodology takes the following information into account in estimating fatalities for each state in which cell phone use was a contributing factor:

- Number of licensed drivers who report talking on car or cellular phone on at least some trips, nationally and within each state (based on 2000 MVOSS <sup>9</sup>).
- Vehicle miles traveled by those drivers, nationally and within each state (based on NHTSA *Traffic Safety Facts 2000* <sup>97</sup>).
- Estimated fatalities in which cell phone use is a contributing factor, national estimate to be apportioned between the states. These national estimates, for the range of relative risks, were calculated in the earlier analysis.

A sample calculation is provided.

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169

## Methodology for Calculating State Estimates of Expected Fatalities In Which Cell Phone Use Was Contributing Factor (2)



### Assumptions and NHTSA data:

1. From NOPUS 2000, 4% of drivers are using a cell phone at any daytime moment ( $\Delta T = .04$ ). Assume this is true for all States.
2. This leaves 96% (or  $1 - \Delta T = .96$ ) of drivers not using a cell phone at any given daytime moment.
3. If the risk of a crash is equal for cell phone users and non users, Total Risk = 1.0
4. The calculation of 2002 fatality estimates that follows is based on a 50% increase assumed from the earlier calculation of national fatalities.

Example - California (CA) [Data sources: NHTSA *Traffic Safety Facts 2000*, 2000 MVOSS]:

1. Calculate Number of Licensed CA Drivers in 2000 who report Having a Car or Cellular Phone in Vehicle, based on MVOSS 2000 data: 54% of persons age 16 or over

Licensed CA Drivers w/ Phone in vehicle =  $54\% \times \text{Total Licensed CA drivers}$   
 $= 54\% \times 21,244,000$   
 $= 11,471,760$  Licensed CA Drivers w/ Phone in Vehicle in 2000

Similarly, 102,837,500 Licensed US Drivers w/ Phone in Vehicle in 2000

2. Calculate Number of Licensed CA Drivers in 2000 who report they talk on phone on at least some trips ("CP drivers"), based on MVOSS 2000 data: 74% of those who report having car or cellular phone in vehicle

Licensed CA Drivers who talk on Phone on at least some trips =  $74\% \times (54\% \times \text{Total Licensed CA Drivers})$   
 $= 74\% \times 11,471,760$   
 $= 8,489,102$  Licensed CA Drivers who talk on phone on at least some trips ("CP drivers")

Similarly, 76,173,750 Licensed US Drivers who talk on phone on at least some trips in 2000

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170



## Methodology for Calculating State Estimates of Expected Fatalities in Which Cell Phone Use Was Contributing Factor (a)



Example - California (cont'd):

3. Calculate vehicle miles traveled (VMT) per licensed driver in 2000

$$\begin{aligned} \text{VMT per CA driver} &= \text{Total VMT(CA)} / \text{Total Licensed Drivers (CA)} \\ &= 306,649,000,000 \text{ miles} / 22,244,000 \text{ licensed drivers} \\ &= 14,435 \text{ VMT per licensed driver in CA in 2000} \end{aligned}$$

Similarly, 14,425 VMT per Licensed US Driver in 2000

4. Calculate VMT per licensed driver in the state who reports talking on phone on at least some trip in 2000

$$\begin{aligned} \text{VMT per CP drivers} &= \text{VMT per driver} * \text{CP Drivers} \\ &= 14,435 \text{ mi per driver} * 8,489,102 \text{ CP drivers} \\ &= 122,536,940,400 \text{ VMT for all CP drivers in CA in 2000} \end{aligned}$$

Similarly, 1,098,821,278,800 VMT for all CP drivers in US

5. Calculate portion of Total VMT for All CP drivers in US that is VMT for all CP drivers in CA in 2000

$$\begin{aligned} \text{CA\%} &= \text{VMT for all CP drivers in CA in 2000} / \text{VMT for all Licensed US drivers in 2000} \\ &= 122,536,940,400 \text{ VMT} / 1,098,821,278,800 \text{ VMT} \\ &= 11.2\% \text{ of all VMT for CP drivers in US was for CA CP drivers in 2000} \end{aligned}$$

This is the apportionment factor that is multiplied by the national estimate to obtain the state estimate.

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171

## Methodology for Calculating State Estimates of Expected Fatalities in Which Cell Phone Use Was Contributing Factor (a)



Example - California (cont'd):

6. Calculate portion of Total Estimated Fatalities in which cell phone use was a contributing factor in CA in 2000, Relative Risk = 1.2

$$\begin{aligned} \text{Fatalities in CA in which cell phone use was contributing factor} &= \text{Apportionment Factor} * \text{National Fatality Estimate when RR=1.2} \\ &= 11.2\% * 324 \\ &= 36 \text{ fatalities in which cell phone use was contributing factor in CA in 2000} \end{aligned}$$

7. Calculate Total Estimated Fatalities in which cell phone use was a contributing factor in CA in 2002, Relative Risk = 1.2. Assumption: The calculation of 2002 fatality estimates that follows is based on a 50% increase assumed from the earlier calculation of national fatalities.

$$\begin{aligned} \text{Estimated Number of California Fatalities in 2002 if Relative Risk} &= 1.2: \\ 2002 \text{ fatalities} &= 2000 \text{ Fatalities} * 150\% \\ \text{so } 36 * 150\% &= 54 \text{ fatalities in California when cell phone was contributing factor in 2002} \\ &\text{when the relative risk of a crash is 1.2} \end{aligned}$$

The table that follows provides estimates of fatalities for each State across a range of relative risks using the methodology outlined above.

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172

# **NHTSA 2000 & 2002 State Estimates of MV Fatalities (2a) Cell Phone Use was Contributing Factor**



		2000	2001	2002	2003	2004	2005
United States	100.0%	324	311	309	299	317	320
Alabama	2.1%	7	13	16	16	19	25
Alaska	0.3%	1	1	1	1	2	2
Arizona	1.6%	5	11	14	8	17	22
Arkansas	1.1%	3	6	6	5	10	15
California	11.3%	36	66	66	64	102	134
Colorado	1.3%	5	6	12	7	14	18
Connecticut	1.1%	4	7	6	5	10	13
Delaware	0.3%	1	2	2	1	3	4
District of Columbia	0.1%	0	1	1	1	1	2
Florida	5.0%	16	34	44	37	51	66
Georgia	3.0%	12	23	31	18	30	46
Hawaii	0.3%	1	2	3	2	3	4
Idaho	0.6%	2	3	4	2	5	6
Illinois	3.7%	12	23	30	16	34	46
Indiana	2.0%	8	16	21	13	24	31
Iowa	1.1%	3	7	9	8	10	13
Kansas	1.0%	3	6	6	6	9	12
Kentucky	1.7%	6	10	14	8	16	20
Louisiana	1.6%	5	6	12	7	14	18
Maine	0.3%	2	3	4	3	5	6
Maryland	1.6%	6	11	15	9	17	22
Massachusetts	1.3%	5	12	16	9	16	23
Michigan	3.6%	12	22	28	17	33	43
Minnesota	1.3%	5	12	15	9	16	23
Mississippi	1.3%	4	6	10	5	12	16

Note: The calculation of 2002 fatality estimates is based on a 50% increase assumed from the earlier calculation of national fatalities.

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173

# **NHTSA 2000 & 2002 State Estimates of MV Fatalities (2b) Cell Phone Use was Contributing Factor**



		2000	2001	2002	2003	2004	2005
Montana	2.4%	6	9	20	12	23	29
Nebraska	0.4%	1	2	3	2	3	4
Nevada	0.7%	2	4	5	3	6	8
New Hampshire	0.6%	2	4	5	3	6	8
New Jersey	0.4%	1	3	3	2	4	5
New Mexico	2.0%	8	16	26	12	22	29
New York	0.8%	3	5	7	4	6	10
New York	4.1%	15	29	36	23	42	54
North Carolina	3.3%	11	26	26	16	30	39
North Dakota	0.3%	1	2	2	1	2	3
Ohio	3.6%	12	24	31	19	35	46
Oklahoma	1.6%	5	10	13	6	14	18
Oregon	1.3%	4	8	10	6	12	15
Pennsylvania	3.7%	12	23	30	18	34	45
Rhode Island	0.3%	1	2	2	1	3	4
South Carolina	1.7%	5	10	13	6	15	20
South Dakota	0.2%	1	2	2	1	3	4
Tennessee	2.4%	8	16	19	12	22	29
Texas	8.6%	28	48	64	38	73	94
Utah	0.6%	3	6	7	4	6	10
Vermont	0.2%	1	2	2	1	2	3
Virginia	2.7%	9	17	22	13	25	33
Washington	1.6%	6	12	16	9	16	23
West Virginia	0.7%	2	4	6	3	6	8
Wisconsin	2.1%	7	13	17	10	18	23
Wyoming	0.3%	1	2	2	1	3	4

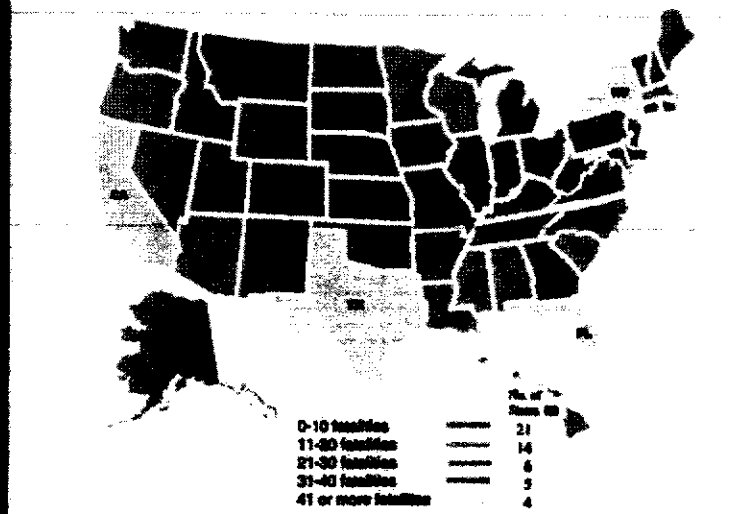
Note: The calculation of 2002 fatality estimates is based on a 50% increase assumed from the earlier calculation of national fatalities.

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174

## Distribution of Estimated Fatalities in which Cell Phone Use was Contributing Factor

R. Steven H. 12/04/04



## Methodology for Calculating State Estimates of Expected Fatalities in which Cell Phone Use Was Contributing Factor



### Methodology 4B

This method expands on the previous methodology by including additional State-based data. The national fatality estimates are apportioned among the States based on a series of subscriptions expressed drivers, vehicle miles traveled, and estimated total fatalities within each State. The State data were compared against the national totals. The percentages were combined and averaged for each State to determine an approximation of how fatalities were apportioned between the States in 2000. Estimated fatalities were then calculated for 2004.

This methodology takes the following steps to calculate the expected fatalities for each State in which cell phone use was a contributing factor:

1. Determine the total number of fatalities in which cell phone use was a contributing factor for the entire country in 2000.
2. Determine the total number of fatalities in which cell phone use was a contributing factor for each State in 2000.
3. Calculate the percentage of fatalities in which cell phone use was a contributing factor for each State in 2000.
4. Calculate the percentage of fatalities in which cell phone use was a contributing factor for the entire country in 2000.

The methodology used in this report is based on the assumption that the percentage of fatalities in which cell phone use was a contributing factor for each State in 2000 is proportional to the percentage of fatalities in which cell phone use was a contributing factor for the entire country in 2000.

A sample calculation is provided:

## Methodology for Calculating State Estimates of Expected Fatalities in Which Cell Phone Use Was Contributing Factor (3)



Example – California (CA) (Data sources: NHTSA Traffic Safety Facts 2000, CTIA data for 2000):

Assumptions and NHTSA data:

1. From NHTSA 2000, 4% of drivers are using a cell phone at any daytime moment (this is exposure time,  $\Delta T = .04$ ). Assume this is true for all States.
2. This leaves 96% (or  $1 - \Delta T = .96$ ) of drivers not using a cell phone at any given daytime moment.
3. If the risk of a crash is equal for cell phone users and non users, Total Risk = 1.0
4. The calculation of 2002 fatality estimates that follows is based on a 50% increase assumed from the earlier calculation of national fatalities.
5. The apportionment factor (CA%) is the average value of the state portion of the national total of the following data: cellular subscribers, licensed drivers, VMT, and fatalities.

1. Calculate portion of Total cellular subscribers in US that were in CA in 2000 (CA%1)

CA%1 = % of US Cellular subscribers in CA  
 = Cellular subscribers in CA divided by Cellular subscribers in US  
 = 12,283,308 CA subscribers / 90,643,068 US subscribers  
 = 13.6% of all US cellular subscribers were in CA in 2000

2. Calculate portion of Total licensed drivers in US that were in CA in 2000 (CA%2)

CA%2 = % of US Licensed drivers in CA  
 = Licensed drivers in CA divided by Licensed drivers in US  
 = 21,244,000 CA licensed drivers / 190,625,000 US licensed drivers  
 = 11.1% of all US licensed drivers were in CA in 2000

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177

## Methodology for Calculating State Estimates of Expected Fatalities in Which Cell Phone Use Was Contributing Factor (3)



Example – California (cont'd):

3. Calculate portion of total US VMT that were in CA in 2000 (CA%3)

CA%3 = % of US VMT in CA  
 = VMT in CA divided by VMT in US  
 = 306,648,000,000 VMT in CA / 2,748,803,000,000 VMT in US  
 = 11.2% of all US VMT were in CA in 2000

4. Calculate portion of Total US Fatalities that were in CA in 2000 (CA%4)

CA%4 = % of US Fatalities in CA  
 = Fatalities in CA in 2000 / Fatalities in US in 2000  
 = 3,753 CA fatalities / 41,821 US fatalities  
 = 9.0% of all US fatalities were in CA in 2000

5. Calculate the apportionment factor (CA%)

CA% = (CA%1 + CA%2 + CA%3 + CA%4) / 4  
 = (13.6% + 11.1% + 11.2% + 9.0%) / 4  
 = 11.2% apportionment factor for CA in 2000  
 This is the apportionment factor that is multiplied by the national estimate to obtain the state estimate.

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178

## Methodology for Calculating State Estimates of Expected Fatalities in Which Cell Phone Use Was Contributing Factor (3)



Example - California (cont'd):

6. Calculate portion of Total Estimated Fatalities in which cell phone use was a contributing factor in CA in 2000, Relative Risk = 1.2

Fatalities in CA in which cell phone use was contributing factor  
 = Apportionment Factor (CA%) \* National Fatality Estimate when RR=1.2  
 = 11.2% \* 324  
 = 36 fatalities in which cell phone use was contributing factor in CA in 2000

7. Calculate Total Estimated Fatalities in which cell phone use was a contributing factor in CA in 2002, Relative Risk = 1.2. Assumption: The calculation of 2002 fatality estimates that follows is based on a 50% increase assumed from the earlier calculation of national fatalities.

Estimated Number of California Fatalities in 2002 if Relative Risk = 1.2:  
 2002 fatalities = 2000 Fatalities \* 150%  
 so 36 \* 150% = 54 fatalities in California when cell phone was contributing factor in 2002  
 when the relative risk of a crash is 1.2

The table that follows provides estimates of fatalities for each State across a range of relative risks using the methodology outlined above.

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179

## NHTSA 2000 & 2002 State Estimates of MV Fatalities (3a) Cell Phone Use was Contributing Factor



State	2000 Relative Risk	2000 National Estimate	2000 State Estimate	2002 National Estimate	2002 State Estimate
United States	1.00	324	324	486	486
Alabama	1.00	0	0	0	0
Alaska	0.25	0	0	0	0
Arizona	2.00	0	0	0	0
Arkansas	1.00	0	0	0	0
California	11.2%	36	36	54	134
Colorado	1.00	0	0	0	0
Connecticut	1.00	0	0	0	0
Delaware	0.25	0	0	0	0
District of Columbia	0.25	0	0	0	0
Florida	0.25	0	0	0	0
Georgia	0.25	0	0	0	0
Hawaii	0.25	0	0	0	0
Idaho	0.25	0	0	0	0
Illinois	0.25	0	0	0	0
Indiana	0.25	0	0	0	0
Iowa	0.25	0	0	0	0
Kansas	0.25	0	0	0	0
Kentucky	0.25	0	0	0	0
Louisiana	0.25	0	0	0	0
Maine	0.25	0	0	0	0
Maryland	0.25	0	0	0	0
Massachusetts	0.25	0	0	0	0
Michigan	0.25	0	0	0	0
Minnesota	0.25	0	0	0	0
Mississippi	0.25	0	0	0	0
Missouri	0.25	0	0	0	0
Montana	0.25	0	0	0	0
Nebraska	0.25	0	0	0	0
Nevada	0.25	0	0	0	0
New Hampshire	0.25	0	0	0	0
New Jersey	0.25	0	0	0	0
New Mexico	0.25	0	0	0	0
New York	0.25	0	0	0	0
North Carolina	0.25	0	0	0	0
North Dakota	0.25	0	0	0	0
Ohio	0.25	0	0	0	0
Oklahoma	0.25	0	0	0	0
Oregon	0.25	0	0	0	0
Pennsylvania	0.25	0	0	0	0
Rhode Island	0.25	0	0	0	0
South Carolina	0.25	0	0	0	0
South Dakota	0.25	0	0	0	0
Tennessee	0.25	0	0	0	0
Texas	0.25	0	0	0	0
Utah	0.25	0	0	0	0
Vermont	0.25	0	0	0	0
Virginia	0.25	0	0	0	0
Washington	0.25	0	0	0	0
West Virginia	0.25	0	0	0	0
Wisconsin	0.25	0	0	0	0
Wyoming	0.25	0	0	0	0

Note: The calculation of 2002 fatality estimates is based on a 50% increase assumed from the earlier calculation of national fatalities.

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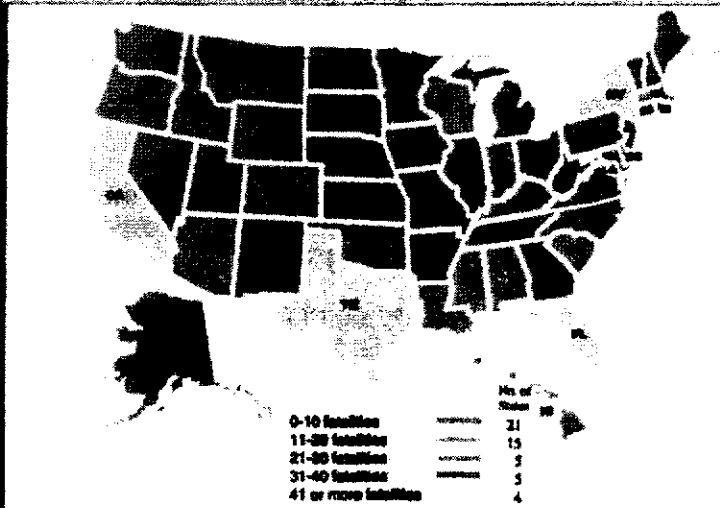
180

# NHTSA 2000 & 2002 State Estimates of MV Fatalities Cell Phone Use was Contributing Factor



State	Population	Year 2000 Estimated Number of Fatalities in which Cell Phone Use was Contributing Factor			Year 2002 Estimated Number of Fatalities in which Cell Phone Use was Contributing Factor		
		2000	2001	2002	2000	2001	2002
Alabama	4,000,000	1	1	1	1	1	1
Alaska	600,000	0	0	0	0	0	0
Arizona	5,000,000	2	2	2	2	2	2
Arkansas	2,500,000	1	1	1	1	1	1
California	35,000,000	15	15	15	15	15	15
Colorado	4,000,000	1	1	1	1	1	1
Connecticut	3,500,000	1	1	1	1	1	1
Delaware	800,000	1	1	1	1	1	1
District of Columbia	600,000	1	1	1	1	1	1
Florida	18,000,000	10	10	10	10	10	10
Georgia	8,000,000	5	5	5	5	5	5
Hawaii	1,000,000	0	0	0	0	0	0
Idaho	1,500,000	1	1	1	1	1	1
Illinois	12,000,000	8	8	8	8	8	8
Indiana	6,000,000	3	3	3	3	3	3
Iowa	3,000,000	1	1	1	1	1	1
Kansas	3,500,000	1	1	1	1	1	1
Kentucky	4,000,000	1	1	1	1	1	1
Louisiana	4,500,000	1	1	1	1	1	1
Maine	1,300,000	1	1	1	1	1	1
Maryland	5,500,000	2	2	2	2	2	2
Massachusetts	6,500,000	2	2	2	2	2	2
Michigan	10,000,000	6	6	6	6	6	6
Minnesota	5,000,000	2	2	2	2	2	2
Mississippi	3,000,000	1	1	1	1	1	1
Missouri	5,500,000	3	3	3	3	3	3
Montana	1,000,000	1	1	1	1	1	1
Nebraska	1,800,000	1	1	1	1	1	1
Nevada	2,500,000	1	1	1	1	1	1
New Hampshire	1,300,000	1	1	1	1	1	1
New Jersey	8,500,000	4	4	4	4	4	4
New Mexico	2,000,000	1	1	1	1	1	1
New York	19,000,000	12	12	12	12	12	12
North Carolina	8,000,000	5	5	5	5	5	5
North Dakota	1,000,000	1	1	1	1	1	1
Ohio	11,000,000	7	7	7	7	7	7
Oklahoma	3,500,000	1	1	1	1	1	1
Oregon	3,500,000	1	1	1	1	1	1
Pennsylvania	12,000,000	8	8	8	8	8	8
Rhode Island	1,000,000	1	1	1	1	1	1
South Carolina	3,500,000	1	1	1	1	1	1
South Dakota	1,000,000	1	1	1	1	1	1
Tennessee	5,500,000	3	3	3	3	3	3
Texas	25,000,000	15	15	15	15	15	15
Utah	2,500,000	1	1	1	1	1	1
Vermont	600,000	1	1	1	1	1	1
Virginia	6,500,000	3	3	3	3	3	3
Washington	5,500,000	2	2	2	2	2	2
West Virginia	1,800,000	1	1	1	1	1	1
Wisconsin	5,500,000	3	3	3	3	3	3
Wyoming	1,000,000	1	1	1	1	1	1

## Distribution of Estimated Fatalities in which Cell Phone Use was Contributing Factor By State for 2000, 2001, and 2002



## Where Are The Fatalities?



Crash data are typically used to provide an account of the fatalities due to a particular causal factor. However, as discussed previously, fatalities due to cell phone use may be masked by other contributing factors. The AEI-Brookings<sup>21,22</sup> and Harvard<sup>11,32</sup> studies provide estimates that suggest the possibility for a substantial number of fatalities (using a RR of 4.3) due to phone use while driving. If a relative risk of 4.3 were used in the current analysis, with an exposure rate of 6%, the estimated fatalities would be substantial in number (on the order of 7,000) and should be clearly evident in the crash record. Given these analytical results and the fact that such large numbers of fatalities have not been observed, it is reasonable to assume that the actual relative risk is much lower than 4.3. The 2001 Montreal Study<sup>30</sup> is the most complete epidemiological study on this issue to date and suggests a relative risk of 1.38. More recent work by the University of Montreal further demonstrates analytically that the earlier 4.3 estimate was flawed.<sup>32</sup> Using the 1.38 value as a base, it seems reasonable to assume that the relative risk is closer to this value and lies within a range of 1.2 to 1.5. Within this range, the current analysis suggests between 508 and 1,248 fatalities in 2002 given an exposure rate of 6%.

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183

## Summary of 2000 and 2002 Crash Estimates



The results of this analysis show that the number of estimated crashes and fatalities in which cell phone use was a contributing factor has increased significantly (by about 50%) as a function of the relative risk from 2000 to 2002.

Within the range of relative risks from 1.2 to 1.5, the current analysis suggests approximately 300 to 800 fatalities in 2000 given an exposure rate of almost 4%.

Recall that within this same range of relative risk, the current analysis suggests an increase in fatalities to between 508 and 1,248 fatalities in 2002 given an exposure rate of 6%.

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184

## ***How Do the Various Sources of Data Come Together?***



In aggregate there is a wealth of information.

After more than a decade of research on the subject, however, conclusions and recommendations differ greatly due to differences in economic, political, personal and academic perspectives, that influence basic assumptions and interpretations of the research.

While the current analysis generated a range of estimated fatalities due to cell phone use while driving, definitive conclusions remain elusive, highlighting the complexity of the issues and the continuing lack of critical data for assessing the true nature and magnitude of the problem.

NTSA Issues the Only, Working Document to Review (2009)

185

## ***Why Is Understanding the Problem So Elusive?*** ***Some of the More Significant Reasons***



- Estimates of the role of distraction in crash causation vary considerably from about 13% to more than 50%, depending on the data source and assumptions used.
- Collection and documentation of distraction related crash data is not consistent across jurisdictions.
- Most often there is no post-crash evidence of the role of distraction in precipitating a crash.
- Some drivers are not aware they were distracted or are not willing to admit it.
- Most state crash reporting forms do not generally address the issue of distraction or more specifically the issue of cell phones.

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186



## ***Another Issue of Concern: Crashworthiness***



There is one safety issue that extends beyond the influence of cell phones on driving behavior and performance. Keeping in mind that use of a cell phone increases the risk of a crash, this issue concerns crashworthiness related to the position of installed wireless devices as well as hand-held devices and those attached to the driver. This is an issue both from the standpoint of a deploying airbag and the potential for a device to become an injurious or lethal projectile. For phones held by drivers in the proximity of the face and head, for driver attached accessories such as microphones and earpieces, or placement in front of the steering wheel during use (e.g., dialing a phone) there is also concern. In addition, instances of devices installed over airbags have been noted by NHTSA. These situations are particularly dangerous given the seemingly obvious potential for serious injury during airbag deployment.

NHTSA Internal Use Only, Working Document in Review (2003)187

## ***Summary of What We Know***



- The number of cell phone subscribers (and users) in the United States continues to grow (2003, > 146,800,000), as does the number of drivers using cell phones while driving.
- Use of either hand-held or hands-free phones increases the risk of a crash.
- Data suggests that the use of cell phones per subscriber is increasing (frequency and duration of calls).
- User demographics are related to how, when and where cell phones are used and the magnitude and types of crashes involved.
- Young, novice drivers who also use cell phones or other wireless communication devices are of particular concern.

NHTSA Internal Use Only, Working Document in Review (2003)188

## Summary of What We Know



- Nature of problem is changing with advances in technology and increased use.
  - Cell phone architecture (e.g., design features, placement) influences the risk of a crash.
  - Cell phone demands (i.e., specific tasks and their difficulty for using) influence the willingness of drivers to use the phone.
    - There is evidence that drivers who use hands-free phones use them more frequently and for longer durations than drivers who use handheld phones.
- Context of the driving environment influences the willingness of drivers to use the phone.
  - Most cell phone crashes occur under benign conditions (e.g., straight road, daytime, clear weather).
  - Most cell phone crashes occur in urban environments.
- Frequency and duration of use, both while driving and overall, influence the risk of a crash.

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189

## Summary of What We Know



- The public is concerned about the safety implications surrounding the use of cellular phones while driving.
- Crash data is incomplete, inaccurate, and difficult to obtain.
- More than half of the States have proposed restrictive legislation.
  - Several states have initiated special studies.
- A variety of research studies are ongoing.

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190

## ***What Others Are Saying***

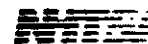


**The following slides present a sample of statements from notable sources that have received considerable visibility in the media. These sources have addressed the cell phone issue either through research or through an analysis of existing information and data to better estimate the nature and/or magnitude of the problem.**

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191

## ***Notable Quotes***



- **Harvard Center for Risk Analysis, 2000**
  - "The weight of the scientific evidence to date suggests that use of a cellular phone while driving does create safety risks for the driver and his/her passengers as well as other road users."
    - However, they note that the magnitude of this risk is unknown
  - "It is not clear whether hands-free cellular phone designs are significantly safer than hand-held designs, since it may be that conversation per se rather than dialing/handling is responsible for most of the attributable risk due to cellular phone use while driving."

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192

## Notable Quotes



- **Harvard Center for Risk Analysis, 2000 (cont'd)**

- "Traffic safety researchers do not find much reassurance in the data [Cellular subscribers vs. US mileage fatality rate, Traffic fatalities] ... because there are many powerful variables (beneficial and adverse) that influence overall fatal crash statistics."
- "As an example, if cellular phones were in fact causing 500 additional fatalities each year in the U.S., the problem – even though large in absolute magnitude – might be masked in the aggregate data by recent reductions in accident fatalities from campaigns against drunk driving and for safety belt use."

NTSB is a Federal Government Agency. Working Document for Review (1999)

193

## Notable Quotes



- **Harvard Center for Risk Analysis, 2000 (cont'd)**

- "Alternatively, if cellular phone use were to increase the risk of motor vehicle collisions but primarily in less severe crashes (i.e., those collisions least likely to cause a fatality, such as rear-end impacts), then one would not expect to see a simple correlation between traffic fatalities and cellular phone use."
- "For example, in rush-hour traffic where cellular phone use is common, fatal crashes account for a disproportionately small share of crashes because congestion produces low-speed collisions in which vehicles may be damaged but occupants receive little or no injury."

NTSB is a Federal Government Agency. Working Document for Review (1999)

194

## **Notable Quotes**



- **Harvard Center for Risk Analysis, 2000 (cont'd)**
  - "Although fatal crashes are of obvious human significance, they may not be the most important outcome when scientists study the risks of using a cellular phone while driving."

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195

## **Notable Quotes**



- **University of North Carolina Highway Research Center, 2001**
  - "Clearly there is a critical need for better information if the risk of crashing while talking on a cell phone is to be appropriately estimated. Without this information, there remains a very important unanswered question: 'Just how dangerous is it to be talking on a cell phone while driving?'"

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196

## **Possible Strategies**



### **• Addressing the Cell Phone Issue**

- Training and education
- Media campaign (PSAs)
- Design changes / guidelines
- Restrictive legislation
- Corporate restriction
- Restrictive designs
- Cooperative systems
- Insurance implications

NTSA Internal Use Only, Working Document In Review (2002)

197

## **Training, Education, Media Campaign (PSAs)**



Traditional approaches have been used for some time with uncertain success. Application of such approaches to other issues (alcohol/seat belts) have shown relatively small benefits (10%-15%) and while some benefits may be realized on this specific issue, efforts may be best directed at establishing a uniform set of guidelines for use covering the range of phone architectures and also highlighting the distraction issue in general. It is clear from focus group discussions that there is a considerable lack of knowledge about distraction and the risks of a crash. Providing exposure to these issues at the high school level may have long term benefits.

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198

## Design Changes/Guidelines



The relationship between the "demands" of using a cell phone and risk has already been pointed out. Clearly, cell phone design is primary in determining the nature and degree of distraction associated with use. This issue highlights a paradox in that the more the use of cell phones is facilitated by design improvements (ease-of-use), the greater the likelihood it will be used (while driving). Indeed, hands-free systems have been touted by many as "safe." However, to the extent that conversation itself contributes to crash risk, any benefits of design improvements may be washed out by increased exposure. Survey data has indicated that if a device is too difficult to use while driving it will not be used. Nevertheless, there are many human factors design improvements that should be addressed. Some of these are highlighted on the slides that follow.

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199

## Design Changes/Guidelines



### • Reducing Manual Demand

- Hands-free systems
  - Most hands-free set-ups are for hands-free conversation, manual dialing is still required
- Voice interface
  - Allows for hands-free dialing and answering
  - Technology not cheap enough for satisfactory performance
- Flip-phone vs. non-flip phone
  - Flip-phones are still very popular, but most require two hands to flip open
  - Cradles that require flip-phones to be open may help this issue

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200

## ***Design Changes/Guidelines***



### **• Reducing Visual Demand**

#### **• Screen size**

- Larger screens allow for larger text sizes, but they also allow for more information and graphics
- Recent incorporation of digital camera capabilities will potentially allow for more image-rich interfaces
- Possibly include "driving" display mode that uses restricted (minimal) visual interface

#### **• Keypad design**

- Ensure that button size and spacing are adequate for minimal entry errors
- Key feedback is essential to reducing the need for visual confirmation of inputs

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## ***Restrictive Legislation***



In response to what is perceived as a significant problem, the state of New York and several local jurisdictions across the country have implemented legislation to limit the use of cell phone to hands-free devices. Inherent in these restriction is the assumption that hands-free architectures are safer. Because the success of these efforts in reducing cell phone related crashes is not easy to assess, it is impossible to determine whether such efforts will tend to improve overall safety, or in fact reduce it (through greater use). Both experimental and epidemiological studies have consistently shown little if any difference between hands-free and hand held architectures. The bases for the lack of a distinction, however, is not clear since each may be associated with attributes for use that can benefit or hinder safety. Until these issues are clarified or an appropriate assessment is made of legislative effectiveness, it would appear that the success of this approach in reducing cell phone related crashes will remain unknown.

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## ***Corporate Restriction***



As highlighted earlier, corporate liability issues have motivated a number of companies to establish formal policies regarding cell phone use. Such policies have often been motivated by high profile, high cost crashes that have taken place on company time or using company vehicles. Businesses would appear to be highly vulnerable to lawsuits in these situations, which could significantly impact small business operations in particular. It would appear that corporate consideration of formal policies on where, when and how to conduct business on the cell phone would be prudent and has the potential to reduce a small, but significant (economic) component of the cell phone crash problem.

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203

## ***Restrictive Designs***



While the focus of technological innovation has been on improving the capability and usability of in-vehicle devices, it has long been recognized that there may be a need to use innovative techniques to limit the availability of certain high demand functions on these devices. The most notable example is the restriction on navigation systems that limits destination entry from a moving vehicle. It has been suggested that such limitations can be applied to cell phones in order to prevent the making or receipt of calls if the vehicle is in motion. While such an approach may be viable for communications systems integrated into the vehicle, such an approach may not be easily implemented for carry-on devices. However, with the implementation of new call location requirements, the use of integrated GPS capabilities would allow determination of phone velocity which could be associated with use in a vehicle. Nevertheless, associating the motion of the phone with a car (as opposed to another type of vehicle such as a bus or train) and a driver (as opposed to a passenger), would still be a challenge.

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204

## ***Cooperative Systems***



Another technological approach is related to the ongoing development of crash avoidance systems and the associated sensor suites. Recent developments in sensors and associated algorithms would theoretically allow determination of imminent threats (traffic conflicts) and determine, with some degree of reliability, whether the driver is distracted (visual or cognitive). With this coincidence of circumstances it may be possible to warn the driver (regain attention to driving) to allow an appropriate avoidance response. It remains to be determined whether such an approach would provide enough time for a driver to refocus attention and respond appropriately.

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## ***Insurance Implications***



One approach adopted by several insurance companies (in Germany and Canada) is to limit insurance coverage if a cell phone was in use at the time of a crash. Other approaches that have been discussed include the addition of a surcharge if cell phones are used while driving. These approaches may have limited impact if adopted only by a few insurers since clients can simply move to another insurer without a cell phone consequence. More universal and publicized policies that spell out consequences of cell phone relevant crashes, however, might influence behavior.

NTSA Internal Use Only, Working Document in Review (7/07)206

## **Possible Strategies**



- **Improving the State of Knowledge**
  - Epidemiological studies
  - Improved crash data collection
  - Laboratory, simulator and test track research
  - ~~Observational research~~
  - Surveys
  - Naturalistic data collection

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207

## **Epidemiological Studies**



Perhaps the greatest contribution to understanding the real-world risks associated with cell phone use has come from the epidemiological studies that have focused on this issue. While not establishing a direct link between cell phone use and crashes, the relationships identified by these studies do come closer to providing a basis for establishing the magnitude of the problem. The key to the value of these studies is access to phone records, which is more readily obtained in Canada. However, as the following slides caution, the relevance of this data to the U.S. population may be limited.

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208

## Epidemiological Studies



As the authors themselves stated, the 2001 Montréal Study<sup>30</sup> is "the first epidemiological study based on a substantial sample that shows a link between risk of having accidents and accidents with injuries and the fact of being a cell phone user as opposed to a non-user."

This study represents a significant step forward in understanding the magnitude of the risks associated with cell phone use while driving. However, there may be certain factors that impact generalizability of this data to the United States at the present time.

It is important to keep in mind that this was a retrospective epidemiological study done on two large cohorts – users and non-users of mobile (cellular) phones. The objective was to verify whether an association exists between cell phone use and crash rates, but this study did not (and could not) confirm a causal relationship based on the research methodology used. Recall also that the population sampled was selected to maximize the number of cell phone users.

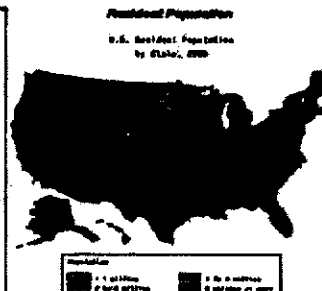
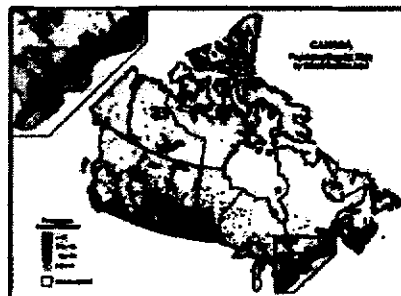
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209

## Epidemiological Studies



Geographic differences between Canada and United States – the lighter colored areas in the two figures represent the most sparsely populated regions – and the availability of cellular service nationwide would also likely effect differences in cell phone usage between the two populations, though the nature of those differences is unknown.



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210

## ***Epidemiological Studies***



- **Other considerations of note:**

- The Canadian data, collected through 2000, indicated that a smaller portion of Canadian drivers reported having cell phones as compared with U.S. drivers who participated in NHTSA's 2000 MVOSS (35.2% to 54%).
- Cell phone usage is somewhat different in Canada as compared to the U.S. For example, in 2000 about 90% of drivers who participated in the Canadian study and who had cell phones reported using phones at some time while driving, compared with about 75% of U.S. drivers with cell phones.
- The Canadian data indicated a higher usage of hand-held phones than that reported in the U.S. at that time (more than 80% vs. 73%).
- A comparison has not been done to consider how service plans may have differed between the U.S. and Canada over the years, however, variances in available service plans and service can impact on usage.

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211

## ***Improved Crash Data Collection***



It would appear that the mainstay of media reports on the role of cell phones in precipitating crashes is the crash data as reported by NHTSA and state resources and interpreted by others. The shortcomings of this data, however, as highlighted earlier, prevents any definitive statements about either the magnitude or nature of the problem. Given the diversity in data collection techniques and the subjective nature of data imbedded in crash reports on the subject of distraction in general, and cell phone in particular, not to speak of the unknowns, it would appear irresponsible to make much of the data other than to develop a general sense of the issues and provide guidance for more focused research. Improvements in the data collection process that would allow for greater comparability along with increased sensitivity to this issue among crash investigators would help improve the data quality, but would not provide a definitive source of information to guide the decision making process.

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212

## **Laboratory, Simulator and Test Track Research**



Perhaps the greatest contribution of experimental research into cell phones has been a better understanding of how cell phone use can influence safety relevant driver behavior and performance, and the mechanisms responsible for those effects. These issues are critical in influencing both the public information side of the issue and the design of these systems since they provide an empirical basis for determining what information (safety) users need to know and what design features offer the lowest level of demand. The research can also provide insight into the methods and timings necessary to warn drivers of traffic conflicts. There is a particular need to expand research to address the use of the broad range of functions now being incorporated into cell phones.

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213

## **Observational Research**



Observational research has proven to be a reliable approach for capturing the rate of hand-held phone use while driving at any given moment. However, the major drawback to this type of research is the inability to obtain accurate observational data on hands-free phone use. Currently, NHTSA relies on the use of survey data to fill this gap, and while such an approach appears to provide a reasonable estimate given the aggregate of other supporting information, it would be best if a more direct approach was employed to obtain hands-free use data. In this regard, it may be possible to utilize currently available, remotely located devices to detect phone use from afar to improve the accuracy and reliability of observational research in obtaining estimates of hands-free use.

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214

## Surveys



Because the cellular phone industry has been incredibly dynamic in recent years in its subscriber and airtime growth, the trends for phones will most likely continue to change over time. Surveys are useful for understanding these trends and how people feel about their phones, and when and where they use them. In order to be sensitive to trends in phone use while driving, survey data must continue to be collected on a regular basis (at least annually).

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215

## Naturalistic Studies



### The Missing Link:

In reviewing available sources of relevant data and the completeness and accuracy of the information they provide, it is clear that it is not possible at this time to determine the magnitude of the cell phone problem, either in terms of crashes or fatalities. All estimates provided in the literature are subject to significant data limitations and associated error, and are based on assumptions that may have little credibility. What is clear is that the key element that is missing is an accurate determination of relative risk. While the model approach to estimating fatal crashes presented earlier is not perfect, it does allow for approximating the magnitude of the problem, given a relative risk. It is argued here that the use of naturalistic driving studies, if implemented properly, can fill that gap as well as answer questions that cannot be addressed by traditional research approaches. In addition, the proposed research would also capture the use of other technologies as well as other distractions (e.g., tuning the radio, eating).

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216

## **Naturalistic Data Collection**

**Large Scale, Statistically Representative Sample of Users**



Unlike other experimental research, naturalistic studies provide an accurate picture of events as they would occur in the real world. While lacking experimental control, these studies do provide a unique opportunity to empirically identify and document driver behavior and performance under conditions that represent the full range of circumstances encountered in real world driving. Within the context of cell phones it provides the capability to describe cell-phone use in terms of behavior and performance in relation to driver demographics, driving style and traffic events (crashes, near misses, driver error). With appropriate subject selection distributed nationally it would be theoretically possible to get meaningful measures of exposure and relative risk, including the conditions under which these devices are used and comparisons to other distractions. This approach would also capture other portable technologies as well.

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217

## **Naturalistic Data Collection**

**Focus on purchasers of OEM in-vehicle technology**



The evolution of technology has focused on integrating a large number of functions within single devices. This trend can be seen in the integration of OEM devices into vehicles that may include audio, navigation and communications systems. Many of these systems have unique voice interfaces that allow control with minimal manual involvement. The manner in which these devices are learned and used is unknown as is their potential to precipitate distraction related crashes. Through a large scale naturalistic study in which purchasers of new vehicles with these systems are offered a monetary incentive (e.g., several thousand dollars off the purchase price) to be a part of the study, it would be possible to collect invaluable information as to the benefits and liabilities of these new devices and interfaces.

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218



## Summary & Conclusions



Unlike most issues in highway safety, those surrounding cell phones represent a unique and daunting challenge. Despite a vast amount of data and research, the most substantive questions regarding the impact of wireless communications on safety remain unanswered. The dynamic nature of the technology and its use, along with the difficulties in collecting complete and accurate crash data, continue to be the greatest challenge. In some notable cases results of studies have been highlighted by the authors as "definitive," and captured by the media and other researchers as having great significance. The material presented here, however, has highlighted a number of shortcomings in the crash data, the research, and the risk analyses. Our analysis, based on the most current data, provides what we believe is a "best" estimate of fatalities and non-fatal crashes and is intended to give the reader a "sense" of the magnitude of the problem. It is further suggested here that realistically, the only mechanism for obtaining the necessary information to properly characterize this problem is through well designed naturalistic driving studies, where the behavior of drivers can be monitored and the consequences of phone use accurately and reliably recorded.

NTSA Internal Use Only, Working Document in Review (2002)

219

## Safety Tips from Transport Canada



Transport Canada Fact Sheet RS200-06 (TP2430E, December 2001) 06, 06

- "Transport Canada recommends against using cell phones while driving. It is distracting and increases the risk of collision. Your primary concern is the safe operation of the vehicle."

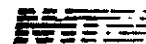
To avoid collisions arising from the use of cell phones:

- Turn the phone off before you start driving. Let callers leave a message.
- If there are passengers in the vehicle, let one of them take or make a call. If you're expecting an important call, let someone else drive.
- If you have to make or receive a call, look for a safe opportunity to pull over and park.

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220

## **NTSB Safety Recommendations Background**



**On February 2002, a serious crash involving the loss of five lives took place in Largo, Maryland. The nature of this crash and the events leading up to it were investigated by the National Transportation Safety Board (NTSB) to determine the contributing causes and to make recommendations that would have the potential to mitigate similar crashes in the future. The following slides provide highlights of this event and the NTSB's findings and recommendations. This material is provided because cell phone use was identified as a potential contributing factor.**

NTSB Internal Use Only, Working Document in Review (7/02)221

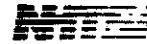
## **NTSB Safety Recommendations Report / Hearing**



- **Single crash that took the lives of 5 persons, including a driver who was using a wireless phone at the moment she lost control of her vehicle.**
- **Interstate 95/495 (the Capital Beltway) near Largo, Maryland**
- **The Board found that the probable cause of the crash was the Explorer driver's failure to maintain control of her vehicle in the windy conditions due to a combination of inexperience, unfamiliarity with the vehicle (she had just purchased it that evening), speed and distraction caused by use of a handheld wireless telephone.**

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## NTSB Safety Recommendations



### June 3, 2003 Safety Recommendations to NHTSA

1. Develop in conjunction with The Advertising Council, Inc., a media campaign stressing the dangers associated with distracted driving.
2. Develop in conjunction with the American Driver and Traffic Safety Education Association a module for driver education curriculums that emphasizes the risks of engaging in distracting behavior.
3. Determine the magnitude and impact of driver-controlled, in-vehicle distractions, including the use of interactive wireless communication devices on highway safety and report findings to the United States Congress and the States.

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223

## Recommendations: Prologue



The recommendations that follow apply to a diverse group of interests that should carefully consider the implications of the information and analyses in this report, and how the recommendations may be used as a stepping-stone to improving knowledge and safety related to in-vehicle use of wireless devices. These interests include:

Users	Manufacturers
Designers	Service providers
Law enforcement	Media and outreach
State and Local governments	Employers
Special interest groups	Parents
Government agencies	Researchers
Educators	Insurance carriers

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224

## **Recommendations: Prologue**



While a definitive estimate of the magnitude of the problem is not possible at this time, we believe it is prudent to use existing data and information to generate a best estimate. Using 2002 crash data across an assumed range of relative risk, a best estimate of fatalities, injury crashes, property damage crashes and non-police reported cell phone related crashes was presented earlier to characterize the potential magnitude of the cell phone problem. While these estimates involve a number of assumptions, we believe they are reasonable, given available data and information. The need for the recommendations that follow are based on the magnitude of the problem reflected in these estimates as well as the aggregate of other information provided in the preceding documentation. Because the estimates are relatively large, we believed that in the interest of saving lives and preventing injury, a conservative approach is called for at this time. As additional data, information and analytical approaches become available, these estimates will be adjusted as appropriate.

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## **Recommendations: Wireless Communications Research**



Given the likelihood that crash data will be unable to accurately capture distractions as a causal factor, it is recommended that a naturalistic, on-road data collection effort be initiated using instrumented owner vehicles. The effort would focus on cell phones as well as other distracted driving behaviors that can have an adverse influence on driving safety. The study would involve a statistically meaningful number of volunteer drivers, perhaps 10,000 or more, distributed nationally, carefully selected to be representative in all relevant aspects covering demographics, driving history, cell phone type and use, and other characteristics deemed relevant. Driver anonymity, data confidentiality and protection, along with monetary compensation, would be used to encourage participation. Data would be collected over a period of at least one year. For this large subject population it is anticipated that sizable number of crashes would naturally occur. All crashes would be investigated in depth, and all detectable critical incidents and near misses will be recorded as well. It is expected that the aggregate of this data would clarify issues of willingness to engage and exposure, and ultimately lead to a more accurate estimate of the magnitude of the problem.

NTSBA Internal Use Only, Working Document in Review (2/03)226

## **Recommendations: Crash Avoidance Research**



Recent advances in crash avoidance technologies (e.g., forward collision avoidance) provide a unique opportunity to mitigate crashes involving distraction by sensing conflict situations during periods of inattention and alerting the driver. Other technologies in development are intended to actually sense driver inattention and provide a means of refocusing driver attention to the driving task. These efforts have the potential to mitigate the adverse consequences of inattention due to cell phone use as well as to other distractions. It is unclear at this time how effective these approaches will be, and more research is necessary to establish appropriate trigger algorithms, nuisance criteria and timings, and to determine the effectiveness of these approaches under real world conditions. It is also important to consider how drivers will adapt to these systems over time (i.e., behavioral adaptation) to ensure that use of these systems does not decrease safety by reducing vigilance or by allowing drivers to use these systems to drive the margin between safe and unsafe.

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227

## **Recommendations: Users**



**The driver's primary responsibility is to operate the vehicle safely. This requires undivided attention and focus on the driving task.**

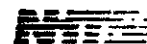
**Using wireless communications devices while driving can be distracting and increase the risk of crash and injury. Therefore, NHTSA recommends that drivers not use these devices while driving, except in emergency. This recommendation applies to both hand-held and hands-free devices.**

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228

36

## **Recommendations: Users**



- **Drivers who use wireless communication devices should not use them while driving. Instead, drivers should do at least one of the following:**
  - **Stop the vehicle in a safe location that is off the road, well away from traffic, before they receive or place their calls.**
  - **Allow a passenger to receive or place calls.**
  - **Use the phone's voice mailbox feature if so equipped, and return the call when not driving.**
- **All drivers should follow these guidelines, and employers are urged to adopt policies implementing them.**

NTSB Internal Use Only. Working Document in Review (2005)

229

37

## **Recommendations: Outreach**



Whereas efforts to educate and inform the public about the risks of distraction and cell phone use by drivers have been highlighted by the NTSB and the industry, past experience with education and public information programs has indicated that these efforts are likely to influence only limited segments of the population. It is nonetheless important to sensitize the general public to the issue of driver distraction. Because of the dynamic nature of cell phone technology and use in particular, we believe that distraction due to cell phones must be emphasized in any outreach programs. It is therefore recommended that:

- **A series of policy-based PSAs be developed, consistent with the NTSB's recommendations, and implemented to focus on the risks of distraction in general, with an emphasis on cell phones in particular.**
- **Because younger drivers appear to be most vulnerable to distraction and tend to use available technologies with less awareness of the potential dangers involved, a lecture series geared to high school students should be developed and included in school curricula to sensitize students to the issue of distraction in general and cell phones in particular.**
- **Employers should be encouraged to establish a formal policy with regard to distraction in general and the use of work-related technologies, including cell phones, while driving and be sensitized to issues of liability.**

NTSB Internal Use Only. Working Document in Review (2005)

230

## ***Recommendations: Legislation***



Decisions as to the need for legislation limiting the use of cell phones from a moving vehicle are a state or local issue and should be based on the determination by authorities that a sufficient problem exists in their jurisdiction to warrant action. Where such action takes place, however, it is recommended that provisions be made for an evaluation of the impact of such action in terms of use and crashes, particularly given the uncertainty of how the use of hands-free devices will influence overall safety.

In view of the greater risks associated with new or novice drivers it is also recommended that consideration be given to specifically prohibiting these drivers from using cell phones while driving, perhaps as a part of graduated licensing programs or through some period of time based on driving experience.

NTSA Internal Use Only, Working Document for Review (7/02)

231

## ***Information Needs From Industry***



In developing the various analyses and information for this report it was necessary to derive estimates from limited or incomplete information about the use of wireless devices in general and from moving vehicles, in particular. Availability of this information in the United States is further limited by the difficulty in obtaining phone records that would facilitate associating a crash with phone use, a problem not encountered in Canada, as reflected in the epidemiological studies referenced. In some cases relevant information is embedded in CTIA reports available at great cost. In the interest of providing research with the best available information to address the issues at hand, it would be helpful for these data to be made generally available so that research can more accurately reflect the true status of cell phone use. Recognizing that it may not be possible to provide all the desired data, the following page identifies a list of information that would be helpful.

NTSA Internal Use Only, Working Document for Review (7/02)

232

## ***Desired Data from Industry***



- **Call Frequency and Duration data**
  - Time of day distributions
  - Regional distributions
  - Roaming vs. non-roaming
  - 911 calls
- **Estimates of mobile vs. landline phone use**
- **Equipment Sales / Use data**
  - Hand-held
  - Hands-free
    - Headsets, Ear buds, Speakerphone systems, etc.
- **Customer Satisfaction / Survey Data**
  - Hands-free vs. Hand-held

NTSA Internal Use Only, Working Document in Review (WDR)233

## ***Applicability***

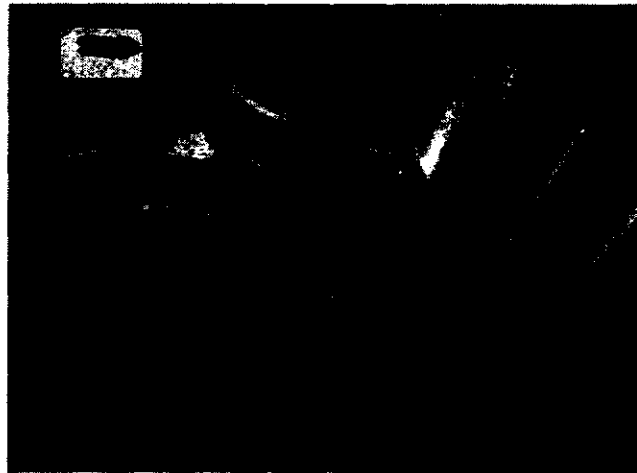


The findings, analyses and recommendations of this effort may have applicability to other issues associated with in-vehicle distraction in general, and the use of advanced in-vehicle technologies, in particular. With current trends for integrating device functionality and expanding the capabilities of advanced in-vehicle technologies, including wireless communications, it would appear that there is reason for concern. As more complex systems are placed in use, it is unknown at this time how, when and where these devices will be used by drivers. Similarly, many distractions other than those involving advanced technologies are also relevant to the research and recommendations presented, particularly from the standpoint of understanding the role they play in crashes, and how best to communicate the risks involved and address the behaviors.

NTSA Internal Use Only, Working Document in Review (WDR)234



## This Driver Lost Control While Using Phone and Struck a Stopped Construction Vehicle



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235

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249

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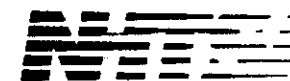
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NTSA Internal Use Only, Working Document to Bureau (2003)

250



# ***The Relationship Between On-Road Wireless Phone Use and Crashes***

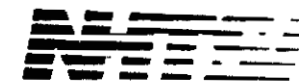


**NHTSA Advanced Research and Analysis**

NHTSA, For Internal Use Only, July 2003

July 2003

# ***What is Distraction?***

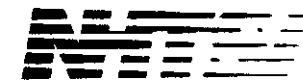


**Distraction refers to the diversion of attention away from the primary task of driving due to other visual, cognitive, auditory or biomechanical activities.**

- **At least 25% of crashes are distraction related.**
- **Examples of sources of distraction include:**

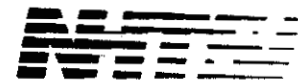
<b>Animals</b>	<b>Eating/Drinking</b>	<b>Reading</b>
<b>Cell Phone</b>	<b>Passengers</b>	<b>Rubber-necking</b>
<b>Children</b>	<b>Radio</b>	<b>Smoking</b>
- **It is not necessary for such activities to result in adverse consequences to be considered a distraction.**

# ***How Do Cell Phones Cause Crashes?***



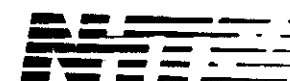
- **Review of cell phone related crashes provides insight into how driver actions and responses associated with cell phone use lead to crashes.**
- **There are four categories of distraction:**
  - **Visual** – e.g., Looking away from road to dial a number
  - **Biomechanical (manual)** – e.g., Manipulating a device
  - **Cognitive** – e.g., Lost in conversation or thought
  - **Auditory** – e.g., Startled by ringing phone
- **These forms of distraction most often occur in some combination.**

# ***Briefing Outline***

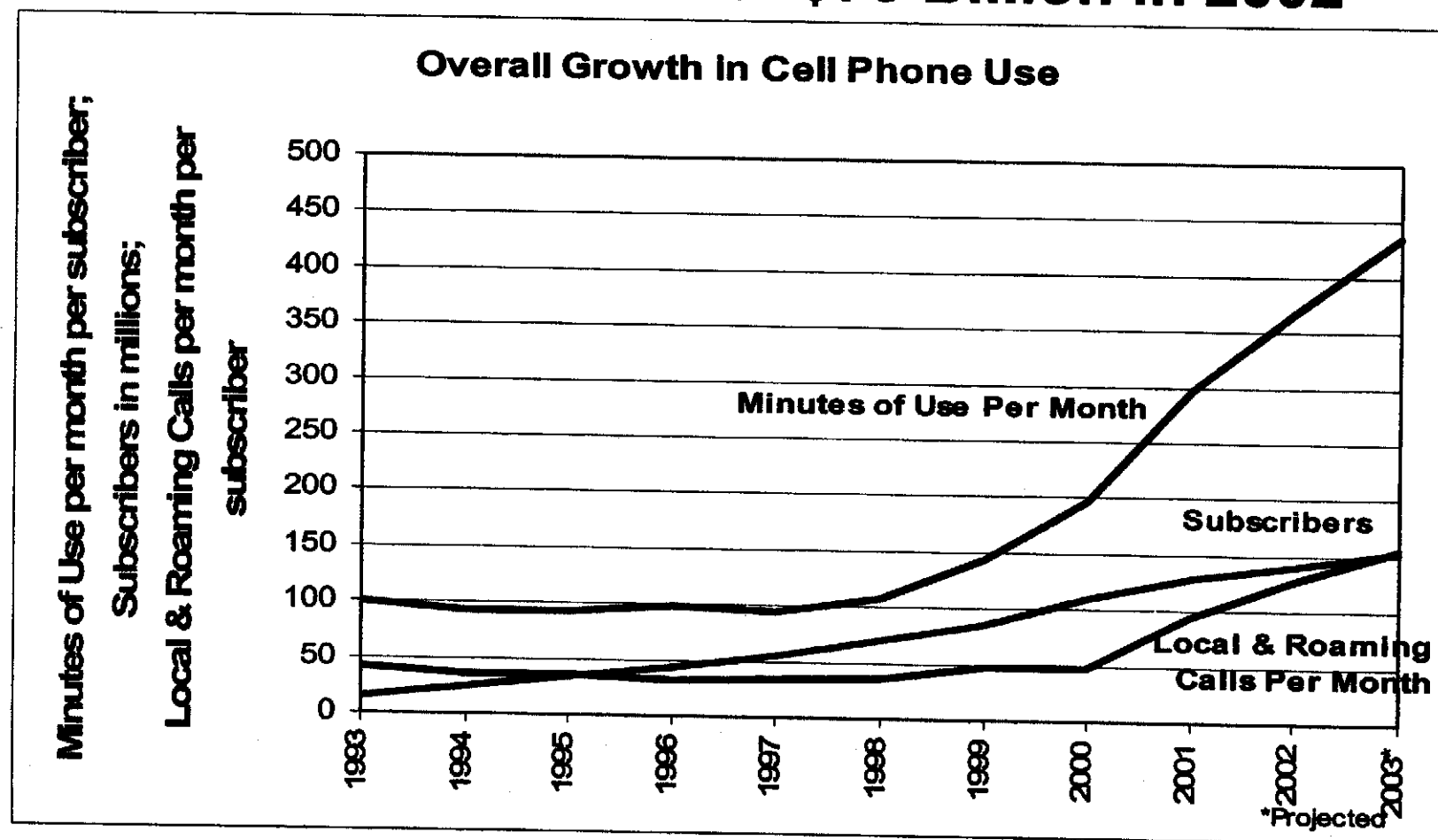


- **Industry Data and Position**
- **Current Cell Phone Usage Rates**
- **Crash Data and Cell Phone Use**
- **Concerns of the American People**
- **States' Legislation/regulations**
- **Research Studies**
- **Estimated Crash Risk**
- **NTSB Recommendations**
- **Dr. Runge With Policy Discussion**

# Cell Phone Growth

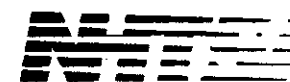


## Service Revenues of \$78 Billion in 2002



NHTSA, For Internal Use Only, July 2003

# ***CTIA Safety Tips***



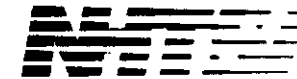
1. **Get to know your phone and its features, such as speed dial and redial.**
2. **When available, use a hands free device.**
3. **Position your phone within easy reach.**
4. **Let the person you are speaking to know you are driving; if necessary, suspend the call in heavy traffic or hazardous weather conditions.**
5. **Do not take notes or look up phone numbers while driving.**
6. **Dial sensibly and assess the traffic; if possible, place calls when you are not moving or before pulling into traffic.**
7. **Do not engage in stressful or emotional conversations that may divert your attention from the road.**
8. **Dial 9-1-1 to report serious emergencies -it's free from your wireless phone!**
9. **Use your phone to help others in emergencies.**
10. **Call roadside assistance or a special non-emergency wireless number when necessary.**

# ***NHTSA Surveys***



- **2000 NOPUS**
  - **4% of drivers using a handheld or hands-free cell phone during daylight hours**
  - **Estimated Exposure Time: 4.7 million hours per day in daytime**
- **2002 NOPUS**
  - **6% of drivers using a handheld or hands-free cell phone during daylight hours**
  - **Estimated Exposure Time: 7.4 million hours per day in daytime**
- **2002 National Survey of Distracted and Drowsy Driving Attitudes and Behaviors**
  - **Estimated 792 million trips each week in which drivers take incoming cell phone calls (19% of estimated 4.2 billion weekly trips)**
  - **Drivers who use cell phones reported an average of 4.5 minutes per call while driving**

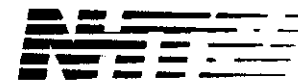
# ***Crash Data***



- **Cell phones not often reported as a contributing factor at the PAR Level**
- **Some states have initiated special studies**
  - **California**
  - **New York**
  - **Virginia**
  - **Wisconsin**
- **Identifying cell phone use as a contributing factor in a crash is very difficult without a witness or access to phone records even with more in-depth crash investigation**



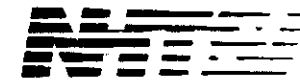
# ***Legislative Update: Public Opinion***



**Surveys of public opinion confirm the driving public's concern over the safety of using cell phones while driving and willingness to accept some restrictions. However, there are clear differences in the opinions of users and non-users. For example, data from 2002 national survey indicate that:**

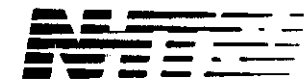
- 88% of all drivers support increased public awareness of the risks of wireless phone use while driving.**
- 57% of all drivers supports a ban on all wireless phone use while a car is moving (except for 911 calls). About one-fourth of drivers who use cell phones support such a ban compared to 69% of drivers who do not use cell phones.**
- 62% support increased fines for traffic violations involving cell phone use. About 40% of drivers who use cell phones support such fines compared to about 70% of drivers who do not use cell phones.**

# ***Legislative Update: State Activity***



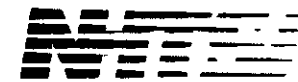
- **NY is still the only state to restrict use of hand-held phones while driving by general public.**
- **Several local jurisdictions have also restricted hand-held cell phone use while driving.**
- **Several states have restricted use of cell phones by novice drivers and/or school bus operators.**
- **Several states have established Task Forces and/or have set up special data collection activities on this issue.**
- **A few states have prohibited local restrictions.**
- **More than 30 states have considered legislation on the issue in the last year.**

# ***Legislative Update: State Activity***



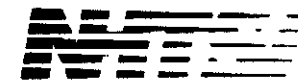
- **New Jersey enacted legislation in 2002 that prohibits the holder of a driver examination permit from using any interactive wireless device while operating a motor vehicle, with emergency exceptions.**
- **Maine enacted legislation in 2003 that requires persons under 21 to obtain an instruction permit and receive education and training prior to obtaining a driver's license. This legislation also prohibits drivers with only an instruction permit from using a mobile telephone while driving.**
- **Arkansas, Illinois, Massachusetts, New Jersey, Rhode Island, and Tennessee have enacted legislation that prohibits the use of cell phones while operating a school bus.**

# ***Hand-held vs. Hands-free***



- **Both hand-held and hands-free architectures increase risk while driving although the mechanisms may differ.**
- **Whereas hands-free phones may have some performance benefits, evidence indicates that drivers who use hands-free phones use them more frequently and for longer durations.**
- **It should be noted that hands-free phones come in many forms, and they differ significantly in demands on the driver.**
  - **Headsets, earpieces, and speakerphones**
  - **Some with voice dialing**
  - **Some with both voice dialing and voice command**

# ***Experimental Research***

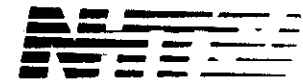


- **Large body of independent and NHTSA-sponsored studies (dozens of studies since the early 1990s) directed at issues associated with cell phone use while driving and traffic safety**
  - **In the laboratory**
  - **Using driving simulators**
  - **On-the-road research (controlled and naturalistic)**
  - **Observational research such as NHTSA's National Occupant Protection Use Survey (NOPUS)**

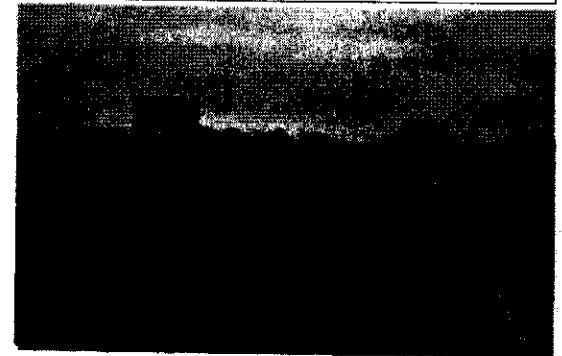
# **NHTSA**

## ***Experimental Research***

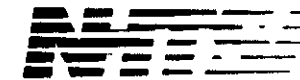
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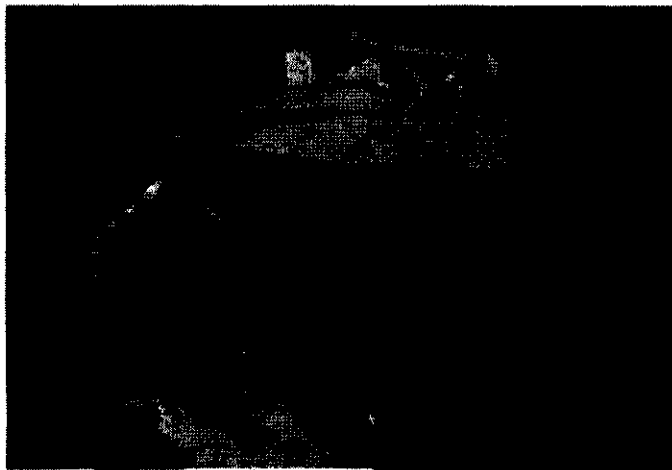
- **Test Track**
  - **Examined distraction from a number of in-vehicle devices, including cell phones**



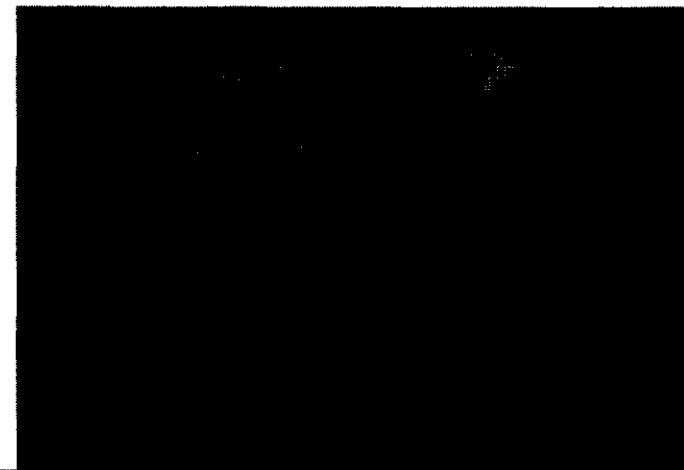
# NHTSA



## Experimental Research: Test Track



Dialing Handheld  
Cell Phone => Hits  
Traffic Control Barrel  
on Right



Hands-Free And  
Writing A List =>  
Crashes into Cross  
Traffic at Light

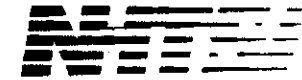


Destination Entry Navigation Display => Runs Off Road

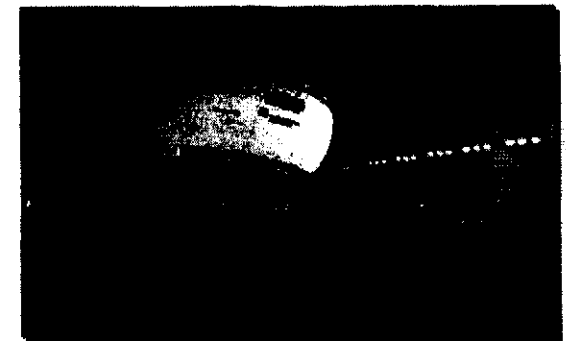
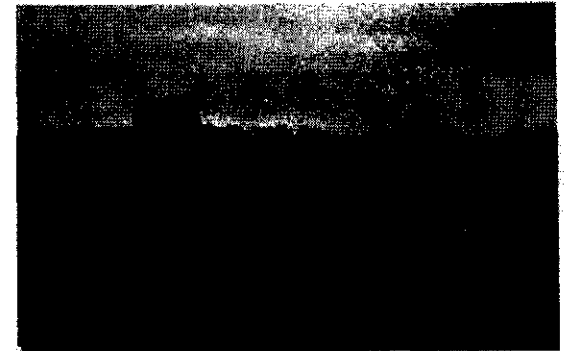
NHTSA, For Internal Use Only, July 2003

# **NHTSA**

## ***Experimental Research***



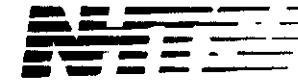
- **Test Track**
  - **Examined distraction from a number of in-vehicle devices, including cell phones**
  
- **NADS**
  - **Examination of driver performance and behavior using different cell phone architectures**





# **NHTSA**

## **Experimental Research: NADS**



**Hands-Free Phone  
Task => Crashes into  
Forward Vehicle**



**Handheld Phone  
Task => Runs off Right  
Side of Road**



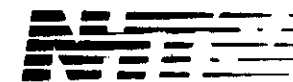
**Dialing A Handheld Cell Phone => Brakes Hard to Avoid Hitting Forward Vehicle**

**\*\*\*Important:** Video images of NADS study participants are subject to confidentiality agreements and may not be shown in the public domain without the express permission of the participants.

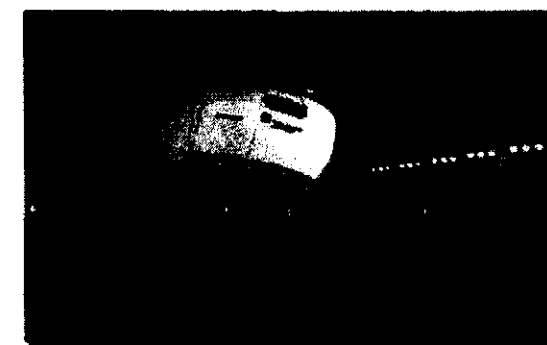
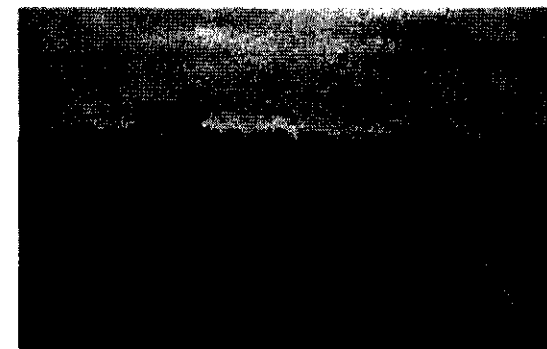
NHTSA, For Internal Use Only, July 2003

# **NHTSA**

## ***Experimental Research***



- **Test Track**
  - **Examined distraction from a number of in-vehicle devices, including cell phones**
- **NADS**
  - **Examination of driver performance and behavior using different cell phone architectures**
- **Naturalistic**
  - **100-car naturalistic study that will capture cell phone use under typical on-road driving conditions**



# NHTSA



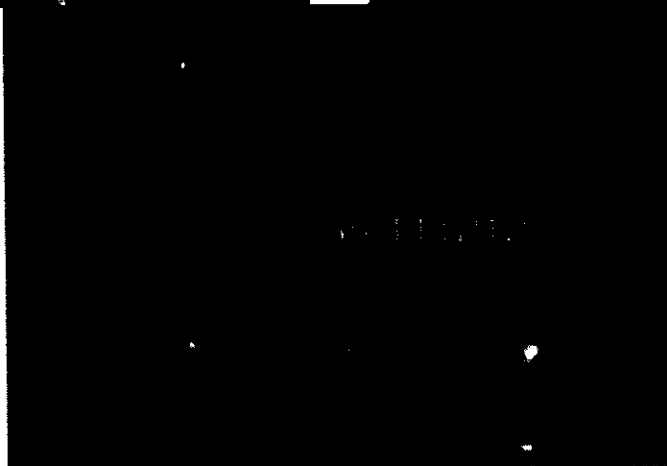
## *Experimental Research: Naturalistic*



Eating While Driving  
=> Crashes into  
Forward Vehicle



Handheld Phone  
Conversation  
& Personal Hygiene

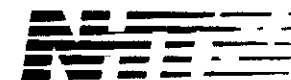


Answering Handheld Cell Phone => Runs off Right Side of Road

\*\*\*Important: Video images from 100-Car Naturalistic Driving Study are subject to confidentiality agreements and may not be shown in the public domain without the express permission of the participants. Public display of video at this time will compromise integrity of current study.

NHTSA, For Internal Use Only, July 2003

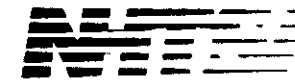
# A Tragic Example



*Rio de Janeiro, Brazil.*

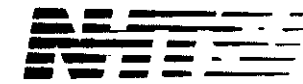
A vehicle is being removed from a busy road by a tow truck operator. A car hits the back of the truck, killing all the passengers - the driver, his wife and their daughter. The driver was talking on a cell phone and became distracted. He did not see the tow truck.

# ***Cost Benefit Studies***



- **AEI-Brookings Joint Center for Regulatory Studies**
  - **1999 78 fatalities per year (range 10-1000)\***
- **Harvard Center for Risk Analysis**
  - **2000 900 fatalities per year**
  - **2002 2,600 fatalities per year** (includes responsible drivers and others)
- **Both groups conclude that benefits and costs do not justify restrictions.**

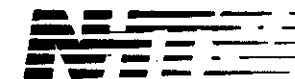
# ***Notable Comments from 2000 Harvard Study***



- **“The weight of the scientific evidence to date suggests that use of a cellular phone while driving does create safety risks for the driver and his/her passengers as well as other road users.”**
  - **However, they note that the magnitude of this risk is unknown**
- **“It is not clear whether hands-free cellular phone designs are significantly safer than hand-held designs, since it may be that conversation per se rather than dialing/handling is responsible for most of the attributable risk due to cellular phone use while driving.”**

**(Source: Lissy, Cohen, Park, & Graham, 2000)**

# ***NHTSA Estimates of Exposure While Driving in 2002***



<b>Percent of Daylight Driving Time Spent Using a Cell Phone</b> (2002 NOPUS)	6%
<b>Number of Drivers Using Cell Phones During the Average Daylight Moment</b> (2002 NOPUS)	801,000 drivers per moment
<b>Daylight Hours of Cell Phone Use While Driving Per Day</b> (derived from 2002 NOPUS data)	7,440,000 hours per day
<b>Daylight Miles Driven Using a Cell Phone Per Day</b> (derived from 2002 NOPUS data)	243,800,000 miles per day
<b>Trips While Taking Incoming Cell Phone Calls Per Day</b> <b>Trips While Making Outgoing Cell Phone Calls Per Day</b> (derived from National Survey of Distracted and Drowsy Driving Attitudes and Behaviors 2002)	113,000,000 trips per day 111,000,000 trips per day

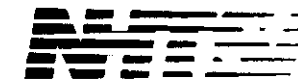
# ***Relative Risk Models***



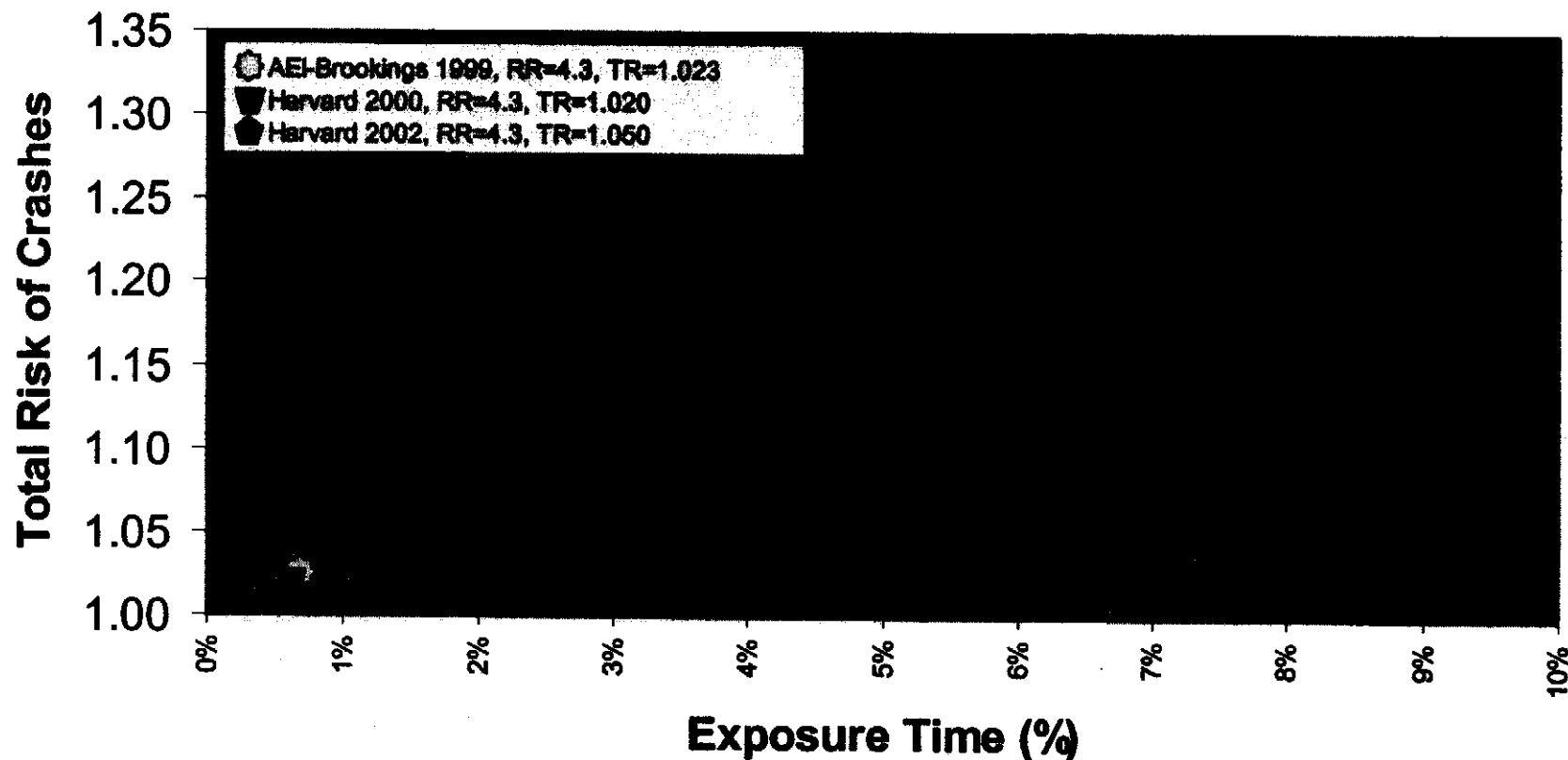
- **Purpose – Predict Increase in Total Risk of Crashes**
  - **Estimate the Increase Risk Due to the Distraction**
  - **Estimate the Duration of the Distraction Activity**
- **Most Published Analyses Have Used a High Relative Risk (RR) Factor (4.3) Based on Earlier Research and Low Exposure**
- **Recent Studies Indicate a Much Smaller RR (1.38)**
- **Recent Studies Also Indicate a Much Larger Degree of Exposure**



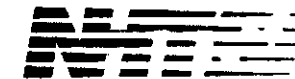
# Plotting Estimates of Total Risk of Crashes Across All Drivers



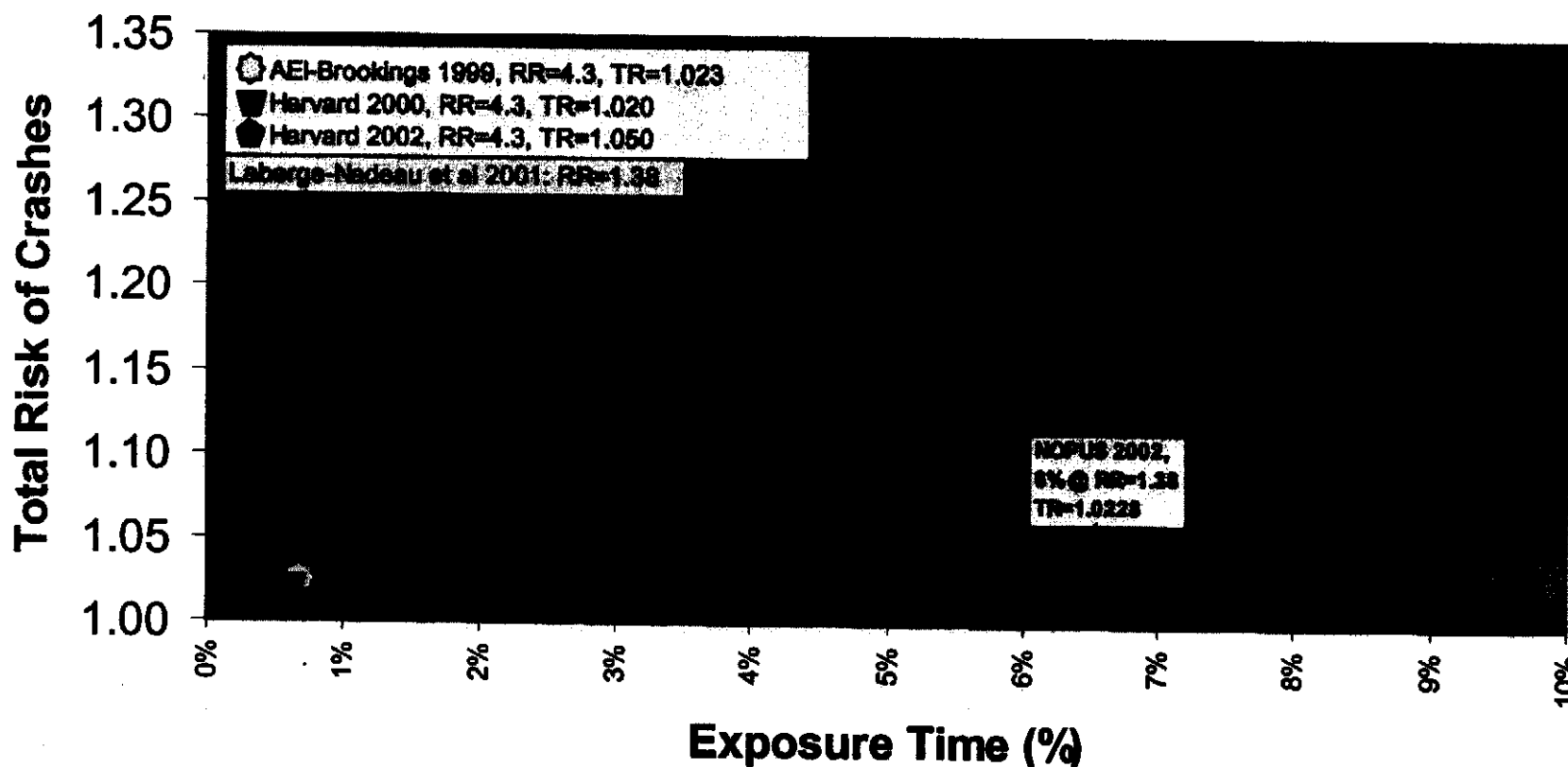
Summary of Estimated Total Risk of Crashes as Function of Exposure Time and Relative Risk Based on Results from Recent Studies



# Plotting Estimates of Total Risk of Crashes Across All Drivers



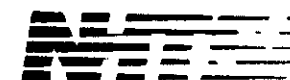
Summary of Estimated Total Risk of Crashes as Function of Exposure Time and Relative Risk Based on Results from Recent Studies



# NHTSA 2002 Crash Estimates

## Given 6% Exposure Time ( $\Delta T=.06$ )

### Conservative Risk Levels

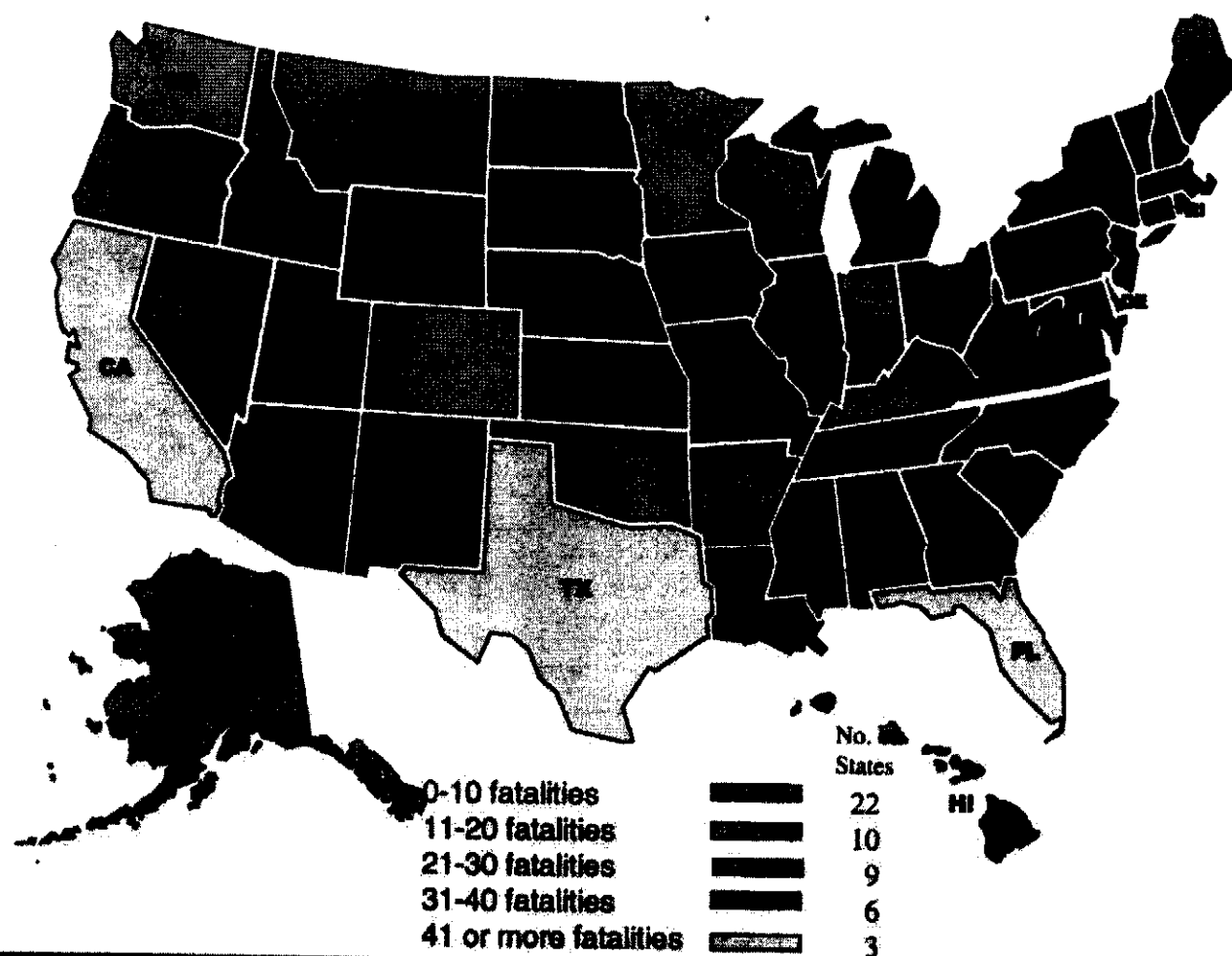


Year 2002	RR=1.0	RR=1.2	RR=1.38	RR=1.5
<b>Total Risk</b>	<b>1.0000</b>	<b>1.0120</b>	<b>1.0228</b>	<b>1.0300</b>
<b>Estimated Total Police Reported Crashes in which Cell Phone Use <u>Was Not</u> a Contributing Factor to the Crash</b>	<b>6,279,356</b>	<b>6,204,897</b>	<b>6,139,378</b>	<b>6,096,462</b>
<b>Estimated Police Reported Crashes in which Cell Phone Use <u>Was</u> a Contributing Factor to the Crash</b>	<b>0</b>	<b>74,459</b>	<b>139,978</b>	<b>182,894</b>
<b>Estimated Total Crashes (*CP) (Reported plus Non-reported)</b>	<b>0</b>	<b>127,853</b>	<b>240,355</b>	<b>314,046</b>
<b>Estimated PDO Crashes (*CP) (Reported plus Non-reported)</b>	<b>0</b>	<b>98,214</b>	<b>184,636</b>	<b>241,243</b>
<b>Estimated Injury Crashes (*CP) (Reported plus Non-reported)</b>	<b>0</b>	<b>29,184</b>	<b>54,864</b>	<b>71,685</b>
<b>Estimated Fatal Crashes (*CP)</b>	<b>0</b>	<b>455</b>	<b>855</b>	<b>1,117</b>
<b>Estimated Fatalities (*CP)</b>	<b>0</b>	<b>508</b>	<b>955</b>	<b>1,248</b>

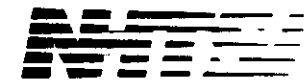
\*CP = Cell Phone Was a Contributing Factor to the Crash

Note that calculations assume distribution of crash severity (fatal, injury, PDO) is same for total police reported crashes and for crashes in which cell phone use was a contributing factor to the crash; and equivalence in relative risk is assumed across for daytime and nighttime.

***Distribution of Estimated Fatalities in which  
Cell Phone Use was Contributing Factor  
By State For 2002, RR=1.38***

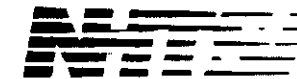


# ***Future Directions in U.S. Mobile Phone Use***



- **Results from 2002 quarterly Telephia surveys indicate the following:**
  - **About 35% of young adults (ages 18-24) use their wireless service for more than 500 minutes per month, compared to 20% of all users.**
  - **Use of SMS and other 2-way messaging services has increased from 12% in 2001 to 20% in 2002.**
  - **45% of young adults say they frequently use wireless data services, including SMS and the wireless internet, compared with 22% of all users combined.**

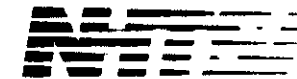
# ***NTSB Report / Hearing***



- **Single crash that took the lives of 5 persons, including a driver who was using a wireless phone at the moment she lost control of her vehicle.**
- **Interstate 95/495 (the Capital Beltway) near Largo, Maryland**
- **The Board found that the probable cause of the crash was the Explorer driver's failure to maintain control of her vehicle in the windy conditions due to a combination of inexperience, unfamiliarity with the vehicle (she had just purchased it that evening), speed and distraction caused by use of a handheld wireless telephone.**

# **NTSB Recommendations**

**June 3, 2003**



## **Safety Recommendations to NHTSA**

1. **Develop in conjunction with The Advertising Council, Inc., a media campaign stressing the dangers associated with distracted driving.**
2. **Develop in conjunction with the American Driver and Traffic Safety Education Association a module for driver education curriculums that emphasizes the risks of engaging in distracting behavior.**
3. **Determine the magnitude and Impact of driver-controlled, in-vehicle distractions, including the use of interactive wireless communication devices on highway safety and report findings to the United States Congress and the States.**

## **Safety Recommendations to the States**

4. **To the 49 States that do not have such legislation, enact legislation to prohibit holders of learner's permits and intermediate licenses from using interactive wireless communication devices while driving.**

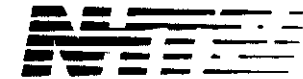
# ***Last Official NHTSA Statement***



- **“NHTSA's consumer information will now include advice that growing evidence suggests using a wireless phone or other electronic device while driving can be distracting and drivers should not talk on the phone or use other devices while their vehicles are in motion.”** *[Emphasis added]*
  - Rosalyn G. Millman, NHTSA Acting Administrator, July 18, 2000
- **This NHTSA position has not been widely publicized.**



# ***Safety Tips from Transport Canada***



## **Transport Canada Fact Sheet RS200-06 (TP2436E, December 2001) <sup>65, 66</sup>**

- “Transport Canada recommends against using cell phones while driving. It is distracting and increases the risk of collision. Your primary concern is the safe operation of the vehicle.”

### **To avoid collisions arising from the use of cell phones:**

- Turn the phone off before you start driving. Let callers leave a message.
- If there are passengers in the vehicle, let one of them take or make a call. If you're expecting an important call, let someone else drive.
- If you have to make or receive a call, look for a safe opportunity to pull over and park.

# **GSA (2002)**

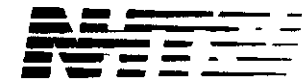


- ***Recommended policy (FMR Bulletin B-2) on the use of wireless phones while driving motor vehicles owned or leased by the Federal Government. Federal agencies should:***
  - **Discourage the use of hand-held wireless phones by a driver while operating motor vehicles owned or leased by the Federal government.**
  - **Provide a portable hands-free accessory and/or hands-free car kit for government owned wireless phones.**
  - **Educate employees on driving safely while using hands-free wireless phones.**

# ***NHTSA Proposed Policy***

## ***Recommendations to OST, July 2002***

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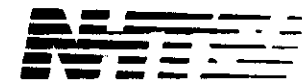


**The driver's primary responsibility is to operate the vehicle safely. This requires undivided attention and focus on the driving task.**

**Using wireless communications devices while driving can be distracting and increase the risk of crash and injury. Therefore, NHTSA recommends that drivers not use these devices while driving, except in emergency. This recommendation applies to both hand-held and hands-free devices.**

# ***NHTSA Proposed Policy***

***Guidelines for Implementation, July 2002***



- **Drivers who use wireless communication devices should not use them while driving. Instead, drivers should do at least one of the following:**
  - **Stop the vehicle in a safe location that is off the road, well away from traffic, before they receive or place their calls.**
  - **Allow a passenger to receive or place calls.**
  - **Use the phone's voice mailbox feature if so equipped, and return the call when not driving.**
- **All drivers should follow these guidelines, and employers are urged to adopt policies implementing them.**

## **DRAFT: NHTSA CELL PHONE POLICY**

The wireless communications industry has grown at an extraordinary rate in recent years. There are currently more than 170 million cell phone subscribers – more than half of the U.S. population. According to a National Highway Traffic Safety Administration survey, 6% of daylight driving time – up from 4% in 2000 - involves talking on the phone.

However, NHTSA's position is that the primary responsibility of the driver has always been to operate a motor vehicle safely. It is a task that requires full attention and focus. Statistics show that all distractions, whether associated with the use of technology or not, can increase the risk of a crash.

NHTSA estimates that driver distraction contributes to about 25 percent of all police-reported traffic crashes. Though all distractions are a concern, we have seen the growth of a particular distraction, namely cell phone use while driving. While the precise impact cannot be quantified, we nevertheless have concluded that the use of cell phones while driving has contributed to an increasing number of crashes, injuries and fatalities.

A significant body of research worldwide indicates that both hand-held and hands-free cell phones increase the risk of a crash. Indeed, research has demonstrated that there is little, if any, difference between the use of hand-held and hands-free phones in contributing to the risk of a crash while driving distracted. Hands-free or hand-held, we have found that the cognitive distraction is significant enough to degrade a drivers' performance.

We recommend that drivers not use these devices when driving, except in an emergency. Moreover, we are convinced that legislation forbidding the use of handheld cell phones while driving may not be effective in improving highway safety since it will not address the problem. In fact, such legislation may erroneously imply that hands-free phones are safe to use while driving.

## **DISTRACTION STATEMENT DRAFT**

Whether the vehicle is a small car or a large truck, there are many things that can distract the driver from his or her primary task – getting to a destination safely. Those distractions come in a many forms, from eating and drinking to conversations with others in the vehicle. While drivers must recognize that all distractions can be dangerous, wireless communication devices are a particularly unique and troublesome since they involve cognitive distraction. Research has consistently demonstrated that diversion of a driver's cognitive attention can seriously impair the ability to drive safely. And, the reality is, driver' performance can be compromised regardless of whether the device is hand-held or hands- free. Consequently, we recommend that drivers not use a cell phone while driving.

(DRAFT LETTER)

Dear Governor:

As you know, the wireless communications industry has grown at an extraordinary rate. Today there are more than 147 million cell phone subscribers – more than half of the U.S. population. According to a survey by the National Highway Traffic Safety Administration, 6% of daylight driving time – up from 4% in 2000 - involves talking on the phone. That translates into more than 200 million in-car calls per day.

However, the primary responsibility of the driver has always been to operate a motor vehicle safely. It is a task that requires full attention and focus. Statistics show that all distractions, whether associated with the use of technology or not, can increase the risk of a crash.

NHTSA estimates that driver distraction contributes to about 25 percent of all traffic crashes. Though all distractions are a concern, we have seen the growth of a particular distraction, namely cell phone use while driving. While the precise impact cannot be quantified, we nevertheless have concluded that the use of cell phones while driving has contributed to an increasing number of crashes, injuries and fatalities.

A significant body of research worldwide indicates that both hand-held and hands-free cell phones increase the risk of a crash. Indeed, research has demonstrated that there is little, if any, difference between the use of hand-held and hands-free phones in contributing to the risk of driving while distracted. In either operational mode, we have found that the cognitive distraction is significant enough to degrade a drivers' performance.

We recommend that drivers not use these devices when driving, except in an emergency. Moreover, we are convinced that legislation forbidding the use of handheld cell phones while driving will not be effective since it will not address the problem. In fact, such legislation may erroneously imply that hands-free phones are safe to use while driving.

We will be working at the national level on an educational campaign to alert drivers to the risks associated with the use of wireless communication devices while driving. Meanwhile, we recommend that police agencies in your state vigorously enforce existing traffic laws whenever motorists operate vehicles in an unsafe manner as a result of distracted driving or other behavior.

Your state should also consider the vulnerability of novice drivers as it relates to distractions, including cell phone use. Countermeasures, including education and restrictions on cell phone use by novice drivers may be an appropriate way to address the problem.

To further assist you and the lawmakers of your state, NHTSA has developed a comprehensive summary of available research on the subject. It can be accessed through the website: [www.nhtsa.dot.gov](http://www.nhtsa.dot.gov).

If my staff can provide you with further information, have them contact Ray Owings,  
NHTSA Associate Administrator for Advanced Research and Analysis, (202) 366-1537.

Sincerely,

Norman Y. Mineta, Secretary



**WIRELESS COMMUNICATION DEVICES  
TALKING POINTS  
JULY 2003**

**Background:** The wireless industry has grown at an extraordinary rate. Today there are over 147 million cell phone users – more than half of the U.S. population. According to a NHTSA survey, 6% of daylight driving time – up from 4% in 2000 - involves talking on the phone. That translates into more than 200 million in-car calls daily.

- The primary responsibility of the driver at all times is to operate a motor vehicle safely. It is a task that requires full attention and focus.
- Statistics show that all distractions, whether associated with the use of technology or not, can increase the risk of a crash. NHTSA estimates that driver distraction contributes to about 25 percent of all traffic crashes.
- Though all distractions pose a potential safety risk, we have recently seen the growth of a particular distraction, namely cell phone use while driving.
- Though the precise impact cannot be quantified through traditional data collection processes, we nevertheless have concluded that the use of cell phones while driving has contributed to an increasing number of crashes, injuries and fatalities.
- A significant body of experimental research indicates that both hand-held and hands-free cell phones increase the risk of a crash. Indeed, there is little if any difference between hand-held and hands-free phones in contributing to the risk to themselves and others.
- Limiting use to hands-free phones while driving will not solve the problem. In either operational mode, we have found that the cognitive distraction is significant enough to degrade a drivers' performance. We therefore recommend that drivers not use wireless communication devices, including text messaging systems, when driving, except in an emergency.
- Moreover, legislation that only forbids the use of handheld cell phones while driving will not be effective since it will not address the problem. In fact, such legislation may erroneously imply that hands-free phones are safe.
- States should additionally consider the increased vulnerability of novice drivers as it relates to distractions, including cell phone use. Countermeasures, including education and restrictions on cell phone use by young drivers, are advised.
- Wireless communication devices are not the only driver distraction of concern to NHTSA. The agency will continue to study the range of distractions and will develop programs and partnerships as necessary to reduce those risks. The agency also will monitor the impact of driver adaptation to wireless communication devices.

- The agency also will continue to work with industry to make sure that wireless and other technologies will be developed to minimize driver distraction.

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