CELL PHONE USE AND MOTOR VEHICLE COLLISIONS: A REVIEW OF THE STUDIES

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FOREWORD

This report is a response to House Concurrent Resolution No. 294, Senate Draft 1, which was adopted by the Legislature during the Regular Session of 2005. The resolution requests the Legislative Reference Bureau to conduct a review of existing studies and statistics on the causal relationship between wireless telephone use while operating a motor vehicle and increased motor vehicle-related accidents. This report contains our findings and recommendations on the matter.

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FACT SHEET

House Concurrent Resolution No. 294, S.D. 1, adopted by the Legislature in the 2005 Regular Session, requested the Bureau to conduct a review of existing studies and statistics on the causal relationship between wireless telephone use while operating a motor vehicle and increased motor vehicle-related accidents.

I. Highlights

The Bureau reports that studies have found the following:

1. The studies find that cellular telephone use while operating a motor vehicle is a distraction-inducing action.

2. The studies generally do not prove or disprove that cellular telephone use while operating a motor vehicle is a cause of motor vehicle collisions. Instead, the studies generally find that a statistical association, not necessarily a causal relation, exists between cellular telephone use while operating a motor vehicle and motor vehicle collisions.

3. The studies do not address whether cellular telephone use while operating a motor vehicle is the most prevalent cause of motor vehicle collisions among collisions that are caused by a distraction-inducing action. Instead, the studies address associations, rather than causal relations, between various potential distractions and motor vehicle collisions. However, no definitive answer has yet emerged as to which driver distraction is associated with the greatest risk of crash involvement.

4. Last, the studies find that a hands-free cellular telephone is not much safer than a hand-held cellular telephone. Both tend to be equally distracting. Moreover, the type of phone does not affect the statistical association between phone use and the risk of a crash.

II. Frequently Asked Questions

1. *Is causation difficult to prove?*

   Answer: Yes. The gold standard for proving causation is the randomized experiment, in which a large number of people are randomly selected and divided into two groups. In this instance, one group would be required to use cellular telephones while driving. The other group would be prohibited from using cellular phones while driving. The task for the experimenters would then be to wait and see which group is involved in more motor vehicle collisions over a period of time.

Such a study, it is noted, would be very difficult to perform and possibly unethical.

2. *How is an association different from causation?*

Answer***:*** Association means that two or more variables are related in some fashion. In contrast, causation means that two or more variables are causally linked. An association may be circumstantial evidence for causation, it does not *prove* causation.

The following are examples of a causal relation between an event A and an event B, in which event A *causes* event B (taken from the article on "Causality" from Wikipedia, the free encyclopedia, at http://en.wikipedia.org):

- A cue ball colliding with the eight ball causes the eight ball to roll into the pocket.

- The presence of heat *causes* water to boil.

- The moon's gravity *causes* the Earth's tides.

- A good blow to the arm *causes* a bruise.

- My pushing of the accelerator *causes* the car to go faster.

In contrast, the following are examples of an association between an event A and an event B (taken from the articles on "Causality", "Joint effect", and "Wrong direction", in Wikipedia, the free encyclopedia, at http://en.wikipedia.org, and from Burns, W.C., Spurious Correlations, at http://www.burns.com):

- Good health was associated with bodily lice infestation, during the Middle Ages. Thus, people of that time incorrectly inferred that the departure of bodily lice caused sickness. The reverse turned out to be the truth. The rise in bodily temperature during a sickness caused the lice to leave.

- The shoe size of a child is associated with the child's reading skills. Does reading practice cause the feet to grow? Or does growing feet stimulate the desire to read? Neither is correct. With age, a child's reading skills naturally improve and the child's feet naturally grow.

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Chapter 1

INTRODUCTION

This report is the Bureau's response to House Concurrent Resolution No. 294, Senate Draft 1, which was adopted by the Legislature during the regular session of 2005. The resolution requests the Legislative Reference Bureau to conduct a review of existing studies and statistics on the causal relationship between wireless telephone use while operating a motor vehicle and increased motor vehicle-related accidents, and to report its findings, recommendations, and any proposed legislation prior to the next regular session (see Appendix A).

The resolution indicates that the Legislature recognizes that the use of wireless telephone while operating a motor vehicle is not "the only distraction-inducing act committed by drivers." Accordingly, the Legislature is hesitant to impose a ban on such use of a wireless telephone until the Legislature can first determine that wireless telephone use while operating a motor vehicle is "the most prevalent cause of distraction-induced motor vehicle accidents."

Restated, the three major issues raised in the resolution are as follows:

(1) Is cellular telephone use while operating a motor vehicle a distraction-inducing action?

(2) Is cellular telephone use while operating a motor vehicle a cause of motor vehicle collisions?

(3) Is cellular telephone use while operating a motor vehicle the most prevalent cause of motor vehicle collisions among collisions caused by a distraction-inducing action?

In other words, the resolution asks whether cell phone use is a driver distraction, a cause of motor vehicle accidents, and the most prevalent driver distraction that causes motor vehicle accidents. The resolution also contains a sub-issue on whether hands-free cell phones are safer than hand-held cell phones.

The short answers to these three issues, based on the statistical studies that were reviewed by the Bureau, are as follows:

(1) Yes. The studies indicate that cellular telephone use while operating a motor vehicle is a distraction-inducing action. A hands-free phone is not much safer than a hand-held phone. This issue is discussed in chapter 2.

(2) The answer is not known. Instead, the studies generally find that a statistical association, not necessarily a causal relation, exists between cell phone use while operating a motor vehicle and motor vehicle collisions. A hands-free phone is not much safer than a hand-held phone. This issue is discussed in chapter 3.

(3) The answer is not known. The studies examine possible associations, rather than causal relations, between various potential distractions and motor vehicle collisions. However, no definitive answer has yet emerged as to which driver distraction is associated with the greatest risk of crash involvement. This issue is discussed in chapter 4.

The Bureau's findings are detailed in the following chapters.

Chapter 2

EXPERIMENTS ON CELL PHONE DISTRACTIONS

This chapter deals with the first issue raised under H.C.R. No. 294, S.D. 1, that is: whether cellular telephone use while operating a motor vehicle is a distraction-inducing action. It should be noted that this issue has already actually been conceded by the Legislature. As stated earlier, the Legislature expressly recognizes in the resolution that such cell phone use is not the only distraction-inducing act engaged in by drivers. This recognition is either an assumption or implicit recognition that such use is a distraction-inducing act.

In any case, the purpose of this chapter then is to merely confirm the Legislature's belief that cell phone use while operating a motor vehicle is indeed a driver distraction.

The Bureau reviewed a line of studies mainly from 2001 to 2003 that use experiments to determine whether a driver's use of a cellular telephone while operating a motor vehicle distracts the driver. These experimental studies measure whether cell phone use degrades driving performance relative to driving without using the cell phone.

Distraction itself, notes McKnight and McKnight (1991), is not directly observable. It is a hypothetical construct that explains why performance of some task is degraded in the presence of certain conditions. The extent to which cellular phones are a distraction can be assessed through measures of response to changes in the highway-traffic environment that require the driver to do something. The presence of a distraction can be inferred from a driver's failure to respond or from the driver's delayed responses.

These studies are conducted using either a driving simulator or on-road test tracks in order to test for distraction. An outcome is measured and compared under different driving conditions. The most common outcome is braking response. Other outcomes include vehicle control responses, driving performance, and driver errors. Generally, the control condition is driving only. The driving condition at issue is driving while using a cell phone. Both hand-held and hands-free conditions are studied.

These studies primarily find that using a cell phone while driving degrades driving performance when compared to driving without using a cell phone. The use of a cell phone increases non-responses or slows response time to traffic situations and traffic signals. In particular, phone use slows the braking response time, and the impairment increases as traffic density increases. Cell phone use also has after-effects, as the negative effects of using a cell phone, such as disobeying the speed limit and failing to stop, possibly extend even after the termination of the call. Use of a cell phone while driving results in a reduction of car speed and an increase in the distance from the leader car.

A secondary finding of these experimental studies is that use of a hands-free cell phone is as equally distracting as the use of a hand-held phone. Both types of phone use produce equivalent deficits or nearly identical performance decrements. Accordingly, a hands-free phone does not appear much safer than a hand-held phone. However, one experimental study did find that use of a hands-free phone is effective to some extent. It noted that with single-handed driving using a cellular phone, break reaction time is delayed, there is significant deflection of the steering wheel, and stable driving is difficult. That study nonetheless found that either type of cell phone use will delay the driver's information processing.

Due to the experimental nature of these studies, the applicability of these studies to the real world is questionable. It has been pointed out that it is unknown whether experimental findings are applicable to drivers using phones in their own vehicles (McEvoy et al. (2005)). Experimental studies have not examined actual traffic incidents (Violanti and Marshall (1995)). Experimental studies have not directly addressed the issue of collision risk (Wilson et al. (2003). Finally, simulation experiments are only indirectly related to driving (Congsiglio et al. (2003)).

Nevertheless, these studies collectively suggest some real world implications. One is that the reduction of car speed and increased distance from the leader car may cause disruption in the flow of traffic and become dangerous on congested roads or in fast traffic. Another is that prolonging the driver's reaction time prolongs the stopping distance. Accordingly, if the distance needed to stop the car is larger than the headway distance of the car, a collision could occur. Additionally, increased reaction time in braking can increase the frequency and severity of collisions by reducing the time available for a driver to choose and carry out an avoidance maneuver. Finally, because cell phone use erodes the performance safety margin and distracts drivers from their critical primary task of vehicle control, it can be anticipated that a causal relation exists between cell phone use and collisions.

In summary, then, these experimental studies suggest that the use of a cell phone while driving is a distraction. It degrades driving performance because it increases non-responses or slows response time to traffic situations and traffic signals in driving simulators and on-road test tracks. Also, it does not appear that a hands-free phone is much safer than a hand-held phone.

Table 1, on the following page, outlines the studies that served as references for this chapter.

TABLE 1. EXPERIMENTS ON CELL PHONE DISTRACTIONS

Study	Type of Experiment	Participants	Driving performance to be measured to infer distraction	Driving conditions under which performance is measured	Does cell phone use degrade driving performance relative to the control condition?	Does a hands-free phone degrade performance to a lesser degree than does a hands-held phone?	Real world implications
McKnight and McKnight (1991)	Driving simulator	Young (25 and under); Middle-age (26-49); and Older persons (50 and older)	Vehicle control responses	Control (no distraction); Placing a call; Casual phone conversation; Intense phone conversation; Tuning a radio (benchmark)	Yes. Cell phone use significantly increases non-responses and time to respond to highway-traffic situations.	--	--
Fuse et al (2001)	Driving simulator	Male college students	Braking response	Driving only; Placing a call while looking at the phone; Reaching for a phone with eyes on the road; Reaching for a phone with eyes on the phone; Placing a call without vision restraint; Answering a call without vision restraint; Audio cassette tape playing; Repeating on the phone what is heard on the tape	Yes. The driver's reaction time is prolonged when the driver is grasping a mobile phone in one hand and looking at it while driving. Engaging in conversation has a relatively smaller influence on driving performance.	--	Prolonging the driver's reaction time prolongs the stopping distance. If the stopping distance is larger than the headway distance of the car, a collision could occur.
Ishida and Matsuura (2001): Japan	On-road test track	Young adults, mostly male, aged 20 years or less, 21-22 years, and 31 years or older	Driving performance	Driving only; Listening to radio; Hands-free phone use; Hand-held phone use	Yes. Car speed reduces and the distance from the vehicle in front lengthens. Gaze is fixed to the front, eye movement decreases, and division of attention declines. When initially operating the cell phone, glance time towards the apparatus is substantial and the driver will be looking aside.	Yes, to some extent. With a hand-held phone, brake reaction time is delayed, there is significant deflection of the steering wheel, and stable driving is difficult.	Reducing car speed and increasing the distance from the leader car may cause disruption in the flow of traffic and become dangerous on congested roads or in fast traffic.

Study	Type of Experiment	Participants	Driving performance to be measured to infer distraction	Driving conditions under which performance is measured	Does cell phone use degrade driving performance relative to the control condition?	Does a hands-free phone degrade performance to a lesser degree than does a hands-held phone?	Real world implications
Strayer et al (2001): Utah	Driving simulator	Male and female undergraduates aged 18 to 30	Braking response	Listening to radio (control); Listening to a book on tape (control); Hand-held phone conversation; Hands-free phone conversation	Yes. Participants engaging in cell phone conversations missed twice as many simulated traffic signals as when they were not talking on the cell phone. Participants took longer to react to those signals that they did detect.	No	--
Strayer et al (2003): Utah	Driving simulator	Male and female undergraduates aged 18 to 32	Braking response	Driving only (control); Conversing on a hands-free cell phone on a call initiated prior to driving, and driving	Yes. The impairment increases as traffic density increases	--	--
Hancock et al (2003): Massachusetts	On-road test track	Younger (ages 25-36 years); and Older (ages 55-65) drivers	Braking response	No cell phone task or stopping task (control); Cell phone task: manual and recall functions—no conversation; Stopping task; Cell phone task and stopping task	Yes. Cell phone use significantly reduces stopping accuracy.	--	Phone use erodes performance safety margin and distracts drivers from their critical primary task of vehicle control. As such, it can be anticipated that a causal relation exists between in-vehicle technologies and collisions.
Consiglio et al (2003): Ohio	Driving simulator	Young adults, male and female (18-27 years of age)	Braking response	No phone use (control); Listening to music on a radio; Conversing with a passenger; Conversing using a hand-held phone; Conversing using a hands-free phone	Yes. Phone use slows braking response time, compared to braking response under the control condition.	No	Increased reaction time in braking can increase the frequency and severity of collisions by reducing the time available for a driver to choose and carry out an avoidance maneuver.
Abdel-Aty (2003): Florida	Driving simulator	Not specified	Driver errors	Driving prior to the call; Answering and conversing on hand-held phone; Answering and conversing on a hands-free phone; Driving after the call	Yes. Also, the negative effect of using a cell phone possibly extends after termination of the call. Disobeying the speed limit and failing to stop are dominant after phone calls.	No	--

Chapter 3

CELL PHONE USE AND MOTOR VEHICLE COLLISIONS

This chapter deals with the main issue raised under H.C.R. No. 294, S.D. 1. This issue, the second of the three, is whether a *causal* relation exists between telephone use while operating a motor vehicle and motor vehicle collisions – in other words, proof that cell phone use actually causes motor vehicle accidents. The studies reviewed in this chapter are therefore discussed in more detail than were the studies in the previous chapter.

It should be noted at the outset that the Bureau was not able to find any studies that sought to prove a causal relationship between wireless telephone use while operating a motor vehicle and increased motor vehicle-related accidents. Evidently, proving causation is very difficult to do.

Instead, the Bureau found studies dating from 1995 to 2005 that sought to prove that an *association* exists between cellular phone use while operating a motor vehicle and a motor vehicle collision. These studies conclude that cell phone use while operating a motor vehicle is statistically associated with motor vehicle collisions. However, most of them also expressly caution that their conclusions do not necessarily imply that a causal relation exists between cell phone use and motor vehicle collisions. In other words, they state that a statistical association is not the same thing as a causal relation. Also, a common limitation noted in the studies is the lack of data that drivers were actually using cell phones at the time of the collision. One of the studies, though, does conclude that its finding of an association, together with the satisfaction of other criteria, support a causal inference between cellular phone use and crash risk.

In statistics, an association comes from two variables that are related. Association is often confused with causation. Association does not imply causation (Wikipedia article on "Association (statistics)," at http://en.wikipedia.org). As a general matter, a mere association between two events A and B does not necessarily mean that event A is a cause of event B. The reverse could be true. The association could mean that event B is a cause of event A. Furthermore, it is also possible that a third, as yet unaccounted for, event C is the cause of both event A and event B (see Wikipedia article on "Correlation implies causation (logical fallacy)", at http://en.wikipedia.org).

All of these studies are conducted by using what appears to be the case-control design, or a variation of it, to compare data on actual cell phone use with data on actual motor vehicle collisions. The data on cell phone use and motor vehicle collisions are collected from cell phone companies, police reports, government reports, insurance files, field observations, and driver interviews or questionnaires. In the case-control design, a case group is compared against a control group with regard to whether some outcome event occurred or did not occur. In general, the case and control groups are defined by whether or not the driver sustained a collision, and the outcome event is past cell phone use. In some of the studies, though, the case and control groups are defined instead by whether or not the driver uses a cell phone, and the outcome event is a past collision. A variation of the case-control design is the case-crossover design, in which the case group "crosses over" to become the control group as well, and instead, the hazard interval, which is an interval of time leading up to the collision, is compared with a control interval, which is the same interval of time on a day in which a collision did not occur.

As stated previously, these studies find that cell phone use while driving is statistically associated with an increased risk of a motor vehicle collision. Stated intuitively, a driver who uses a cell phone while driving is more likely to have an accident than is a driver who does not use a cell phone while driving. The studies provide estimates of the risk. These estimates range in magnitude from 1.16 to 9.0.

A secondary finding of these real world studies is that the association between phone use and risk of a crash is not affected by the type of phone. No safety advantage is found in using hands-free phones rather than a hand-held phones.

These studies are grouped by study design and briefly described below.

Case-control studies:

In Violanti and Marshall (1995), the study was conducted in New York State. The objective of the study was to examine the association among cell phone use, eighteen other driver inattention factors, and actual traffic accidents. The case group was drivers who filed an accident report for a serious traffic accident in 1992-1993. The control group was drivers whose record checks indicated the absence of any reported traffic accidents within the past ten years. The outcome event was monthly cell phone usage in the vehicle, which were obtained from cell phone billings. The authors found that use of a cell phone in a vehicle for more than 50 minutes per month was associated with a 5.59-fold increased risk of a traffic accident.

The study's limitations, as reported by the authors, were that:

(1) The findings suggest a statistical association and not a causal relationship between cellular phone use and accidents;

(2) The lack of direct evidence that persons were using a cellular phone at the time of the accident;

(3) The epidemiological case-control method is prone to potential sources of bias; and

(4) Only a small number of cellular phone users were found in the total sample of accident and non-accident groups.

In Violanti (1997), the study was conducted in Oklahoma. The objective of the study was to focus on the statistical risk associated with cell phones and fatalities. The case group was drivers killed in a collision. The control group was drivers who survived a collision. The outcome event was the use or presence of a phone at the collision scene, as noted in the police accident report. The author found that drivers using a cell phone had a 9-fold increased risk for a fatality over drivers not using a phone. Drivers with a phone present in the vehicle had a 2-fold increased risk for a fatality over drivers without a phone present in the vehicle.

The study's limitations, as reported by the author, were that:

(1) Exposure data in the form of information on the amount of miles driven per year or changes in cellular phone ownership was not available;

(2) The traffic database contained limited information about other potential distractions related to driving;

(3) The type of phone used, whether hands-free or manual-dial, was unknown;

(4) Accident factors are possibly under-reported in police accident reports; and

(5) The analysis implies a statistical, but not necessarily a causal, relationship.

In Sagberg (2001), the study was conducted in Norway. The objective of the study was to study accident risk during telephone use in cars using a method that requires knowledge about the responsible party of each accident. Responsibility for the accident was judged by the driver's insurance company. The study design appears to have been the case-control design. The case group was drivers who reported an accident to their insurance company and were judged by the company to be the responsible party. The control group was drivers who reported an accident to their insurance company and were judged by the company to be innocent. The outcome event was phone use during the accident, as reported by the drivers in questionnaires from the authors. The author found that use of mobile telephones during driving is associated with a 1.72-fold increase in the risk of being involved in an accident, irrespective of fault. Also, the increased risk is 2.2 for a driver being involved as the responsible driver in an accident if the driver uses a mobile phone as compared to not using the phone.

The study's limitations, as reported by the author, were as follows:

(1) The possible underestimation of risk; and

(2) The possibility that drivers that were responsible for the accidents were less willing to reply to the questionnaire than were the innocent drivers.

In Laberge-Nadeau et al. (2003), the study was conducted in Quebec, Canada. The objective of the study was to verify whether an association exists between cell phone use and crash rates; specifically, whether cell phone users have more or fewer crashes than non-users and whether the frequency of cell phone use is or is not correlated with collision risks. The authors appear to have used the case-control design. The case group was drivers who responded to the authors' questionnaire that they were cell phone users. The control group was drivers who responded that they were not cell phone users. The outcome event was a police-reported collision in a driver's record. The authors found that the increased risks for injury collisions and also for all collisions is 38 per cent higher for men and women cell phone users. In other words, cell phone users had a 1.38 increased risk for a collision over non-cell phone users.

The study's limitations, as reported by the authors, were as follows:

- The study could not control for all factors of each crash: neither for telephone use while crashing, nor if telephone use was a factor in the crash. The data was not available.

These authors were confident that their study satisfied several criteria given by Hill and other considerations that reinforce a causal inference of cellular phone use and crash risk. They felt that their etiologic inference about the association of higher crash risks and the frequent use of a cell phone was justified.

The authors indicated that their study satisfied six of the nine criteria of Hill's Criteria of Causation, which outline the minimal conditions needed to establish a causal relationship between two items. They specifically noted that they met the criteria of strength of the association, a dose-response relationship between the frequency of phone calls and monthly crash risk, consistency of findings among several groups of the study participants, plausibility with knowledge acquired from other studies, coherence with knowledge acquired from other studies, and specificity of the association, to a degree.

The most significant of these findings, evidently, is the finding of a dose-response relationship between the frequency of cell phone use and crash risks. The presence of such a relationship is said to be strong evidence for a causal relationship.

On the other hand, they did not clearly specify whether their study met the criterion of a temporal relationship, which is the one criterion deemed the only absolutely essential one, and which requires that exposure always precedes the outcome. They noted that data was not available on whether telephone use was a factor in the crash. In other words, it appears that they had no data to prove that cell phone use always preceded the crash.

This appears to be the only study reviewed in this chapter that expressly tested its findings against Hill's Criteria of Causation.

In Wilson et al. (2003), the study was conducted in Vancouver, Canada. The objective of the study was to corroborate the epidemiological studies of Violanti and Marshall, Redelmeier and Tibshirani, and Laberge-Nadeau et al., using a different methodological approach. The study design appears to have been the case-control design. The case group was drivers who were observed during a survey using cell phones. The control group was drivers who were observed during the survey not using cell phones. Both groups were matched on date, time, and location of observation. The distinction between cell phone users and nonusers is thus not absolute, because some nonusers could be users at unobserved times. Both groups were subsequently identified through their license plates. The outcome event was an at-fault collision, as recorded in the driver's past insurance claims records. The authors found that drivers who were observed using cell phones in their vehicles have a higher risk of collision than drivers who were observed not using cell phones. The increase in risk associated with cell phone use while driving is 1.16 (i.e., a 16 per cent greater risk). The authors deemed the risk relatively small or minor.

The study's limitations, as reported by the authors, were as follows:

(1) It is unknown whether the drivers were using cell phones at the time of their collisions;

(2) The amount of cell phone usage was unknown, because there was no access to telephone company records;

(3) No temporal link was made between cell phone use and the collisions of cell phone users;

(4) There is a likelihood that a portion of the so-called "nonusers" in fact use cell phones in their vehicles at some time;

(5) There is a possibility that the variables of age, driving exposure, alcohol-related violations, and aggressive driving were over-controlled or over-compensated for, thereby masking a relatively small effect of cell phone use; and

(6) There is a possibility of error in the matching process in linking observed drivers to drivers identified in vehicle and driver records.

Case-crossover studies:

In Redelmeier and Tibshirani (1997), the study was conducted in Toronto, Canada. The objective of the study was to evaluate potential associations between the use of a cell phone and the risk of a motor vehicle collision in real-world circumstances. The case and control group was drivers who reported a collision with substantial property damage to a reporting center and who also acknowledged having cell phones. The outcome event was cell phone activity, the data being obtained from billing records. The hazard interval was the 10 minutes preceding the collision. The control interval was the same period while driving the day before, for the primary analysis. For supplementary analyses, alternative comparison days and intervals of an hour leading up to the collision were used. The authors found that use of a cell phone was associated with risk of having a motor vehicle collision that was about four times as high as that among the same drivers when they were not using their cell phones. The increase in risk appeared to be greatest for calls made near the time of the collision, and was not statistically significant for calls made more than 15 minutes before the event. The increased risk was 4.8 for calls within 5 minutes before the collision, as compared with 1.3 for calls more than 15 minutes before the collision.

The study's limitations, as reported by the authors, were that:

(1) Underestimation of risk was possible due to persons not consenting to participate;

(2) The selection of a control period is problematic due to varying driving behavior from day to day;

(3) Imbalances in some temporary conditions related to the driver, the vehicle, or the environment are not entirely eliminated by the case-crossover design;

(4) The study indicates an association but not necessarily a causal relation between the use of cellular telephones while driving and a subsequent motor vehicle collision;

(5) The study did not include serious injuries, therefore the study provides no information on how or whether phone use is associated with fatalities; and

(6) The data do not indicate whether drivers were at fault in the collisions.

In McEvoy et al. (2005), the study was conducted in Perth, Australia. The objective of the study was to determine whether phone use affects the risk of more serious crashes involving personal injuries and whether the risk differs for hands-free versus hand-held phones. The case and control group was drivers who were taken to a hospital emergency room following a collision and who reported owning or using a cell phone. The outcome event was cell phone activity, the data being obtained from phone company records. The hazard interval was the 10 minutes preceding the collision. The control intervals were the same period of time while driving 1, 3, and 7 days before the collision. The authors found that mobile phone use within the period during and up to 10 minutes before the estimated time of the crash was associated with a 4-fold increase in the likelihood of crashing.

The study's limitations, as reported by the authors, were as follows:

(1) The possibility of researchers misclassifying calls that occurred after the crash as having occurred before the crash;

(2) The possibility of participants not reporting the use of the phone before crashing;

(3) The possibility of non-participants differing from participants; and

(4) The findings point to a statistical rather than causal association.

In summary, these real world studies generally find that there is a statistical association, but not necessarily a causal relation, between cell phone use while driving and motor vehicle collisions. Also, the association is not affected by whether the phone is hands-free or hand-held. One of the studies, though, states that its analysis also supports a finding of causation.

Table 2, on the following page, outlines in tabular format the studies reviewed in this chapter.

TABLE 2. STUDIES ON CELL PHONE USE AND ACTUAL CRASHES

Study	Case group	Control group	Outcome event by which to assess the risk of collision associated with cell phone use	Is it riskier to use a cell phone while driving than to not use a cell phone while driving?	Is it less risky to use a hands-free phone than to use a hand-held phone?	Is causation established between cell phone use and motor vehicle collisions?
Violanti and Marshall (1995): New York State	Drivers who filed an accident report for a serious traffic accident	Drivers whose record checks indicated the absence of any reported traffic accidents	Monthly cell phone usage in vehicle obtained from cell phone billings	Yes. Use of a cell phone in a vehicle for more than 50 minutes per month was associated with a 5.59-fold increased risk in a traffic accident.	--	No. Statistical associations and not causal relationships are revealed
Redelmeier and Tibshirani (1997): Toronto, Canada	Drivers who reported a collision with substantial property damage to a reporting center and who acknowledged having a cell phone	Same drivers, the day before the collision (case-crossover)	Cell phone activity during the 10 minutes preceding the collision (hazard interval) compared with the same period while driving the day before (control interval), obtained from billing records	Yes. Use of a cell phone was associated with a risk of having a motor vehicle collision that was about four times as high as that among the same drivers when they were not using their cell phones.	No safety advantage observed as to hands-free as compared with hand-held phones.	No. An association, but not necessarily a causal relation, between the use of cellular phones while driving and a subsequent motor vehicle collision is indicated
Violanti (1997): Oklahoma	Drivers killed in a collision	Drivers surviving a collision	Phone use or phone presence at collision scene as noted in the police accident report	Yes. Drivers using a phone had a 9-fold increased risk for a fatality over those not using a phone. Drivers with a phone present in the vehicle had a 2-fold increased risk for a fatality over those without phones present in the vehicle.	--	No. A statistical, but not necessarily a causal, relationship is implied

Study	Case group	Control group	Outcome event by which to assess the risk of collision associated with cell phone use	Is it riskier to use a cell phone while driving than to not use a cell phone while driving?	Is it less risky to use a hands-free phone than to use a hand-held phone?	Is causation established between cell phone use and motor vehicle collisions?
Sagberg (2001): Norway	Drivers who reported an accident to their insurance company, and were judged by the company to be responsible for the accident	Drivers who reported an accident to their insurance company, and were judged by the company to be innocent	Phone use during accident as reported by the drivers in questionnaires	Yes. (1) Use of mobile telephones during driving increases by 72% the risk of being involved in an accident irrespective of responsibility for the accident. 72% means 1.72-fold increase. The increased risk is 2.2 (a 120% increase) for a driver being involved as the responsible driver in an accident while using a mobile phone as compared to driving without using the phone. (2) Rear-end collisions are clearly over-represented among the accidents occurring during mobile telephoning.	No statistically significant difference in risk increase as between hand-held and hands-free phones. Thus, open issue as to what extent hand-held phones are associated with higher risk than hands-free systems	--
Laberge-Nadeau et al (2003): Quebec, Canada	Drivers who responded in a questionnaire that they were cell phone users	Drivers who responded in a questionnaire that they were not cell phone users	A police-reported collision in a driver's record	Yes. The increased risks for injury collisions and also for all collisions is 38% higher for men and women cell phone users.	--	Yes. Several criteria and considerations are satisfied that reinforce a causal inference of cellular phone use and crash risk.

Study	Case group	Control group	Outcome event by which to assess the risk of collision associated with cell phone use	Is it riskier to use a cell phone while driving than to not use a cell phone while driving?	Is it less risky to use a hands-free phone than to use a hand-held phone?	Is causation established between cell phone use and motor vehicle collisions?
Wilson et al (2003): Vancouver, Canada	Drivers observed using cell phones during a survey and identified through their license plates	Drivers observed not using cell phones during a survey and identified through their license plates	An at-fault collision recorded in the drivers' past insurance claims records	Yes. Drivers who were observed using cell phones in their vehicles have a higher risk of collision than drivers who were observed not using cell phones. The increase in risk associated with cell phone use while driving is relatively small, 1.16 for all drivers. Individuals who use cell phones while driving are riskier drivers than are those who either refrain from cell phone use in vehicles or have a low likelihood of usage. The cell phone users have more violations for speeding, impaired driving, seat belt nonuse, aggressive driving, and nonmoving violations. These differences likely reflect differences in lifestyle, attitude, and personality.	--	--
McEvoy et al (2005): Perth, Australia	Drivers who were taken to a hospital emergency room upon a collision and who reported owning or using a cell phone	Same drivers, during several days of the week before the collision (case-crossover)	Cell phone activity during the 10 minutes preceding the collision (hazard interval) compared with the same period while driving 1, 3, and 7 days before (control intervals), obtained from phone company records	Yes. Mobile phone use within the period during and up to 10 minutes before the estimated time of the crash was associated with a 4-fold increase in the likelihood of crashing.	The type of mobile phone did not affect the association between phone use and risk of crash.	No. A statistical, rather than a causal, association is indicated

Finally, to place the efforts of the studies reviewed in this chapter in some perspective, a word or two on proving causation is in order. As stated earlier, proving causation is evidently very difficult to do.

The authors in these studies emphasize that a finding of a statistical association between cell phone use and motor vehicle collisions does not necessarily imply that a causal relation also exists between cell phone use and motor vehicle collisions. As an illustration, Redelmeier and Tibshirani (1997) point out that if it is emotional stress that is the cause of both the increased use of a cellular telephone and decreased driving ability, then individual calls may do nothing to alter the chances of a collision.

Furthermore, Redelmeier and Tibshirani (1997) also specify the type of study that could be capable of finding a causal relation. They state that the most rigorous experimental method for testing the effects of cellular telephones on motor vehicle collisions is to assess outcomes for persons randomly assigned to use or not use the devices. Stated otherwise, set up the two groups: cell phone users and non-users. Then watch and see which group gets into more collisions. However, they caution that such a study would be very difficult to perform and possibly unethical.

Redelmeier and Tibshirani's comments are in accord with general comments on probabilistic causation found in an article on causality in the Wikipedia website, at http://en.wikipedia.org/wiki/Causation. According to the Wikipedia article, probabilistic causation means as follows: A probabilistically causes B if and only if the occurrence of A increases the probability of B. Probabilistic causation is "notoriously difficult" to prove. The difficulty in establishing this type of causation is expressed by the widely accepted statement: correlation does not imply causation.

As noted at the beginning in this chapter, a mere *association* between two events A and B does not necessarily mean that event A *causes* event B. Perhaps, the reverse could be the truth. In other words, it is event B that causes event A.

For example, in the Middle Ages, people believed that lice were beneficial to one's health because there would rarely be any lice on sick people. In other words, people noticed a correlation between good health and bodily lice infestation. They inferred incorrectly that the departure of lice (event A) caused people to get sick (event B). Evidently, the truth was the other way around. People getting sick (event B) caused lice to leave their bodies (event A). Lice are evidently extremely sensitive to body temperature. A small increase of body temperature, such as in a fever, will cause the lice to search for another host (from the Wikipedia article on Wrong direction, at http://en.wikipedia.org).

As another example, gun ownership (event A) is correlated with crime (event B). This association, however, does not necessarily imply that gun ownership (event A) therefore causes crime (event B). The true causal relation could be the other way around. Increases in crime (event B) causes increases in gun ownership (event A). Concerned citizens want to protect themselves from becoming victims of the growing crimes in their neighborhood by arming themselves with guns (from the Wikipedia article on Wrong direction, at http://en.wikipedia.org).

In addition to the two possibilities that either event A causes event B or event B causes event A is a third possibility that it is a third as yet undiscovered event C that is the cause of both event A and event B.

For example, smoking (event A) and lung cancer (event B) are correlated. Smokers have dramatically increased lung cancer rates. However, this association does not necessarily mean that smoking (event A) causes an increased lung cancer rate (event B). Nor does the association mean that lung cancer (event B) causes smoking (event A), despite a tobacco company executive having once suggested that victims of lung cancer took up cigarette smoking in order to relieve their pain. Rather, it is possible that a certain genetic defect (event C) is the cause of both cancer (event B) and the yearning for nicotine (event A) (from the Wikipedia articles on "Causality" and "Wrong direction", at http://en.wikipedia.org).

Another cigarette-related example is that a correlation was found between cigarette smoking (event A) and low college grades (event B). Cigarette smokers make lower college grades than nonsmokers. However, this association does not necessarily mean that smoking (event A) *causes* low grades (event B). It could be that low grades (event B) cause students to smoke (event A). Or it could be that a third variable such as sociability (event C) causes both smoking (event A) and low grades (event B) (from Burns, W.C., Spurious Correlations, at http://www.burns.com, quoting Huff, D., How to Lie with Statistics).

As another example, during the summer months, both ice cream consumption (event A) and murder rates (event B) increase. They are highly correlated. However, the correlation does not imply that ice cream consumption (event A) causes murder (event B). Alternatively, the correlation does not imply instead that committing murder (event B) causes ice cream consumption (event A). Rather, both are joint effects of a common cause, namely, hot weather during the summer season (event C) (from the Wikipedia article on Joint Effect, at http://en.wikipedia.org/wiki/Joint_effect).

As yet another example, children's shoe sizes (event A) are strongly correlated with their reading skills (event B). Yet, the correlation does not imply that learning new words causes the feet to grow. Instead, with age (event C), children's reading skills improve and their feet grow (from Burns, W.C., Spurious Correlations, at http://www.burns.com, quoting Freedman, D. et al., Statistics Second Edition).

Similarly, and as a final example, studies have shown repeatedly that children with longer arms reason better than those with shorter arms. But there is no causal connection between length of arms (event A) and reasoning ability (event B). Children with longer arms reason better because they are older. Age (event C) is the third variable that causes increases in both arm length (event A) and reasoning ability (event B) (from Burns, W.C., Spurious Correlations, at http://www.burns.com, quoting Poulos, J.A., A Mathematician Reads the Newspaper).

The Wikipedia article on causality further explains that, in statistics, it is generally accepted that observational studies (like counting cancer cases among smokers) can give hints, but can never establish cause and effect. The gold standard for causation is the randomized experiment. This type of experiment requires a large number of people to be randomly selected and divided into two groups. One group is required to smoke while the other group is prohibited from smoking. The task then is to determine whether one group develops a significantly higher lung cancer rate. The article advises that, obviously, for ethical reasons the experiment cannot be performed, but the method is widely applicable for less damaging experiments.

Another approach toward proving causation appears to be the one taken in Laberge-Nadeau et al. (2003). The authors of that study sought to establish an association between cell phone use and motor vehicle collisions and, additionally, to satisfy Hill's Criteria of Causation. These criteria are the minimal conditions needed to establish a causal relationship between two events that are associated with each other. There are nine of these criteria, as follows (from http://www.drabruzzi.com/hills_criteria_of_causation.htm):

(1) Temporal relationship. Exposure always precedes the outcome. This is the only absolutely essential criterion;

(2) Strength of the statistical association. The stronger the association, the more likely it is that the relation is causal;

(3) Dose-response relationship. An increasing amount of exposure increases the risk. A dose-response relationship is strong evidence of a causal relationship. However, its absence does not rule out a causal relationship. A threshold may exist above which a relationship may develop;

(4) Consistency of the association. Results are replicated in studies in different populations using different methods. Accordingly, numerous experiments have to be done before meaningful statements can be made about the causal relationship between two or more items. For example, it has taken thousands of highly technical studies of the relationship between cigarette smoking and cancer before a definitive conclusion could be made that cigarette smoking increases the risk of (but does not cause) cancer;

(5) Plausibility of the association. A theoretical basis exists for making the association. For example, the association agrees with accepted beliefs;

(6) Consideration of alternative explanations. In judging whether a reported association is causal, it is necessary to determine the extent to which researchers have taken other possible explanations into account and have effectively ruled out such alternate explanations;

(7) Experiment. The condition can be prevented or ameliorated by an appropriate experimental regimen;

(8) Specificity of the association. This is established when a single putative cause produces a specific effect. This is considered by some to be the weakest of all the criteria. When specificity of an association is found, it provides additional support for a causal relationship. However, absence of specificity in no way negates a causal relationship. Causation is most often multiple. It is highly unlikely that a one-to-one cause-effect relationship will be found between two phenomena; and

(9) Coherence of the association. The association should be compatible with existing theory and knowledge. However, as with the issue of plausibility, research that disagrees with established theory and knowledge are not automatically false. They may, in fact, force a reconsideration of accepted beliefs and principles.

Chapter 4

COMPARING DIFFERENT DRIVER DISTRACTIONS

This chapter deals with the third and final issue raised under H.C.R. No. 294, S.D. 1: whether cellular telephone use while operating a motor vehicle is the *most* prevalent cause of motor vehicle collisions among collisions caused by a distraction-inducing action. Discussion of this more complex issue seems premature at this time, especially since the more basic issue of whether such cell phone use is simply a *cause* of accidents is so difficult to resolve.

The Bureau found no studies that address, much less resolve, the issue of which of the driver distractions is the most prevalent cause of motor vehicle collisions. Instead, the Bureau found studies that address, but do not resolve, the issue of discovering and comparing associations between various sources of driver distractions and motor vehicle collisions.

In these four studies, which date from 2001 to 2005, driving outcomes such as crashes, adverse driving events, and other indicators of distraction, are examined for many different sources of driver distractions. One of those sources is cell phone use. Other common distractions include eating or drinking, smoking, grooming, tuning a radio or CD, and conversing with other occupants. All the studies were apparently able to measure the proportions of accidents or like events attributable to the different sources of distraction. However, none were able to measure the relative risks of those different sources of distraction.

Apparently, there is a difference between proportions and risks. A proportion is merely the percentage of accidents attributable to a source of distraction. A risk, on the other hand, is the probability of an accident attributable to a source of distraction. Risk is determined by exposure. Exposure, here, refers to the engaging in a source of distraction while driving, such as using the cell phone, eating, grooming, talking to a passenger, listening to the radio, or smoking. There is some uncertainty among some of the studies reviewed in this chapter as to what units of measurement should be involved in measuring exposure. At the very least, it seems that exposure should be measured in units of frequency and of duration. One study, namely Stutts et al. (2003), argues that a third unit of measure should be a unit of cognitive distraction or cognitive attention. In any case, if comparisons involve only proportions of accidents attributable to each source of distraction but no correction is made for the exposure for each source of distraction, then it will not be possible to compare the risks attributable to the various sources of distractions (see Sagberg (2001)).

In Glaze and Ellis (2003), the authors made a survey of crash scenes in Virginia that involved driver inattention or distraction. The participants, state troopers and officers, were asked to indicate the main distraction in each crash. Distractions examined involved eating or drinking, smoking, grooming, passenger/children, unrestrained pet, other distraction inside the vehicle, adjusting radio/changing CD or tape, adjusting vehicle controls, cell phone, document, pager, technology device, other personal items, something entering/striking vehicle, looking at crash or other incident, looking at scenery or landmarks, other distraction outside the vehicle, and unknown distraction.

The authors calculated the percentages of crashes "caused" by the different types of distractions. They concluded that cell phone use was not the most frequent distraction reported overall. In other words, the authors merely calculated the proportions of accidents "caused" by the different types of distractions and made no corrections for the exposure of each type of distraction or each source of distraction. They did not even discuss exposure or risk.

In Stutts et al. (2001), the authors analyzed the Crashworthiness Data System ("CDS") data from the National Accident Sampling System. The CDS data consists of information collected on annual probability samples of nationwide police-reported traffic crashes where at least one passenger vehicle is towed from the crash scene. Since 1995, the attention status of the driver was added to the data collection protocol. The distractions examined were outside distraction, radio or CD, other occupant, moving object, other device/object, vehicle/climate controls, eating or drinking, cell phone, smoking, other distraction, and unknown distraction.

The authors examined the attention status of the driver and the specific distracting event for those drivers identified as distracted. Based on 1995-1999 CDS data, they concluded that cell phone use was not the most frequently reported source of driver distraction. However, they cautioned that their findings were based purely on the available crash data and did not take into account the frequency of the various distractions. They stated that without a measure of exposure it would not be possible to draw conclusions regarding the relative risk of crashing associated with a particular distraction. They indicated that the frequency of the various distractions was not accounted for in their findings, and impliedly, that frequency is necessary to measure those risks.

In Stutts et al. (2003), three hours of naturalistic driving were recorded on video for each participating driver. Drivers were recruited from Chapel Hill, North Carolina and outside of Philadelphia, Pennsylvania. The sources of distraction examined were cell phone use, eating or drinking, music/audio, smoking, reading/writing, grooming, occupant distraction, conversing, internal distraction, and external distraction. The driving outcomes examined were hands not on the steering wheel, eyes not on the road, and adverse driving events such as wandering, encroachment, or sudden braking. The extent to which these driving outcomes translate into actual increases in crashes, however, is an unknown.

The authors found that cell phone use was not the potentially distracting activity that engaged drivers the most while the vehicles were moving. However, they stated that they had no definitive answer as to which driver distraction carries the greatest risks of crash involvement. They explained that they were not able to directly measure the drivers' level of cognitive attention. In other words, they were unable to capture any measure of cognitive distraction.

Evidently, they were able to measure the frequency and duration of distracting behaviors, since they were able to note that some behaviors, like manipulating audio controls, were quite frequent but of short duration, while others, like smoking, were less frequent but of much longer duration. Accordingly, it appears that the authors believe that ascertaining the risks of crash involvement requires a measure of cognitive attention, in addition to measures of frequency and of duration.

In Dingus et al. (2005), an entire year of naturalistic driving was recorded on video or sensor for each participating driver. Drivers were recruited from the urban to suburban areas of Northern Virginia and Washington, D.C. The sources of distraction or "secondary tasks" examined were wireless device, passenger-related, internal distraction, vehicle-related, personal hygiene, dining, external distraction, talking/singing without a passenger, smoking, daydreaming, and other. The driving outcomes or "traffic events" examined were crashes, near crashes, and incidents in which a conflict required an evasive maneuver, but was of lesser magnitude than a near crash.

The authors found that wireless devices, primarily cell phones, contributed to the highest percentages of traffic events. Among rear-end lead-vehicle conflicts, cell phone use contributed much more frequently to incidents and near-crashes than any other secondary task but did not contribute to any actual crashes. But cell phone use did contribute to other types of crashes, such as run off road, single vehicle conflict (driver ran into a barricade), and following vehicle conflict (subject vehicle was struck).

However, the authors stated that they have yet to determine the relative risks of each distraction source. They explained that the overall risk of a distraction source is determined by its exposure, which in turn is measured by the frequency and duration of the source. However, frequency and duration were not considered in their data. The authors promised a future report on those relative risks. Accordingly, it appears that these authors, unlike Stutts et al. (2003), believe that ascertaining relative risks requires measures of only frequency and duration.

In summary, then, these studies address the issue of *association* between sources of driver distractions and motor vehicle collisions. They do not, however, address the issue of *causation*. Furthermore, these studies cannot provide a definitive answer, at this time, as to which driver distraction carries the greatest risk of crash involvement.

Table 3, on the following page, outlines in tabular format the studies reviewed in this chapter.

TABLE 3. STUDIES ON DRIVER DISTRACTIONS

Study	Methodology	Participants or subjects	Sources of driver distraction	Driving outcomes or traffic events by which to infer distraction	Measurements used for outcomes	Preliminary findings	What are the relative crash risks of the different driver distractions?	Reason for conclusion
Stutts et al (2001) Phase I	CDS data analysis	CDS data: information collected on annual probability samples of nation-wide police-reported traffic crashes where at least one passenger vehicle is towed from the crash scene	Outside distraction; Radio, CD; Other occupant; Moving object; Other device/object; Vehicle/climate controls; Eating, drinking; Cell phone; Smoking; Other distraction; Unknown distraction	Crashes where at least one passenger vehicle is towed from the crash scene	--	Cell phone use is not the most frequently reported source of distraction	Not possible to draw conclusions regarding the relative risk of crashing associated with a particular distraction	No measure of exposure
Stutts et al (2003) Phase II: North Carolina and Pennsylvania	Naturalistic driving recorded on videos in the vehicle for three hours of driving	Males and females ranging in age from 18 to 60+	Cell phone use; Eating or drinking; Music/audio; Smoking; Reading/writing; Grooming; Occupant distraction Conversing; Internal distraction; External distraction	Hands not on steering wheel; Eyes not on road; Adverse driving events (wandering, encroachment, sudden braking)	Frequency; Duration	Cell phone use was not the potentially distracting activity that engaged drivers the most while the vehicles were moving	No definitive answer as to which driver distractions carry the greatest risks of crash involvement	Inability to directly measure drivers' level of cognitive attention. Also, unknown is the extent to which the driving outcomes measured translate into actual increases in crashes.
Glaze and Ellis (2003): Virginia	Survey of crash scenes involving driver inattention/ distraction	State troopers and officers	Eating or drinking; Smoking; Grooming; Passenger/children; Unrestrained pet; Other distraction inside the vehicle; Adjusting radio/changing CD or tape;	Crashes	Frequency	Cell phone use was not the most frequent distraction reported overall	--	--

Study	Methodology	Participants or subjects	Sources of driver distraction	Driving outcomes or traffic events by which to infer distraction	Measurements used for outcomes	Preliminary findings	What are the relative crash risks of the different driver distractions?	Reason for conclusion
			Adjusting vehicle controls; Cell phone; Document; Pager; Technology device; Other personal items; Object entering/striking vehicle; Looking at crash; Looking at scenery or landmarks; Other outside distraction; Unknown distraction					
Dingus et al (2005) phase II abstract: Northern Virginia/Washington, DC metro	Naturalistic driving, recorded on vehicle sensors and videos in the vehicle for a one year period	Male and female drivers aged 18 to 55+ in an urban to suburban area	Secondary tasks-- Wireless device; Passenger-related; Internal distraction; Vehicle-related; Personal hygiene; Dining; External distraction; Talking/singing w/o passenger; Smoking; Daydreaming; Other	Traffic events-- Crashes; Near crashes; Incidents (requires an evasive maneuver but conflict is of lesser magnitude than a near crash)	Frequency	Cell phone use contributed to the highest percentages of traffic events. Among rear-end lead-vehicle conflicts, cell phone use contributed much more frequently to incidents and near-crashes than any other secondary task but did not contribute to any crashes.	No determinations yet of the relative risks of each distraction source.	Exposure, which determines the overall risk of a distraction source, is measured by frequency and duration, which were not considered in the data.

Chapter 5

FINDINGS

The three major issues set forth in H.C.R. No. 294, S.D. 1, were as follows:

(1) Is cellular telephone use while operating a motor vehicle a distraction-inducing action?

(2) Is cellular telephone use while operating a motor vehicle a cause of motor vehicle collisions?

(3) Is cellular telephone use while operating a motor vehicle the most prevalent cause of motor vehicle collisions among those caused by a distraction-inducing action?

In other words, the resolution asks whether cell phone use is a driver distraction, a cause of motor vehicle accidents, and the most prevalent driver distraction that causes motor vehicle accidents.

The Bureau reports what the studies have found with regard to each of them:

(1) Cellular telephone use while operating a motor vehicle is a distraction-inducing action.

Experimental studies on the effects of cell phone use on driving performance confirm the Legislature's recognition that cell phone use is indeed a distraction-inducing action.

These studies are conducted using either a driving simulator or on-road test tracks. An outcome such as braking response is measured and compared under different driving conditions, including the control condition of driving only and the condition at issue of driving while using a cell phone. These studies find that using a cell phone while driving degrades driving performance when compared to driving without using a cell phone. Use of a cell phone increases non-responses or slows response time.

In general, these experimental studies also find no difference in the type of cell phone used. Both the hands-free cell phones and the hand-held cell phones produce equivalent deficits or nearly identical performance decrements.

(2) It is not universally known whether cellular telephone use while operating a motor vehicle is a cause of motor vehicle collisions.

No studies were found that directly address and resolve the issue of whether a causal relation exists between cellular telephone use while operating a motor vehicle and motor vehicle collisions. Instead, studies were found that address and resolve the issue of whether an *association* exists between cellular telephone use while operating a motor vehicle and motor vehicle collisions. They generally find that a statistical association, but not necessarily a causal relation, exists. One study illustrates the difference between association and causation by hypothesizing that, although cell phone use is associated with motor vehicle collisions, it could be that the reason they are associated with each other is that they both share a common cause, namely, emotional stress.

Specifically, studies find that cell phone use while driving is associated with an increased risk of having a motor vehicle collision. In other words, a driver who uses a cell phone while driving is more likely to have an accident than will a driver who does not use a cell phone while driving. Some estimates of the likelihood of an accident is that a driver who uses a cell phone while driving is four times more likely to have an accident than will a driver who does not use a cell phone while driving. Studies also find that the type of phone, whether hands-free or hand-held, does not affect the association between phone use and risk of a crash. One of the studies, though, states that its finding of a statistical association and other criteria also support a causal inference between cell phone use and crash risk. The authors of the study indicate that the study satisfies six of the nine criteria of Hill's Criteria of Causation, which outlines the minimal conditions needed to establish a causal relationship between two items.

These studies are conducted by comparing a case group against a control group with regard to a past event or outcome. For example, drivers who had accidents are compared to drivers who did not have any accidents with regard to whether or not the drivers used a cell phone in the vehicle. Or, drivers who have cell phones are compared to drivers who do not have cell phones with regard to whether or not the driver had an accident.

(3) It is not known whether cellular telephone use while operating a motor vehicle is the most prevalent cause of motor vehicle collisions among motor vehicle collisions caused by a distraction-inducing action.

No studies were found that address, much less resolve, the issue of which of the driver distractions causes the most motor vehicle collisions. Instead, studies were found that address, but do not resolve, the issue of which of the driver distractions are the most associated with motor vehicle collisions. They attempt to measure driving outcomes such as crashes, adverse driving events, or other indicators of distraction, for comprehensive sources of possible driver distractions.

However, they ultimately were not able to determine the individual risks of each source of distraction. Accordingly, they were not able to determine which of the driver distractions carries the greatest risk of crash involvement.

APPENDIX

HOUSE OF REPRESENTATIVES
TWENTY-THIRD LEGISLATURE, 2005
STATE OF HAWAII

H.C.R. NO. 294 S.D. 1

HOUSE CONCURRENT RESOLUTION

REQUESTING A REVIEW OF EXISTING STUDIES AND STATISTICS ON THE CAUSAL RELATIONSHIP BETWEEN WIRELESS TELEPHONE USE WHILE OPERATING A MOTOR VEHICLE AND INCREASED MOTOR VEHICLE-RELATED ACCIDENTS.

WHEREAS, wireless telephones have become a very popular and affordable commodity in today's society; and

WHEREAS, the numerous safety benefits of carrying a wireless telephone in the motor vehicle are well documented, including the ability to report accidents, road rage, dangerous driving, criminal behavior such as drunk driving, and requests for assistance for stranded motorists; and

WHEREAS, wireless telephones also enable people to keep conveniently in contact with family, friends, and society; and

WHEREAS, however, using wireless telephones while operating a motor vehicle creates a potentially dangerous situation, not only for other motorists but for pedestrians as well, and the number of accidents attributable to wireless telephone misuse seem to be increasing; and

WHEREAS, according to a recent study published by the New England Journal of Medicine, the risk of the occurrence of an accident is four times more likely when the driver is busy conversing with someone on a wireless telephone, and the driver's attention is more apt to be on the discussion than on the road; and

WHEREAS, as early as 1991, a study performed by the American Automobile Association Foundation for Traffic Safety found that drivers using wireless telephones were twenty to thirty per cent more likely to be involved in a highway traffic accident situation; and

WHEREAS, in 2001, New York became the first state in the nation to adopt a ban on the use of hand-held mobile telephones while driving on public roads, except in emergency situations; and

WHEREAS, eliminating all but hands-free wireless telephone use while driving could dramatically reduce motor vehicle collisions; and

WHEREAS, however, the Legislature recognizes that the use of wireless telephones while operating a motor vehicle is not the only distraction-inducing act committed by drivers; and

WHEREAS, other actions, such as eating, drinking, applying cosmetics, reading, adjusting the volume or changing what is on a motor vehicle's radio, or even talking to a passenger, may also contribute significantly to a driver's inattentiveness while driving; and

WHEREAS, if the Legislature is to ban a distraction-inducing action while operating a motor vehicle, the Legislature believes that it should not discriminate against a particular distraction-inducing action without first determining if that action is the most prevalent cause of distraction-induced motor vehicle accidents; and

WHEREAS, as such, the Legislature further believes that, prior to imposing a ban on the use of wireless telephones while operating a motor vehicle, the Legislature should obtain more information on the causal relationship between using a wireless telephone while operating a motor vehicle and the incidence of increased motor vehicle-related accidents; now, therefore,

BE IT RESOLVED by the House of Representatives of the Twenty-third Legislature of the State of Hawaii, Regular Session of 2005, the Senate concurring, that the Legislative Reference Bureau is requested to conduct a review of existing studies and statistics on the causal relationship between wireless telephone use while operating a motor vehicle and increased motor vehicle-related accidents; and

BE IT FURTHER RESOLVED that the Legislative Reference Bureau is requested to report its findings, recommendations, and any proposed legislation to the Legislature not later than twenty days prior to the convening of the Regular Session of 2006; and

BE IT FURTHER RESOLVED that a certified copy of this Concurrent Resolution be transmitted to the Director of the Legislative Reference Bureau.

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