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16. Abstract

This report summarizes literature on the issues of distraction, attention, aggression and fatigue as they relate to driving behavior and traffic crashes. There are three sections to this report: Distraction and Attention, Aggression, and Fatigue. Information in each section is presented in the same basic format. First, the key term for each section is defined. Second, the research findings in the area and their implications for OHSP program development are discussed. Finally, the report concludes with an annotated bibliography of relevant literature from each subject area.

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This report summarizes literature on the issues of distraction, attention, aggression and fatigue as they relate to driving behavior and traffic crashes. There are three sections to this report: Distraction and Attention, Aggression, and Fatigue. Information in each section is presented in the same basic format. First, the key term for each section is defined. Second, key research findings in the area are summarized and finally the implications of these findings on state highway safety program development are discussed. The report concludes with an annotated bibliography of relevant literature from each subject area.

Distraction and Attention

The issue of distraction as it relates to driving cannot be discussed independently of the more general issue of attention. *Distraction in the driving situation can be defined as a shift of attention away from stimuli critical to safe driving toward stimuli that are not related to safe driving.* Given this definition, we must now explore what we mean when we discuss a "shift of attention." *Attention is generally defined as the process of concentrating or focusing limited cognitive resources to facilitate perception or mental activity.*

Three different attentional processes must be examined to understand fully how attention and distraction may occur and subsequently affect safe driving. These processes are *selective* attention, *divided* attention, and *sustained* attention. Using selective attentional processes, a person attempts to attend deliberately to one or more stimuli in preference to other available stimuli. An example in the driving situation would be a driver who focuses heavily on reading street signs to the exclusion of maintaining a safe position on the road. Divided attention differs from selective attention in that when a person is using a divided attention process, that person is trying to attend to two or more stimuli simultaneously. A person who is trying to attend to both the street signs and their position on the roadway is using divided attentional skills to perform their task. Sustained

attention is the process by which a person maintains their level of attention to a stimulus for a prolonged period of time. Long-haul driving across many miles of open road requires significant sustained attention resources.

Summary of research findings

In general, the research on inattention and distraction comes to the same conclusion. Crashes can be avoided to the extent that drivers attend to stimuli that are important for driving. Moreover, crashes become more likely as drivers fail to attend properly to stimuli through purposive processes (e.g., selective attention on the wrong stimuli), inadequate attentional resources (e.g., dividing one's attention between too many stimuli), or distraction (e.g., an irrelevant stimulus like your coffee spilling diverts your attention from the driving task).

Driver inattention, broadly defined, has been identified as a major factor in traffic crashes for a considerable length of time. In 1979, inattention was identified as the most prevalent cause of traffic crashes in the Indiana Tri-Level Study of the Causes of Traffic Crashes (Treat et al., 1979). This in-depth study of crash causation found that four types of attentional errors that drivers committed represented over 50% of the crashes investigated. In 23% of cases, the error was found to be improper lookout ("looked but didn't see.") This could represent cases in which the drivers' attentional workload requirements exceeded the capacity of the driver. A preoccupation with competing thoughts (cognitive distraction) was identified as the cause of 15% of crashes. Distractions within the car requiring attention (e.g., spilled coffee) were identified as the cause of 9% of crashes, while some distraction outside the car (e.g., looking at a crash scene) were identified in another 4% of crashes.

More recently, Wang et al. (1996) examined crash data from the National Accident Sampling System (NASS) crash-investigation data file to explore inattention and distraction. These authors examined data from the 1995 NASS

data file that included special data on driver distraction and inattention to driving. In this analysis of tow-away crashes, 25.5% of crashes involved driver inattention. The authors note, however, that this percentage should be regarded as conservative due to the large number of crashes coded "unknown" and difficulties associated with identifying precrash attentional lapses of the driver after the fact. When one examines causal factors for only those crashes with a known value for crash cause, one finds that nearly half (47%) of crashes were caused by inattention.

The research literature is generally consistent with respect to the large proportion of crashes to which inattention or distraction are assigned as the cause. There is less consensus in the literature, however, about how to describe the nature or cause of the inattention/distraction that was identified as the cause of the crash. Much of the recent research in this area has focused on the use of cellular phones when driving.

The research literature on the issue of cell phone use and driving is growing rapidly. Most of the discussions of the safety implications of cell phone use while driving center on distractions caused by operating and conversing on the phone and attentional resource drain associated with cell phone operation and conversation. Unfortunately, crash data sets are ill suited for these types of analyses due to a lack of information about cell phone use prior to the crash, so much of what we know comes from highly-controlled, human factors experiments. The good part about these studies is the generally high level of experimental control that is possible. The bad part about these studies is that it is difficult to simulate real-world attentional stressors adequately, and thus some study findings may not generalize well to actual driving and crashes.

In an excellent summary of the evidence to date, Goodman et al. (1997) attempted to answer several key questions related to cell phone and driving safety. First, this report states that use of cell phones does increase the risk of a

crash, at least in "isolated cases." However, the authors point out that, "What remains unknown is the relative contribution of cellular phone use, per se, and characteristics of the involved drivers (e.g., less capacity to time-share attention between cellular phone use and driving tasks, greater propensity for risk taking)," (p. 13, Goodman et al. 1997). Second, NHTSA points out that the magnitude of the problem is uncertain because cell phone use while driving is currently inadequately reported in crash records. The authors point out that this alone cannot be interpreted to mean that there is no problem of sufficient magnitude to warrant action; it just is difficult to assess at this time.

When Goodman et al. focused on the human factors research on the effects of cell phone use, they found:

1. When compared to driving alone, cell phone manual dialing can disrupt vehicle control activities like lane keeping and speed maintenance, but this disruption does not always appear, especially in closed-courses.
2. Manual dialing is more disruptive than tuning a radio and several studies report drivers engage in some compensatory behavior to adjust for the disruption (like slowing down).
3. Simple conversations have little impact on lane keeping and speed maintenance, but sometimes affect driver situational awareness (e.g., increased reaction times, reduced mirror checking).
4. Demanding conversations (business, high emotional content) increase driver brake reaction times, indicating a reduction in situational awareness.

The authors summarized their findings as follows: "Manual dialing can be disruptive of both vehicle control performance and situational awareness and judgment. The incidence and magnitude of vehicle control disruption while driving on public roads appears to be less than that encountered in driving simulators or on test tracks, but may nonetheless pose a safety concern. On-road studies indicate that if hands-free voice communication activities have any

detrimental effects, they are on driver situational awareness and not on vehicle control performance," (p. 11, Goodman et al., 1997).

Program Implications

Distraction is a major factor in traffic crashes, with up to 50% of crashes being caused by some error related to the focus of attention for the driver. Moreover, crashes become more likely as drivers fail to attend properly to stimuli through purposive processes (e.g., selective attention on the wrong stimuli), inadequate attentional resources (e.g., dividing one's attention between too many stimuli), or distraction (e.g., an irrelevant stimulus like your coffee spilling diverts your attention from the driving task).

Because of the difficulties in studying attention and attentional effects on performance, it is difficult to develop a list of specific causes or remedies to crashes caused by driver inattention or distraction. The problem is that minor lapses of attention at the wrong time can result in tragedy, and major lapses of attention at the right time can be uneventful. On the other hand, we do know some general facts about attentional processes that may be helpful in understanding and developing programs to try to prevent some of these crashes.

We know that as a person becomes experienced with a task, that task will generally require fewer attentional resources to perform. This suggests that programs like the graduated license for new drivers may help to reduce crashes caused by distractions or information overload. It has also been found that attentional capacity increases until the late teens and remains steady until beginning to decline in later life. This would suggest that younger and older drivers need special consideration when considering programs, policies, or technologies that may tax attentional resources. These drivers may also be good candidates for special training to improve attention.

There are two other major factors that affect a person's attentional resources, namely fatigue and alcohol use. Both fatigue and alcohol use significantly decrease the amount of attentional resources a person has to devote to a task. Indeed, crashes related to fatigue and alcohol use often involve some lapse of attention that leads directly to the crash. Thus, programs that target fatigue and alcohol use could have an impact on the number of distraction-related crashes that occur. That is, programs that target fatigue and alcohol use may impact the larger group of distraction-related crashes if countermeasure programs focus at least in part on the more general issue of attention and distraction.

In order for OHSP to develop and select programs to achieve their highway safety goals, we should first examine the proportion of crashes that are associated with each error type and then examine what could be done to prevent those errors. Unfortunately, the Michigan crash data set does not have codes to identify crashes caused by inattention or distraction. Therefore, we must look elsewhere for a data source to provide guidance.

The Indiana Tri-Level study described earlier provides a foundation upon which a plan may be developed. In 23% of the crashes examined, the crash was caused by an improper lookout, or "looked but didn't see." This was the largest group of distraction related crashes. If this finding held true in Michigan, this would represent 2,806 fatal or serious injury (KA) crashes in 1998. There are two basic reasons why a person may believe they were looking out but did not see the crash threat. First, a driver may have seen the threat but did not recognize the stimulus as a threat. Second, a driver may not have seen the threat due to a lack of sufficient attentional capacity. These two causes have different possible remedies.

Training and reminder programs may be the key to reducing the number of crashes caused by drivers not recognizing threats. Indeed, programs reminding drivers about motorcycle conspicuity, hazards driving around large trucks, and

special driving needs during inclement weather all fall within the realm of programs that could affect this component of the problem. Crashes caused by insufficient attentional capacity may require a more general approach.

As was stated earlier, experience with a task does reduce the attentional capacity required to perform the task. Therefore, it stands to reason that driving practice, particularly in conditions that tax attentional resources, would help reduce crashes caused by insufficient attentional resources. This would be true particularly for young and older drivers who lack the attentional resources of their middle-aged cohorts. These groups may benefit additionally because members of these age groups may not have the same amount of regular practice driving in conditions that challenge them.

Fatigue is a major contributor to attention deficits that lead to crashes, as is alcohol consumption. Put simply, programs to reduce fatigue and alcohol consumption prior to driving would have a major impact on reducing these inattention crashes. Because fatigue is such an important issue, it will be discussed in detail in a later section of this report.

Moving on to the next most frequent attention-related crash category from the Tri-Level study we find that 15% of crashes were caused by a driver's preoccupation with competing thoughts (cognitive distraction). This would represent about 1,830 KA crashes in Michigan in 1998. We can call this day dreaming, but the scenario is one in which a driver is thinking about the fight he just had with his boss, or another driver is trying to remember if the address she is looking for is 2500 WEST State or 2500 EAST State instead of the driving task. Attention can be shifted from a person's internal focus to a proper focus on external stimuli if the external stimuli are sufficiently noticeable. For example, daytime running lamps increase the noticeability of cars, especially on gray days and around dusk and dawn. Special attention signs that announce an upcoming controlled intersection represent another type of device that can help break the

driver's attention to the distraction (day dream) and get it back onto the driving task where it belongs.

Distractions inside the car were identified as the cause of 9% of crashes. In Michigan, this would represent nearly 1,100 crashes in 1998. These are crashes caused by spilled coffee, answering the cell phone, taking care of the child in the rear seat, etc. There are two ways to affect these crashes: eliminate the source of the distraction, or control the source of the distraction. Attempts to eliminate the source of in-vehicle distractions include passenger restrictions for young drivers and prohibitions on in-vehicle cell phone use. Attempts to control the source of distractions include conveniently located cup holders for beverages and hands-free cell phones.

Distractions outside the car were the cause of another 4% of crashes (representing perhaps 500 crashes in Michigan in 1998). This would include gawkers at a crash scene, people looking at historic or interesting landmarks, etc. Programs and policies that serve to mask possible distractions from the view of drivers (like screening crash scenes and worksites) should be effective in controlling these crashes.

Each of the articles reviewed concluded that safety will be improved to the extent that the driving environment is free from attention-grabbing stimuli not pertinent to the driving task and/or that safety will be improved to the extent that new technologies and signing reduce the attentional load placed on drivers, freeing up attentional resources. Of course, we must always be aware of the danger that as we provide systems that free up attentional resources, some drivers will react by behaving in ways that will further restrict the reservoir of available attention resources. An example of how changing technology to solve one problem may result in another problem can be found with the adoption of hands-free cellular calling.

A hands-free cellular calling system typically has a voice-recognition system that interprets the voice of the caller and dials the number without the caller having to punch the number in a keypad. In addition, a hands-free system does not require the caller to hold a handset up to talk. The microphone and speakers are placed strategically in the car to pick-up the caller's voice and transmit the voice of the person on the other end of the line. A hands-free system significantly reduces the attentional demands associated with punching in a phone number and holding the handset. However, if phone calls are longer or more calls are made because of the ease of using a hands-free system, much of the benefit derived may be lost by extending the amount of time drivers are dividing attentional resources between conducting a conversation and driving. Although the dangers associated with dialing a phone while driving are relatively obvious, studies have shown that there are significant attentional resource requirements associated with carrying on a cell phone conversation, especially if the conversation has a lot of emotional content or is cognitively challenging (like talking business with a client or boss).

Aggression

Aggressive driving is a popular term currently being used by a wide variety of groups to describe an even wider variety of driving behaviors and motivations. In general, definitions of aggressive driving have focused principally on the specific behaviors of the driver and not the driver's motivation. For example, NHTSA (1998) defines aggressive driving as, the operation of a motor vehicle in a manner which endangers or is likely to endanger persons or property. In order to better understand and control "aggressive" driving, we must first examine both the troublesome behaviors AND the motivations that underlie those behaviors.

There is little disagreement with respect to the behaviors that are described to define aggressive driving. These behaviors include (but are not limited to) speeding, weaving through traffic, tailgating, flashing headlamps, running traffic control devices and the like. There is, on the other hand, less consensus about what motivates those behaviors and how those motivations may affect what is called an aggressive driving behavior and what is called an inappropriate or inconsiderate driving behavior. This issue is critical to understanding aggressive driving and developing countermeasure programs.

Among the most useful definitions of aggression in this context was provided by Dollard and his colleagues in 1939 and later summarized by Shinar (1998). In this definition, aggression is defined as *a sequence of behavior with the desired result being the injury of the person at whom it was directed.* Furthermore, this definition states that aggression *is always a consequence of frustration.*

Summary of research findings

Recent studies have consistently found that aggressive driving is a prominent concern among drivers in the United States. Indeed, a nationwide survey (EPIC-MRA Report, 1997) showed that there may be some reason for this concern. Large proportions of drivers were found to have aggressive driving tendencies.

Nearly 60% of drivers age 18-25 were found to have aggressive driving tendencies, 39% of single drivers, and 34% of drivers age 26-29. Unfortunately, because crash reports do not include information on the intent of the driver prior to the crash, we cannot determine to what extent crashes that are caused by unsafe driving (like speeding or tailgating) are related to an act of aggression, risk taking or risk misperception, or poor driving. However, Shinar (1998) provides an excellent theoretical model that can help us understand the relationships between frustration, aggression, and subsequent unsafe driving behavior.

Shinar starts with a definition of aggression as a sequence of behavior with the desired result being the injury of the person at whom it was directed. Furthermore, this definition states that aggression is always a consequence of frustration. Factors that can increase or decrease overt aggression include:

1. level of frustration – the greater the frustration the more aggressive the response.
2. penalty for aggressive behavior – the greater the likelihood for punishment the lower the aggression.
3. legitimacy of the frustrator – aggression will be greater to the extent that the source of the frustration is perceived as unfair or inappropriate.

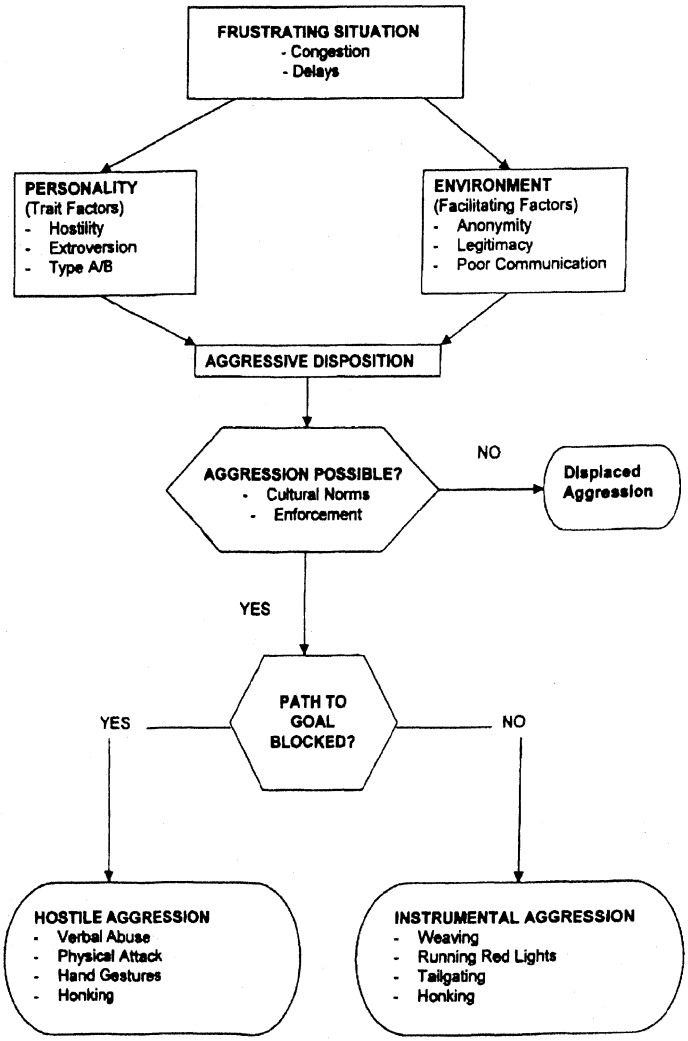
Shinar next points out that an aggressive behavior can assume one of two general forms: instrumental or hostile. Instrumental aggressive behaviors include all of the driving behaviors that the aggressor assumes will help him/her move ahead and overcome the frustrating obstacle. Hostile behaviors are those that are actually aimed at hurting the frustrator rather than overcoming the obstacle.

Shinar's frustration-aggression model presents a systems approach to the problem of aggressive driving. This model proposes that aggressive driving can be reduced not only by changing driver behavior directly (e.g., through

enforcement), but also through changes in the environment that causes aggression. Furthermore, Shinar's model hypothesizes that efforts that focus only on restraining drivers' instrumental aggression through enforcement may actually contribute to additional on-road and off-road rage as displaced aggression.

In this model, **aggressive** driving is defined as a syndrome of frustration-driven instrumental behaviors that are manifested in:

1. inconsiderateness towards or annoyance of other drivers (tailgating, flashing lights, honking)
2. deliberate dangerous driving to save time at the expense of others (running red lights, weaving).



Road rage is differentiated from aggressive driving by being defined as hostile (rather than instrumental) behavior that is purposefully directed at other road users.

Shinar points out that, unlike the overly broad definition used by NHTSA, this definition does not allow cases of speeding through a dangerous curve, or weaving at excessive speed to be classified

as examples of aggressive driving, let alone rage. Although these behaviors are objectively dangerous and engaging in these behaviors is purposive, they were not caused by any impediments or frustrations to movement. The figure on the prior page is a schematic representation of the Shinar model.

Program Implications

Recent studies have consistently found that aggressive driving is a prominent concern among drivers in the US. Aggression can be defined as a sequence of behavior with the desired result being the injury of the person at whom it was directed. Furthermore, aggression is a consequence of frustration. This model proposes that aggressive driving can be reduced not only by changing driver behavior directly (e.g., through enforcement), but also through changes in the environment that causes aggression. Furthermore, this model hypothesizes that efforts that focus only on restraining drivers' instrumental aggression through enforcement may actually contribute to additional on-road and off-road rage as displaced aggression.

The model presented earlier has a significant impact on the types of programs state highway safety planners may decide to implement to reduce aggressive driving crashes. If one was to remove the sources of frustration from the driving environment, aggressive driving would be reduced. The question then becomes, what are drivers' sources of frustration and how can they be affected.

Drivers become frustrated to the extent that their ability to achieve their goals is blocked by someone or something. For example, frustration often results from conditions that are found to be different from one's expectancies. Take the example of someone driving to Detroit from Jackson, Michigan. The person may become frustrated if the trip is delayed unexpectedly by a traffic backup caused by a traffic crash. However, the driver's level of frustration may be diminished to extent that the delay is communicated to the driver in a timely manner via radio or changeable-message signs; that the communications provide him/her with an

understanding about the delay and possible opportunities to divert around the delay; or the information is provided in time for the driver to reschedule the trip or the planned arrival time.

Any number of changes may be put into place to reduce the amount of frustration drivers experience while driving that may lead to an aggressive act. Programs that reduce road congestion through increased road construction, development and use of alternate routes, and better crash response and clean-up, all should act to reduce aggressive driving by reducing the number of frustrations drivers encounter on the road from those situations. In addition, programs that provide information to permit drivers to develop more accurate expectancies about the driving environment they are going into (like radio broadcasts, driver information kiosks, and changeable-message signs along the roadway) should also work to reduce the frustration drivers experience.

Programs designed to decrease the number of drivers who act out their frustrations by driving more aggressively may include an increased focus among traffic enforcement officers of driving behaviors that lead to conflict and increased frustration (like weaving through traffic and tailgating). Automated enforcement techniques like red-light cameras may also serve to reduce the occurrence of certain types of aggressive driving behaviors. The down side of enforcement programs is that the person being pulled over will almost certainly experience even more frustration from being pulled over (and the attendant delay), and subsequently may drive in an even more aggressive manner or even take out his/her frustrations on other people outside of the driving environment.

Another way to affect how problem drivers handle frustration is the development of frustration and anger management courses for persons repeatedly convicted of driving aggressively or persons convicted of a possible aggressive driving violation that leads to an injury-producing crash. Problems associated with escalating violence that can result from two or more drivers acting aggressively

toward one another may be handled more generally through public information campaigns that point out the value of disengaging from driving contests with angry, aggressive, and frustrated drivers. These messages may also include specific problem signs to watch for and strategies for disengaging from the potentially troublesome situation.

Fatigue

For the purposes of this discussion, fatigue is defined as *a state of sleepiness that impairs driving ability through increased reaction time, as well as decreased vigilance, attention, and information processing ability.*

Summary of research findings

Driver sleepiness is a causative factor in 1-3% of all motor vehicle crashes in the US, and surveys of the prevalence of sleepy behavior in drivers suggests that sleepiness may be more common than is reflected in this estimate (Lyzinski et al., 1998). Stutts et al. (1999) report that two-thirds of adults report a sleep problem and 1 in 13 reported a diagnosed sleep disorder. More alarmingly, 57% percent of people reported to have driven when drowsy in the past year, and 23% reported actually falling asleep at the wheel. It is quite difficult to estimate the proportion of crashes that are caused by fatigue because in addition to falling asleep at the wheel, fatigue contributes to crashes by making drivers less attentive and by impairing performance levels.

Compared to nonsleep crashes, sleep-related crashes are more likely to occur at night or midafternoon, times when people have a natural propensity for sleep. They are also more likely to involve a single vehicle running off the roadway, to occur on higher-speed roads, and to result in serious injury (Stutts et al., 1999). In addition, the driver is likely to be alone and is especially likely to be young and male.

People are sleep deprived for many reasons and the effects of sleep loss accumulate over time and do not dissipate. Even sleeping 30-40 minutes less than needed each night during a normal work week can result in a 3-4 hour sleep debt by the weekend. This is enough to significantly increase levels of daytime sleepiness.

Young people and shift workers are most likely to be sleep deprived. For young people, there is a circadian effect that causes adolescents in particular to have difficulty going to sleep late at night, even when they know they have to get up early the next day. This effect is compounded by the lifestyle choices among young people that often lead to too little sleep being achieved. Shiftworkers, especially night and rotating shift workers, often suffer from both poor quality of sleep and inadequate amounts of sleep.

Only one strategy is reported in the literature as being effective in reducing the detrimental effects caused by fatigue, namely, sleep. All other countermeasures that drivers often use (e.g., rolling down the windows, turning up the radio, stopping to stretch) are unsupported as effective by the research literature, even though drivers often cite these strategies as being at least somewhat effective for them.

Program Implications

Fatigue is a state of sleepiness that impairs driving ability through increased reaction time, as well as decreased vigilance, attention, and information processing ability. Over 50% percent of people report to have driven when drowsy in the past year, and 23% report actually falling asleep at the wheel. Young people and shift workers are most likely to be sleep deprived. Shiftworkers, especially night and rotating shift workers, often suffer from both poor quality of sleep and inadequate amounts of sleep. Only one strategy is reported in the literature as being effective in reducing the detrimental effects caused by fatigue, namely, sleep.

One of the most significant impacts on driver fatigue may well come from improving the nature of shift work in the workplace. Research evidence has repeatedly shown that workers on rotating shifts have significantly higher crash and workplace injury rates than do other workers. However, we must keep in

mind that sleep deprivation will affect everyone who happens to be putting in extra hours, stays out late, or tries to make it back late from an out-of-town trip.

Among all drivers, there needs to be increased education about steps that should be taken when one finds oneself becoming drowsy while driving. However, this may be difficult for a couple of reasons. First, many drowsy drivers do not feel drowsy or do not recognize or admit their feelings of drowsiness. Second, some drivers may recognize their drowsiness but do not admit they are in danger of crashing. These problems are illustrated with findings that show that one-quarter of drivers whom a police officer identified as asleep prior to the crash told an interviewer that they did not feel at all drowsy just before the crash. In addition, 1 out of 4 drivers involved in "fell asleep" crashes reported they had driven while drowsy on more than 10 occasions during the past year. Thus, there is a clear need for identifying cues for drivers to use to help them identify when they are too drowsy to drive.

Finally, if we can help drivers identify when they are too drowsy to drive, we must then convince them that they should stop driving as soon as safely possible and sleep. This is probably a significant undertaking given that so many drivers report significant experience "driving while drowsy" and have experienced few significant negative outcomes. As Stutts et al. (1999) point out, this is not dissimilar from alcohol-impaired driving in which the vast majority of alcohol-impaired drivers reach home safely, without crashing or receiving a traffic citation. What may well be required is a change in the public mindset such that people come to believe that drowsy driving is as unacceptable a behavior as drunk driving. The AAA Foundation for Traffic Safety's "Wake Up!!" campaign, designed to increase this perception, is modeled in many respects after the drunk driving campaigns of the 1960s and 1970s.

Annotated Bibliography

This bibliography is divided into three sections, reflecting the three major sections of the report. The UMTRI library reference number (e.g., UMTRI-58204) has been provided to make it easier for readers to locate these articles in the UMTRI library. References without the UMTRI reference number cannot be found in the UMTRI library at this time.

Distraction and Attention Literature

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Gustafson, R. 1987. Reaction time as a function of alcohol and selective attention. Oerebro University, Sweden. 8 p. *Journal of Social Behavior and Personality*, Vol. 2, No. 4, 1987, pp. 515-522. UMTRI-80402. Given a specific level of alcohol in the system, investigated whether subjects focus attention to only the most salient feature of the external situation. This hypothesis did not prove to be true in this experiment measuring reaction times in response to marked lights.

Hada, H. 1994. *Drivers' visual attention to in-vehicle displays: effects of display location and road types.* Michigan University, Ann Arbor, Transportation Research Institute. 87 p. Sponsor: Mitsubishi Motors Corporation, Okazaki (Japan) Report No. UMTRI-94-9. UMTRI-90851. Two studies are described concerning the attentional demand of in-vehicle displays while driving on public roads. The results of both experiments showed that

drivers' glance behavior relative to in-vehicle displays was affected by the display location and the road type, with road type having a more significant effect.

Harrell, W. A. 1993. Older motorist yielding to pedestrians: are older drivers inattentive and unwilling to stop? Alberta University, Edmonton, Canada. 12 p. *International Journal of Aging and Human Development*, Vol. 36, No. 2, 1992-93, pp. 115-127. UMTRI-83971. A field experiment which demonstrates older drivers are not inattentive and unwilling to stop for a pedestrian is analyzed by age and willingness of motorists to stop, along with other minor details in regard to the pedestrian.

Holahan, C. J. 1977. *Effects of visual distraction on reaction time in a simulated traffic environment.* Texas University, Austin, Council for Advanced Transportation Studies. 14 p. Sponsor: Texas Office of Traffic Safety, Austin. Report No. Research Report 47. UMTRI-40420. An older laboratory study of advertising signs (number, colors, location) and their effect on reaction time and highway accidents.

Holahan, C. J. 1979. *Psychological analysis of degree of safety in traffic environment design.* Texas University, Austin, Council for Advanced Transportation Studies. 158 p. Sponsor: Texas Office of Traffic Safety, Austin. Report No. RR-62. UMTRI-43955. An older study of the relationship of visual distractors and traffic safety.

Johnston, A. W.; Cole, B. L. 1976. *Investigations of distraction by irrelevant information.* Melbourne University, Australia. 21 p. Australian Road Research, Vol. 6, No. 3, Sept 1976, pp. 3-23. Sponsor: Australian Road Research Board, Victoria. UMTRI-53249. Addresses roadside signage conflicts with safe driving via a lengthy laboratory investigation of distraction.

Kobayashi, T. 1988. Human factors in driving. Nissan Motor Company, Ltd., Technological Strategy Planning Office, Tokosuka, Japan. 14 p. *International Journal of Vehicle Design*, Vol. 9, Nos. 4/5, 1988, pp. 586-599. UMTRI-57400. A discussion of the limited reliability of human physiological and mental functions in relation to safe driving, with sections addressing attention, driver error, and fatigue.

Kostyniuk, L. P.; Eby, D. W. 1998. *Exploring rear-end roadway crashes from the driver's perspective.* Michigan University, Ann Arbor, Transportation Research Institute. 45 p. Sponsor: Honda R and D North America, Inc., Raymond, Ohio. Report No. UMTRI-98-52. UMTRI-91800. This pilot study examined rear-end crashes from the driver's perspective to identify self-reported reasons and causes of such crashes, to identify commonalities in the self-reported causes, locations, and circumstances of these crashes, and to explore the merit of using this approach to develop countermeasures to the rear-end crash.

Kramer, A. F.; Larish, J. F.; Strayer, D. 1995. Training for attentional control in dual task settings: a comparison of young and old adults. Illinois University, Urbana/ Utah University, Salt Lake City. 27 p. *Journal of Experimental Psychology*, Vol. 1, No. 1, Mar 1995, pp. 50-76. Sponsor: National Institute on Aging, Bethesda, Md. UMTRI-87439. An examination of the influence of training on the dual task performance of young and elderly adults, how processing changes with training, and whether these changes differ over the adult years.

Matthews, G.; Sparkes, T. J.; Bygrave, H. M. 1996. Attentional overload, stress, and simulated driving performance. Dundee University, Scotland. 25 p. *Human Performance*, Vol. 9, No. 1, 1996, pp. 77-101. UMTRI-88954. This study tests the hypothesis that driver stress is associated with

performance impairment because stress-prone drivers are vulnerable to overload of attentional resources. Involved 80 subjects, and demonstrated that stressed drivers adapted to high levels of demand fairly efficiently, but they may be at risk of performance impairment when the task requires relatively little active control.

McCann, R. S.; Lynch, J.; Foyle, D. C.; Johnston, J. C. 1993. *Modelling attentional effects with head-up displays.* Sterling Software, Palo Alto, Calif./ San Jose State University, Calif./ National Aeronautics and Space Administration, Ames Research Center, Moffett Field, Calif. 5 p. Human Factors and Ergonomics Society. 37th Annual Meeting. Designing for Diversity. Proceedings. Volume 2. Santa Monica, Human Factors and Ergonomics Society, 1993. Pp. 1345-1349. UMTRI-84959 A13. Performance with Head-Up Displays is affected by both attention switching and the degree to which attention is shared between domains.

McKnight, J.; McKnight, A. S. 1991. *The effect of cellular phone use upon driver attention.* National Public Services Research Institute, Landover, MD. 19 p. Sponsor: American Automobile Association, Foundation for Traffic Safety, Washington, D.C. UMTRI-80718. Discusses a study designed to assess the effect of phone use upon the driver's ability to meet the perceptual and cognitive demands of the highway traffic environment and as a possible distraction.

Moray, N. 1990. Designing for transportation safety in the light of perception, attention, and mental models. Illinois University, Urbana. 13 p. *Ergonomics*, Vol. 33, No. 10-11, Oct-Nov 1990, pp. 1201-1213. UMTRI-57921. This paper is concerned with errors in the acquisition of information which are caused by perceptual and attentional mechanisms, with a brief summary of the author's feelings about probabilistic risk assessment and related attempts to predict error.

Parasuraman, R.; Nestor, P. 1993. *Attention and driving: assessment in elderly individuals with dementia.* Catholic University of America, Washington, D.C./ Harvard Medical School, Boston, Mass./ Veterans Administration Hospital, Mass. 11 p. Retchin, S. M., ed. Medical Considerations in the Older Driver. Philadelphia, Saunders, W. B. Company, 1993. Pp. 377-387. UMTRI-86102 A08. This is a chapter in a book about elderly drivers. Psychological assessment of older drivers should include related tests for attention, since crash risk is related to selective attention.

Parasuraman, R.; Nestor, P. G. 1991. Attention and driving skills in aging and Alzheimer's Disease. Catholic University of America, Washington, D.C./Harvard Medical School, Boston, Mass./ Veterans Administration Hospital, Brockton, Mass. 19 p. *Human Factors,* Vol. 33, No. 5, Oct 1991, pp. 539-557. Sponsor: National Institute on Aging, Bethesda, Md. UMTRI-58202. This paper proposes, on both theoretical and empirical grounds, that attentional skills in relation to driving should be examined in older adults with and without dementia of the Alzheimer's type.

Pless, I. B.; Taylor, H. G.; Arsenault, L. 1995. The relationship between vigilance deficits and traffic injuries involving children. McGill University, Montreal, Quebec, Canada/ Case Western Reserve University, Cleveland, Ohio. 6 p. *Pediatrics*, Vol. 95, No. 2, Feb 1995, pp. 219-224. UMTRI-87013. This large case-control study concludes that among children whose behavior may have been a factor in the occurrence of an injury, there is subjective evidence of increased hyperactivity and objective evidence of deficits in vigilance and attention when compared with closely matched controls.

Reason, J.; Manstead, A.; Stradling, S.; Baxter, J.; Campbell, K. 1990. Errors and violations on the roads: a real distinction? Manchester University, Department of Psychology, England. 8 p. *Ergonomics*, Vol. 33, No. 10-11,

Oct-Nov 1990, pp. 1315-1332. UMTRI-57927. Attempted to see if a distinction between errors and violations was justified for self-reported driver behavior.

Rumar, K. 1990. The basic driver error: late detection. Statens Vaeg- och Trafikinstitut, Linkoeping, Sweden. 10 p. *Ergonomics*, Vol. 33, No. 10-11, Oct-Nov 1990, pp. 1281-1290. UMTRI-57925. Discusses the basic road user error of failing to see another road user in time, why such errors happen, and how they can be reduced.

Schumann, J.; Sivak, M.; Flannagan, M. J.; Aoki, M.; Traube, E. C. 1995. *Visual displays and selective attention: do the elderly benefit if the information is flashing?* Michigan University, Ann Arbor, Transportation Research Institute. 30 p. Sponsor: American Automobile Manufacturers Association, Detroit, Mich. Report No. UMTRI-95-32. UMTRI-88337. Flashing stimuli were not processed in an automatic manner, and though there is evidence that automatic processes are more resistant to aging, flashing did not benefit older subjects in this laboratory study.

Schumann, J.; Sivak, M.; Flannagan, M. J.; Mefford, M. L. 1996. *Processing of flashing displays by younger and older drivers.* Michigan University, Ann Arbor, Transportation Research Institute. 23 p. Sponsor: American Automobile Manufacturers Association, Detroit, Mich. Report No. UMTRI-96-20. UMTRI-89189. A study on whether there was evidence for automatic processing of flashing, and if so, whether to use flashing as a means of assisting older drivers in extracting relevant info.

Shinar, D. 1993. *Traffic safety and individual differences in drivers' attention and information processing capacity.* Ben Gurion University of the Negev, Beer Sheva, Israel. 19 p. Alcohol, Drugs and Driving, Vol. 9, No. 3-4, 1993, pp. 19-237. UMTRI-85775. Argues that the driver's personality, needs, and

intentions appear to determine the driving style which in turn determines the situations in which the driver is likely to find himself/herself, and which may or may not tax the driver's attentional and information processing capacities.

Sussman, E. D.; Bishop, H.; Madnick, B.; Walter, R. 1985. *Driver inattention and highway safety.* Transportation Systems Center, Cambridge, Mass./ National Highway Traffic Safety Administration, Office of Crash Avoidance, Washington, D.C. 9 p. Transportation Research Record, No. 1047, 1985, pp. 40-48. UMTRI-56330 A02. A summary of the results of a research review into driver attentional processes with regard to the (a) safety implications of inattention (b) psychological and physiological indices of inattention, and (c) in-vehicle instrumentation for detecting inattention. Areas of research are suggested that could be valuable in the development of practical attention monitors for in-vehicle use.

Treat, J. R.; Tumbas, N. S.; McDonald, S. T.; Shinar, D.; Hume, R. D.; Mayer, R. E.; Stansifer, R. L.; Castellan, N. J. 1979. *Tri-level study of the causes of traffic accidents: final report.* Executive summary. Indiana University, Bloomington, Institute for Research in Public Safety. 78 p. Sponsor: National Highway Traffic Safety Administration, Washington, D.C. Report No. DOT-HS-034-3-535-79-TAC(S)/ DOT/HS 805 099. UMTRI-43120. An in-depth study of crash causation, considered by many to be the foundation of work that describes human errors as the most important cause of traffic crashes.

Wang, J.-S.; Knipling, R. R.; Goodman, M. J. 1996. *The role of driver inattention in crashes: new statistics from the 1995 crashworthiness data system.* Information Management Consultants, Inc., McLean, Va./ Federal Highway Administration, Washington, D.C./ National Highway Traffic Safety Administration, Washington, D.C. 16 p. Association for the

Advancement of Automotive Medicine. 40th Annual Conference. Proceedings. Des Plaines, AAAM, 1996. Pp. 377-392. UMTRI-89535 A24. A good analysis of the NHTSA1995 Crashworthiness Data System (CDS) data in regard to crashes caused by driver inattention; relates some crashes to fatigue.

Aggression Literature

American Automobile Association, Foundation for Traffic Safety. 1997. *Aggressive driving: three studies.* Sponsor: American Automobile Association, Foundation for Traffic Safety, Washington, D.C. 39 p. UMTRI-89861. Briefly addresses the topic in three studies. The first was written by Louis Mizell, the owner of a corporation that maintains databases of crime reports in Bethesda, Maryland, who was commissioned to research all incidents of violence that involved traffic altercations and use of vehicles as weapons. The second study, by Matthew Joint and Hants Basingstoke, discusses a survey done by the Automobile Association in Great Britain to establish the extent to which British motorists had experienced and perpetrated particular types of aggression when driving. The third study, by Dominic Connell, Matthew Joint and Hants Basingstoke, addresses why there is road rage in regard to emotion, environmental influences, and cures.

Ellison, P. A.; Govern, J. M.; Petri, H. L.; Figler, M. H. 1995. Anonymity and aggressive driving behavior: a field study. Towson State University, Md. 5 p. *Journal of Social Behavior and Personality*, Vol. 10, No. 1, 1995, pp. 265-272. UMTRI-87266. A field study examined the relation between anonymity and aggressive driving behavior, and in general, results are consistent with previous findings that anonymity facilitates aggression.

EPIC ■ MRA Report. 1997. *Aggressive Driver Edition.* Lansing, MI. Statistics regarding aggressive driving based on interviews with 875 adult licensed drivers.

Grey, E. M.; Triggs, T. J.; Haworth, N. L. 1989. *Driver aggression: the role of personality, social characteristics, risk and motivation.* Monash University,

Human Factors Group, Clayton, Victoria, Australia. 169 p. Sponsor: Australian Federal Office of Road Safety, Canberra. Report No. CR 81. UMTRI-82815. Examines the construct of aggressive driving and reviews related topics.

National Highway Traffic Safety Administration. 1998. *Strategies for aggressive driver enforcement.* National Highway Traffic Safety Administration, Washington, D.C. 20 p. Report No. DOT/HS 808 744. UMTRI-91822. An excellent brief manual offering strategies to assist law enforcement agencies in coordinating aggressive driving activities.

Novaco, R. W. 1988. *Automobile driving and aggressive behavior: effects of multiple disinhibitory influences.* California University, Irvine. 32 p. Sponsor: Drivetime Foundation. Report No. UCI-ITS-WP-88-5. UMTRI-77538. Discusses the disinhibitory factors of physiological arousal, traffic context, cognitive scripts, and contagion mechanisms.

Novaco, R. W. 1990. *Aggression on roadways.* California University, Irvine. 73 p. Baenninger, R., ed. Targets of Violence and Aggression. Amsterdam, Elsevier Science Publications, 1990. Sponsor: Drivetime Foundation. Report No. UCI-ITS-WP-90-5. UMTRI-80942. Reviews existing aggression research, discusses validity issues, and presents a typology of roadway aggression. Also addresses disinhibiting influences that heighten the probability of roadway aggression.

Ritzel, D. O.; Shannon, D. V.; Sarvela, P. D. 1999. Aggressive driving and road rage in the United States. Southern Illinois University, Carbondale. 2 p. *American Driver and Traffic Safety Education Association Chronicle*, Vol. 47, No. 4, Fall 1999, pp. 9-10. UMTRI-61171. A very brief commentary which offers a self-evaluation to indicate a safe driver.

Shinar, D. 1998. Aggressive driving: the contribution of the drivers and the situation. Ben-Gurion University of the Negev, Beer Sheva (Israel) 24 p. *Transportation Research*, Vol. 1F, No. 2, Dec 1998, pp. 137-160. UMTRI-61052. An excellent article defining aggressive driving in terms of the frustration-aggression model, and proposing a multi-factor approach to the problem. Describes five studies to support this approach, by showing that specific aggressive behaviors-- such as honking and running red lights-- are associated with cultural norms, actual and perceived delays in travel, and congestion.

Slovenko, R. 1997. Dealing with road rage: commentary. Wayne State University, Law School, Detroit, Mich. 3 p. *Medicine and Law*, Vol. 16, No. 4, 1997, pp. 813-816. UMTRI-91726. A brief commentary on road rage and congestion.

Fatigue Literature

American Academy of Otolaryngology - Head and Neck Surgery, Inc. *Motorists with a sleep disorder may be more dangerous than a drunk driver.* http://www.entnet.org/pressroom/sleep_disorders.html. 2/25/00. A recent press release citing a study comparing reaction times of sleepy subjects to alcohol impaired subjects.

Brown, I. D. 1994. Driver fatigue. Medical Research Council, Cambridge, England. 17 p. *Human Factors*, Vol. 36, No. 2, June 1994, pp. 298-314. UMTRI-59295. Discusses the sources and implications of fatigue for the driver specifically regarding prolonged and irregular working hours.

Corfitsen, M. T. 1994. Tiredness and visual reaction time among young male nighttime drivers: a roadside survey. Glostrup Police Department, Copenhagen County, Denmark. 8 p. *Accident Analysis and Prevention*, Vol. 26, No. 5, Oct 1994, pp. 617-624. UMTRI-59368. A roadside survey in Denmark identified tiredness as a common affliction among young male nighttime drivers, who were accurate at self-assessing their level of tiredness, which was assessed using a simple visual reaction-time test.

Dalziel, J. R.; Job, R. F. S. 1997. Motor vehicle accidents, fatigue and optimism bias in taxi drivers. Sydney University, Department of Psychology (Australia) 6 p. *Accident Analysis and Prevention*, Vol. 29, No. 4, July 1997, pp. 489-494. UMTRI-60331. A study of 42 Australian taxi drivers over two years attempted to correlate accident involvement with end of shift/tiredness.

Desmond, P. A.; Hancock, P. A. 1997. *Motivation, and fatigue-related impairments in simulated driving.* Minnesota University, Minneapolis,

Human Factors Research Laboratory. 5 p. Human Factors and Ergonomics Society. 40th Annual Meeting. Ancient Wisdom, Future Technology. Proceedings. Volume 2. Santa Monica, Human Factors and Ergonomics Society, 1997. Pp. 1003-1007. UMTRI-91358 A17. 80 study participants used a simulator to aid in the assessment of fatigue/motivation on drive performance. The motivation was a driving skill assessment instruction.

Findley, L. J.; Suratt, P. 1996. Automobile crashes and sleep. 2 p. *Virginia Medical Quarterly*, Vol. 123, No. 4, Fall 1996, pp. 258-259. UMTRI-90006. Brief article by director of a sleep disorders center that quotes statistics of sleep-related vehicle accidents and advocates the identification of people with severe sleep apnea. Discusses specific physician responsibilities required in Virginia regarding the safe operation of a motor vehicle.

Hanning, C. D.; Welsh, M. 1995. Sleepiness, snoring and driving habits. Leicester General Hospital (England) 4 p. *Journal of Sleep Research*, Vol. 5, No. 1, Mar 1996, pp. 51-54. UMTRI-90102. Self report questionnaire was sent to 5,000 drivers randomly selected from the policy holders of an insurance company to assess the affects of snoring on sleepiness and related traffic accidents.

Hartley, L., ed. 1998. *Managing fatigue in transportation; Fatigue in transportation*, 3rd conference. Proceedings. Murdoch University, Institute for Research in Safety and Transport, Perth (Australia) Published by Elsevier Science Ltd., Oxford (England) 476 p. UMTRI-91353. A book presenting a mixture of worldwide papers on the scope, causes, and assessment of fatigue along with new approaches to managing fatigue.

Highway & Vehicle Safety Report. 2000. Volume 27, Number 4. Articles of interest herein. Under the Developments and Decisions section: "People

with sleep apnea perform worse on tests that determine reaction time than people who are legally too drunk to drive in most states, according to a recent study by Stanford University." Another section entitled "Finnish study: Use of cell phones delays reaction time" discusses braking delay as a result of use of a voice-activated instrument as a contributor to rear-end crashes.

Highway safety forum on fatigue, sleep disorders and traffic safety. 1994. Proceedings. Institute for Traffic Safety Management and Research, Albany, N.Y. 86 p. Sponsor: New York State Governor's Traffic Safety Committee, Albany, N.Y.; National Sleep Foundation; National Highway Traffic Safety Administration, Washington, D.C. UMTRI-87228. Presentations of sleep disorder and traffic safety experts, rich with relevant facts about the nature and scope of the problem of fatigued and sleepy drivers, with testimonials and countermeasures.

Insurance Institute for Highway Safety Status Report. 1997. *Special issue: truck driver fatigue.* Insurance Institute for Highway Safety, Arlington, Va. 8 p. Insurance Institute for Highway Safety Status Report, Vol. 32, No. 6, 26 Jul 1997. UMTRI-90070. A discussion on the debate of hours-of-service rules, including a good history back to 1928 on hours-of-service rules.

Knipling, R. R.; Wang, J.-S. 1994. *Crashes and fatalities related to driver drowsiness/fatigue.* National Highway Traffic Safety Administration, Washington, D.C./ Information Management Consultants, Inc. 8 p. UMTRI-87310. Offers great statistics (nationally), and relates them to age and sex of those who have problems with fatigue.

Lenne, M. G.; Triggs, T. J.; Redman, J. R. 1998. Interactive effects of sleep deprivation, time of day, and driving experience on a driving task. Monash University, Department of Psychology, Melbourne (Australia) 7 p. *Sleep*,

Vol. 21, No. 1, 1998, pp. 38-44. UMTRI-91340. A study of performance decrements based on amount of sleep deprivation, time of day, and driving experience.

Lyznicki, J. M.; Doege, T. C.; Davis, R. M.; Williams, M. A. 1998. *Sleepiness, driving, and motor vehicle crashes.* American Medical Association, Council on Scientific Affairs, Chicago, Ill. 6 p. UMTRI-92335. A report from the Council on Scientific Affairs assessing the contribution of driver sleepiness to highway crashes and reviewing recent recommendations to change federal hours-of-service regulations for commercial motor vehicle drivers. A good synopsis of information from a variety of current sources.

Mast, T. M.; Jones, H. V.; Heimstra, N. W. n.d. 1965. *The effects of fatigue on performance in a driving device.* South Dakota University, Department of Psychology, Vermillion. 15 p. UMTRI-01608. A very old study of 60 males using a driving simulator to assess performance decrements associated with fatigue.

Maycock, G. 1995. *Driver sleepiness as a factor in car and HGV accidents.* Transport Research Laboratory, Crowthorne, England. 41 p. Report No. TRL Report 169. UMTRI-88446. Summary of two surveys: a postal questionnaire of male car drivers; and an interview survey of male Heavy Goods Vehicle (HGV) drivers in regard to fatigue.

Maycock, G. 1996. *Sleepiness and driving: the experience of UK car drivers.* Transport Research Laboratory, Crowthorne (England) 9 p. Journal of Sleep Research, Vol. 5, No. 4, Dec 1996, pp. 229-237. UMTRI-90164. A postal questionnaire sent to a 9,000 males explores the relationship between accidents and daytime sleepiness, utilizing the Epworth scale and information regarding snoring.

Milosevic, S. 1997. Drivers' fatigue studies. Belgrade University (Serbia) 9 p. *Ergonomics*, Vol. 40, No. 3, Mar 1997, pp. 381-389. UMTRI-60422. Several different studies of truck and bus drivers are summarized. Some studies used psychophysiological tests before and after driving to assess fatigue, while others used questionnaires.

Moskowitz, H., ed. 1990. *Fatigue, sleep deprivation, circadian rhythms and their interaction with alcohol and other drugs.* Proceedings of an international symposium held in Santa Monica, California. California University, Los Angeles. 104 p. Alcohol, Drugs and Driving, Vol. 5, No. 4 and Vol. 6, No. 1, 1990. UMTRI-57760. Nine different papers from a symposium held April 13-16, 1989.

National Highway Traffic Safety Administration . 1998. *Drowsy driving and automobile crashes.* National Highway Traffic Safety Administration, Washington, D.C. 27 p. Report No. DOT/HS 808 707. UMTRI-91262. NCSDR/NHTSA (National Center on Sleep Disorders Research/National Highway Traffic Safety Administration) Expert Panel on Driver Fatigue and Sleepiness reports the results of a literature review and opinions of the expert panel on driver fatigue and sleepiness regarding key issues involved in the problem.

National Transportation Safety Board. 1999. S*afety report. Evaluation of U.S. Department of Transportation efforts in the 1990s to address operator fatigue.* National Transportation Safety Board, Washington, D.C. 110 p. Report No. NTSB/SR-99/01. UMTRI-92624. An update on the activities and efforts by the DOT and the modal administrations to address operator fatigue and, consequently, the progress that has been made in the past 10 years to implement the actions called for in the three intermodal recommendations and other fatigue-related recommendations. Also

provides some back-ground information on current hours-of-service regulations, fatigue, and the effects of fatigue on transportation safety.

New York State Task Force on the Impact of Fatigue on Driving. 1994. Institute for Traffic Safety Management and Research, Albany, N.Y./ New York State Governor's Traffic Safety Committee, Albany, N.Y. 25 p. UMTRI-87227. A New York state task force studied the impact of fatigue on driving, and offers numerous traffic safety recommendations divided up by eight different topic areas, which are then prioritized and offered as concluding recommendations.

Reyner, L. A.; Horne, J. A. 1998. *Evaluation of 'in-car' countermeasures to sleepiness: cold air and radio.* Loughborough University, Sleep Research Laboratory, Leicestershire (England) 5 p. Sleep, Vol. 21, No. 1, 1998, pp. 46-50. Sponsor: Great Britain Department of Transport, London (England) UMTRI-91333. A study of cold air and radio use as countermeasures to sleepiness; using a simulator, they demonstrate these are at best only temporary aids.

Shuman, M. 1992. Asleep at the wheel. 4 p. *Traffic Safety,* Vol. 92, No. 1, Jan/Feb 1992, pp. 6-9. UMTRI-58246. A very brief, general article about the hazards of falling asleep while driving.

Stutts, J. C.; Wilkins, J. W.; Vaughn, B. V. 1999. *Why do people have drowsy driving crashes? Input from drivers who just did.* North Carolina University, Chapel Hill, Highway Safety Research Center/ North Carolina University, Chapel Hill, School of Medicine. 87 p. Sponsor: American Automobile Association, Foundation for Traffic Safety, Washington, D.C. UMTRI-92726. Phone interviews of 1,403 drivers involved in recent police-reported crashes in NC whose physical condition at the time of crash was identified as either "asleep" or "fatigued" by the investigating officer.

Results suggest that the public perceives drowsy driving to be a somewhat less important cause of motor vehicle crashes than alcohol, but more important than poor weather conditions, speeding, or driver inexperience, and about equal in importance with aggressive driving.

Summala, H.; Haekkaenen, H.; Mikkola, T.; Sinkkonen, J. 1999. Task effects on fatigue symptoms in overnight driving. Helsingin Yliopisto, Traffic Research Unit (Finland) 9 p. *Ergonomics*, Vol. 42, No. 6, Jun 1999, pp. 798-806. UMTRI-61034. Four drivers participated in a study utilizing instrumented cars to examine the effects of task and time-on-task on fatigue symptoms in overnight driving.