CHANGING BEHAVIORS TO PREVENT DROWSY DRIVING AND PROMOTE TRAFFIC SAFETY: REVIEW OF PROVEN, PROMISING, AND UNPROVEN TECHNIQUES

Final report

I. Review of scientific and technical literature

II. Survey of drowsy driving behavioral countermeasures

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TABLE OF CONTENTS

EXECUTIVE SUMMARY …….3

ACKNOWLEDGMENTS ……6

I. REVIEW OF SCIENTIFIC AND TECHNICAL LITERATURE

INTRODUCTION ……...7

METHODS ……8

RESULTS ……9

DISCUSSION AND CONCLUSIONS ……..17

II. SURVEY OF DROWSY DRIVING BEHAVIORAL COUNTERMEASURES

INTRODUCTION ……..19

METHODS ……..21

Study Design ……..21

Subjects ……..22

RESULTS ……24

DISCUSSION AND CONCLUSIONS ……37

APPENDIX ……..39

REFERENCES ……..45

EXECUTIVE SUMMARY

Excessive sleepiness may result in an increased risk of a motor vehicle crash either because the motorist falls asleep while driving or because he experiences reduced attention to road events and driving tasks due to fatigue/sleepiness. These crashes are primarily of the "drift-off-the-road" sort, as driving off the road may reflect the behavior of a sleepy driver. The amount of legal and scientific evidence regarding driver fatigue is large enough to warrant special attention towards investigating ways of preventing crashes that have drowsiness as a major contributing factor to the cause.

The temporal occurrence of these fall-asleep crashes corresponds with the known circadian variations in sleepiness. There is a primary peak in the number of automobile accidents in the early morning hours, and a secondary peak during the mid-afternoon siesta time, around 3:00pm (Pack et al 1995). Further, the temporal occurrence of these fall asleep crashes is a function of age. These crashes occur mostly during the late night and early morning hours for persons between 18-45 years of age, and during the afternoon siesta time for the elderly. (Pack et al 1995).

It is assumed that drivers engage in a variety of behaviors to remain alert at the wheel. However, very little is known about the actual techniques employed to stay awake. Many agencies as well as individuals advocate engaging in certain types of behaviors in order to stay awake, such as rolling down the window or stopping to ingest some caffeine or a meal. Some experienced drivers claim that certain things work better than others. However, there have been no findings of definitive proof that any of these behaviors are more effective than others, or that they sustain alertness for an extended period. This study aims to examine the countermeasures that have been shown to be effective, ineffective, or potentially effective in combating drowsy

driving.

We first performed an investigation of the literature regarding countermeasures that drivers use in an effort to combat drowsiness and remain alert while driving. We conducted our search by utilizing the services of on-line computer reference databases such as MEDLINE and PSYCHINFO, as well as the search engines on the World Wide Web. In the current literature on the subject, we found very little information *with scientific backing* of what does or does not work. From the information (or lack thereof) acquired from the literature search, as well as from the input of a few small focus groups, a survey tool on behaviors associated with drowsy driving and directed towards those who are knowledgeable in driving safety was devised in order to identify conditions that may either exacerbate or prevent drowsy driving behavior.

While there is a small amount of preliminary scientific data for many technological devices and behaviors that may be used to combat drowsy driving, it seems that the richest data come in the form of anecdotal accounts. In terms of countermeasures, prior studies have found that the first choice of sleep experts is prevention through careful scheduling of duties (e.g. avoiding night duty and early rising) (Åkerstedt 1995). The second choice is behavioral sleep management such as napping (Åkerstedt 1995). Some experts say that only in the most unusual circumstances should drugs be used that directly enhance alertness (Åkerstedt 1995).

We found that few, if any, empirical studies have revealed definitive proof of what measures may be effective in combating drowsiness while driving. Thus, we endeavored to design a study which would assess not only experts' opinions with respect to the effectiveness of certain behavioral countermeasures but also the extent to which this population could cite definitive scientific evidence regarding proven, disproved or promising techniques. We were

aware of several rumored empirical studies into this area, and hoped to uncover any data, published or not, that would provide some proof of any effective measures.

We devised a survey and sent it to 1221 persons who possessed interest and expertise in the area of fatigue research, of which 283 responded. The respondents' feedback supported our hypothesis that there exists little if any scientific proof of what behaviors are effective (or ineffective) countermeasures to drowsiness while driving. The data also indicated that most people, regardless of their occupation, level of education, and any other demographic characteristics, agree that there is no substitute for sleep.

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I. REVIEW OF SCIENTIFIC AND TECHNICAL LITERATURE

INTRODUCTION

The extent to which sleepiness/drowsiness is a contributing factor in motor vehicle crashes is debatable. While official federal estimates are quite low, approximating 1-3% of all crashes (Dinges 1995), there is escalating concern that this represents a severe underestimate, based on insufficient data, of how much sleepiness acts as a contributor to motor vehicle crashes. Thus, many researchers are now coming to recognize drowsy driving as a significant cause of road catastrophes. Excessive sleepiness results in an increased risk of motor vehicle crashes primarily because the driver either falls asleep while driving or experiences reduced attention to road events and the driving task due to fatigue/sleepiness.

There is enough evidence regarding driver fatigue as a probable major factor in many motor vehicle accidents to warrant attention towards investigating ways of preventing crashes that have drowsiness as a contributing factor in the cause. It is assumed that drivers engage in many different types of behaviors to remain alert at the wheel. However, very little is known about the actual techniques employed. In an effort to provide a foundation on which to devise a drowsy driving prevention questionnaire aimed at experts in fatigue and/or traffic safety, a thorough review of the scientific and technical literature on the issue of drowsy driving countermeasures was performed.

METHODS

We performed a thorough investigation of the existing literature regarding countermeasures that drivers employ in an effort to combat drowsiness and remain alert while driving. We began our search by employing the services of on-line computer reference databases such as MEDLINE and PSYCHINFO. The following is a sample of the words or phrases used in executing the search along with the number of recovered articles falling in that category:

Key Word(s)	# of articles
Accident and falling asleep	3
Driving and fatigue	20
Fall asleep and crashes	0
Fall asleep crashes and prevention	0
Prevention and sleepiness	0
Prevent and sleepy	3
Prevention and drowsiness	19
Prevention and fatigue and vehicle	3
Countermeasures and sleepiness	0
Countermeasures and drowsiness	0

Our literature search was further carried out by World Wide Web searches utilizing Internet search engines such as INFOSEEK, YAHOO, LYCOS, and MAGELLAN. The same keywords were used in the World Wide Web searches. We would read and take careful notes on all articles that appeared to have *any* relevance to the topic of operation of a motor vehicle while drowsy, whether the article mentioned possible countermeasures or not.

RESULTS

The intensive literature search did not reveal any knowledge regarding behavioral countermeasures that were not yet known. No scientific articles were found when performing searches with keywords such as “countermeasure and fatigue and crashes”, “drowsiness and accidents”, and “dozing off and crashes”. In the few cases that numerous articles were found, (i.e., keywords such as “accidents and sleepiness”, “sleepiness and driving” and “fatigue and drivers”), the articles did not reveal any scientifically validated behavioral countermeasures for drowsy driving. It is safe to say that the literature on scientifically validated drowsy driving behavioral countermeasures is almost nonexistent. The literature that does exist seems to promote the combined use of naps and caffeine as the best ways to combat driver fatigue. However, the existing articles say nothing about validated, unproven or disproved behavioral countermeasures.

While the literature on scientifically validated behavioral countermeasures is insufficient, there are numerous anecdotal accounts that may be useful in devising experimental designs to test the effectiveness of commonly used countermeasures. According to the 1994 New York State Drowsy Driving Survey of 1000 randomly sampled licensed drivers in 62 counties of New York state, the following were among the respondents’ recommended preventative strategies for drowsy drivers:

- Stopping and getting out of the car
- Napping
- Changing drivers
- Listening to the radio
- Conversing
- Consuming beverages or snacks, including those with caffeine
- Slapping the face

- Opening the window

Of the 1000 drivers sampled, 59% had driven over shoulder rumble strips, and virtually all of these respondents felt that the strips would help keep drivers alert on the road. 45% of the respondents stopped at a roadside rest area within the past year when they felt drowsy while driving. Almost all of these respondents felt that stopping helped to combat drowsiness (New York State Task Force on the Impact of Fatigue on Driving / Team to Explore the Nature and Scope of Drowsy Driver Crashes in New York State 1994).

Falling asleep at the wheel accounts for a large number of vehicle accidents that occur under monotonous driving conditions (such as driving on long, smooth, relatively non-winding roads). Of course, boredom is often seen as an antecedent to drowsiness. If investigators believe that driving conditions are very likely to give rise to listlessness, they may be more likely to explore the possibility of drowsiness as a cause in the accident. What this indicates is that investigators may overlook the possible importance of drowsiness as a contributing factor if they do not feel that the driving conditions would lead to ennui.

Involvement in drowsy driver crashes is also strongly related to the gender and age of the driver. In the years between 1990 and 1993, male drivers comprised a higher proportion of drivers who fell asleep than they did among all drivers **(citation)**. Approximately one third of the drivers who fell asleep were 18-24 years old, whereas the people in this age range comprise only 19 percent of all drivers (New York State Task Force on the Impact of Fatigue on Driving / Team to Explore the Nature and Scope of Drowsy Driver Crashes in New York State 1994). Horne and Reyner (1995) have found that young adults, those under 30 years old, especially men, are the most likely to have these accidents, especially in the early morning hours. These drivers were the most prevalent group of road users during this time of day. Older adults may be

more prone to these accidents in the early afternoon hours. Further investigation is needed concerning this relation between gender, age and drowsy driving.

Informal group discussions with an assemblage of 25 Philadelphia college students, from the University of Pennsylvania, Drexel University and Temple University, revealed that the respondents usually employ the following behavioral techniques to combat drowsy driving:

- Turning up the volume of the radio
- Avoiding driving at night
- Rolling down window
- Trying not to stare at division line
- Driving over rumble strips
- Listening to rap music
- Chewing gum (flavor need not be mint)
- Pulling over and napping if it is during the day
- Smoking
- Conversing with someone
- Driving a stick shift
- Slapping/Pinching self
- Screaming
- Rotating drivers
- Drinking coffee / caffeinated beverages
- Stopping by the next rest area if it is *not* dark
- Playing games in the car

Of the aforementioned behaviors, the most common technique employed by the participants were as follows:

- Turning up volume of radio (76%)
- Drinking caffeinated beverages (52%)
- Rolling down window (48%)

- Slapping / Pinching self (24%)

(% = number of participants who employed behavior out of 25 total participants)

Out of 25 college students interviewed, only one student reported combating drowsy driving by pulling over to rest, a technique that is believed to be the only safe countermeasure to drowsy driving (Horne 1995).

There is little substantive evidence that countermeasures employed while continuing to drive, such as rolling down the window or turning up the volume of the radio, are of more than temporary benefit. Horne and Reyner's (1995) findings have been that a car radio while driving drowsy does *not* improve deteriorating driving performance. In fact, it can distract sleepy drivers from being aware of their sleepiness and impaired driving and thus encourage them to continue driving in such a sleepy state. The only other report that could be found on the effects of a car radio on sleepy drivers was by Fagerstrom and Lisper (1977). Although devoted to driving behavior, only reaction-time data were presented, where it was shown that extroverts (versus introverts) benefited more from having a radio playing in the background (e.g., longer sleep latency), as did inexperienced (versus experienced) drivers. The effects were small, however.

A countermeasure for nodding off is to get the best sleep you can before a trip (Rosekind 1995). A study was done to see what factors predicted the severity of jet lag, which can be extended over to drowsy driving. The number one factor in predicting jet lag severity that emerged was how much sleep had been lost just prior to the trip. "We recommend at a minimum, trying to get two nights of good sleep before you begin a duty period" (Rosekind 1995). In addition, if you need 8 hours of sleep, you should try to get 8 hours and no less. (Rosekind 1995). These recommendations generate across all modes of transportation. Thus, it is essential that an individual get 8 good hours of sleep in preparation for a long drive.

Seemingly, the most valid index of alertness in the driver is the EEG. There is good evidence that rising alpha (8-11Hz) and theta (4-7 Hz) EEG activities indicate increasing sleepiness and thus the potential for lapses in attention and behavior (Dinges 1995). Several biobehavioral techniques for managing fatigue have been scientifically shown to promote alertness. Some of these countermeasures include:

- Effectively using safe hypnotics to periodically promote sleep in certain shift work scenarios.
- Taking scheduled naps based on scientific studies of their utility for reducing physiological sleepiness.
- Safely and effectively consuming caffeine to periodically promote alertness
- Using bright lights to help promote alertness on the job (Dinges 1995)

These biobehavioral techniques are among some of the scientifically validated fatigue countermeasures that could extend over to the issue of combating drowsiness at the wheel. For instance, long distance drivers might consider taking scheduled naps at specified rest areas en route to their destination. Further, a drowsy driver can stop by a rest area to effectively consume coffee or some other caffeinated beverage in order to maintain a level of alertness that is safe for operating a motor vehicle. Finally, since bright lights help to promote alertness, the driver should avoid driving at night, particularly after sleep loss and/or consuming alcohol.

Alcohol considerably increases the experience of sleepiness and is therefore frequently used to induce sleep. One implication is that you should not consume alcohol before driving, or if you intend to drive the following day, as it will increase your sleepiness thereby decreasing your alertness at the wheel. Alcohol also induces increased relaxation, which causes snoring due to a slight obstruction of the respiratory organs, or sleep apnea, total temporary obstruction of the respiratory organs. Apnea and to a lesser extent, snoring, lead to reduced alertness the next day

(Åkerstedt 1996). This reduced alertness could prove to be catastrophic if the person gets behind the wheel.

It is often recommended that sleepy drivers exercise during a break from driving, in order to remain alert at the wheel. Again, there is not substantive supporting evidence. The few relevant findings (Horne 1988) come from studies of sustained total sleep deprivation incorporating long bouts of heavy exercise, with the result that exercise has no beneficial outcome and may even worsen sleepiness. Horne and Foster (1995) have examined the effects of shorter, more practical amount of exercise on less extreme levels of sleepiness. They found that while several subjects reported that the moderate levels of exercise increased their alertness, the effect only lasted for approximately 10-15 minutes after cessation of exercise.

The only safe countermeasure to a drowsy driving automobile accident is to cease driving as soon as possible. Upon cessation, a nap and/or caffeine consumption can be effective. Hence, taking a break from driving is clearly a recommendation as it necessitates cessation of driving. Indeed, the best countermeasure to sleepiness is to sleep. The question then becomes—what is the nap duration that provides a measurable optimum degree of recovery? Studies have shown that naps of durations between one hour and three hours considerably improve alertness and performance (Horne and Reyner 1995). There is also evidence that naps involving sleep durations less than one hour (e.g., 20-45 minutes) can promote alertness (Horne and Reyner 1995). The greatest gain in alertness appears to be derived from the first hour of sleep (relative to subsequent hours). Although napping can significantly help fatigue, it should not be used to the exclusion of longer periods of recovery sleep.

Napping is a fatigue countermeasure that can be of great benefit if used properly and limitations are recognized. The limitations include:

- Napping requires dissipations of sleep inertia to be beneficial.
- Napping does not promote circadian adjustment to night work.
- Napping does not significantly repay cumulative sleep debt. (Dinges 1995)

There is no evidence that resting without sleep for the same period of time as a nap will reverse sleepiness and promote alertness in an operator who is experiencing fatigue due to sleep loss, no matter how physically restful the rest period may be.

After "sleeping/napping", probably the next most potent method for alleviating sleepiness is to take a pharmacological stimulant, the most acceptable being caffeine, due to the few adverse side-effects (Walsh et al. 1995). Little systematic research has been undertaken on the effects of caffeine on driving, however. In a study of driving performance in sleepy drivers driving a realistic car simulator, Horne and Reyner (1995) found that both caffeine and napping significantly reduced driving incidents, sleepiness, and EEG activities indicative of drowsiness, with the effects lasting for an hour of driving. It should be noted, however, that contrary to popular belief, coffee does not *overcome* the effects of drowsiness while driving. In other words, caffeine is not a substitute for sleep, since the effects dissipate fast.

In general, for prevention of alertness deficit, the following criteria for scheduling are recommended:

- Early rising (before 0600h) should be avoided.
- Extended duration (>16h) of time awake should be avoided.
- At least 7 hours of sleep should be provided.
- The length of duty should not exceed 10 hours.
- If sleep has been interfered with, the length of duty should be reduced.

- Taking a nap (Further research is needed to assess the use of mininaps of <5 min as countermeasures.)
- Main sleep period should be allocated to night hours.
- Rotation between night and day duty should be avoided. (Åkerstedt 1995)

DISCUSSION AND CONCLUSIONS

While there is a small amount of preliminary scientific data for many technological and behavioral measures to combat drowsy driving, it is apparent that the richest data come in the form of anecdotal accounts. In terms of countermeasures, the obvious first choice is prevention through careful scheduling of duties (e.g., avoiding night duty and early rising) (Åkerstedt 1995). The second choice is behavioral sleep management (i.e., napping) (Åkerstedt 1995). Caffeine can also be consumed to promote alertness, but the effects will dissipate fast.

In order to prevent crashes resulting from drowsy driving, drivers must learn to recognize the dangers of driving while sleepy and then take appropriate action to avoid catastrophe. One of the most important actions is to take a break from driving. According to the recommendations of researchers, the driver should try to nap and/or ingest some caffeine during the break. The problem is that it is often not possible to employ one or both of these recommended behaviors. The question then becomes, "what, if anything, can the driver do instead to stay awake?" Further research is needed to reveal the effectiveness of any other countermeasures, both behavioral and technological. Additional research is also needed to assess the effectiveness of distractions on sleepy drivers (e.g., is it effective for a drowsy driver to use a cellular phone as a distraction mechanism from sleepiness in order to avoid a crash ?)

The issue of drivers falling asleep at the wheel and causing crashes has not received enough attention from medical professionals, traffic safety programs or the general public. A quintessential element in preventing sleep-related motor vehicle crashes involves the education of people in all sectors of society about the risks of driving when sleepy. Thus, further research

based upon both the opinions of sleep and traffic safety experts and the most popular anecdotal suggestions is urgently needed to develop and evaluate effective countermeasures. It is a challenge but no doubt possible, if we raise awareness of the problem.

II. SURVEY OF DROWSY DRIVING BEHAVIORAL COUNTERMEASURES

INTRODUCTION

With the nature and extent of the social problem of drowsy driver automobile accidents firmly established by media and governmental reports, the American Automobile Association Foundation for Traffic Safety proposed a study to assess what experts believe to be the most effective countermeasures to drowsiness while driving. Possible countermeasures may constitute changes in driver behavior or the utilization of technological warning devices. The study of technological devices to help combat drowsiness while driving is still relatively new, and very little conclusive data have been found as of yet. A number of studies assessing driver behavior in relation to this area exist; however, most conclude that drivers simply must plan accordingly *prior* to driving, thus decreasing the possibility of falling asleep behind the wheel (Åkerstedt 1995). Few, if any, studies have determined what measures may be effective *while driving*.

A thorough review of the literature on the subject of drowsy driving countermeasures provided the insight that there exists a dearth of conclusive scientific research into the area. This realization became the impetus to design a study which would assess not only experts' opinions with respect to the effectiveness of certain behavioral countermeasures but also the extent to which this population could cite definitive scientific evidence regarding proven, disproved or promising techniques. We were aware of several rumored empirical studies into this area, and hoped to uncover any data, published or not, that would provide some proof of any effective measures.

Our primary aim was to descry any definitive evidence of whether a particular **behavioral** countermeasure to drowsiness while driving could be considered effective or ineffective. We did not inquire about opinions of whether technological devices are preferable to

behavioral alterations or vice versa. We also did not ask *why* some measures would work, while others would not. Our survey simply attempted to assess whether a particular type of behavior (e.g. chewing ice or slapping oneself in the face) would have *any* type of countering effect on drowsiness while driving. Again, our favored response consisted of one with scientific support. Following that, the opinions of an expert in sleep research or traffic safety, or of an experienced driver appeared to be the next best thing.

METHODS

STUDY DESIGN

Based on the information acquired from the literature search, we devised an instrument that was directed towards those who are knowledgeable about fatigue and/or driving safety and which asked for their opinions on behaviors associated with drowsy driving. Through analyzing the responses on this self-administered questionnaire, we hoped to identify not only conditions that may either exacerbate or prevent drowsy driving behavior but also what techniques would be best to use in order to counteract drowsiness in the event that it was excessive enough to interfere with driving.

We created our database of possible respondents by reviewing directories of relevant scientific societies (e.g. International Sleep Research Societies) and by obtaining the mailing and/or attendee lists from conferences concerning fatigue research as it relates to the prevention of motor vehicle accidents. Details about all lists consulted follow in the Subjects section. Mailing list data were entered into a Microsoft Access database. All other relevant data were entered into the Microsoft Excel and Systat 7.0 data analyzing systems. These latter data included, but were not limited to: nature of behavioral issue (e.g., changing perception of risk of driving sleepy); extent to which an issue is proven to be effective; extent to which an issue is unproven, but has high potential; extent to which and issue is unproven, but has low potential; extent to which issue is proven to be ineffective.

Respondents were categorized according to their occupations and analyses were done to compare responses of those with different specialties. The occupational categories were as follows:

1. Researchers/Scientists
2. Educators
3. Medical/Healthcare Professionals
4. Transportation Safety Research Specialists
5. Human Factors Engineer/Engineer Other
6. Administrators
7. Others

Respondents were also categorized according to whether they were sleep professionals or non-sleep professionals for data analysis and comparison purposes.

SUBJECTS

A total of 1221 experts (age 22-76) in driving, fatigue and traffic safety were asked to complete a Drowsy Driving Prevention Questionnaire. Volunteers were selected for participation based on their involvement in drowsy driving and sleepiness/fatigue forums in the past six years in the United States, Australia, Sweden, Ireland, and Europe. We also reviewed the directories of the following scientific societies to identify those persons who list their primary interest as fatigue and its prevention: American Sleep Disorders Association, American Sleep Society, Sleep Research Society, American Psychological Society, World Federation of Sleep Research Societies, Society for Research and Biological Rhythms, Human Factors-Ergonomics Society, Society for Neuroscience, and International Sleep Research Societies. In addition, we reviewed directories from the American Trucking Association, Automotive companies, the U.S. Army, the U.S. Air Force (Sustained/Continuous Operations), the U.S. Navy, NASA Ames Fatigue Research Division, and New York Drowsy Driving Task Force. We surveyed these individuals (eliminating redundancies of people belonging to more than one group) in order to identify their

knowledge and opinions about behaviors that may prevent drowsy driving. The information obtained through the various resources was screened for relevance to behavioral countermeasures and driving drowsy.

All information obtained about a participant through this study was treated with strict confidentiality, except as may be required by law, and all records were identified by a code number known only by the study staff. The purposes of identifying each participant with a code number were to be able to perform analyses of demographic characteristics of the study sample and to provide a means through which we could send copies of the results out to all respondents. All data and responses from the participant were numerically coded and stripped of identifiers to protect the participants' confidentiality.

RESULTS

A total of 1221 questionnaires were distributed nationally and internationally. The original survey is located in the Appendix for reference. We obtained a response rate of 23.2% (16.8% national, 4.9% international, 1.5% unknown). 72.4% of respondents were from the United States, 21.2% of respondents were international. We could not identify the country from which 6.4% of the returned surveys came. The age of the respondents ranged from 22-76, with a mean of 47.4 and standard deviation of 10.9. 76.3% of respondents were males, 22.6% were females, and 1.1% did not specify their gender. The modal highest academic degree earned (comprising nearly 1/3 of respondents) was a Ph.D. The modal occupation of the study sample (24.7% of respondents) was researcher/scientist.

We asked our volunteers what they considered to be the first sign(s) of drowsiness while driving. This question was open-ended and Table 1 shows the top 5 reported first sign(s) of drowsiness while driving.

Table 1. Top 5 reported first sign(s) of drowsiness while driving—(open-ended)

Behavior	# Times reported (N=283)	% Respondents
Involuntary Eyelid Closures	99	35.0%
Inattention	69	24.4%
Yawning	46	16.3%
Inability to Stay in Lane	44	15.6%
Disengagement from Environment	33	11.7%
Feeling Tired	33	11.7%

We requested that the respondents provide us with their opinions about these first signs of drowsiness in order to assess expert opinion about things for which a driver should look when trying to gauge drowsiness. It seems that one of the primary factors contributing to these fall asleep crashes is that the drivers can not (or will not) recognize that they are extremely drowsy. It would seem obvious that if, for example, a driver's eyes are closing, his attention is wandering and he is incessantly yawning, the driver would realize that he is becoming (or is already) drowsy. However, many people overlook these indicators for one reason or another, an issue which requires further study.

For the next part of the survey, we asked the following question:

> "Please rate the extent to which you believe the following factors would increase or decrease the individual's drowsiness while driving."

The scale for the responses to this question is as follows:

1=**Definitely** would **increase** drowsiness

2=**Probably** would **increase** drowsiness

3=**No Effect**

4=**Probably** would **decrease** drowsiness

5=**Definitely** would **decrease** drowsiness

We surveyed 26 driving factors in order to identify what the respondents felt would constitute a "drowsiness-inducing" driving context. As stated previously, it seems that certain driving contexts are closely correlated with a high incidence of fall-asleep auto crashes. These contexts include, but are not limited to: monotonous driving conditions, alcohol consumption, and driving at night. Table 2 shows the contexts that we listed and their response means in descending rank order.

Table 2. Extent to which a certain driving context will INCREASE or DECREASE drowsiness/sleepiness while driving

Rank	Driving context	Mean
1	Driving while being in a hurry to get to an appointment	4.17
2	Driving while having to go to the bathroom	4.16
3	Driving in high winds (30-40 m.p.h.)	3.92
4	Driving on a bumpy road	3.92
5	Driving with heavy traffic	3.92
6	Driving on an unfamiliar route	3.92
7	Driving on a highway with road construction underway	3.86
8	Driving on a winding road	3.84
9	Driving in a snow storm	3.77
10	Driving a vehicle that needs brake repair	3.75
11	Driving while emotionally upset	3.74
12	Driving in a heavy rain storm	3.69
13	Driving with moderate traffic	3.32
14	Driving on a non-divided highway	3.28
15	Driving on a 2-lane rural highway	3.11
16	Driving on an overcast day	2.66
17	Driving on a divided highway	2.58
18	Driving with a broken radio	2.56
19	Driving on a humid day	2.47
20	Driving at night, before midnight	2.28
21	Driving in darkness	2.18
22	Driving on a straight road	2.15
23	Driving with little or no other traffic	2.15
24	Driving after having 1-2 beers or glasses of wine	1.67
25	Driving at night, after midnight	1.38
26	Driving after having 3-4 beers or glasses of wine	1.20

Table 3 shows the top 5 reported driving contexts likely to **decrease** drowsiness while driving while Table 4 shows the top 5 reported driving contexts likely to **increase** drowsiness while driving.

Table 3. Top 5 reported driving contexts likely to **decrease** drowsiness while driving.

Rank	Driving context	Mean
1	Driving while being in a hurry to get to an appointment	4.17
2	Driving while having to go to the bathroom	4.16
3	Driving in high winds (30-40 m.p.h.)	3.92
4	Driving on a bumpy road	3.92
5	Driving with heavy traffic	3.92

Table 4. Top 5 reported driving contexts likely to **increase** drowsiness while driving.

Rank	Driving context	Mean
1	Driving after having 3-4 beers or glasses of wine	1.20
2	Driving at night, after midnight	1.38
3	Driving after having 1-2 beers or glasses of wine	1.67
4	Driving with little or no other traffic	2.15
5	Driving on a straight road	2.15

From Table 4, it is fairly simple to deduce a worst case scenario for a drowsiness-induced auto accident being very likely: driving at night, on a straight road with little or no other traffic, after having consumed one or more alcoholic beverage(s) – a situation that is all too common.

For the next part of the questionnaire, we asked the volunteers the following question:

"To what extent are each of the following behaviors likely to result in increased **alertness** in a **drowsy/sleepy** driver? Please also estimate the duration the behavior(s) will remain effective in combating drowsy driving for all items that you indicate "**Probably** will **increase** driver alertness" or "**Definitely** will **increase** driver alertness."

Our scale of responses went as follows:

1=**Definitely** will **not** increase driver alertness

2=**Probably** will **not** increase driver alertness

3=**Probably will** increase driver alertness

4=**Definitely will** increase driver alertness

We did not provide a "No Effect" option this time, because we wanted to impel the respondents to pick one side or the other. See Table 5, which extends for several pages, for respondents' ranking (by response mean) of the extent to which certain behaviors will result in **increased alertness** in a drowsy/sleepy driver.

Table 5. Extent to which respondents think that certain behaviors will result in **increased alertness** in a drowsy/sleepy driver.

Rank	Behavior	Mean
1	Letting someone else drive for 1-2 hours while you sleep in the passenger seat before driving again	3.68
2	Pulling off road to take a 30-45 minute nap	3.57
3	Pulling off road to take a nap for >1 hour	3.52
4	Pulling off road to take a 10-20 minute nap	3.41
5	Pulling off road to exercise for 10 minutes	3.37
6	Pulling off road to consume caffeinated beverage	3.32
7	Pulling of road to walk for 10 minutes	3.29
8	Conversing with someone in vehicle	3.24
9	Consuming caffeinated beverage while driving	3.19
10	Stopping by rest area to wash face with cold water	3.16

Rank	Behavior	Mean
11	Taking legal stimulants while driving	3.03
12	Rolling down window of vehicle	3.00
13	Singing while driving	2.91
14	Listening to stimulating music while driving	2.91
15	Listening to loud music in vehicle	2.89
16	Talking on the car phone or CB radio	2.87
17	Letting someone else drive for 1-2 hours while you rest but do not sleep before driving again	2.87
18	Changing the temperature in the vehicle	2.86
19	Pulling off road to eat a snack	2.82
20	Chewing on ice while driving	2.80
21	Driving on an unfamiliar route	2.78
22	Listening to talk radio or sports talk show	2.77
23	Pulling off road to rest for 10-20 minutes without sleeping	2.72
24	Pulling off road to consume non-caffeinated beverage	2.72
25	Pulling off road to rest for 30-45 minutes without sleeping	2.71
26	Talking on cellular phone while driving	2.70
27	Performing hand, arm, or leg exercises while driving	2.69
28	Slapping/pinching oneself	2.69
29	Listening to a radio/tape story	2.68
30	Chewing gum while driving	2.57
31	Smelling something unpleasant while driving	2.56
32	Pulling off road to eat a meal	2.55
33	Consuming non-caffeinated beverage while driving	2.54
34	Chewing tobacco while driving	2.53
35	Rolling head and/or shoulders while driving	2.54
36	Smoking while driving	2.51
37	Eating something nutritious while driving	2.50
38	Eating a low calorie snack while driving	2.45
39	Sitting up straight while driving	2.43
40	Changing driver’s seat position	2.42
41	Moving driver’s seat upright	2.42
42	Playing mind games while driving	2.39
43	Eating something non-nutritious while driving	2.37
44	Tapping fingers to music while driving	2.36
45	Talking to yourself while driving	2.35
46	Having a peppermint scent release in vehicle	2.31
47	Eating a high calorie snack while driving	2.29
48	Looking at scenery while driving	2.28
49	Focusing intently on driving task itself	2.26
50	Having a menthol scent released in vehicle	2.25
51	Thinking while driving	2.24
52	Squeezing the steering wheel while driving	2.21
53	Smelling something pleasant while driving	2.18

Rank	Behavior	Mean
54	Changing lanes on the highway	2.14
55	Turning light on in vehicle while driving	2.12
56	Increasing speed	2.10
57	Keeping a good attitude about yourself	2.03
58	Tightening seat belt	2.00
59	Loosening clothing	1.99
60	Taking shoes off	1.96
61	Loosening seat belt	1.82
62	Propping foot up on dashboard	1.82
63	Removing seat belt	1.75
64	Removing driver's head rest	1.70
65	Meditating while driving	1.52
66	Putting car in cruise control	1.46
67	Taking pain medication	1.45
68	Driving alone	1.43
69	Taking allergy medication	1.42
70	Continuing to drive (Doing nothing)	1.26

Countermeasures involving naps and caffeine had the highest means, indicating that such behavioral countermeasures "Definitely will increase alertness" (see Table 5). Other countermeasures who's means made it into the top 10 (page 27) included pulling over to exercise or walk, conversing with another person in the vehicle, and stopping by a rest area to wash face with cold water. Interestingly, "rolling down the window" had a mean response of 3.00, putting it within the top 12 recommended behaviors.

While there were no significant differences of responses to the survey among the different occupational specialties, there **were** some differences among the responses of sleep professionals and non-sleep professionals. Based on a t-test with a P-value <.05, comparing sleep professionals' responses with non-sleep professionals responses, we conclude that experts in the sleep field were consistently less compelled by the effects of the *countermeasures* that we suggested than those in non-sleep fields. Table 7 shows the **driving contexts** in which there was a significant difference among the responses of sleep professionals and non-sleep professionals.

Table 7. Driving contexts on which sleep professionals and non-sleep professionals significantly differed.

Driving Context	Sleep	Non-sleep	P value
Driving with a broken radio	2.80	2.48	0.001
Driving in high winds (30-40mph)	3.74	3.99	0.031
Driving on a 2-lane rural highway	2.94	3.19	0.040

Table 8 shows the **behavioral countermeasures** on which sleep professionals and non-sleep professionals significantly differed.

Table 8. Countermeasures that sleep professionals and non-sleep professionals significantly differed.

Countermeasure	Sleep	Non-sleep	P value
Rolling down window of vehicle	2.87	3.09	0.009
Looking at scenery while driving	2.06	2.38	0.006
Listening to a radio/tape story	2.40	2.85	0.000
Listening to talk radio or sports talk	2.59	2.90	0.006
Taking shoes off	1.81	2.02	0.046
Changing driver's seat position	2.23	2.52	0.004
Talking on the car phone or CB radio	2.70	2.96	0.028
Talking to yourself while driving	2.21	2.43	0.049
Pulling off road to walk for 10 min.	3.15	3.35	0.017
Pulling off road to exercise for 10 min.	3.22	3.44	0.008
Pulling off road to rest for 10-20 min. w/o sleeping	2.45	2.82	0.002
Pulling off road to rest for 30-45 min. w/o sleeping	2.46	2.83	0.003
Pulling off road to eat a snack	2.67	2.90	0.040
Pulling off road to consume non-caffeinated beverage	2.46	2.82	0.000
Consuming non-caffeinated beverage while driving	2.29	2.65	0.000
Sitting up straight while driving	2.29	2.53	0.021
Having a peppermint scent released in vehicle	2.04	2.47	0.000
Having a menthol scent released in vehicle	2.00	2.39	0.000
Moving driver's seat upright	2.26	2.51	0.011

Countermeasure	Sleep	Non-sleep	P value
Rolling head and/or shoulders while driving	2.35	2.60	0.016
Smelling something unpleasant while driving	2.40	2.67	0.013
Smelling something pleasant while driving	1.90	2.27	0.000
Eating a low calorie snack while driving	2.23	2.53	0.006
Eating something nutritious while driving	2.22	2.59	0.000
Eating something non-nutritious while driving	2.16	2.44	0.011
Loosening clothing	1.77	2.06	0.003
Meditating while driving	1.35	1.56	0.021
Stopping by rest area to wash face with cold water	3.02	3.22	0.008
Keeping a good attitude about yourself	1.68	2.15	0.000

A t- test with p value <.05 comparing males' responses to that of females', revealed that females consistently rated behavioral countermeasures as less likely to increase alertness than did males. The results are depicted in Table 9.

Table 9. Countermeasures on which males and females significantly differed

Countermeasure	Males	Females	P value
Taking shoes off	2.01	1.80	0.026
Increasing speed	2.13	1.91	0.021
Pulling off road to take a 10-20 min. nap	3.47	3.21	0.006
Pulling off road to exercise for 10 min.	3.42	3.23	0.027
Pulling off road to consume caffeinated beverage	3.36	3.19	0.041
Having a peppermint scent released in vehicle	2.36	2.13	0.022
Having a menthol scent released in vehicle	2.28	2.10	0.047
Taking legal stimulants while driving	3.09	2.86	0.038
Loosening clothing	2.03	1.86	0.045
Squeezing the steering wheel while driving	2.27	2.05	0.027

For the next part of the survey, we asked respondents the following question:

"Of the behaviors listed above (items 28-97), please indicate those that you are most likely to recommend that people use, ranking your top 5 choices from 1-5 (1=most likely to recommend). Please explain the reason for your choice".

Table 10 shows the results of this open-ended question.

Table 10. Top 5 most popularly recommended drowsy driving countermeasures

Recommendation	# Times reported (N=283)	% Respondents
Letting Someone Else Drive for 1-2 Hours While You Sleep in the Passenger Seat Before Driving Again	186	65.7%
Pulling Off Road to Take a 30-45 min. Nap	183	64.7%
Pulling Off Road to Take a 10-20 min. Nap	176	62.2%
Pulling Off Road to Take a Nap for >1 Hour	156	55.1%
Pulling Off Road to Consume Caffeinated Beverage	102	36.0%

It is interesting to note that almost all of the behaviors that were most often ranked in respondents' top 5 recommended were also their **first** choices, as shown in Table 11 (see page 34).

Table 11. Countermeasures which respondents most often ranked as **#1** in their top recommended.

Recommendation	Times reported as #1 (N=283)	% Respondents
Letting Someone Else Drive for 1-2 Hours While You Sleep in the Passenger Seat Before Driving Again	66	23.3%
Pulling Off Road to Take a Nap for >1 Hour	66	23.3%
Pulling Off Road to Take a 30-45 min. Nap	47	16.6%
Pulling Off Road to Take a 10-20 min. Nap	35	12.4%
Pulling Off Road to Consume Caffeinated Beverage	10	3.5%
Conversing With Someone in Vehicle	7	2.5%

We also asked respondents to indicate the duration for which they believe the countermeasure would be effective (i.e., effective for less than 15 minutes, effective for no more than 30 minutes, effective for between 30 min and 1 hour, effective for more than 1 hour). For "letting someone else drive for 1-2 hours while you sleep in the passenger seat before driving again", **78.45%** of the respondents gave a duration effect of >1 hour (9.54% missing data). . **72.44%** of respondents thought "pulling off the road to take a nap for >1 hour" would be effective for >1 hour**.** For "pulling off road to take a nap for 30-45 minutes ", **66.08%** gave a duration effect of >1 hour (12.01% missing data). **36.75%** of respondents said "pulling off the road to take a 10-20 minute nap" would be effective for >1 hr and **34.28%** said this countermeasure would be effective for between 30 min to 1 hr, with a missing data percentage of 13.06%. This latter group of figures represents an interesting contrast to the responses for the two longer naps.

20.49% of respondents thought "pulling off the road to consume caffeinated beverage" would be effective for >1 hour, **39.93%** thought it would be effective for between 30 min to 1 hour, and **30.03%** thought it would be effective for <30 minutes (9.55% missing data). **38.52%** of respondents thought "conversing with someone in vehicle" would be effective for >1 hour, **21.20%** thought it would effective for no more than 1 hr, and **26.50%** chose a duration of <30 minutes (13.78% missing data).

When asked what behavioral countermeasure they would employ to combat drowsiness while driving, many people in the general public commonly respond with exercise, listening to loud music (or turning up volume of music), or pulling off the road to walk for 10 minutes. The results of the questionnaire revealed that only **19.08%** of respondents thought "pulling off the road to exercise for 10 min" would be effective for >1 hour. A mere **7.42%** believed "listening to loud music" would have an effect for >1 hour, and only **14.84%** thought that "pulling off the road to walk for 10 min" would be effective for >1 hour. A few other commonly used countermeasures include chewing gum while driving, rolling down the window, changing the temperature in vehicle, and slapping or pinching oneself. The results of the survey indicated that only **4.24%** (37.81% missing data), **7.42%** (15.2% missing data), **6.36%** (26.5% missing data), and **1.42%** (33.21% missing data) respectively, thought the countermeasure would be effective for >1 hour.

Note that the large amounts of missing data here can be accounted for by taking into consideration that we asked respondents to indicate an opinion about a countermeasure's duration **only** if they thought that it would probably or definitely **increase** alertness (i.e. if they gave it a rating of 3 or 4). There were difficulties with this part of the instrument, wherein some respondents who indicated that a countermeasure probably or definitely would **not** increase

alertness still indicated a duration of effectiveness. The opposite occurred as well (respondents not listing a duration measurement for a countermeasure that the respondent thought probably or definitely **would** increase alertness). In any case, while there may be a subset of very commonly employed drowsy driving behavioral countermeasures, the respondents who completed our survey indicated that even if the countermeasures are effective, their effects will often dissipate fast.

We also asked respondents to list any behaviors **not** suggested by us in the questionnaire, that they would recommend people to use to combat drowsy driving. The following were the top 5 countermeasures independently recommended by respondents to the questionnaire:

1. Get adequate rest/sleep before driving

2. Driver during normal waking hours

3. Plan trips to avoid drowsy/fatigued times

4. Plan for adequate rest breaks

5. Modify ventilation **or** stop driving

Finally, we asked our respondents to cite any knowledge of scientific evidence regarding behavioral countermeasures that they believed would be effective. It was not surprising that few people were able to cite any scientifically validated studies regarding drowsy driving. In the rare cases that volunteers were able to give citations, the references were articles that we had found in our literature search concerning naps and/or caffeine. There were no articles cited that provided any new or relevant information. We can definitively conclude that drowsy driving behavioral countermeasures such as “rolling down the window, chewing on ice, chewing gum etc”, are strictly anecdotal and there are no scientific studies validating such countermeasures.

DISCUSSION AND CONCLUSIONS

While the aim of the Drowsy Driving Prevention Questionnaire was to identify those drowsy driving behavioral countermeasures that have been scientifically validated, the results did not reveal anything we did not already know. The only scientifically validated fatigue countermeasures included naps and caffeine. Behavioral countermeasures remain merely anecdotal, with no scientific evidence in support of them. Our literature search as well as our questionnaire revealed naps as the favored countermeasure. Napping appeared as a favored preventative strategy for drowsy drivers in the 1994 New York State Drowsy Driving Survey of 1000 **random sampled licensed drivers** in 62 counties of New York State (New York State Task Force on the Impact of Fatigue on Driving / Team to Explore the Nature and Scope of Drowsy Driver Crashes in New York State 1994). It is interesting to note that the results of the New York Survey were quite comparable to ours, even though the former sampled random drivers while we supposedly got experts in sleep and traffic safety. We surveyed 283 experts in fatigue and traffic safety from the U.S. as well as several foreign countries and can conclude the same finding—naps are favored as a drowsy driving countermeasure. Regardless of gender, age, ethnicity, educational background, or occupation, there seems to be a general understanding that there is absolutely no substitute for sleep. One may be able to promote alertness by consuming a caffeinated beverage or some other legal stimulant, but the effect is only temporary. Sleep debt can only be paid back with sleep.

The issue of drivers falling asleep at the wheel and causing crashes has not received enough attention. This study addressed most of the very commonly employed drowsy driving behavioral countermeasures (e.g., rolling down the winder, turning up volume of radio etc.). Our goal was to identify any scientific studies done on these popularly used countermeasures. In terms of literature regarding naps and caffeine, we were able to successfully identify a vast

number of articles. Experts who responded to our survey were also able to cite a multitude of articles. However, we can confidently conclude that the published scientific literature on drowsy driving behavioral countermeasures is remarkably insufficient. Scientists as well as the general public need to devote more attention to the problem of drowsy driving.

There are many directions that further research in this area can take. Not only should any potential countermeasures be empirically tested to reveal their effective or [more likely] ineffective nature, but also more in-depth probes should be made into *why* so many people neglect to employ the countermeasures known to be at least somewhat effective (i.e. naps and caffeine). Why do people not *invariable* pull over and take a nap or just stop to get a cup of coffee? As mentioned above, the drivers may lack the ability or the will to identify themselves as drowsy. There are numerous other reasons why drivers will not stop, not the least of which is concern for their safety. If it is nighttime, for example, many people are wary of stopping to sleep for fear of becoming a crime victim, and so push on to reach their destinations. Measurements in this area of reasoning, however, would be rather difficult to implement. As far as the effectiveness of certain countermeasures, either behavioral, technological, or otherwise, further empirical research into the latest inventions and the most popular anecdotal suggestions on the questionnaire is urgently needed to validate their effectiveness.

APPENDIX

October 29, 1997

Dear Colleague,

We would like your help. Enclosed is a survey we would like you to complete and return to us.

Through support from the AAA Foundation for Traffic Safety, we are attempting to identify proven or promising behavioral countermeasures to drowsy driving. Proven countermeasures are those whose effectiveness has been demonstrated through formal research. Promising countermeasures are unproven techniques with widespread use or apparent effectiveness.

We are only sending this survey out to experts in driving, fatigue, and traffic safety. We value your expert **anonymous** opinion of the effectiveness of the items detailed in the survey as well as those we have neglected to mention. We would greatly appreciate your willingness to take 20-30 minutes out of your busy schedule to complete this survey. **Even if you cannot cite specific evidence that a particular countermeasure is effective in promoting alertness, we would appreciate your opinion on the likelihood that it would be effective.** We will be sending a copy of the results to all respondents who return the name and address form enclosed.

The survey has approval by the Human Subjects Review Board of the University of Pennsylvania and all responses will be treated **confidentially**.

Please fax your completed survey back to us at (215)573-6410 or if you prefer, please mail it to AAAF Study, Unit For Experimental Psychiatry, University of Pennsylvania, 423 Guardian Drive, 1013 Blockley Hall, Philadelphia, PA 19104.

Best wishes,

Lan Nguyen
Beatrice Jauregui
David F. Dinges, Ph.D.
Janet M. Mullington, Ph.D.
University of Pennsylvania

ANONYMOUS DROWSY DRIVING PREVENTION QUESTIONNAIRE

Background Information:

Gender- M F

Age- _____

Highest academic/professional degree earned - _____

Occupation - _____

---

1. What would you consider to be the first sign(s) of drowsiness while driving?

_____
_____
_____
_____
_____

Please rate the extent to which you believe the following factors would increase or decrease the individual's **drowsiness/sleepiness** while driving.

		Definitely would **increase** drowsiness	**Probably** would **increase** drowsiness	**Probably** would **decrease** drowsiness	**Definitely** would **decrease** drowsiness	No Effect
2.	Driving after having 1-2 beers or glasses of wine					
3.	Driving after having 3-4 beers or glasses of wine					
4.	Driving at night, before midnight					
5.	Driving at night, after midnight					
6.	Driving while emotionally upset					
7.	Driving while having to go to the bathroom					
8.	Driving while being in a hurry to get to an appointment					
9.	Driving in darkness					
10.	Driving on a humid day					
11.	Driving in a heavy rain storm					
12.	Driving in a snow storm					
13.	Driving on an overcast day					
14.	Driving with a broken radio					
15.	Driving in high winds (30-40 m.p.h.)					
16.	Driving on a highway with road construction underway					
17.	Driving a vehicle that needs brake repair					
18.	Driving on a 2-lane rural highway					
19.	Driving on a divided highway					
20.	Driving on a bumpy road					
21.	Driving on a non-divided highway					
22.	Driving on a winding road					
23.	Driving on a straight road					
24.	Driving with little or no other traffic					
25.	Driving with heavy traffic					
26.	Driving with moderate traffic					
27.	Driving on an unfamiliar route					

To what extent are each of the following behaviors likely to result in increased **alertness** in a **drowsy/sleepy** driver? Please also estimate the duration the behavior(s) will remain effective in combating drowsy driving for all items you indicate "**Probably** will **increase** driver alertness" or "**Definitely** will **increase** driver alertness".

1. **Definitely** will **not increase** driver alertness
2. **Probably** will **not increase** driver alertness
3. **Probably** will **increase** driver alertness
4. **Definitely** will **increase** driver alertness

DURATION SCALE:
A) Effective for less than 15 min
B) Effective for no more than 30 min.
C) Effective for between 30 min and 1 hour
D) Effective for more than 1 hour
As you rate the duration, please circle the ones that are only effective while employing behavior

	Behaviors that may or may not increase alertness in a drowsy driver	**Definitely** will **not increase** alertness 1	**Probably** will **not increase** alertness 2	**Probably** will **increase** alertness 3	**Definitely** will **increase** alertness 4	**Duration** of effect for items in columns 3 & 4 **Use**: A, B, C, D 5
28.	Chewing gum while driving					
29.	Chewing on ice while driving					
30.	Singing while driving					
31.	Listening to stimulating music while driving					
32.	Rolling down window of vehicle					
33.	Listening to loud music in vehicle					
34.	Changing the temperature in vehicle					
35.	Driving alone					
36.	Conversing with someone in vehicle					
37.	Thinking while driving					
38.	Playing mind games while driving					
39.	Looking at scenery while driving					
40.	Listening to a radio/tape story					
41.	Listening to talk radio or sports talk show					
42.	Taking shoes off					
43.	Propping foot up on dashboard					
44.	Changing driver's seat position					
45.	Increasing speed					
46.	Changing lanes on highway					
47.	Slapping/pinching oneself					
48.	Talking on the car phone or CB radio					
49.	Talking to yourself while driving					
50.	Continuing to drive (Doing nothing)					
51.	Pulling off road to take a 10-20 min. nap					
52.	Pulling off road to take a 30-45 min. nap					
53.	Pulling off road to take a nap for >1 hour					
54.	Pulling off road to walk for 10 min.					
55.	Pulling off road to exercise for 10 min.					
56.	Pulling off road to rest for 10-20 min. w/o sleeping					

DURATION SCALE:
A) Effective for less than 15 min
B) Effective for no more than 30 min.
C) Effective for between 30 min and 1 hour
D) Effective for more than 1 hour
As you rate the duration, please circle the ones that are only effective while employing behavior

	Behaviors that may or may not increase alertness in a drowsy driver	**Definitely** will **not increase** alertness 1	**Probably** will **not increase** alertness 2	**Probably will increase** alertness 3	**Definitely will increase** alertness 4	**Duration** of effect for items in columns 3 & 4 **Use**: A, B, C, D 5
57.	Pulling off road to rest for 30-45 min. w/o sleeping					
58.	Pulling off road to eat a snack					
59.	Pulling off road to eat a meal					
60.	Pulling off road to consume caffeinated beverage					
61.	Pulling off road to consume non-caffeinated beverage					
62.	Consuming non-caffeinated beverage while driving					
63.	Consuming caffeinated beverage while driving					
64.	Sitting up straight while driving					
65.	Having a peppermint scent released in vehicle					
66.	Having a menthol scent released in vehicle					
67.	Moving driver's seat upright					
68.	Driving on an unfamiliar route					
69.	Rolling head and/or shoulders while driving					
70.	Tapping fingers to music while driving					
71.	Taking pain medication					
72.	Taking allergy medication					
73.	Taking legal stimulants while driving					
74.	Smoking while driving					
75.	Chewing tobacco while driving					
76.	Smelling something unpleasant while driving					
77.	Smelling something pleasant while driving					
78.	Eating a high calorie snack while driving					
79.	Eating a low calorie snack while driving					
80.	Eating something nutritious while driving					
81.	Eating something non nutritious while driving					
82.	Loosening clothing					
83.	Loosening seat belt					
84.	Tightening seat belt					
85.	Removing seat belt					
86.	Turning light on in vehicle while driving					
87.	Letting someone else drive for 1-2 hours while you sleep in the passenger seat before driving again					

DURATION SCALE:
A) Effective for less than 15 min
B) Effective for no more than 30 min.
C) Effective for between 30 min and 1 hour
D) Effective for more than 1 hour
As you rate the duration, please circle the ones that are only effective while employing behavior

	Behaviors that may or may not increase alertness in a drowsy driver	**Definitely** will **not increase** alertness 1	**Probably** will **not increase** alertness 2	**Probably will increase** alertness 3	**Definitely will increase** alertness 4	**Duration** of effect for items in columns 3 & 4 **Use**: A, B, C, D 5
88.	Letting someone else drive for 1-2 hours while you rest but do not sleep before driving again					
89.	Putting car in cruise control					
90.	Talking on cellular phone while driving					
91.	Removing driver's head rest					
92.	Meditating while driving					
93.	Stopping by rest area to wash face with cold water					
94.	Squeezing the steering wheel while driving					
95.	Performing, hand, arm, or leg exercises while driving					
96.	Focusing intently on driving task itself					
97.	Keeping a good attitude about yourself					

98. Of the behaviors listed above (items 28-97), please indicate those that you are most likely to recommend that people use, ranking your top **5** choices from 1-5 (1= most likely to recommend). Please explain the reason for your choice.

RANK	**ITEM #**	**REASON FOR CHOICE**
1		
2		
3		
4		
5		

99. What other behaviors besides those listed above would you recommend people to use to combat drowsy driving?

_____
_____
_____
_____

100. For the behaviors that you have indicated, "**Definitely will increase driver alertness**", please indicate where one can find the evidence to support your opinion. (e.g., scientific/technical study/report; common anecdote; personal experience; unpublished data) If possible, please give citations/sources for any scientific evidence for any other behaviors associated with drowsy driving; or the name, address, and/or phone number of anyone who would be able to cite scientific evidence for such behaviors.

Item #	Evidence/Source
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

101. Please feel free to provide any additional comments, opinions, suggestions.

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