

TRS 1501 Appendix A

NSTSCCE

**National Surface Transportation
Safety Center for Excellence**

**Driver Drowsiness/Fatigue:
A Wake-up Call**

Goal



- Provide you with education, training, and materials on topics related to commercial driver drowsiness and fatigue so you can effectively train your drivers to become aware of the warning signs and strategies for combating drowsiness and fatigue while driving.

Topics

- **Understanding the Issue**
 - ▣ Defining Drowsiness vs. Fatigue
 - ▣ The commercial driving environment and drowsiness/fatigue
 - ▣ Real-world video examples
- **Detecting and Monitoring Driver Drowsiness and Fatigue**
 - ▣ Onset of Drowsiness
 - ▣ Measures of Drowsiness
- **Managing Driver Drowsiness and Fatigue**
 - ▣ FMCSA's Driving Tips Website
 - ▣ The North American Fatigue Management Program
 - ▣ "*Million-Miler*" Best Practices

Learning Objectives



Learners should have an understanding of:

- The impact of driver drowsiness/fatigue on commercial trucking;
- Current means of detecting and monitoring driver drowsiness/fatigue; and
- Sources of training materials for educating commercial drivers on the dangers of drowsy driving and strategies for preventing it.

Quick Quiz* (True or False)

1. There is no relationship between one's sleep and work schedule and risk of being involved in a drowsy-driving crash.
 - **FALSE.** Studies have found a direct correlation between the numbers of hours a person works and their risk of being in a drowsy driving crash. People who work more than one job where their primary job involves an atypical schedule are twice as likely to be involved in a sleep-related crash when compared to people in non-sleep related crashes.
2. The largest at-risk group for sleep-related crashes is commercial drivers.
 - **FALSE.** Sleep-related crashes are most common in young people, who tend to stay up late, sleep too little, and drive at night. One study found that in 55 percent of sleep-related crashes, drivers were age 25 years or younger and were predominantly men. Another study found almost one-third of commercial drivers have some degree of sleep apnea.

Quick Quiz* (True or False)

3. Overall, sleep-related crashes have certain characteristics that set them apart from other types of crashes.
 - **TRUE.** Research has provided a good picture of the common characteristics of drowsy-driving crashes, which tend to occur at night or in mid-afternoon, involve a single vehicle running off the roadway, lack any evidence of braking, and involve a young male driving alone.

4. People with a sleep and breathing disorder called obstructive sleep apnea have about the same risk as the rest of the general population of being involved in a drowsy-driving crash.
 - **FALSE.** Sleep apnea is a condition in which a person's airway collapses many times to halt breathing until the person briefly awakens. The most common signs of sleep apnea are loud, irregular snoring, and excessive daytime sleepiness. Studies indicate that persons with untreated sleep apnea have two to seven times more crashes than people without the disorder. Studies also show that once treated, most patients can be safe drivers once again.

Quick Quiz* (True or False)

5. Eating a big lunch tends to make everyone sleep.

- **FALSE.** Things such as heavy meals, warm rooms, and long drives only unmask the presence of sleep deprivation or sleep debt; they do not cause sleepiness.

6. People can usually tell when they are going to fall asleep.

- **FALSE.** Sleep is not voluntary. If you're tired, you can fall asleep and never know it. When you're driving at 60 miles per hour and fall asleep for a few seconds (a microsleep), you can travel up to the length of a football field without any control of your vehicle.

Quick Quiz* (True or False)

7. Drivers in drowsy-driving crashes are more likely to report sleep problems.

- **TRUE.** According to studies, drivers in fatigue-related crashes were more likely to report problems sleeping prior to a crash than drivers in other non-sleep crashes.

8. Rolling down a window or singing along with the radio while driving will help keep someone awake.

- **FALSE.** An open window or music has no lasting effect on a person's ability to stay awake. In fact, they may mask the person's lack of alertness further.

Quick Quiz* (True or False)

9. Wandering, disconnected thoughts are a warning sign of driver fatigue.

- **TRUE.** If you are driving and your thoughts begin to wander, it is time to pull over and take a short nap, consume some caffeine, or stop driving for the day..

10. You can stockpile sleep on the weekends to avoid being sleepy during the week.

- **FALSE.** Sleep is not money. You can't store up sleep to borrow it later on. But, just as with money, you can go into debt.

Defining the Issue

- Driver drowsiness/fatigue is a contributing factor in many vehicle crashes¹
 - 100,000 crashes per year
 - 40,000 injuries/1,550 deaths per year

- 2 out of 5 drivers (41%) admit to “falling asleep or nodding off” while driving at least once in their lifetime.²

Defining the Issue

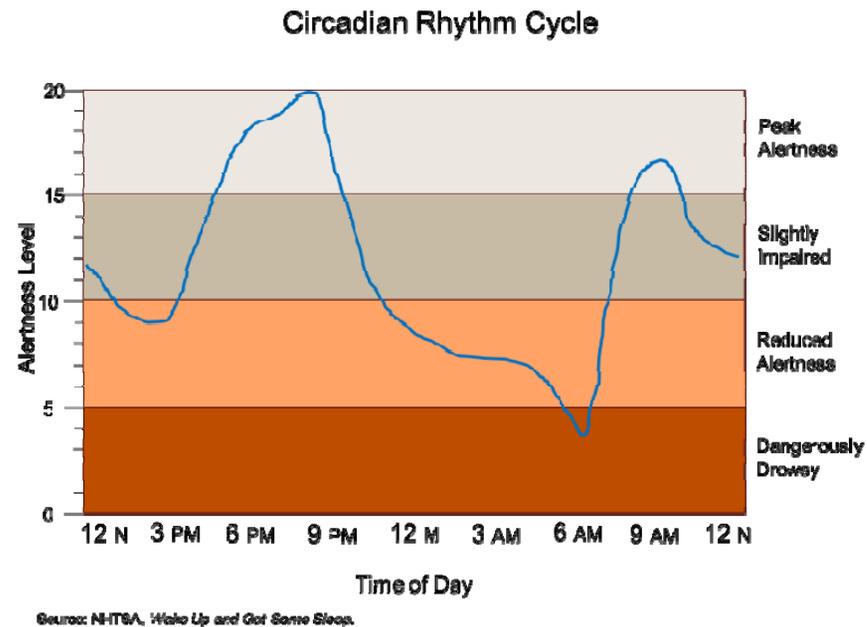
- Drowsy/fatigued drivers:
 - Are often unaware of their condition
 - Pay less attention to the driving environment, leading to *driver errors*
- Frequently drive for 3-30 seconds with their eyes totally closed.

Who is at Risk?

- Young people
 - ▣ Under the age of 26
 - ▣ Particularly males
- Shift workers
 - ▣ Long work hours (especially at night)
- Commercial Drivers
 - ▣ Long driving hours (especially at night)
- Individuals with untreated sleep disorders
 - ▣ Obstructive sleep apnea (OSA)

Characteristics of a Sleep-rated Crash

- More likely to occur at night or mid-afternoon



- Single vehicle running off the roadway
- Higher-speed roadways
- No indication of braking
- Driver is alone (often younger male)

The Impact on Commercial Trucking

- ❑ Drowsy driving crashes¹
 - ▣ Estimated to cost \$12 billion annually
 - ▣ Account for 35% of the 4,400 annual truck driver deaths



Driver Drowsiness vs. Fatigue

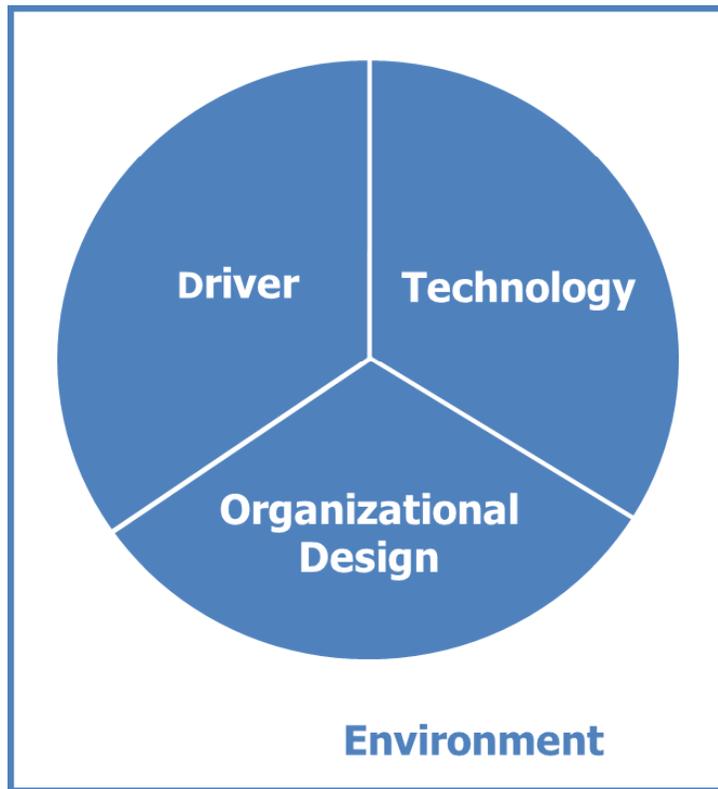
- Fatigue
 - ▣ A state of reduced physical or mental alertness which impairs performance (*Williamson et al., 1996*)
 - ▣ Results from physical or mental exertion

- Drowsiness
 - ▣ Inclination to sleep (*Stutts et al., 1999*)
 - ▣ Results from boredom, lack of sleep, hunger, or other factors

- Terms are often used interchangeably

Understanding the Driving Environment

Socio-technical Systems (STS) Model



The Driver, Fleet, Technology, and Environment do not function independently but influence each other.

Examples:

- A fleet's sleep hygiene policy (*organizational design*) impacts a driver's ability to rest as needed (*driver*).
- The occurrence of false alarms (technology) impacts the driver's trust (*driver*) of the system.

Understanding the Commercial Driving Environment

- Conducted several focus groups to support the development of an Operator Drowsiness Monitoring System
- Objectives
 - ▣ Elements of a **typical 24-hour work day**
 - ▣ Potential **countermeasures** commercial drivers chose to combat drowsiness (*What do drivers do now to fight drowsiness?*)
 - ▣ **Barriers** that impact commercial drivers' decision to pull over and rest (*Why won't drivers stop and get some rest?*)

Understanding the Commercial Driving Environment

- Typical Work Day
 - Reported duration of sleep per day Mean: 5.7 hours; SD=0.82 hours (*recommended 7-8 hours minimum*)
 - Top reported reasons for taking breaks
 - Fuel (5 of 13)
 - Use restroom (4 of 13)
 - Eat (4 of 13)
 - Sleep (1 of 13)

Understanding the Commercial Driving Environment

- How drivers fight drowsiness:
 - Most common strategy used to stay awake (9 of 13) was a caffeinated or energy drink.
 - Other popular strategies (6 of 13) included rolling down the window, adjusting the radio, talking on CB, and getting out of the truck and walking around.
 - Only 2 participants mentioned napping as a strategy.

Understanding the Commercial Driving Environment

- Why don't drivers stop when tired?
 - **#1 Reason** that would prevent them from pulling over because of the onset of drowsiness or fatigue
 - **Parking** (9 of 13)
 - Lack of safe, legal, quiet, and/or fee-free parking
 - **Others barriers mentioned include:**
 - Demands of the job
 - Being on time

Understanding the Commercial Driving Environment

□ Key Take-Aways

- Numerous and challenging factors that may deter CMV drivers from pulling over even when they know they are drowsy.
 - Environmental reasons (i.e., parking) are the most commonly faced.
 - Organizational design factors (i.e., job demands) were also mentioned as deterrents to pulling over to rest.
- Solution will involve everyone.

Participant Comment:

“It all comes back to economics. If a company and driver can make a reasonable living by stopping regularly and following all of the laws, drowsiness would not be a problem or issue.”

Real-World Examples



Real-World Examples



Detecting and Monitoring Driver Drowsiness

- Onset of Driver Drowsiness
 - ▣ Gradual, cumulative process
 - ▣ Often takes some time before it manifest into noticeable signs
 - ▣ Warning Signs
 - Physical characteristics
 - ▣ Yawning
 - ▣ Tired, frequently blinking eyes
 - ▣ Slack face
 - Driving performance
 - ▣ Lane drifting
 - ▣ Difficulty maintaining constant speed
 - Driver mannerisms
 - ▣ Rubbing the face
 - ▣ Frozen stare
 - ▣ Feeling restless or irritable

Measures of Drowsiness and Fatigue

- Driver-based measures (physical changes)
 - Electroencephalography (EEG)
 - Monitors brain's electrical activity

Advantages	Disadvantages
Reliable under controlled conditions	Susceptible to coughing, sneezing, vibration, and large body movements
Regarded as the standard	Intrusiveness to the driver (must wear headgear)

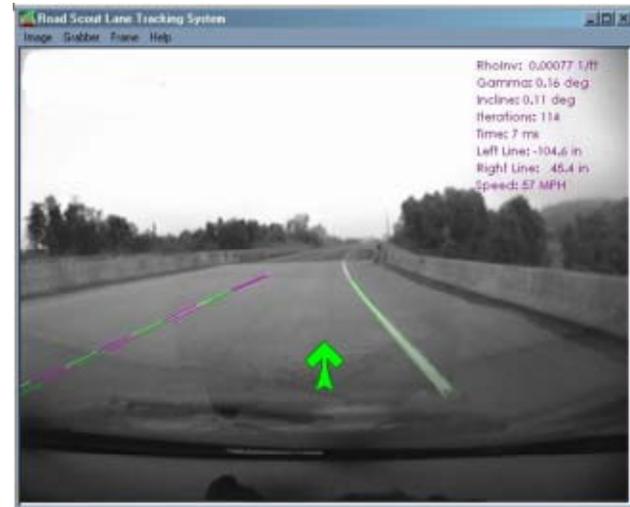
Measures of Drowsiness and Fatigue

- Driver-based measures (physical changes)
 - Ocular (Eye) measures
 - Monitors ocular movement (e.g., eye closures [PERCLOS], eye blinks)

Advantages	Disadvantages
Eye closures are most effective ocular measure	Eye blink monitoring is confounded by the individual differences
Non-intrusive	Difficulties with well-lit conditions, eyewear, and rapid changes in head position

Measures of Drowsiness and Fatigue

- Vehicle-based measures
 - ▣ Lane Position (e.g., lane-drift, time-to-lane crossing)
 - Monitors the vehicle's position relative to the lane markings



Advantages	Disadvantages
Have promised as an indicator of fatigue and drowsiness especially when tied with driver-based measures	Dependent on lane marking presence and quality
	Difficulties with weather conditions such as snow or rain.

Measures of Drowsiness and Fatigue

- Vehicle-based measures
 - ▣ Steering wheel inputs
 - Monitors the driver's steering behavior

Advantages	Disadvantages
Non-intrusive	Have difficulties with road condition and cross-winds
Most researchers agree that increased fatigue results in increased steering variability	Susceptible to individual differences in driving styles

Measures of Drowsiness and Fatigue

- Key Take-Aways
 - ▣ Drowsy driving is difficult to detect
 - Physiological measures have promise but difficult to implement
 - Individual differences are important
 - ▣ No single measure is successful 100% of the time
 - Weather
 - Eyewear
 - Individual differences
 - ▣ Possible solution is data fusion
 - Integration of information from multiple sources
 - Output has potentially greater value than the original data from individual sources.

Current Fatigue/Safety Tools for Fleets

- Website:
www.fmcsa.dot.gov
- Real-world examples

The screenshot displays the FMCSA website interface. At the top, it features the U.S. Department of Transportation logo and navigation links for 'Keyword Links', 'Contact Us', and 'Español'. The main header reads 'Federal Motor Carrier Safety Administration' with a background image of a bus and an American flag. Below this is a navigation menu with links for 'Home', 'Rules & Regulations', 'Registration & Licensing', 'Forms', 'Safety & Security', 'Facts & Research', 'Cross Border', and 'About FMCSA'. The breadcrumb trail indicates the current page is 'Home > Facts & Research > CMV Web-Based Driving Tips Home Page'. A search bar is located on the right side of the page.

The main content area is titled 'CMV Web-Based Driving Tips Home Page'. It includes a 'Facts & Research' section with a sub-section for 'CMV Driving Tips'. A left-hand navigation bar lists various driving tip categories: 'Project Background', 'Too Fast for Conditions', 'Unfamiliar Roadway', 'Inadequate Surveillance', 'Driver Fatigue', 'Driver Distraction', 'Following Too Closely', 'Inadequate Evasive Action', 'Documents', and 'References'. The main text explains that the website aims to raise the consciousness of CMV drivers about common driving errors and provides valuable driving tips through an accessible online tool. It mentions that the tips are supported by real-world video clips recorded in a naturalistic driving study by the Virginia Tech Transportation Institute (VTTI). The text also notes that each video clip is followed by a set of questions to help encourage drivers to think about and examine their behavior.

At the bottom of the page, there is a footer with links for 'Feedback', 'Privacy Policy', 'USA.gov', 'Freedom of Information Act (FOIA)', 'Accessibility', 'OIG Hotline', 'Web Policies and Important Links', and 'Site Map | Plug-Ins'. The contact information for the Federal Motor Carrier Safety Administration is provided: '1200 New Jersey Avenue SE, Washington, DC 20590 • 1-800-832-5660 • TTY: 1-800-877-8339' and a link to the 'Field Office Roster'.

Current Fatigue/Safety Tools for Fleets

□ Fatigue Management Program

- Online fatigue management training for drivers, drivers' families, carrier executives and managers, dispatchers and shippers/receivers
- Information on how to develop a corporate culture that facilitates reduced driver fatigue;
- Information on sleep disorders screening and treatment;
- Driver and trip scheduling information;
- Information on Fatigue Management Technologies.



Summing up Driver Drowsiness

- ❑ Driver Drowsiness has a significant impact on vehicle safety
- ❑ Driver Drowsiness develops slowly and is difficult to reliably detect. Need multiple measures of drowsiness.
- ❑ Solution is dependent on everyone (Driver, Fleet, Government, Public)
- ❑ Million-Milers' Recommendations for best practices:
 - ▣ Maintain more predictable and regular work schedules
 - ▣ Obtain adequate sleep before driving
 - ▣ Take rest breaks and naps to help manage fatigue
 - ▣ Recognize the warning signs and risks of drowsy driving
 - ▣ Optimize the sleeping environment

Questions?

