Driving Drowsy – Apps and Vehicle Assistive Technologies

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Current Concepts in Sleep Medicine
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Disclosures

• Nothing to disclose.
• I am employed at the Orlando VA Medical Center but do not represent my employer during this conference.
Objectives

• Discuss the definition and implications of driving drowsy.
• Discuss ways of identifying impaired drivers.
• Discuss interventions to prevent accidents related to drowsiness.
Driving Drowsy

Definition of DROWSY

1 a :
   ready to fall asleep • The pills made her drowsy.

b :
   inducing or tending to induce sleep • drowsy music
Driving Drowsy

• An estimated 1 in 25 adult drivers (aged 18 years or older) report having fallen asleep while driving in the previous 30 days.

• The National Highway Traffic Safety Administration estimates that drowsy driving was responsible for 72,000 crashes, 44,000 injuries, and 800 deaths in 2013.

http://www.cdc.gov/
DID YOU KNOW?

Up to 6,000 fatal crashes each year may be caused by drowsy drivers

THE DROWSY DRIVING PROBLEM

Drowsy driving is a major problem in the United States. Falling asleep at the wheel is clearly dangerous, but being sleepy affects your ability to drive safely even if you don’t fall asleep. Drowsiness—

• Makes drivers less able to pay attention to the road.
• Slows reaction time if you have to brake or steer suddenly.
• Affects a driver’s ability to make good decisions.

http://www.cdc.gov/
• Video of Drowsy Drivers
WHAT IS DROWSY DRIVING?

Drowsy driving is the dangerous combination of driving and sleepiness or fatigue. This can happen to a driver for several reasons:

- Untreated Sleep Disorders
- Medications
- Drinking Alcohol
- Not Enough Sleep
- Shift Work

http://www.cdc.gov/
Characteristics of Accidents Related to Drowsiness

- Late at night (Midnight – 7 am) or mid-afternoon (2 pm – 4 pm)
- Single vehicle running off the road
- High-speed roadways
- Driver is usually alone
- Usually males between the ages 16-25 yrs
- No indications of braking

WHO’S MORE LIKELY TO DRIVE DROWSY?

- **Commercial drivers** who operate vehicles such as tow trucks, tractor trailers, and buses.
- **Shift workers** (work the night shift or long shifts).
- Drivers with **untreated sleep disorders** such as one where breathing repeatedly stops and starts (sleep apnea).
- Drivers who **use medications** that make them sleepy.
- Drivers who do not get **enough sleep**.
LEARN THE WARNING SIGNS OF DROWSY DRIVING

- Yawning or blinking frequently.
- Difficulty remembering the past few miles driven.
- Missing your exit.
- Drifting from your lane.
- Hitting a rumble strip on the side of the road.

For more warning signs visit the American Academy of Sleep Medicine
Signs of Drowsiness

• Difficulty focusing, frequent blinking, or heavy eyelids
• Daydreaming; wandering/disconnected thoughts
• Trouble remembering the last few miles driven; missing exits or traffic signs
• Yawning repeatedly or rubbing your eyes
• Trouble keeping your head up
• Drifting from your lane, tailgating, or hitting a shoulder rumble strip
• Feeling restless and irritable

http://drowsydriving.org/
What can we do to prevent drowsy driving?

• Before “hitting the road”
  • Get adequate sleep—most adults need 7-9 hours to maintain proper alertness during the day
  • Schedule proper breaks—about every 100 miles or 2 hours during long trips
  • Arrange for a travel companion—someone to talk with and share the driving
  • Avoid alcohol and sedating medications—check your labels or ask your doctor

http://drowsydriving.org/
PREVENT DROWSY DRIVING, BEFORE TAKING THE WHEEL

There are a few things you should do before taking the wheel to prevent driving while drowsy.

Get enough sleep! Adults need 7 hours and teens need at least 8 hours.

Develop good sleeping habits such as sticking to a sleep schedule.

Avoid drinking alcohol or taking medications that make you sleepy. Check the labels.

Talk to your doctor about treatment options if you have a sleep disorder or symptoms such as snoring.
What can we do to prevent drowsy driving?

• Stop driving
• Take a nap
• Drink a caffeinated beverage.
• Be aware of rumble strips.

http://drowsydriving.org/
How Can Technology Help?

• Smart Phone Apps
• Integrated Vehicle Drowsiness Detections
• Driver Assistance and Crash Prevention Technology
• Automated Driving Systems
Smartphone Apps

• Most apps consist of a timer that resets when the user interacts with the phone
• If user fails to respond to command prompts, a combination of tones lights and screen color changes occur
Stay Awake App

• $1.99 at the iTunes App Store
• Can choose interactive mode (requires you to touch the screen) versus voice mode
• Easy to use
• Can set alert frequency
• May be distracting
Stay Awake App

• Set alarm time and place in your pocket - phone will make audible tone or vibrate or both
• Can also set to “Autosense” and put in your pocket – phone will alert if movement is not detected
• Will not take your focus off driving like the previous app
• Not specifically made for drowsy driving
Wakey Wakey App

• Similar to Stay Awake App
• Has customizable sounds for an additional cost
Drive Safe Free

• Monitors, scores and alerts your driving
• Uses GPS and rear camera to produce driver evaluation and profile
• Scores maneuvers based on briskness of movements, accelerations, braking, turnings, lane weaving, lane drifting, over-speeding and tailgating
• Does not alert you to current state and only produces an overall score
Integrated Vehicle Drowsiness Detections

• Multiple automobile manufacturers offer drowsiness detection systems
  • Audi
  • BMW
  • Ford
  • Mazda
  • Mercedes
  • Nissan
  • Subaru
  • Volvo
Mercedes Attention Assist

• Attention Assist Video
How do these system work?

• Detecting Drowsiness
  • Behavioral measures
    • Yawning, eye closure, blinking, head position
  • Vehicle based measures
    • Lane deviations, steering wheel movement, pressure on pedals
  • Physiological measures
    • EKG, EEG, EoG, EMG
  • Subjective
    • Epworth, Stanford, Karolinska Sleepiness Scales

Subjective – Stanford Sleepiness Scale

<table>
<thead>
<tr>
<th>Degree of Sleepiness</th>
<th>Scale Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feeling active, vital, alert, or wide awake</td>
<td>1</td>
</tr>
<tr>
<td>Functioning at high levels, but not fully alert</td>
<td>2</td>
</tr>
<tr>
<td>Awake, but relaxed; responsive but not fully alert</td>
<td>3</td>
</tr>
<tr>
<td>Somewhat foggy, let down</td>
<td>4</td>
</tr>
<tr>
<td>Foggy; losing interest in remaining awake; slowed down</td>
<td>5</td>
</tr>
<tr>
<td>Sleepy, woozy, fighting sleep; prefer to lie down</td>
<td>6</td>
</tr>
<tr>
<td>No longer fighting sleep, sleep onset soon; having dream-like thoughts</td>
<td>7</td>
</tr>
<tr>
<td>Asleep</td>
<td>X</td>
</tr>
</tbody>
</table>
Vehicle Based Measures

• Steering Wheel Movement
  • Sensor on steering column measures driver’s steering behavior
    • Less micro-corrections when drowsy

• Standard Deviation of Lane Position
  • As drowsiness increases, so does standard deviation from lane position

• As it turns out, vehicle based measures alone are poor predictors of performance of error risk due to drowsiness and are not specific to drowsiness. They can be affected by road conditions, climate and lighting.

Behavioral Measurements

• PERCLOS
  • Percentage of eyelid closure over the pupil over time, reflecting slow eyelide closures (droops), rather than blinks
    • Thought to be very reliable in the simulation setting
    • Can be affected by eyewear
    • Can be affected by lighting conditions

• Yawning, head movement, etc. are still being researched at the time of this article

Physiological Measures

• Electro-Oculogram
  • SEM vs REM
• Heart Rate
• EMG
• EEG
• VERY reliable, difficult to obtain consistently for everyday drivers
• Affected by movement

Integrated Vehicle Drowsiness Detection Systems

• Observations:
  • Though some car makers have these systems readily available and even standard, not every automobile manufacturer has these features (or at least, they don’t advertise that they do)
  • Seem to be more prominent on European cars
  • Even Ford, which had the “Driver Assist” system on the 2016 Ford Fusion does not seem to have it on the newer models
  • They are not heavily mentioned on the National Highway Traffic Safety Administration Website (if at all)
  • Seemingly being replace by Driver Assistance and Crash Prevention Technology
Driver Assistance and Crash Prevention Technology

• Crash Imminent Braking
• Forward Collision Warning System
• Blind Spot Monitoring
• Lane Departure Warning
• Pedestrian Automatic Emergency Braking
• Back-Up Cameras
• Adaptive Cruise Control
Driver Assistance and Crash Prevention Technology

  • Trust in these technologies varies
    • study subjects trusted side-view assist more than active lane keeping/lane departure
  • Among car manufacturers, trust in systems varies
    • Audi and Honda side-assist was more trusted than Infiniti
What about eliminating the driver?

• Public transportation
• Self Driving Cars
Self Driving Cars

• Tesla Video
Self-Driving Tesla Was Involved in Fatal Crash, U.S. Says

By BILL VLASIC and NEAL E. BOUDETTE  JUNE 30, 2016

But Not So Fast…

A Tesla Model S, with its self-driving mode enabled. In a statement, the National Highway Traffic Safety Administration said it had sent an investigative team to examine the vehicle and the crash site in Williston, Fla. Jasper Juinen/Bloomberg
Still, there is hope…

• Many car manufacturers are working on Automated Driving Systems
In Summary

• Driving Drowsy can be dangerous and has lead to multiple motor vehicle accidents and fatalities.
• It is important to recognize signs of drowsiness - yaw.
• Caffeine, medications, apps and driver assist technologies can be helpful, but do not replace common sense.
• Remember, the best way to mitigate sleepiness is with SLEEP!
Citations

• http://www.cdc.gov
• http://drowsydriving.org/