



THE ZONE 2014
ZONAR'S ANNUAL CONFERENCE

Driver Fatigue
Ronald R. Knippling, Ph.D.

SAFETY for the LONG HAUL

MOTOR CARRIER SAFETY ASSOCIATES



TODAY'S TOPICS

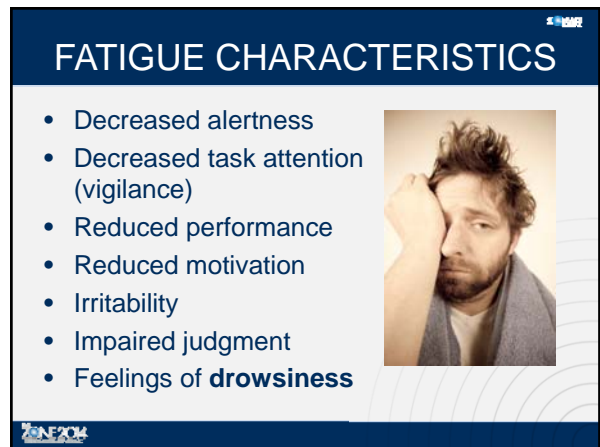
- Fatigue Characteristics
- Individual Differences in Susceptibility
- The "Alertness Rollercoaster"
- HOS & Fatigue
- Driver Fatigue & Health
- Improving Sleep & Alertness
- The NAFMP



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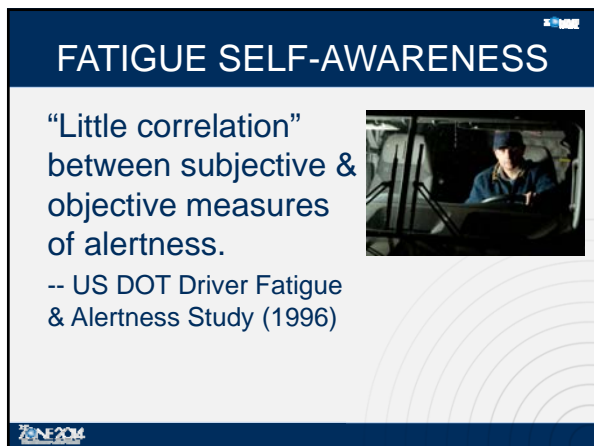
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FATIGUE CHARACTERISTICS


- Decreased alertness
- Decreased task attention (vigilance)
- Reduced performance
- Reduced motivation
- Irritability
- Impaired judgment
- Feelings of **drowsiness**

FATIGUE SELF-AWARENESS

"Little correlation" between subjective & objective measures of alertness.

-- US DOT Driver Fatigue & Alertness Study (1996)




OBJECTIVE SIGNS (1 of 2)

- Eyes:
 - Eyelid droop
 - Loss-of-focus
- Yawning
- Thoughts:
 - Wandering, disjointed
 - Scattered, dreamlike visions
- Head movements:
 - Gentle swaying
 - Jerks
- Reduced field-of-view ("tunnel vision")




OBJECTIVE SIGNS (2 of 2)

- **Body movements:**
 - Fidgeting, shifting positions
 - Adjusting windows, HVAC
- **Vehicle control:**
 - Weaving (progressive)
 - Crossing rumble strip
 - “Drift & jerk” steering
 - Variable Speed
- **Delayed or incorrect responses**
- **Microsleeps.**




FATIGUE-RELATED CRASHES

- Mostly single-vehicle crashes
- Driver alone
- Often on monotonous rural roads
- Most 2:00am to 7:00am
- Severe crashes!
- Large Truck Crash Causation Study:
 - 4% truck driver asleep-at-the-wheel
 - 13% fatigue present.
- Asleep-at-the-wheel (4% overall):
 - 13% of single-vehicle crashes
 - 0.4% of multi-vehicle crashes



FATAL-TO-DRIVER CRASHES

- 1990 NTSB in-depth investigation of 182 fatal-to-driver large truck crashes
- Most were road departures
- Fatigue was a principal cause in 31%
- **Fatigue was the biggest cause**
- However, this finding **cannot be generalized!** Fatal-to-driver crashes:
 - ~ 1/700 truck crashes
 - Police-reported fatigue rate ~30 times higher than that for all truck crashes



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FACTORS AFFECTING ALERTNESS

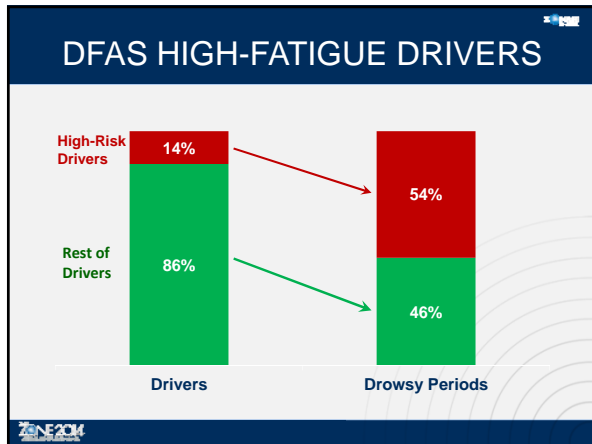
Source	Specific Factors
Physiological (Brain & Body)	<ul style="list-style-type: none"> • Individual differences in susceptibility • Amount of recent sleep • Time-of-day (circadian rhythm) • Time awake • Other: health, mood, stimulants, other drugs
Task-Related	<ul style="list-style-type: none"> • Time-on-task (e.g., time driving) • Task complexity • Task monotony

INDIVIDUAL DIFFERENCES IN SUSCEPTIBILITY

““There were large individual differences in levels of alertness and performance.”

-- US DOT Driver Fatigue & Alertness Study (1996)





THE DROWSIEST DRIVER: HOW BAD?

DFAS (80 Drivers):
Worst driver had more drowsy events than the 49 best combined.

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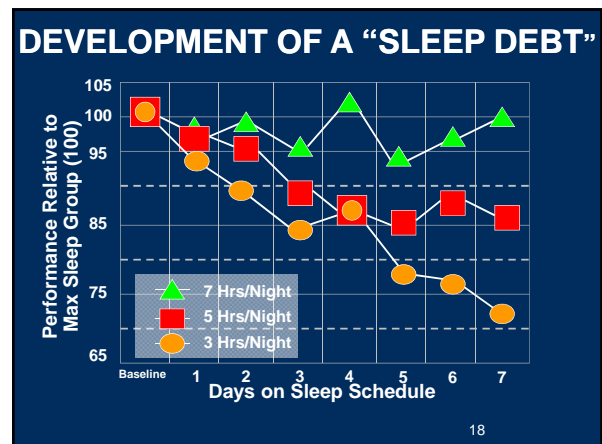
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RECENT SLEEP

- Last main sleep period (e.g., last night)
- Previous sleep periods (e.g., the nights before; even previous weekend)
- Naps: *very beneficial!*



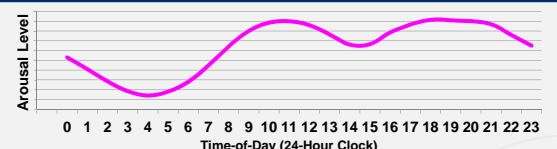
TIME-OF-DAY

“The strongest & most consistent factor influencing driver fatigue and alertness . . .”

-- US DOT Driver Fatigue & Alertness Study (1996)



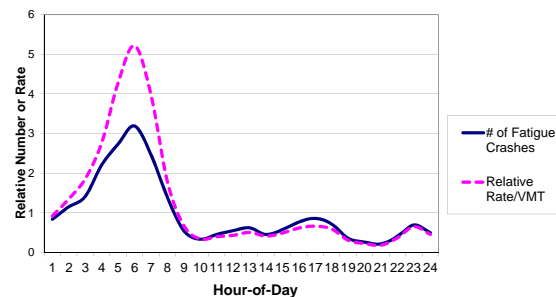
CIRCADIAN RHYTHMS



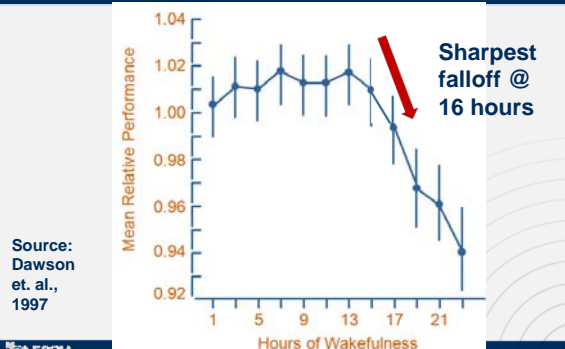
- 24-hour Circadian Rhythm controlled by the brain.
- Drives many physiological processes; e.g., metabolism, hormones, heart rate, alertness.
- Deepest valley: 3-6am. Good time for sleep!
- Smaller dip: 1-3pm. Time for a nap?
- Fatigue crashes follow an inverse pattern.

FATIGUE CRASHES BY TIME-OF-DAY

Fatal CMV Fatigue Crashes & Relative Rates

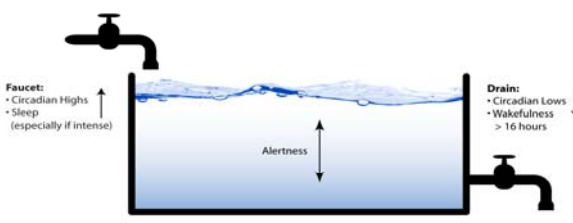


TIME AWAKE: “NATURE’S HOS RULE”



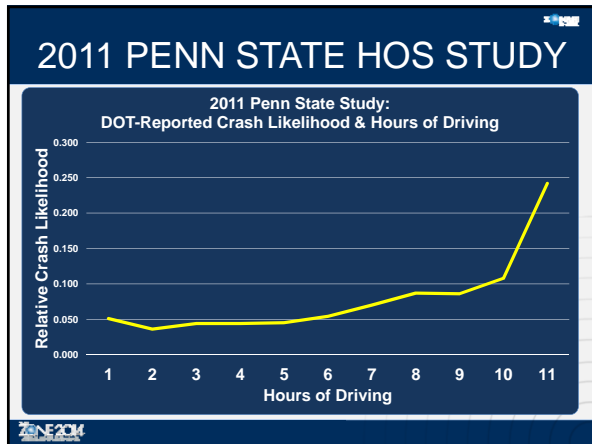
Source: Dawson et. al., 1997

“BATHTUB” MODEL OF DAILY ALERTNESS



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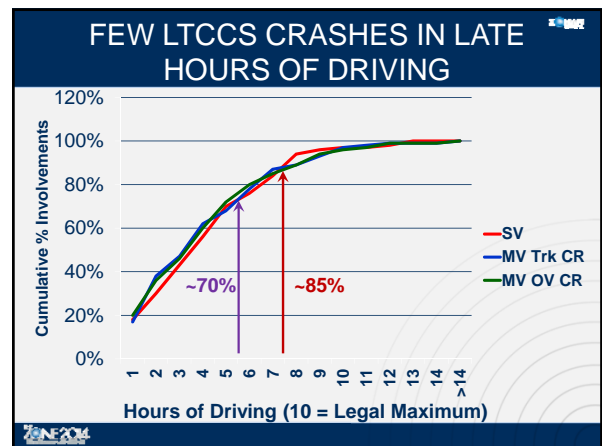
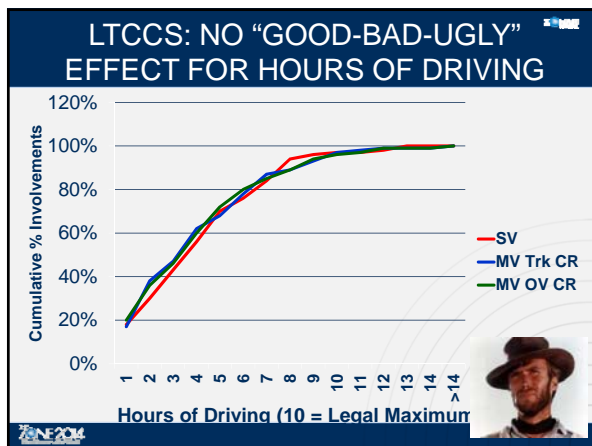


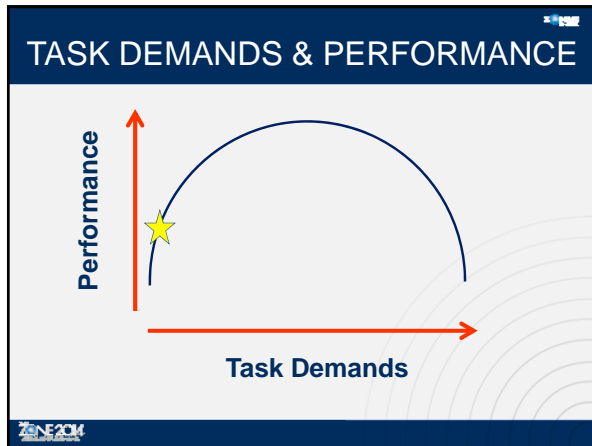
- ### STUDY DEFICIENCIES
- Correlational studies **do not** demonstrate causation.
 - **Did not** control for known confounds:
 - Time-of-day
 - Roadway type; divided vs. undivided
 - Traffic density
 - **Did not** analyze crashes; e.g.,
 - At-fault/not-at-fault
 - Specific causes; e.g., asleep-at-wheel
 - Single-vehicle vs. multi-vehicle

HOURS OF DRIVING

“Not a strong or consistent predictor of observed fatigue.”
-- US DOT Driver Fatigue & Alertness Study (1996)

- ### THE GOOD, THE BAD, & THE UGLY
- Truck crash categories:
- **“Good”**: Multi-vehicle crash, other vehicle at-fault
 - **“Bad”**: Multi-vehicle crash, truck at-fault
 - **“Ugly”**: Single-vehicle truck crash
-





Questions?

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for the LONG HAUL

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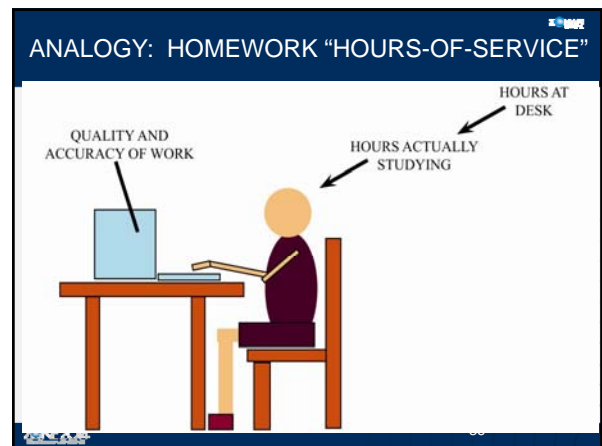
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HOS STRENGTHS

- Relatively simple
- Reasonably enforceable
- Directly control time-on-task
- Limit work to time awake "window" (16 hours)
- Afford the opportunity for sufficient sleep and rest
- Encourage schedule regularity
- "Level the playing field"
- Help protect workers
- Compliant carriers and drivers have lower crash rates

HOS WEAKNESSES

- Prescriptive, not performance-based
- No provisions re: individual differences
- No direct effects on sleep hygiene behaviors
- Largely unrelated to time-of-day (circadian rhythm)
- Few crashes are "HOS relevant" – e.g., ~4% in Driving Hour 11



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DRIVER FATIGUE & HEALTH

- New NIOSH Study: CMV drivers are among the **unhealthiest** Americans:
 - New survey: **69%** obese
 - **51%** smoke
 - Few exercise regularly.
- Poor sleep & lifestyle contribute to:
 - Cardiac conditions
 - Diabetes
 - Obesity
 - Etc.





OBSTRUCTIVE SLEEP APNEA (OSA)

- Apnea = stoppage of breathing lasting 10+ seconds
- OSA = breathing stops during sleep due to closures of the upper airway
- ≥ 5 apneas per hour = OSA
- Some people: >100 per hour!
- ~28% of CMV drivers have mild to severe OSA.
- Increase in crash rate: 2-7 fold.



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OSA RISK FACTORS & WARNING SIGNS


- **Risk factors:**
 - Obese/overweight
 - Male
 - 40+ years old
 - Large neck size (>17" for men)
 - Recessed chin/large overbite
 - Family history
- **Other warning signs:**
 - Excessive sleepiness
 - Snoring
 - High blood pressure
 - Diabetes





MANAGING OSA

- **Education**
- **Screening** based on risk factors
- **Testing** (Sleep Study) & diagnosis
- **Treatment:** Usually CPAP (Continuous Positive Airway Pressure)
- **Monitoring** Treatment Compliance


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FATIGUE MANAGEMENT "DO'S" (1 of 2)

- Value alertness and wellness
- Recognize sleep as a main ingredient
- Be aware of the fatigue factors affecting you at any time
- Self-assess your fatigue level based on **objective** signs
- "Go with" your circadian rhythms, not against them
- Use dark and light as aids to fatigue management.

FATIGUE MANAGEMENT "DO'S" (2 of 2)

- Seek OSA screening if you have risk factors
- Follow the 5 keys to wellness
- Use caffeine wisely
- Be cautious about other drugs
- Take breaks, especially with naps
- Comply with HOS rules
- Wear your safety belt!

FATIGUE MANAGEMENT "DON'TS"

- Ignore signs of fatigue
- Use caffeine excessively
- Use alcohol as a sleep aid
- Eat heavy meals before driving
- Rotate your daily work-rest schedule backwards (when you can avoid it)
- Exercise strenuously just before sleep periods
- Let a sleep debt worsen
- Set the alarm clock on weekends.

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Reality: HOS compliance is legally required and beneficial, but insufficient for driver safety and health.

Needed: A supplemental, proactive approach, focusing on driver health and lifestyle, and the causes of fatigue.

www.nafmp.com


NATIONAL TRANSPORTATION SAFETY BOARD ENDORSEMENT

- **Seven** NTSB recommendations to the U.S. DOT and industry in support of motor carrier fatigue management programs.
- H-10-9 (Aug 16, 2012): U.S. DOT should “**Require** all motor carriers to adopt a fatigue management plan based on the NAFMP guidelines . . . ”




NAFMP METHODS

- Training modes:
 - Instructor-led PowerPoint modules (with instructor notes)
 - Web-based
- FMP Implementation Manual (for carrier managers)
- FMP Website & Resource Center
- Learning Management System (LMS) to track individual (driver and manager) and carrier achievement.



NAFMP INSTRUCTIONAL PROGRAM

Module	Audience	Duration
1: FMP Introduction and Overview	Carrier Execs & Managers	45 min
2: Safety Culture and Management	Carrier Execs & Managers	1.5 hours
3: Driver Education	Drivers	3 hours
4: Family Education	Drivers' Families	45 min
5: Train-the-Trainer (for Driver Education and Family Education)	Managers & Other Trainers	3.5 hours
6: Shippers and Receivers	Shippers & Receivers	30 min
7: Sleep Disorders for Managers	Carrier Execs & Managers	1.5 hours
8: Sleep Disorders for Drivers	Drivers	1.5 hours
9: Driver Scheduling and Tools	Dispatchers & Managers	1 hour
10: Fatigue Monitoring and Management Technologies	Carrier Execs & Managers	1 hour

Thanks for your attention!



Ron Knipling
Safety for the Long Haul Inc.
Motor Carrier Safety Associates
(703) 533-2895
rknipling@verizon.net

-- Safety Training & Management Support --