Can cab engineering create passive improvements in driver sleep, health, and fuel efficiency?

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Where are we going?

• Driving and cab impacts on sleep/health
• Daimler naturalistic study findings
• Need for scientific U.S. trials
Sleep and circadian disruption: impacts on physiology and behaviors

• Metabolism
  – impaired insulin and glucose response in healthy people (at right)

• Inadequate Sleep
  – 20% increase in calories consumed (Brondel, 2001)

• Exercise
  – 50% reduction in sleep disorders (Sherril, 1998)
Driver health:

*Long work hours + shift work + sedentary + poor food options*

- **86%** of truck drivers are overweight or obese (2x gen pop)
- An obese driver incurs **$1,000 more** in health care costs annually
- Obesity, diabetes, sleep apnea = double+ crash risk
- Average cost of a fatal crash is **$3.6 million**
SHIFT Randomized Trial: Wave 1 Baseline Means

Days per week with healthy physical activity: 1.3

Hours of sleep per 24 hrs: 6.5

BMI: 36.4

Daily servings of fruits and vegetables: 2.4

High calorie meals/snacks/drinks per week: ≈15
Driving hours and cab impacts

• Van Dongen et al (2014) naturalistic study
  – On duty driving: sleep = 6.1 hrs
  – Restart home: sleep = 8.8 hrs

• Lab and sleeper berth studies of noise effects
  – cardiovascular reactivity, sleep structural changes, increased latency to REM stage

• Dinges et al (2002)
  – Driving = more awakenings, less REM, 50% worse sleep efficiency vs. home
Driving Trucks and Sleep

• Irregular work and sleep patterns
• Noisy truck stops
• Environmental challenges (heat & cold)
• Schedule pressures
• Lack of parking
Daimler Trucks Top Fit Program

Driver Health & Wellness Research & Development
Noise Impact on Driver Sleep

- Popp et al (2008) naturalistic driver study
  - Highway Noise: sleep = 6.2 hrs
  - Control: sleep = 6.36 hrs
  - REM On-set: 89 min
  - REM On-set: 69 min
  - Arousals/hr 16
  - Arousals/hr 14
  - Increased reaction times and errors
Daimler ECO Driver Study

- Rothe et al (2009) naturalistic driver study
  - Control vs. Sleep deprived
  - Subjective Sleep quality
    - Yes
  - Subjective & Objective drowsiness
    - Yes
  - Objective driving performance
    - Yes
  - Rested drivers used 2.26% less fuel (100k miles/$1,700 yr.)
  - Rested drivers used the service brake 30% less
Daimler Customer Fleet Study

• Rothe et al (2008) naturalistic driving study
  – Top Fit Truck vs. Series Actros (fleet trucks)
  – Top Fit: enhanced sound insulation, bed and seat
  – 12 customer fleet drivers
  – 2 weeks in each truck: normal route & working schedule

  – Average fuel savings with Top Fit truck 4.52% (850 gallons/100,000 miles = $3,400)
Daimler Truck Study New Actros

- Rothe et al (2012) naturalistic driving study
  - New Actros 2011: with Top Fit Truck enhancements
  - New Actros vs. Old Actros
  - Reduced mental stress (EEG)
  - Improved fuel efficiency with New Actros
Discussion

• Daimler Trucks naturalistic driving studies
  – Cab engineering positively impacted driver sleep
  – Rested drivers were more economical drivers
  – However, small samples, short durations, and European routes were used in studies

• Daimler Trucks implemented Health & Wellness Features in New Actros (2011)

• Same results under U.S. driving conditions?
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