PULSAR INFORMATICS

Predicting Performance and Safety Based on Driver Fatigue

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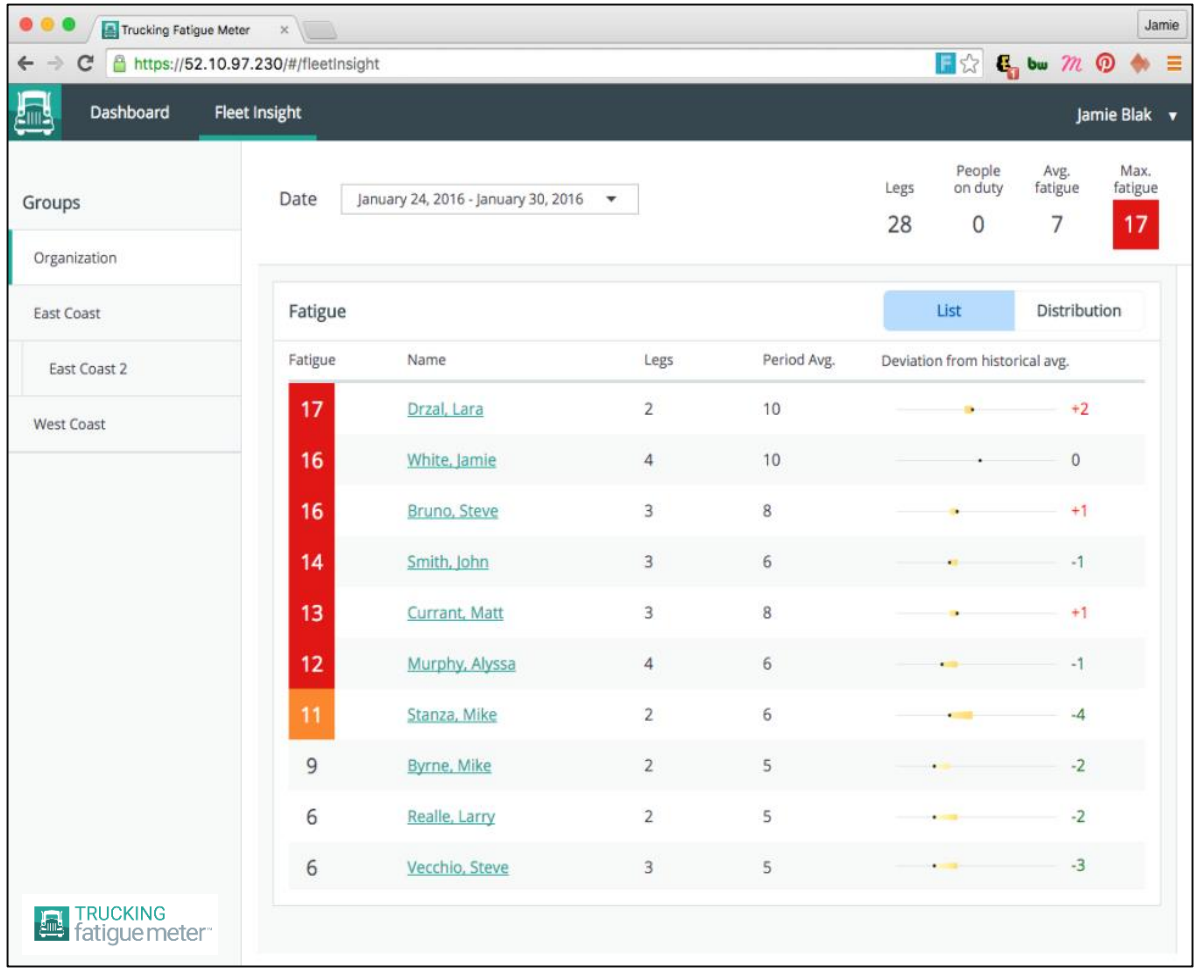
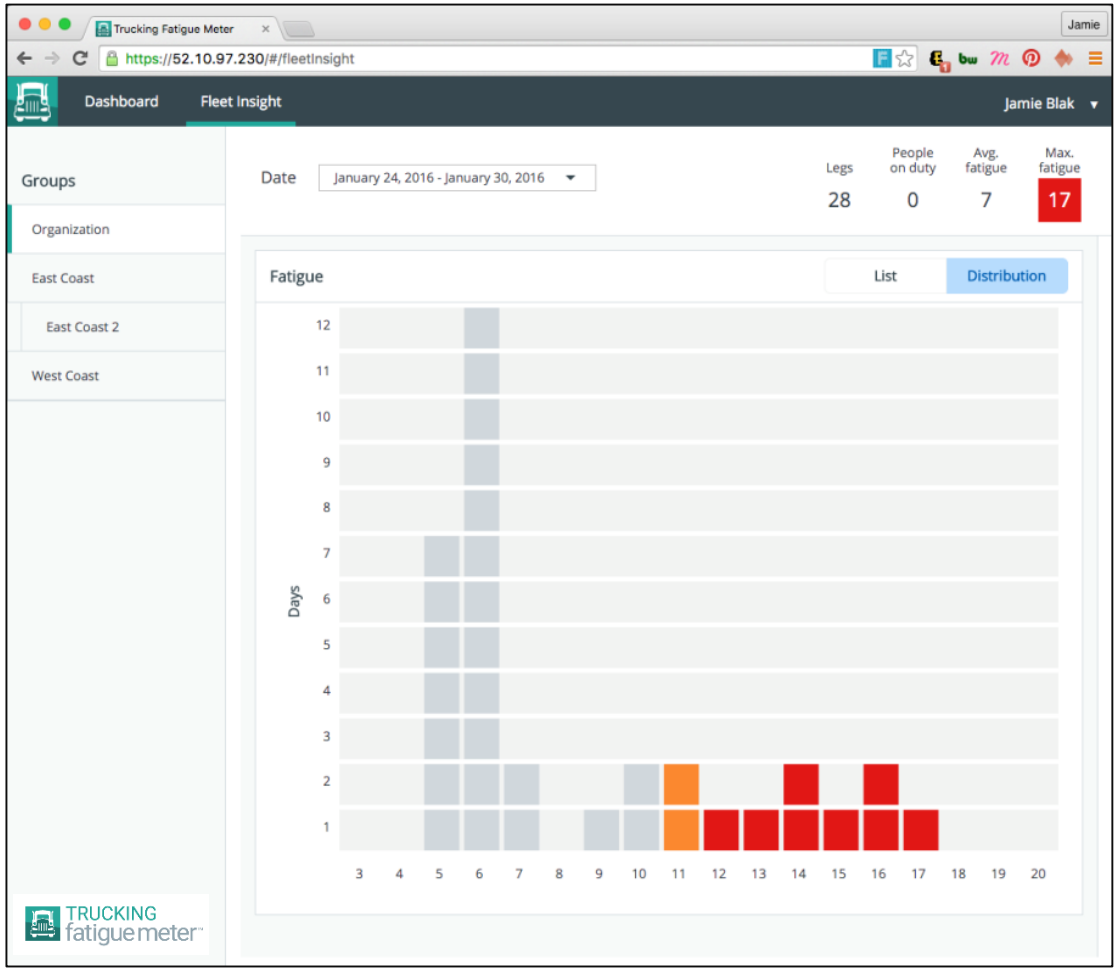
Fatigue Meter: Identify drivers at elevated fatigue risk

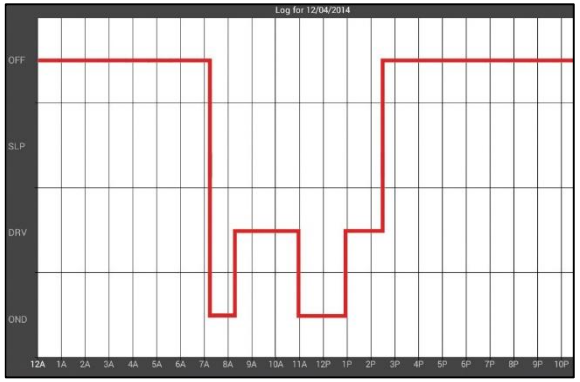




Data collected in naturalistic field study

Study overview:

- **106 US truck drivers**
  - **44 local drivers**
  - **26 regional drivers**
  - **36 long-distance drivers**
- **Drivers were studied across two duty cycles intervened by a restart break of at least 34h**
- **Data collected included:**
  - **HOS logs**
  - **Wrist actigraphy and sleep diary**
  - **Continuous measurement of vehicle performance**
- **Analysis based on 48 drivers**



Hours of Service Logs

Sleep tracking

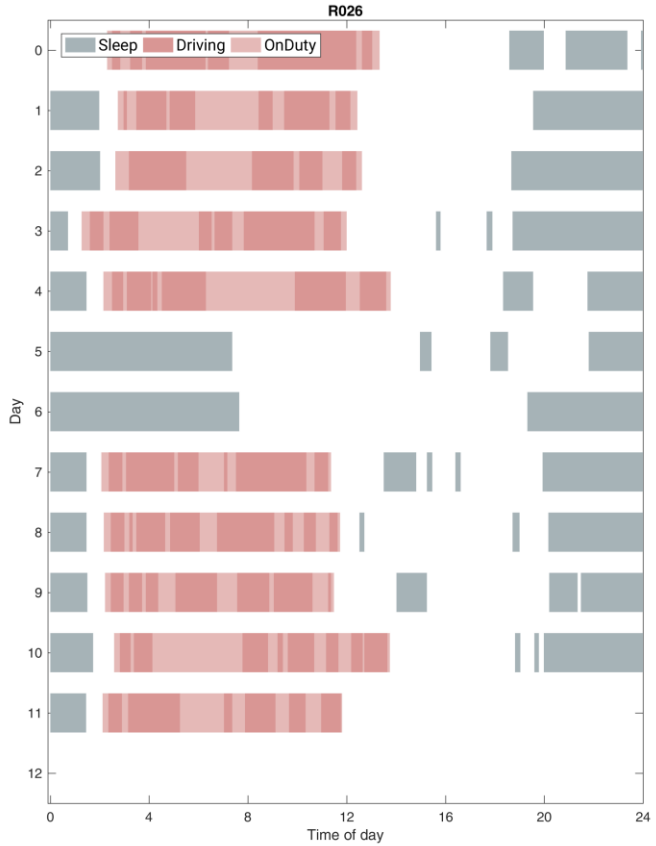
Data Acquisition System

Timing of duty and sleep

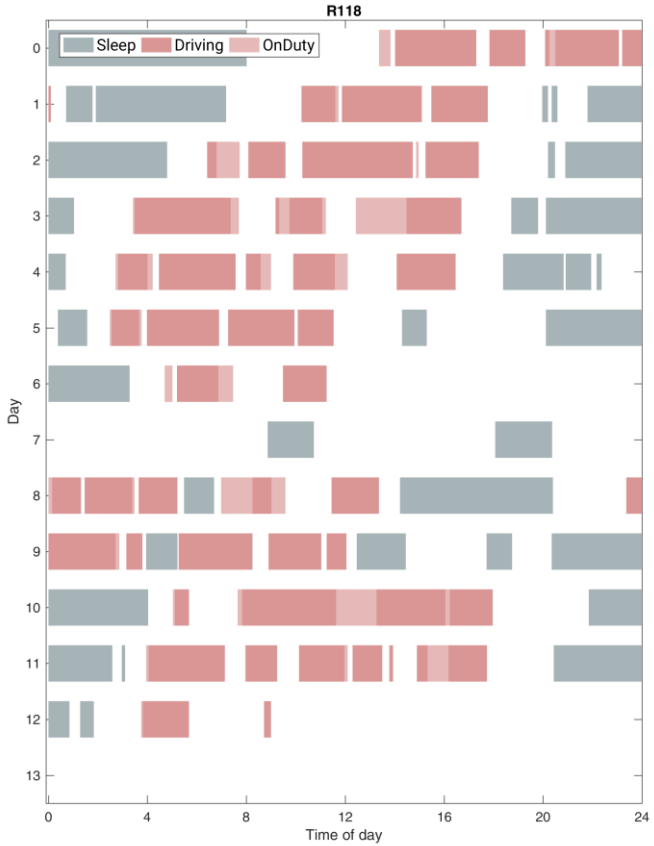
Drivers exhibited wide variety of schedule patterns

Day driver

Night driver



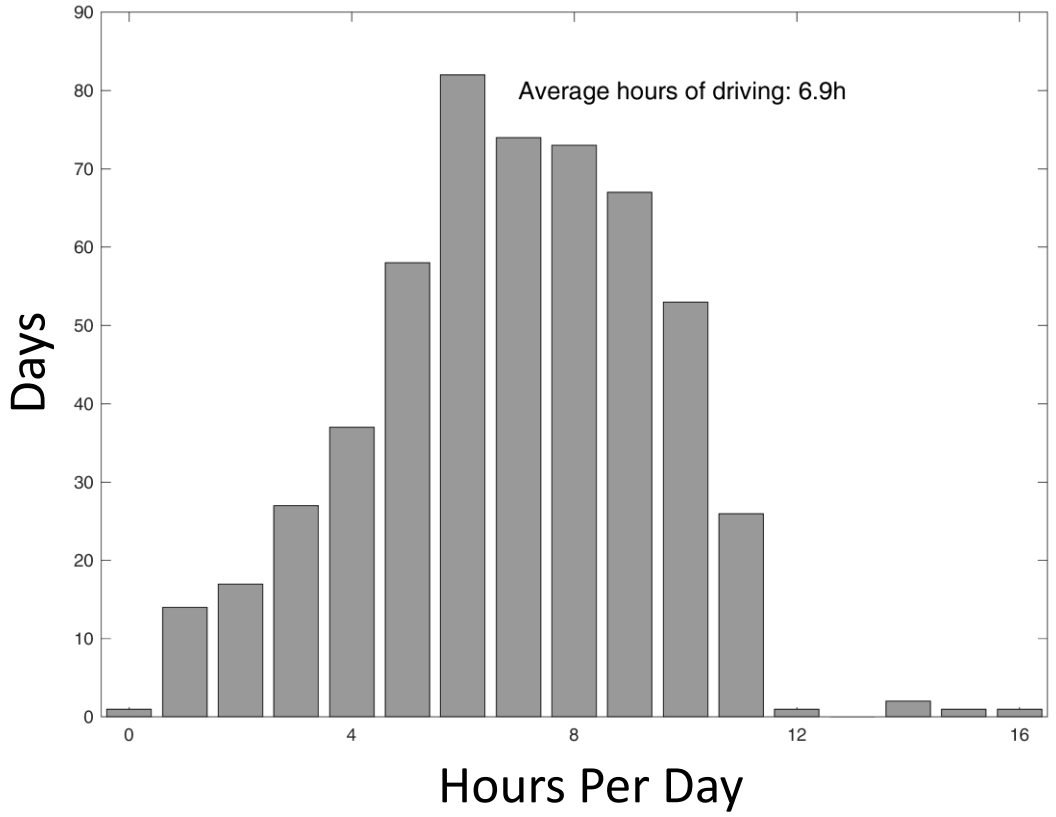
Mixed driver



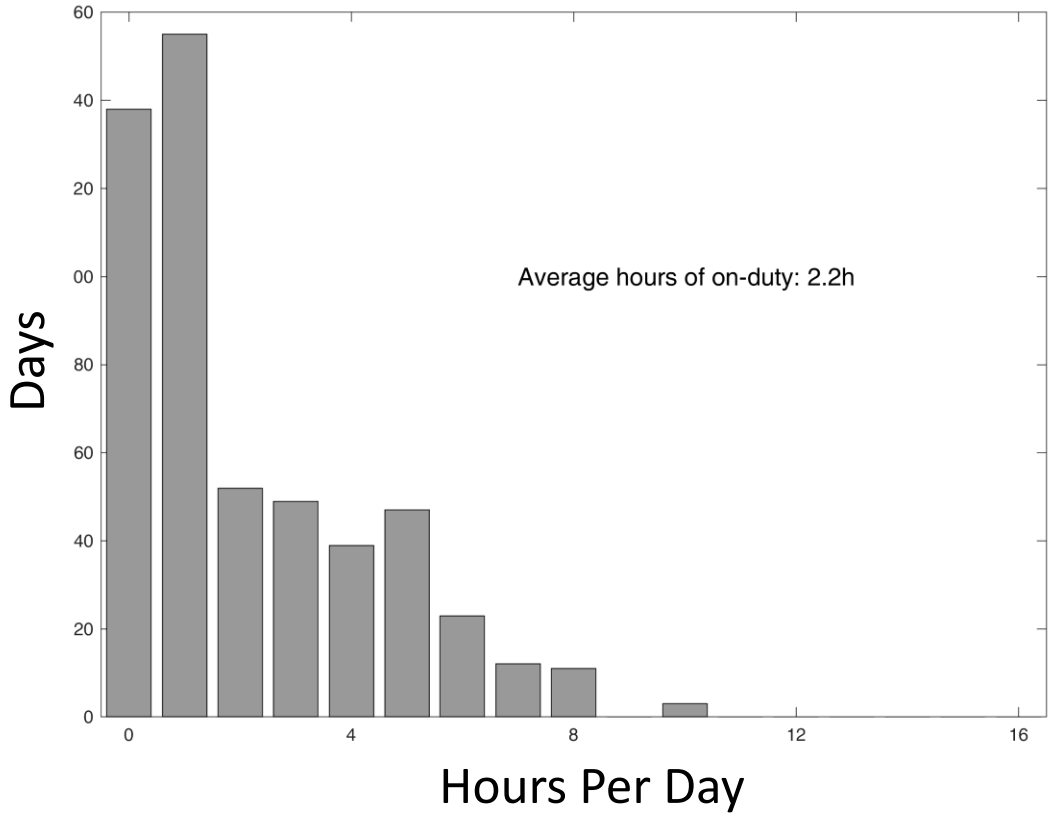
Analysis of the work day duration and composition

Total hours driving per day → Risk (Exposure)

Total Hours Driving Per Day



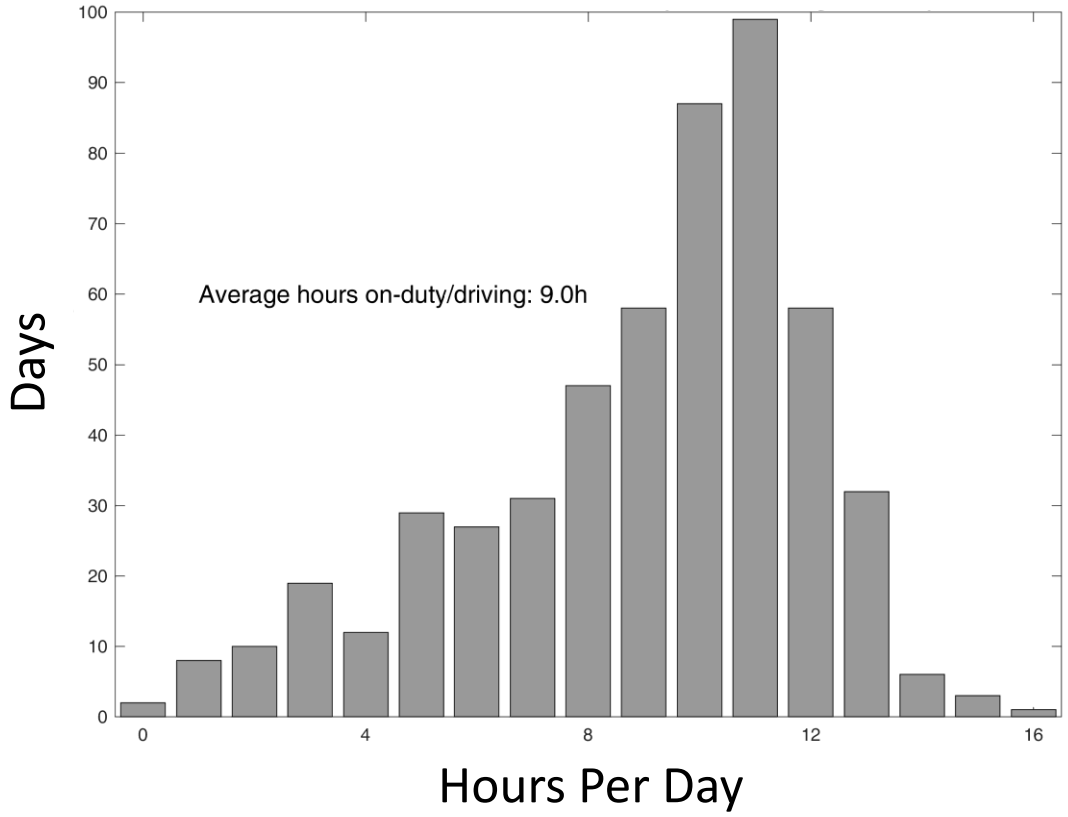
Total Hours On-Duty but not Driving



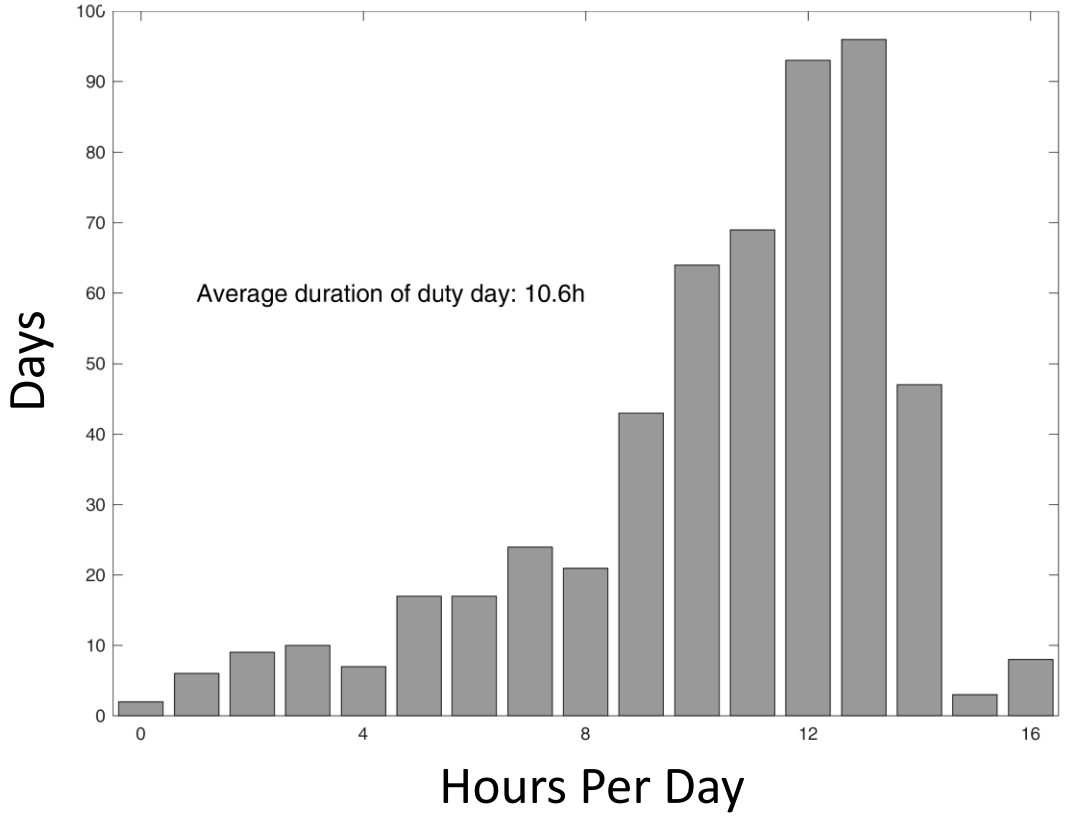
Analysis of the work day duration and composition

Long duty days → **Restricted sleep opportunity** → **Fatigue**

Total Hours Driving & On-duty Per Day



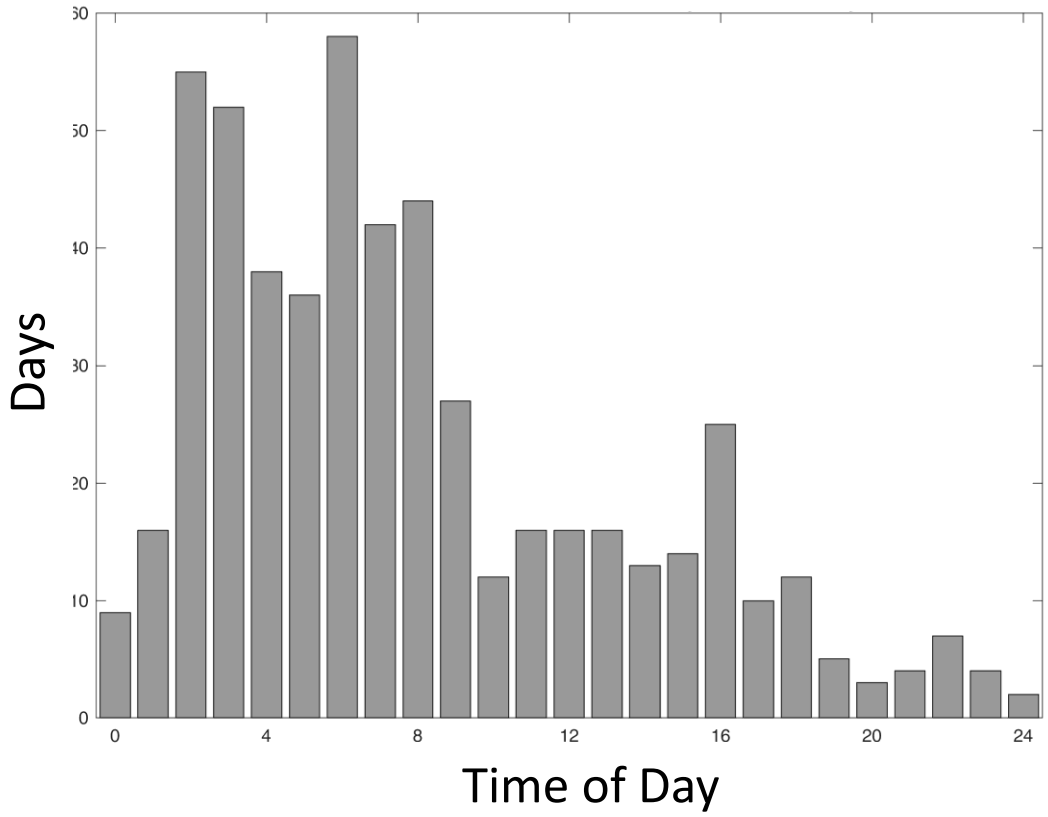
Total Hours Driving & On-duty & Breaks



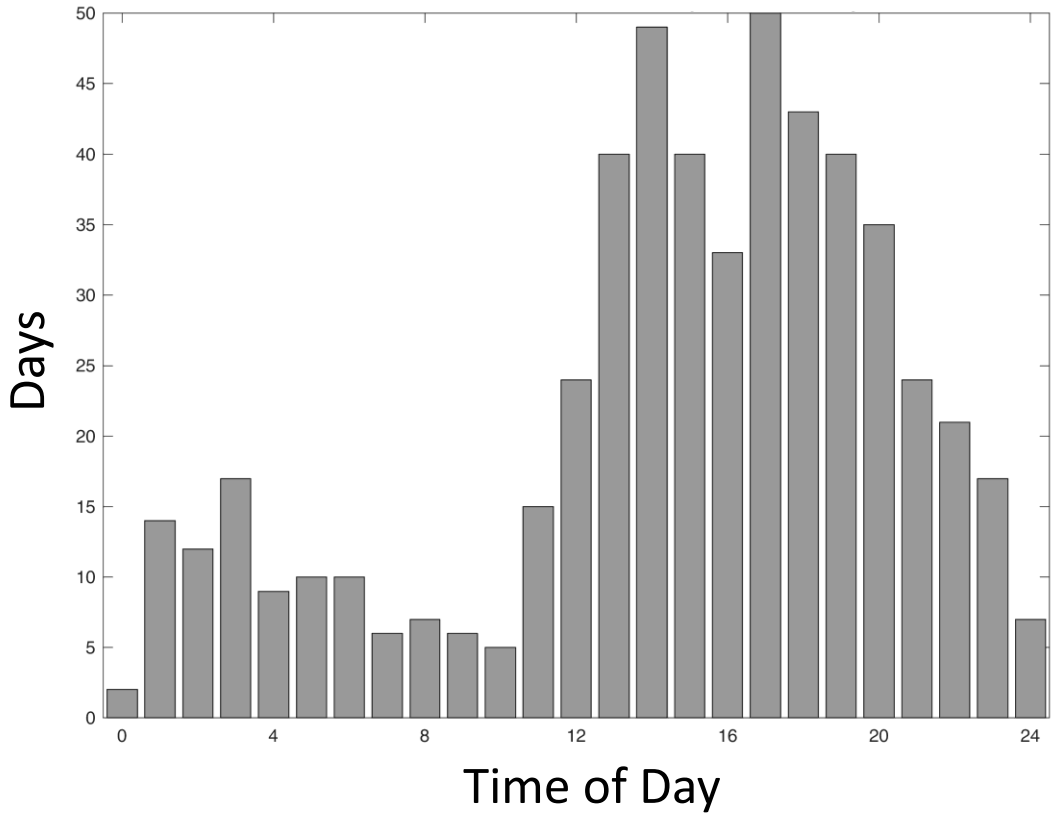
Analysis of the work day by time of day

Variable start times → **Disrupted circadian cycles** → **Fatigue**

Start Time



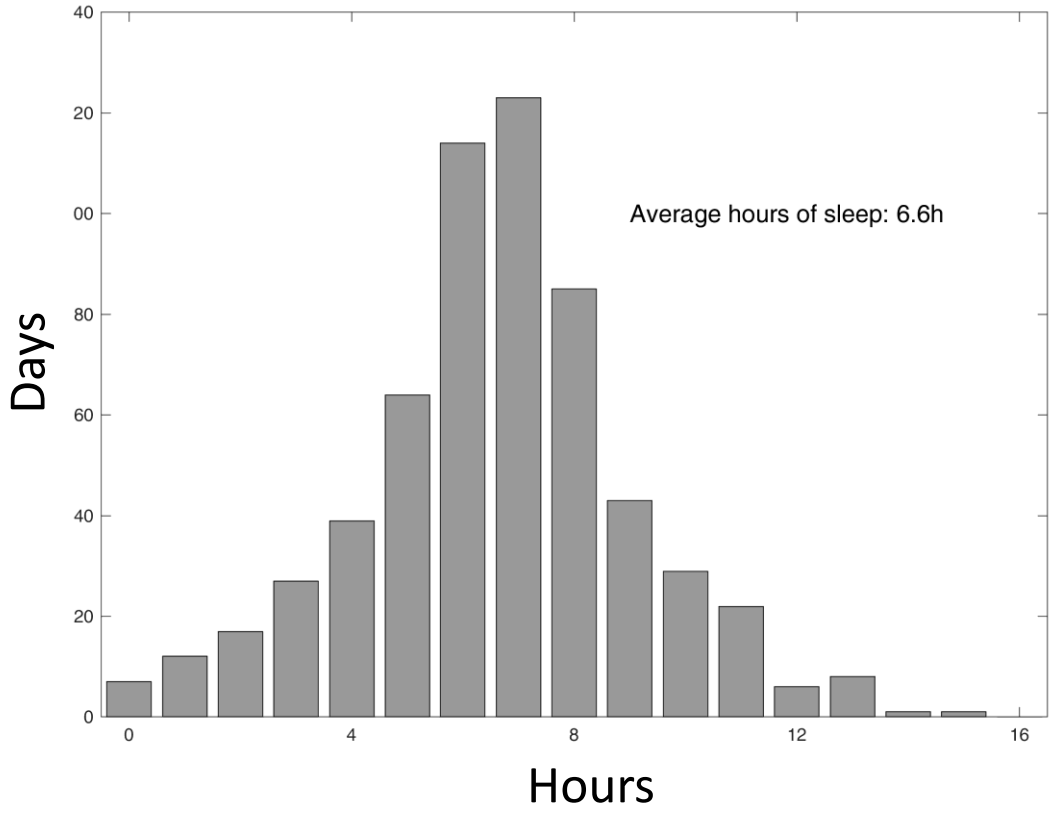
End Time



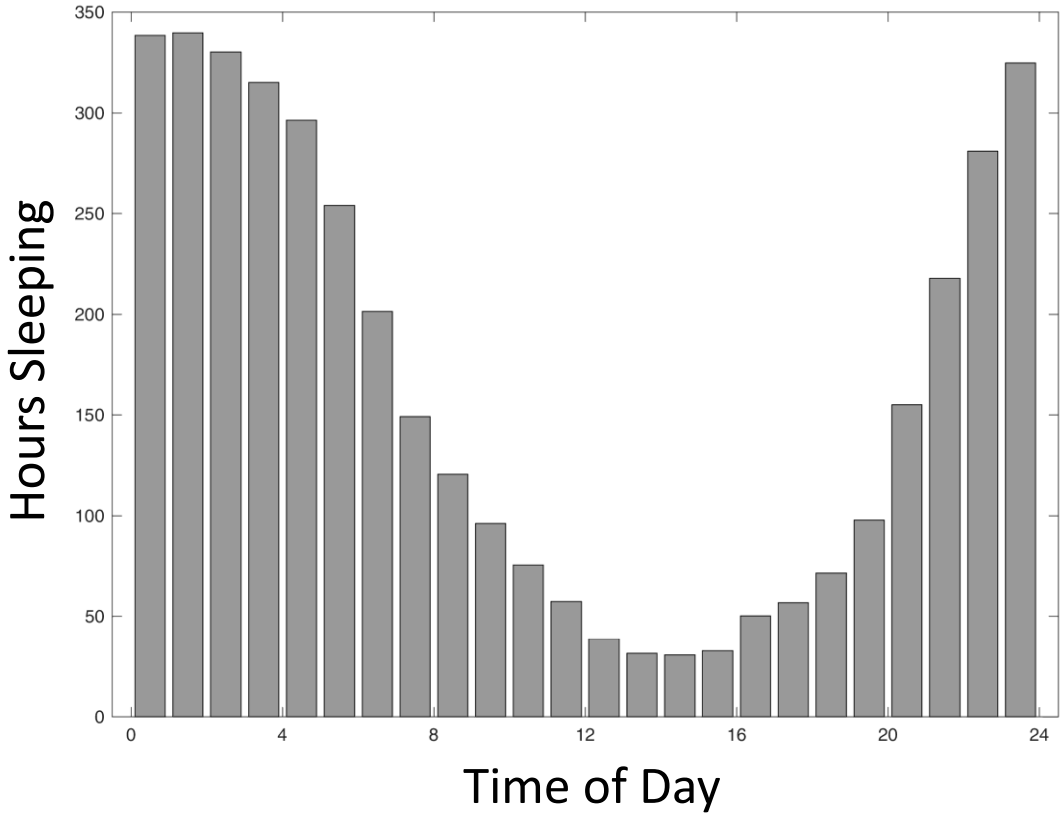
Analysis of sleep timing and duration

17.1% of the time drivers had <5 hours of sleep (105/600 driver-days)

Total Daily Sleep Duration



Distribution of Sleep Timing

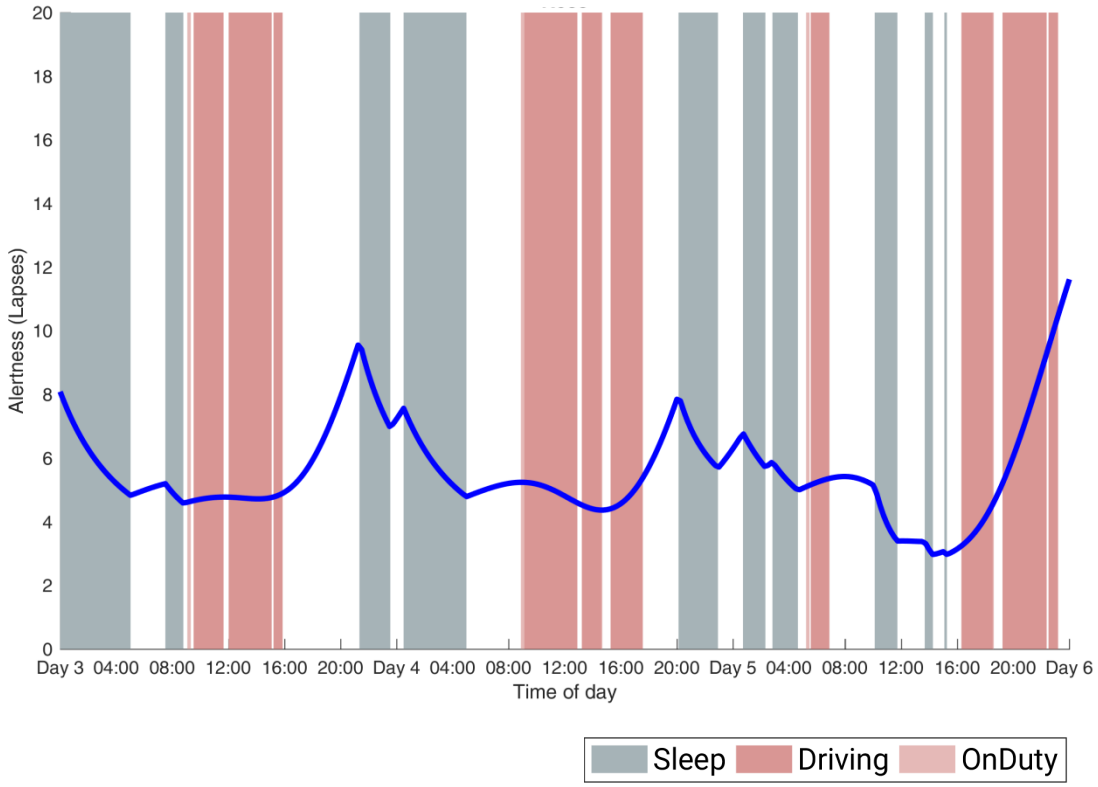


Analysis of fatigue and performance

Analysis overview:

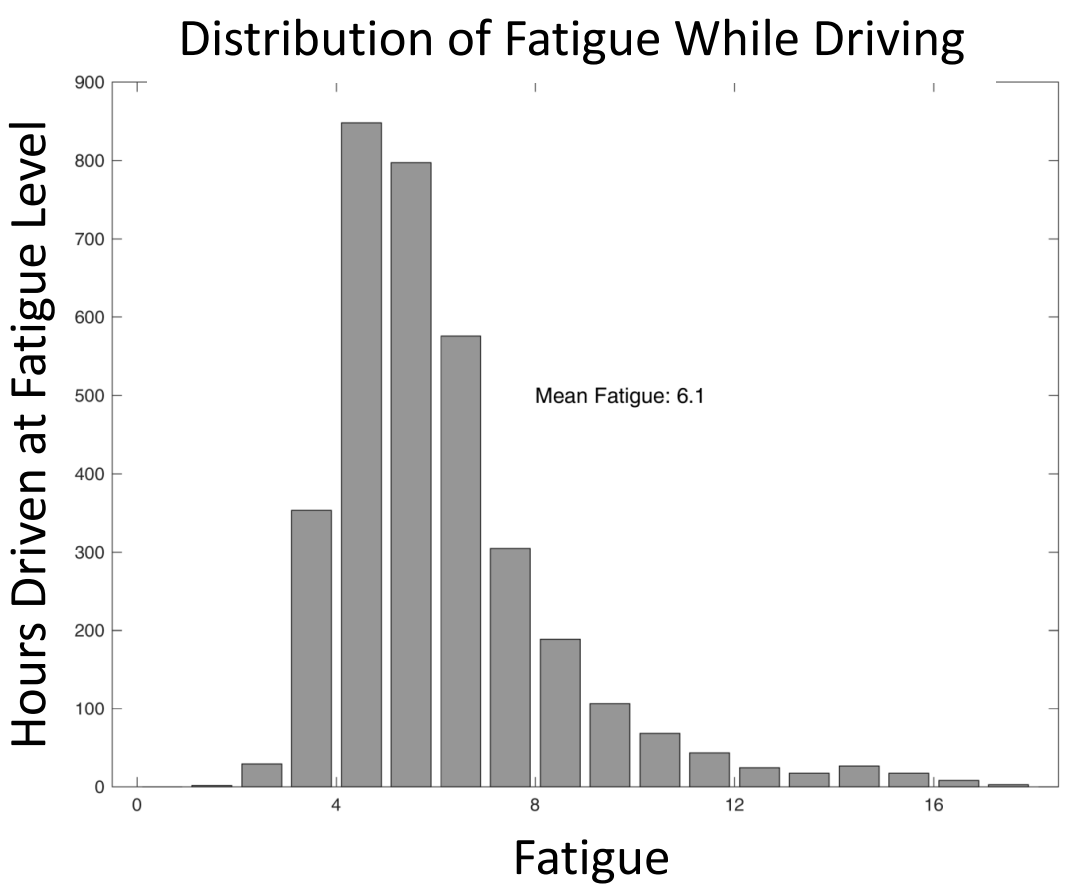
- Extracted hard braking events from vehicle acceleration data based on threshold of 3mph/s and 5mph/s with initial speed greater than 50mph.
- Estimated fatigue based on HOS data from the ELD using published biomathematical model (McCauley et al., 2009, 2013)
- Estimated effect of fatigue on hard-braking rates based on nonlinear mixed-effects with time-of-day covariates.

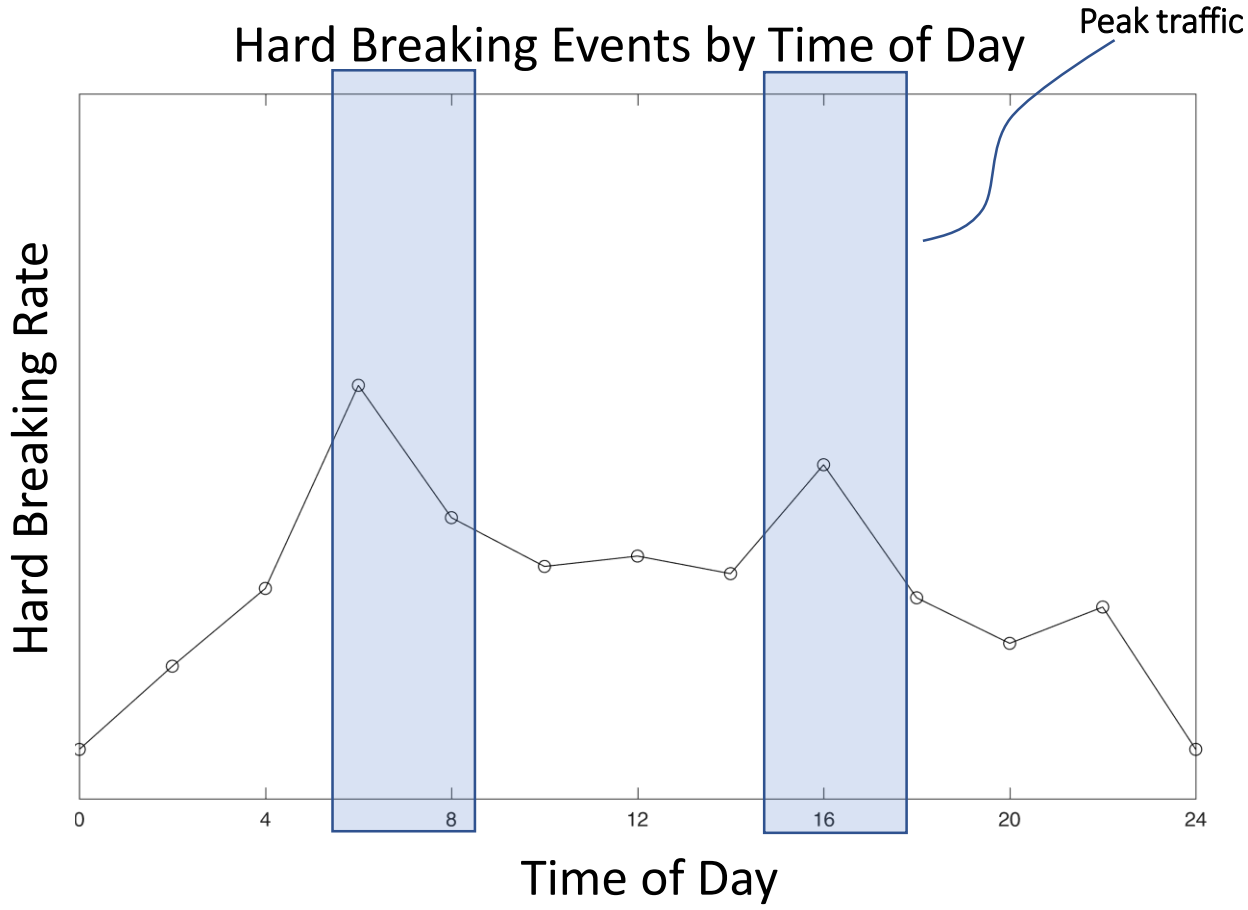
Estimated Fatigue based on HOS data



Estimated fatigue and hard breaking events

Fatigue was above 12 while driving only 2.8% of the time





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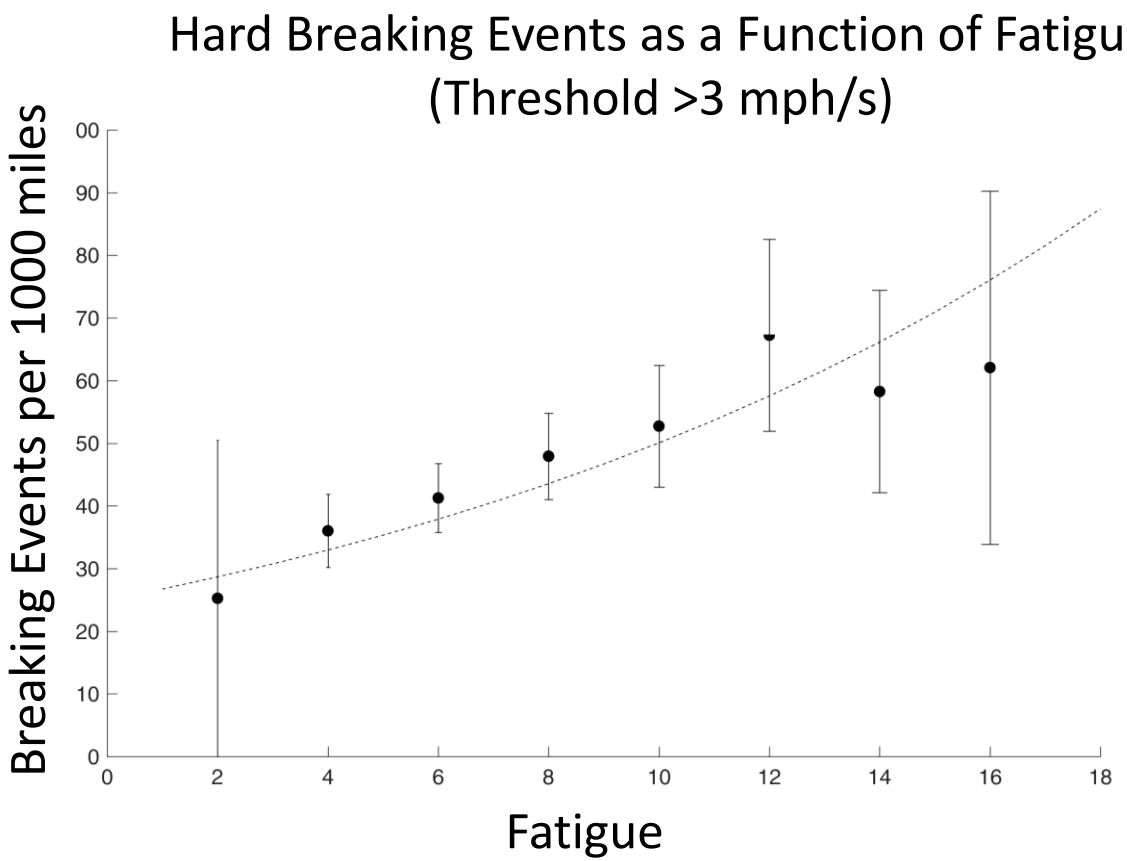

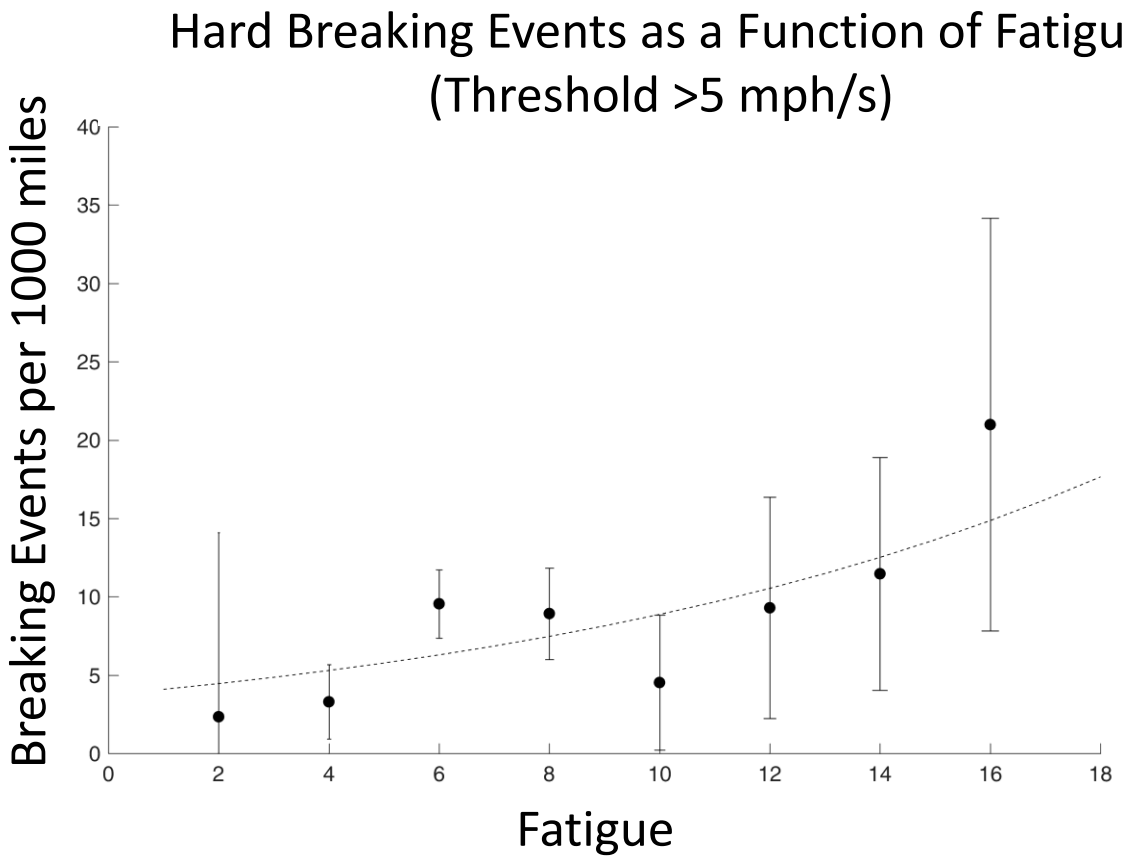

Acknowledgments

Trucking Fatigue Meter
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