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Analysis of Risk as a Function of Driving-Hours 1 Through 11

Richard Hanowski, Ph.D.
Director, Center for Truck & Bus Safety
Virginia Tech Transportation Institute (VTTI)

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U.S. Department of Transportation
Federal Motor Carrier Safety Administration

National Highway Traffic Safety Administration
Our Mission: Save lives, prevent injuries, reduce vehicle-related crashes

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Project Overview

- The revised Hours-of-Service (HOS) regulations were published on April 28, 2003
- One central component of the revised regulations was an increase in off-duty time from 8 to 10 hrs
- Hanowski, Dingus, Sudweeks, Olson and Fumero (2005) found that this increase in off-duty time led to drivers getting more sleep – approximately 1 hr more than under the old HOS regulations

Time-on-Task

- A second key component of the revised regulations was an increase in allowable driving time from 10 to 11 hrs
- An important question associated with this change – “Does the additional 1 hr of allowable driving time increase crash risk?”
- That is, “Does an increase in *time-on-task* (from 10 to 11 hrs) increase crash risk?”

Previous Findings

- Findings from previous research to answer this question are mixed
- For example, Hanowski et al. (2005) found no difference in critical incident occurrence between the 10th and 11th hours (i.e., no time-on-task effect)
- Also, the Driver Fatigue and Alertness Study (Wylie et al., 1996), a naturalistic study, found a strong time-of-day effect but not a time-on-task effect

More Related Findings

- However, Park, Mukherjee, Gross, and Jovanis (2005), using crash reports, did find an increase in crash risk associated with increasing driving-hours; increasing slightly between driving-hours 1 through 4 and then increasing significantly in the 5th hour

Current Study

- Analysis of data collected in a naturalistic driving study to investigate:
  1. Critical incidents as a function of driving-hours 1 through 11*
  2. For drivers that drove into the 11th hour, assess critical incidents for driving-hours 1 through 11*
  3. Modeling the data to look for significant differences across driving-hour (logistic regression)
  4. Critical incidents as a function of shift within the driver's work week or "tour-of-duty"
  5. Critical incidents as a function of time-of-day*

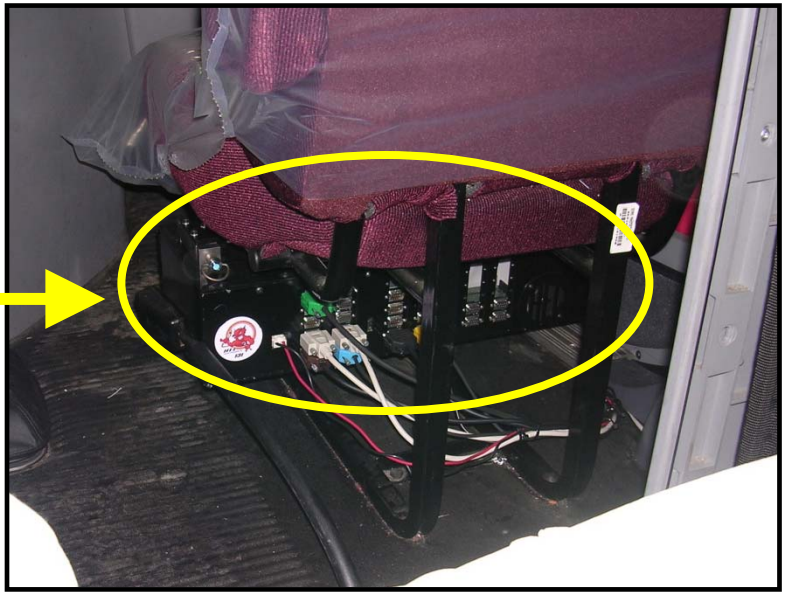
Method

- Data collected during a Field Operational Test (FOT) of a Drowsy Driver Warning System (DDWS)
- Data collection began in May 2004 and ended in September 2005 (after the implementation of the revised HOS regulations)
- Naturalistic data collection approach is when data are collected as study participants drove company trucks during their normal, revenue-producing runs

Data Collection Approach

- 46 trucks were instrumented with the DDWS and a Data Acquisition System (DAS)
- 103 drivers participated, driving for, on average, 12.4 weeks
- 4 trucking companies; line-haul and long-haul represented
- Continuous data collection approach used
- Over 100 data measures collected on driving performance (e.g., lane position), actigraphy, questionnaires and 4 video cameras

Data collection system box under passenger's seat



Data collection system box

Front VORAD

Rearward Camera

Face & Forward Cameras

Data Collection Statistics

- ~2.3 million miles of driving data
- ~190,000 hours of actigraphy data
- ~12 terabytes of data
- In terms of data collected, largest and most complete on-road study ever conducted
- Provides opportunity to look at various commercial motor vehicle issues, beyond the effectiveness of the DDWS

Critical Incidents

- Critical Incidents = crashes, near-crashes, and crash-relevant conflicts
- In terms of number of critical incidents, Analysis 1 had:
  - 819 Critical Incidents
    - 12 Crashes (6 V1 at-fault; 3 deer hits)
    - 12 Tire-Strikes
    - 85 Near-Crashes
    - 710 Crash-relevant Conflicts

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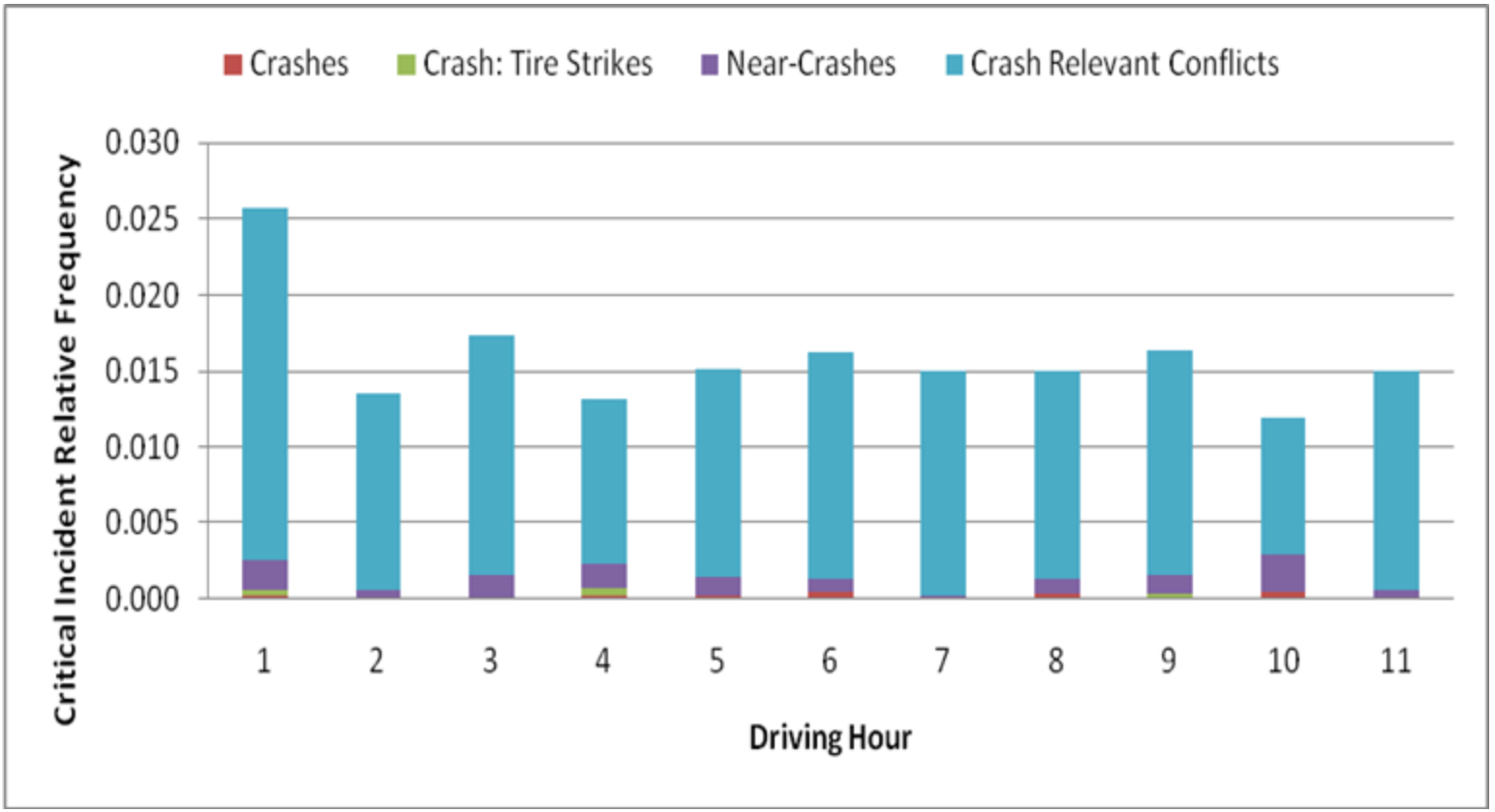
Key Results

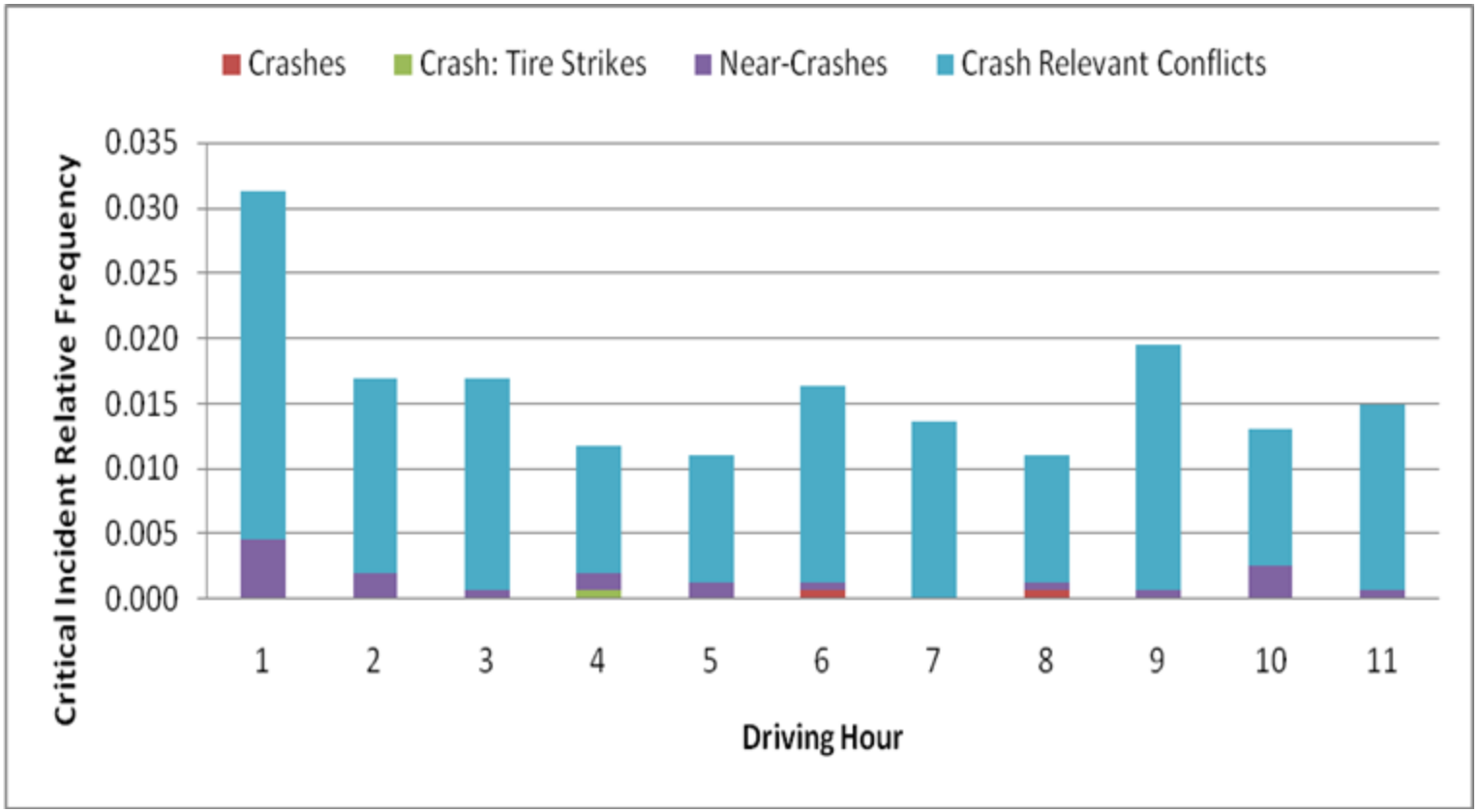
- *Driving Hours 1 through 11*
- Conducted 8 sub-analyses, parsing the data in different ways to help ensure no significant findings were overlooked
- For each driving hour, frequency of critical incidents and opportunities (exposure) was determined
- A rate was then calculated:
  - *Critical Incidents per Driving-Hour*
  - *Total Opportunities per Driving-Hour*
- Odds ratios on the rates were evaluated

Time-on-Task Results: At-fault



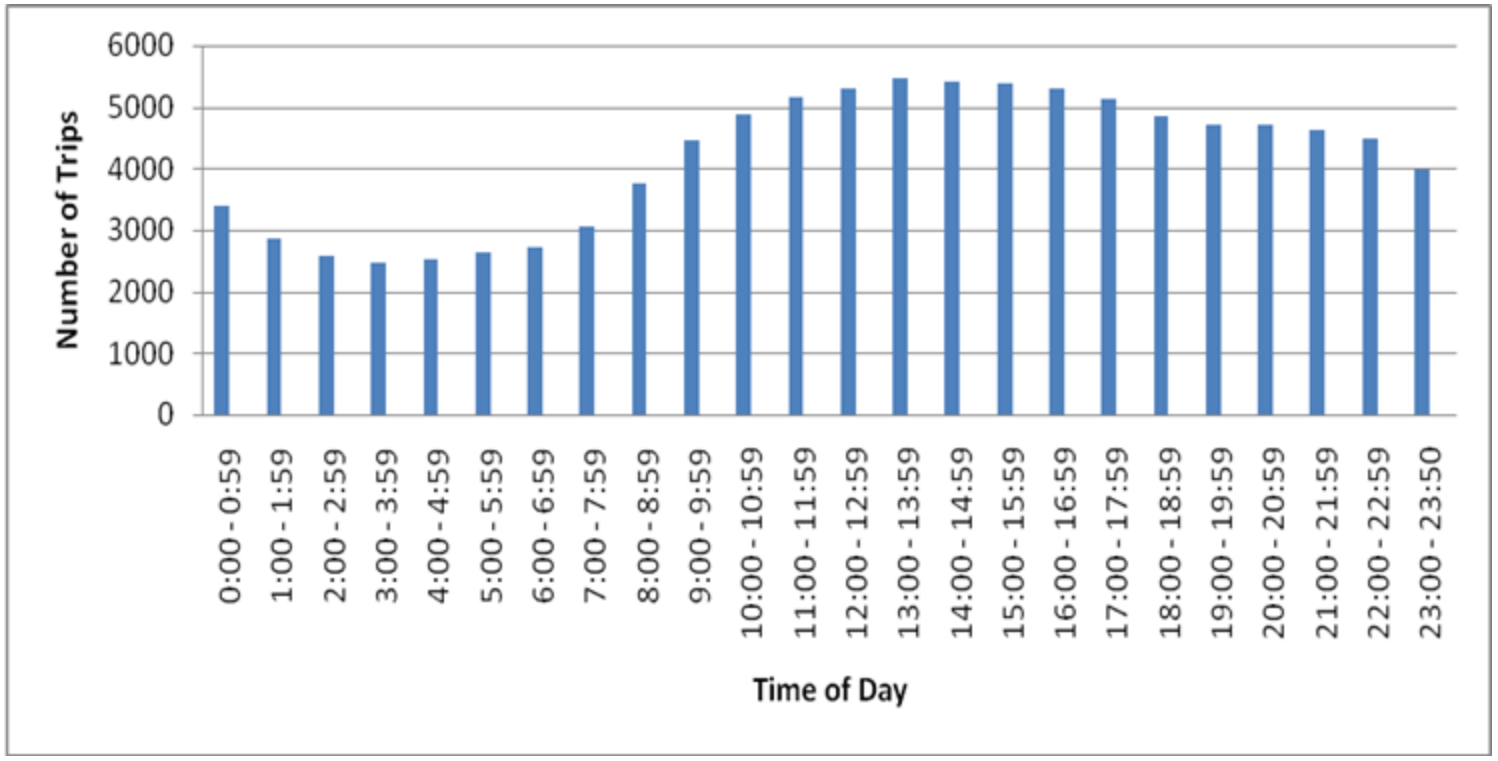
Critical Incident Relative Frequency as a Function of Driving-Hour where the Subject Driver was At Fault

Time-on-Task Results: 11th Hour Drives (N = 1535 trips), At-fault



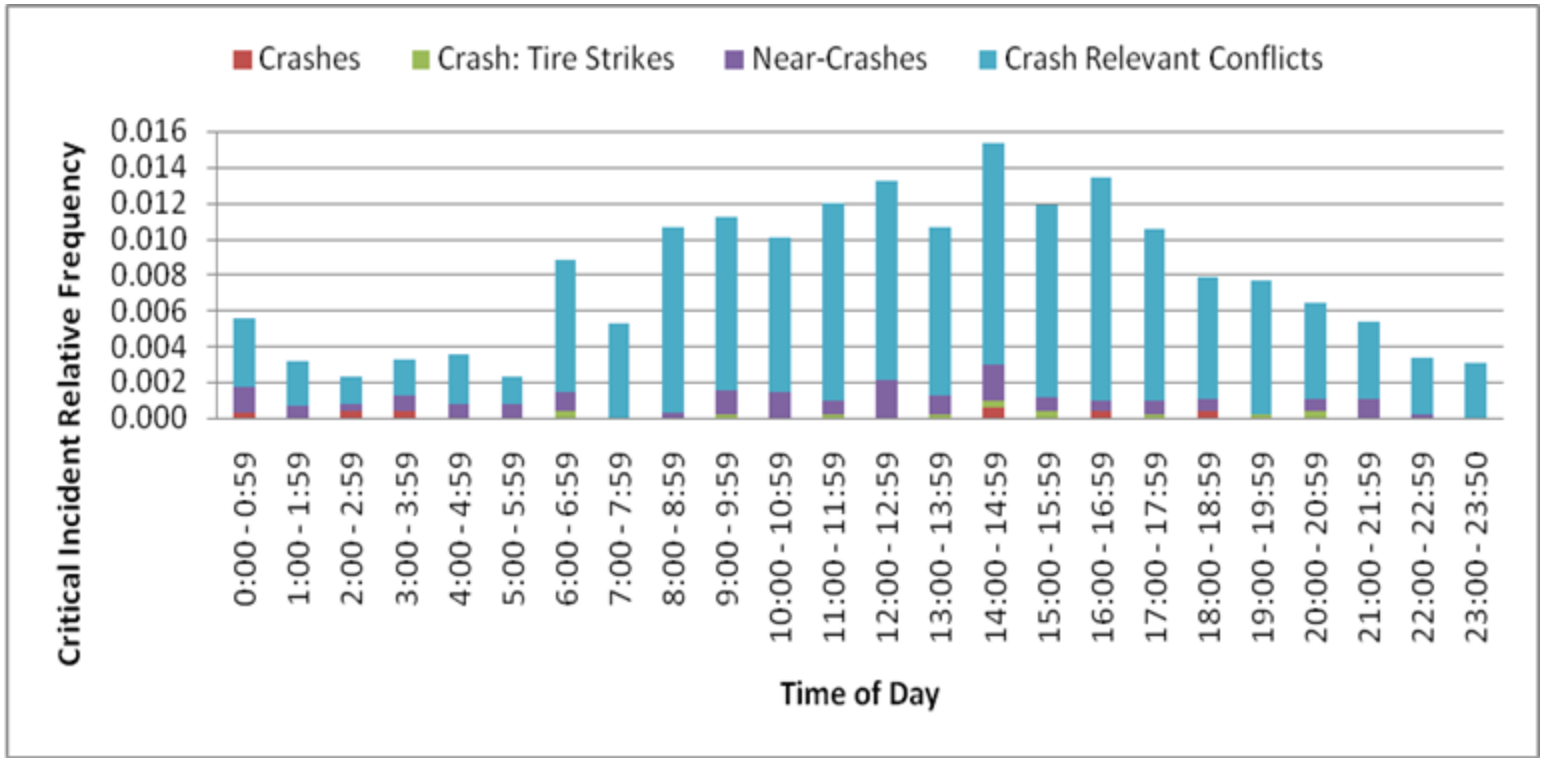
Critical Incident Relative Frequency as a Function of Driving-Hour
for Trips that went into the 11th Driving-Hour, and the Truck Driver was At-fault

Time-of-Day Results



Number of Trips as a Function of Time-of-Day

Time-of-Day Results

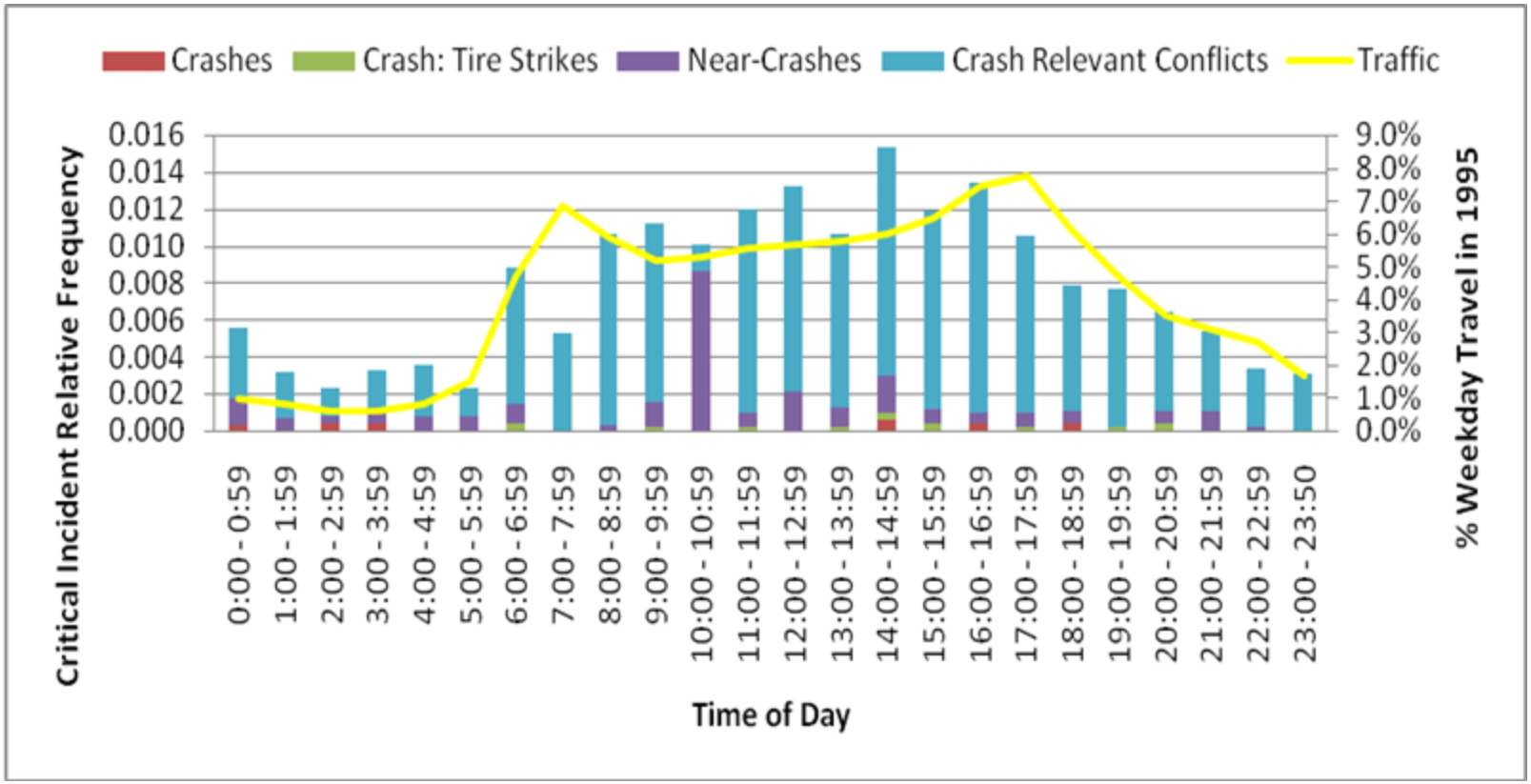


Critical Incident Relative Frequency as a Function of Time-of-Day

Time-of-Day Follow-Up Analyses

- Looked at circadian lows vs circadian highs (nothing significant)
- Looked at traffic density
- Plotted data from Festin (1996) that was broken up by time-of-day…

Time-of-Day/Traffic Density Results



Critical Incident Relative Frequency as a Function of Time-of-Day, with Traffic Density Plot Superimposed (R^2=0.69)

Conclusions

- Study resulted in a major finding that is relevant to the assessment of the 2003 HOS regulations
- A statistically significant difference in critical incident relative frequencies between the 1st driving-hour and all other driving-hours
- However, there was generally no statistical difference between the 2nd through 11th driving-hours

Consistent Results

- 1st hour "spike" was also seen in the LTCCS database
  - Of all hours, the 1st driving-hour had the highest raw percentage of crashes (14.7%)
  - Note that the LTCCS database does not account for exposure, however the current study with naturalistic data did
- Findings from this study are consistent with Wylie et al. (1996) with regard to time-on-task; i.e., poor predictor of crashes…except for the first hour

No Difference in Hours 2 – 11

- Why the 1st hour spike?
  - Sleep Inertia?
  - “Take-off” and “Landing” effects?
  - Time-of-day?
- Study results do not support the hypothesis that there is an increased risk from CMV drivers driving in the 11th hour as compared to the 10th hour, or any driving-hour
- Caution: Though this dataset is perhaps the best of its kind, it represents a small fraction of CMV drivers, vehicles, miles driven, and there were very few crashes

hanowski@vtti.vt.edu