

# Tenth International Conference on Managing Fatigue

Revised Abstract

## Cumulative Driver Fatigue

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### Problem

The new HOS rules coming out of the US DOT attempt to do a better job of regulating the driver's hours behind the wheel, but as we all know there is more to fatigue management than just driving: it's not just how much time you spend driving, it's how much you've been *working* [including driving], your sleeping hours and habits, and so forth. A fatigued individual has a reduced ability to focus on the task of driving, and can, therefore, be considered a distracted driver. Unlike the distractions of cell phones, food, or navigation systems which can all be put away or delayed, it is not possible for a driver to ignore the internal distraction of fatigue. As part of Cartasite's commitment to driver safety, we are underwriting a long term research to study how cumulative driver fatigue manifests itself in driving behavior. A new study from the data scientists at Cartasite is expected to provide new insights on this critical matter. Our research focuses on the cumulative effect of all activities [including driving] that individuals are involved with while being away from their '*HomeBase*' to determine if there is a measurable effect on the individuals' driving behavior/performance.

### Method

Data were collected over a period of approximately three months: April 2016 – July 2016. The Initial Data Set (IDS) contained 976,674 hourly intervals of being *Away From HomeBase* (AFHB) for 2,031 drivers. [ Note: For the purposes of this study, we are defining '*HomeBase*' as the location where an individual (1) was most likely to rest for extended periods of time, and (2) was during the midnight of the Local Time. The time *Away From HomeBase* as the time away from individual's *HomeBase*.] The initial data set was filtered to include only drivers [and the corresponding AFHB hourly intervals] who started their work week on Monday after spending midnight at their *HomeBase* and through Friday of this same week. This reduced IDS down to the 491,711 hourly intervals of being AFHB for 1,894 drivers. Light, small & medium size trucks [or equivalent cars & SUV's] represent a major component of the Cartasite Fleet and are included in the Initial Study.

### Results and Discussion

Several trends and preliminary findings were of note. In the first hour of being *Away From HomeBase*, drivers consistently had on average the *highest* number of Speeding and Hard Braking events (See Figure 1).

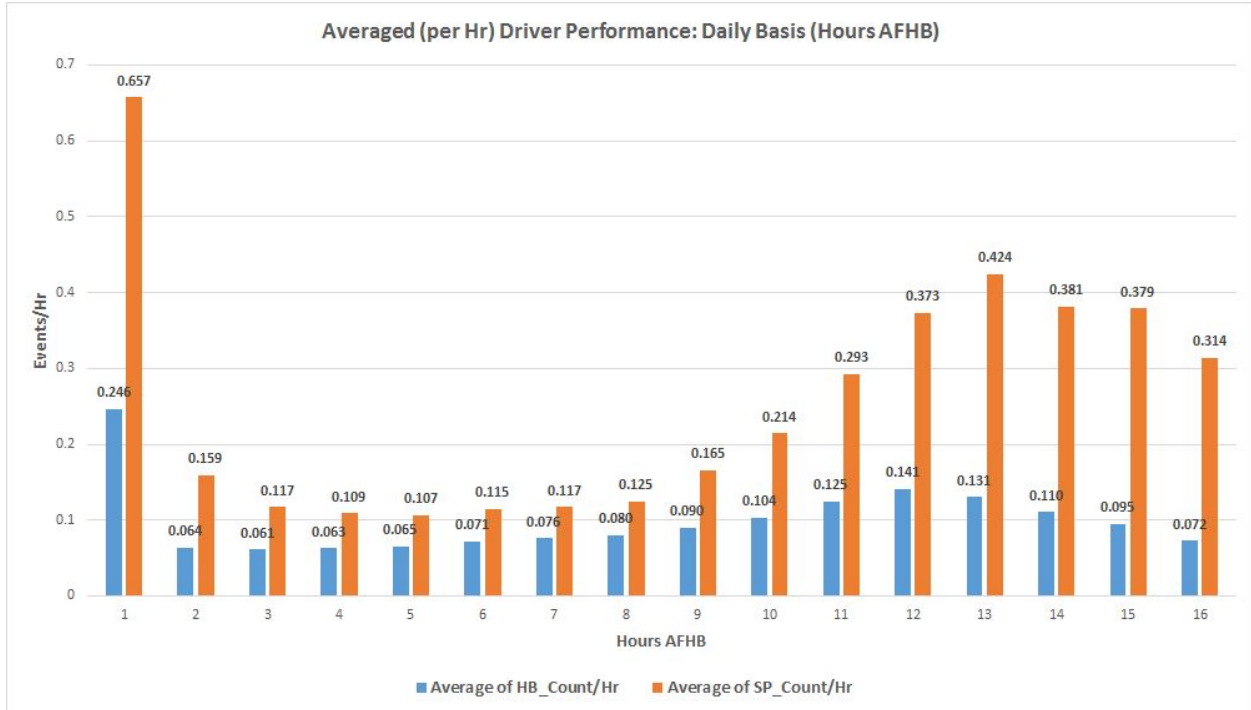


Figure 1. Averaged Driver Performance *Away From HomeBase* during the Day

The 10<sup>th</sup> hour of being *AFHB* appears to be an *inflection point* after which there are significant increases in unsafe driving behavior, as indicated by the amount of Speeding and Hard Braking Events: from the 9<sup>th</sup> to the 11<sup>th</sup> hour we see a jump of 75% in Speeding Events and a nearly 40% increase in Hard Braking Events per hour of being *AFHB*. It is not unreasonable to assume that this increase in risky driving behavior is related to individual’s fatigue – the 10 hours is a long time to spend on *task* and *Away From HomeBase*.

It is also critical to point out that the count of Speeding Events is *on average* 2-3 times higher between the 10<sup>th</sup> and 16<sup>th</sup> hours than between the 2<sup>nd</sup> and 9<sup>th</sup> hours while *AFHB*. At this same time the count of the Hard Braking Events at 16<sup>th</sup> hour is dropping to the level that we see between 2<sup>nd</sup> and 9<sup>th</sup> hours after reaching maximum of 0.141 HB Events per hour at the 12<sup>th</sup> hour. This intuitively unexpected *dichotomy* ought to be further researched.

These trends led us to look at driving behavior during a longer period of time - during the regular work week (Monday through Friday). Specifically, how does driving behavior change over the course of the week? As Figure 2 shows, there is an upward trend over the course of the week for both Speeding and Hard Braking Events counts, though the increase is far more pronounced for Speeding.

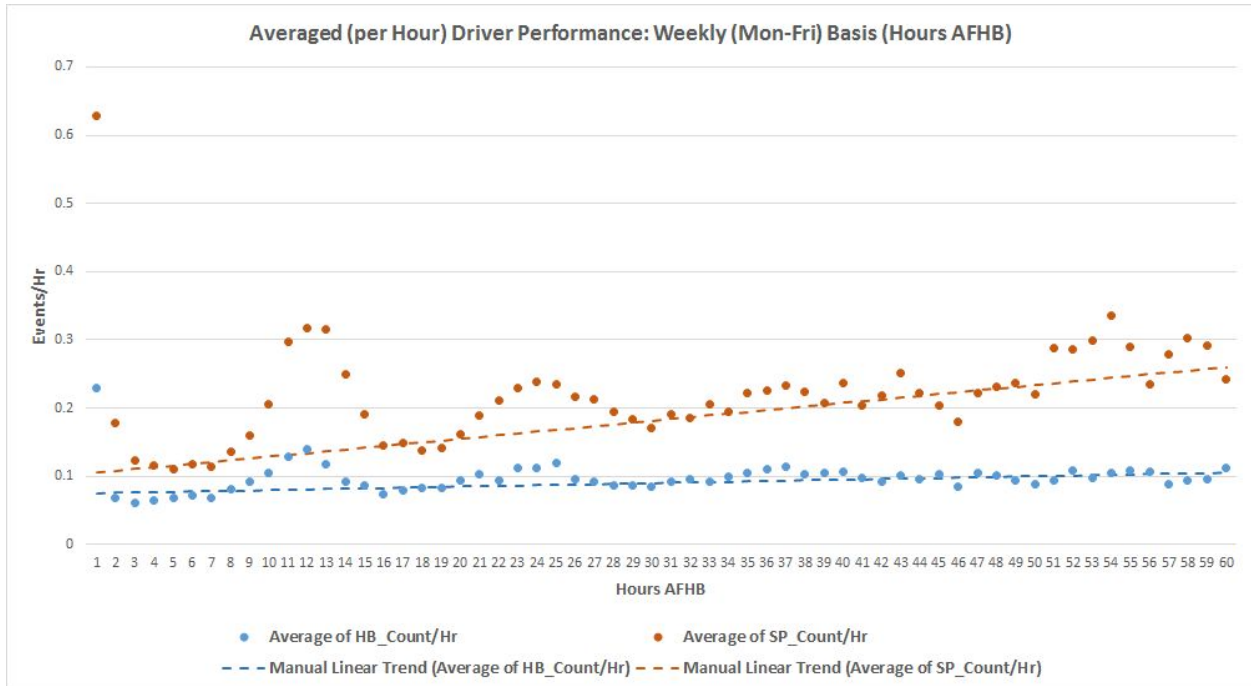


Figure 2. Averaged Driver Performance during the Workweek by Hours AFHB

Following this, we sought to identify how a group of drivers who regularly work long hours compared to those that do not.

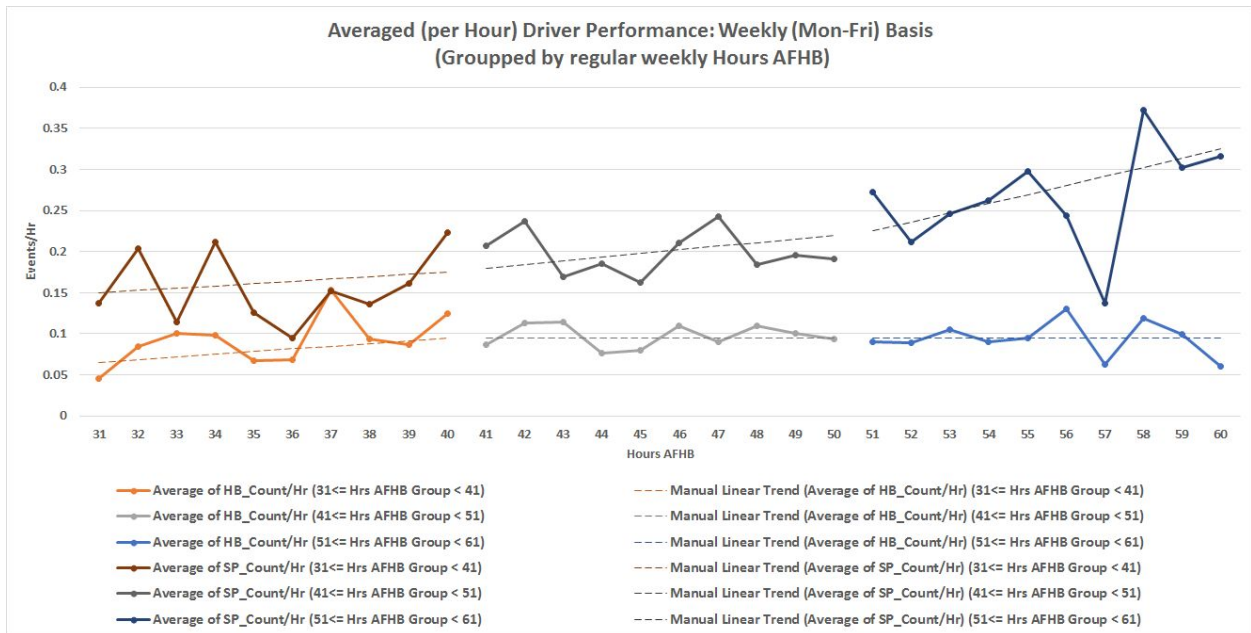


Figure 3. Averaged Driver Performance during the Workweek Grouped by Regular Hours AFHB

As seen in Figure 3, there are (1) persistent linear trends within the groups, and (2) trends are varied between the groups of the drivers who are regularly *Away From HomeBase* for 31-40 hours per week vs. 41-50 hours per week vs. 51-60 hours per week . Table 1 summarizes our findings.

Regular hours AFHB/wk	Manual Linear Trend (Average of SP_Count/Hr)		Manual Linear Trend (Average of HB_Count/Hr)	
	Min (% change)	Max (% change)	Min (% change)	Max (% change)
Between 31 and 40	~0.150 (N/A)	~0.175 (N/A)	~0.065 (N/A)	~0.095(N/A)
Between 41 and 50	~0.180 (+20%)	~0.220 (+26%)	~0.095 (+46%)	~0.095 (0%)
Between 51 and 60	~0.225 (+25%)	~0.325 (+48%)	~0.095 (0%)	~0.095 (0%)

Table 1.

### Summary

The Preliminary Findings of our initial study point to the presence of a variety of trends in the processed data. There are strong, quantifiable patterns that indicate an increase in risky driving behavior as individuals progress through their daily activities while being AFHB [Figure 1]. Further, when examining weekly activities, we see upward trends which point to increases of risky driver behavior for individuals [Figure 2] toward the end of the work week as well as for the groups of individuals aggregated by the *regular* work week hours AFHB [Figure 3]. We expect that processing data collected over longer time periods (12+ months) would allow us to (1) further confirm the trends/patterns observed in the initial study, and (2) quantify the cumulative driver fatigue reflected in the individual’s driving performance metrics and introduce a Cumulative Driver Fatigue Metric.