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Analysis of Risk as a Function of Driving Hours 1–11
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Webinar Transcript

Presenters

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

Speakers

- Dr. Martin Walker, Division Chief for Research, Office of Analysis, Research and Technology

Description

A recently completed naturalistic commercial vehicle study resulted in a dataset of over 2 million driving miles. This dataset was analyzed to investigate whether time-on-task, including driving into the 11th hour, was associated with an increased safety risk. Dr. Hanowski will present the results of this research and highlight the key findings and conclusions.

PRESENTATION – ANALYSIS OF RISK AS A FUNCTION OF DRIVING HOURS 1 THROUGH 11

[0:00]

PRESENTATION TITLE SLIDE: ANALYSIS OF RISK AS A FUNCTION OF DRIVING-HOURS 1 THROUGH 11

Operator

Welcome and thank you for standing by. At this time, all participants are in listen-only mode. During the question and answer session, please press *1 on your touch tone phone.

Today's conference is being recorded. If you have any objections, you may disconnect at this time.

This webinar is part of the series hosted by the FMCSA, Office of Analysis, Research, and Technology. Now we turn the conference to the web conference coordinator.

Kirse Kelly (FMCSA Office of Analysis, Research and Technology):

Thanks Christina and thanks to everyone participating in our webinar today. I'm Kirse Kelly, the web conference coordinator and for this conference we are going to have time permitted at the end for a question and answer period. You'll be able to ask questions over the phone and submit questions in the Q&A box that's at the left side of your screen. You can type questions throughout the entire Webinar and we will answer them, like I said at the end. Please note you'll be given an opportunity to download the presentation at the end of the webinar, that's a favorite question and we will give you that opportunity.

Now let me go ahead and turn you over to Dr. Martin Walker who is division chief for Research at the Office of Analysis, Research, and Technology.

Dr. Martin Walker (Division Chief for Research, FMCSA Office of Analysis, Research and Technology):

Thank you Kirse. Good morning. It is my pleasure to welcome you to participate in today's Webinar which focuses on the topic of critical interest to the commercial motor vehicle industry.

We will highlight the results of a recent FMCSA study that examined important issues in the Hours-of-Service debate particularly regarding time-on-task, for driving hours and provide an opportunity for you to ask questions about them.

By way of background, in 2003 FMCSA published a revised set of regulations concerning the Hours-of-Service of commercial motor vehicle drivers. These regulations were amended later in 2005 and in the 2005 rule making we leveraged data from the Drowsy Driver FOT—Field Operational Test—to examine two components of the revised regulations: increased in off-duty time from 8 to 10 hours, and increase of the allowable driving times from 10 to 11 hours.

In the current study there were two limitations associated with this analysis. The lack of a complete data set because at the time we didn't have all the complete data on all the drivers in the Drowsy Driver FOT and the fact that we didn't have time enough to look at all the critical incidents and measure risk from hours 1 through 11. So, in the previous research, we only examined critical incidents and attempt in 11th hour of driving. Further, additional analyses were conducted to address how critical incidents may vary as a function of driving shift and the time-of-day. The study resulted in major findings that are relevant to the Hours of Service rule and have been used in the 2007 IFR.

We are pleased to have Dr. Richard Hanowski, Director for the Center of Truck & Bus Safety at Virginia Tech Transportation Institute, one of the studies authors with us today to present this Webinar. He will provide an in-depth review of the study's procedures and results.

Dr. Richard Hanowski (Director, Center of Truck & Bus Safety, Virginia Tech Transportation Institute (VTTI)):

Okay, well, thank you Martin. I'm going to kind of get right into this here.

[3:55]

SLIDE 2: ACKNOWLEDGEMENTS

In terms of acknowledgements, just to give you background on the data set and the data that we collected and the analysis effort.

The particular analysis that I'm going to talk about today was funded by the Federal Motor Carrier Safety Administration and what it did was it re-analyzed data that was collected under a NHTSA, that is National Highway Traffic Safety Administration contract. And that data collection effort ended in 2005.

There is a report associated with this analysis effort. To give you the scope, when we did the analysis, we started early last fall, completed it in January. There's a January report and that report is currently going through a peer review process. When you see it, you'll see myself and three co-authors Rebecca Olson, Joe Bocanegra, and Jeff Hickman. And my co-authors are sitting in this meeting here today with me.

[5:08]

SLIDE 3: PROJECT OVERVIEW

To give you a little bit of overview of what the project was all about.

As many of you know the revised Hours-of-Service regulations were published in April of 2003. There were two really central components that we analyzed, we've researched over the last couple of years. One was an increase in off-duty time from 8 hours to 10 hours. We conducted some research and wrote a report back in 2005. What we found was, we had drivers wearing actigraphy markers, actigraphs measured their sleep while they were working on the job, during the course of the study. What we found is that they were getting, when we compared it to previous data from the literature, we found that the drivers were getting about one hour more sleep with this new regulation than they had been previously.

I think that was a positive finding in terms of sleep the drivers are getting. And it has a lot of face validity in it too, I think. If you think drivers are tired and you give them two extra hours of off-duty time, you would expect that they're going to spend some of that time sleeping and that's really what we found.

[6:38]

SLIDE 4: TIME-ON-TASK

The second component though of the revised hours-of-service regulation was the whole area of time-on-task. The idea being that there's the new regulations allowed drivers to drive 11 hours, on the previous regulations they could drive up to 10 hours. So, there's this one additional hour of driving that's now allowed. And so an important question associated with this change was, does this additional one hour of allowable driving time increase risk? And this kind of gets back to the concept of time-on-task. So, you're increasing time-on-task from 10 hours to 11 hours; and again you're focusing on does this have a measurable impact on crash risk?

[7:28]

SLIDE 5: PREVIOUS FINDINGS

There has been previous findings and research done to look at this question back in 05, when we talked about those sleep results I mentioned earlier. We also looked at this risk and we compared the 10th hour to the 11 hour. We looked at the crashes and near crashes that occurred across those two different hours. And we didn't find a difference. We didn't find a time-on-task affect when we looked at just those two hours.

Now as Martin mentioned in the introduction, there are a couple of limitations associated with that research. One, being that at the time we did the study, we were still collecting data, naturalistic study, so we were still in the middle of data collection. We had about three quarters of the data collected that went into the first report.

The second limitation is that we just looked at 2 hours, 10 and 11, we didn't look at any of the other hours. The reason for that was just based on the time that we had to conduct the work in terms of our timeline.

The new research that I'm going to talk about today kind of addresses those limitations. Getting back to some of those previous findings, probably the most cited study when you are talking about truck driver fatigue, is the Driver Fatigue and Alertness Study that was done by Wylie and his colleagues in the mid 90's. This is also a naturalistic study. One of the key findings of that research was that there was a strong time-of-day affect but they did not find a time-on-task affect.

[9:15]

SLIDE 6: MORE RELATED FINDINGS

Now on the other end, there has been researches that have found a time-on-task affect. Paul Jovanis has a couple of studies out where he's looked at a crash reports and has found an increase in crash risk associated with this increase in driving hours. The study that I have there on the slide, highlights the summary findings that the crash risk would increase slightly between the first four hours and then when you get to the 5th hour, then it would really increase significantly. That result seems to indicate that there is a time-on-task affect associated with crash risk.

The literature is little across the board in terms of findings.

That's really what we were focused on in this study, to again focus on time-on-task and provide another data point for the literature to come to grips with this issue.

[10:28]

SLIDE 7: CURRENT STUDY

What we did, we had five basic analysis areas, if you will. We looked at critical incidents as a function of driving hours, 1 through 11. So we looked at all of the driving hours, 1 through 11.

Then, the second one we focused on only drivers that drove into the 11th hour. Because not all of the drivers do. A lot of the drivers don't get to the 11th hour. But we wanted to focus an analysis on the drives that did drive into the 11 hour and look at critical incidents for the driving hours of 1 through 11.

When you are doing these analyses, you have to make assumptions. We were conducting odds ratios, and there were certain assumptions that needed to be made, so for the third analysis, what we wanted to do is we wanted to take another approach and we modeled the data again to look for significant differences across driving hours but we used a logistic regression approach.

A fourth analysis area that we did, we looked at the driving shift or the driver's tour of duty. I think if you look at it, maybe at a more of a macro level of time-on-task and you look at crashes and near crashes that occur within a workweek. You might have, with time-on-task events you might have more incidents occur later in the week based on time-on-task. So we wanted to investigate that as well. Not just based on driving hour which is really I guess at a micro level, but then looking at it at a macro level across the work week.

And then the 5th analysis that we did is we looked at critical incidents as a function of time of day. You remember when I talked about the Wylie study, time-of-day was certainly influential in those results. So we wanted to look at that as well.

[12:28]

SLIDE 8: METHOD

The method that we used was -- we used data that we collected from a field operational test. The test involved a drowsy driver warning system. I know, probably, some of you have heard me present on this study before, have an understanding of it. I'm going to try as best as I can to go through it to get you an understanding of the dataset that we then re-analyzed for this effort.

For this particular FOT, we started collecting data in May of 2004 ending in September '05. It was just intuitous, we didn't plan that the Hours-of-Service would be implemented in January of '04. It's just something that happened. So basically, the dataset included drivers that were now under this new regulation. A few months had passed for them to get in to the swing of things from January to May. We had drivers that were entrenched in this new set of regulations.

Now, I'm going to talk about naturalistic driving quite a bit through this study because that's really the basis of this whole data collection effort. But what this is, is when data are collected as study participants, truck drivers in this case. They drove their own company trucks and they participated in their own normal revenue producing runs.

So rather than, some studies you'll see where drivers will come in and do testing maybe on a simulator in a lab or in a controlled test track. By the way we do all of those studies here at Virginia Tech. This study kind of flips it around a little bit and we go into the real world, into the driver's world and we put a variety of instrumentation data collection equipment into their trucks and we watch what happens when they do their regular thing. So, not a lot of control, we've limited control in terms of what drivers are doing, what shifts they're taking, when they're sleeping. We're just going out there and measuring what happens in the real world, in reality.

[14:47]

SLIDE 9: DATA COLLECTION APPROACH

Okay, the data collection approach for this study, we instrumented 46 trucks. These are tractor-trailer units with a drowsy driver warning system. So, that was a system that was under evaluation for this particular NHTSA Fact Study. We also had our own, Virginia Tech has developed a data acquisition system. And I will talk about that in a second here. Across the whole study, we had 103 drivers participate and each drove on average about 12 and a half weeks.

There were three trucking companies involved; both line haul and long haul operations. The line haul guys, they were essentially, that was a shift where they'd go from one distribution center to another and then they would come back again. For instance, one of our trucking companies ran a split shift operation, flip seat excuse me. So the driver involved in the study was the night driver and he would pick up his truck around 6 o'clock in the evening then and be back in the yard about 5 or 6 o'clock and then the next driver would take it over. Where our long haul drivers, they would typically pick up their trucks on a Sunday night and they will be back in the yard on the Friday of the following week. So, those guys would be gone for about a week at a time. But both of these operations were represented in the study.

A key part of this data collection approach was that we collected data continuously. So whenever the truck was on, turned on and in motion, we were collecting data. The parametric data, that's all the driver input, the steering, the braking, that was all collected at 10 hertz. So 10 times a second we were collecting the data for it.

There was also video associated with this. We had four video cameras. That picture on the right there shows you what the camera views were on the right. The videos was collected at 30 hertz, so its basically streaming video. Just to take a minute to talk about those cameras we used, you can see starting in the upper left corner, you can see the drivers face and going clock-wise around you can see the forward road. Then the two cameras on the bottom, the two views, are the cameras that are positioned on the west coast mirrors looking backwards against the trailer. So with this combination of four cameras we had really a pretty good view of what was going on around the truck and trailer itself and we could see what the driver was doing as well.

Now as part of a study, we collected over 100 measures on driving performance. There's things, like I said, such as the speed the driver was going, the braking input we collected data. we plugged into the can on the truck to get a variety of data that the truck was collecting. We have a forward VORAD that we're collecting data on headway time to collision, we had a system lane tracker system on that we could get information about lane position. So again, over 100 different measures we were collecting at this 10-hertz.

Then, we also had all the drivers or most of the drivers wore an actigraph, that's not really relevant for the study that I'm talking about today. But That was the study, it was important for the study that we did on sleep. An actigraph is a little wristwatch type device with a piezoelectric accelerometer and it measures motion and is correlated highly to polysomnography. So what you can get there is a good measure of how much sleep drivers get at night, a sleep quantity measure and a sleep quality metric that you can also get.

And then as with any study you are going to see, we had questionnaires that the drivers filled out before the study and after the study on a number of different scales.

[19:31]

SLIDE 10

Here are a few pictures just to show you what the data collection system look like. When we do one of these studies we want to be as unobtrusive as possible. We're invading the driver space here. He has a job to do and we don't want to have, as best as we can, have big cameras sticking in his face or cords that he's going to trip over or any interaction with the system. We try to be, again, as inconspicuous as possible. The main data collection system box, you can see it at the top left corner, you can see the different input devices there.

In this particular truck, we installed it under the passenger seat. It's about the size of a small briefcase. You can see some different cabling going into the different input for that box and you can think, all the different sensors that we had would have gone into that main box. And what that box did then was time stamp the data, synchronize it all together and so, you have this continuous data stream of data collected at ten hertz.

I'm going through the bottom row from left to right, you can see the front VORAD. This is a radar unit that we could tell headway, how close was the driver following. Then there's a whole bunch of derivative calculations that you could make, things like time to collision for instance. But basically that gives us some idea of the drivers interaction with other tracks in that forward dimension anyway.

You can see the positioning of the rear cameras pointing backwards. That picture in the middle, that's a weatherproof camera fixed to the top of the west-coast mirror looking back against the trailer.

Then in the bottom right corner, you can see the setup for this particular truck in terms of the face camera that you saw before, the image of that and that forward camera as well.

[21:53]

SLIDE 11: DATA COLLECTION STATISTICS

Okay, so in terms of the data collection statistics, when it was all said and done, we had about 2.3 million-miles of driving data, close to 200,000 hours of sleep data, and in the end, close to 12 terabytes worth of data.

So in terms for any study, as far as I know, this is the largest and most complete on-road naturalistic study that's ever been conducted. And what it did was, it provides obviously an opportunity to look at the Drowsy Monitor, which was the focus on the study, but it also provided an opportunity because we were collecting data continuously, to look at a variety of CMV issues, again far beyond just the Drowsiness Monitor itself.

[22:52]

SLIDE 12: CRITICAL INCIDENTS

If you saw my presentation at TRB this past January, this is the part of the presentation where I started to show some videos. Because when we look at, when I try to explain crashes and near-crashes, and their association, videos really drive the point home, so I am just going to talk through it.

Essentially, the dependent measure if you will, the event of interest for this particular study that we were quantifying was what we call the critical incident. That really characterizes three different types of events of interest for us. One being a crash, two being a near-crash, and three being a crash-relevant conflict.

So what's a crash? It's probably, I'm sure it's obvious, its a contact with an object, either moving or fixed, really at any speed. The video that I showed at TRB, and some of you that have seen my presentation before, there's a really compelling video of a driver who has a rollover crash. What happens is, the driver is driving along about 4:00 in the afternoon. There's an external distraction. He sees a bobtail tractor driving along. He looks out the right window for about three seconds, eyes off road time of about 3 seconds. When he does that a mini van up ahead, hits the brakes. And by the time that 3 seconds elapse and he looks back at the forward roadway, he's within a few feet of the mini van and he takes an evasive action by swerving, yanking on the steering wheel to the left and subsequently ends up rolling over the tractor and the trailer lands on the other side of the highway. So again, it's a very dramatic crash event. What you have in that event and as we analyze critical incidents in general, is you have these driver precursors that we call them, these driver behaviors that lead up to an event. Without some evasive action, in this case without the evasive action of the driver yanking on the steering wheel to the left, he would have had a rear end crash and undoubtedly there would have been fatalities involved. But he had this evasive action, he still ended up having a crash, a rollover crash. But again, there was some action involved.

Near-crashes are almost identical to crashes in the sense that the driver behaviors are -- all what gets the driver in trouble very often, external distractions for instance. I then showed a video of a near-crash. There's one where a driver again has external distraction. He looks out his left window and there's a pickup truck that illegally cuts over into the driver's lane. The pickup truck was in a left hand turn lane, cuts in just as our truck driver looks out and then the truck driver has to quickly again take an evasive swerve maneuver to be able to avoid rear ending the pickup truck. Again, every thing is in place, the driver has some assumptions based on what the traffic is going to do. He feels comfortable enough to divert his eyes from the forward roadway, takes his eyes off the road, and again almost has this crash. That's again, an interesting event for us, as you are looking at driver behavior and performance, because all of what the driver is doing gets the driver into a situation where he almost has a crash.

A crash relevant conflict is again, very similar to a near-crash. There's a subjective component to this as well though, where the evasive maneuver is somewhat less severe as compared to a near-crash. There is an evasive maneuver but for instance, the braking G-force of the acceleration may be less than what we see in a near crash. But again, there is a some type of evasive maneuver, some type of driver behavior that kind of leads him into a situation where he has to take some type of a quick maneuver or another vehicle may have to take a quick maneuver to avoid having a crash.

[27:51]

SLIDE 13: DATASETS

Okay, so the datasets, then, if I give you an idea about the data that we collected for this study. We ran a number of different analyses now for this FMCA project. Just to give you an idea of the numbers we're talking about in terms of the dataset for each analysis. So we ran or the number of critical incidents for each analysis that we did, or the sub analysis if you will varied based on which analysis were conducted. Now we tried to be as thorough as possible, so we parsed the data in a lot of different ways to help ensure that we weren't missing any significant finding. For example, in some of the analysis we looked at the entire dataset, all of the data that he had. Then, we looked at data where just our truck driver was at fault. So, just "at-fault" events.

We conducted also analyses where we only looked at the baseline and control data. So you could think well you're studying a drowsy monitor maybe that had some impact on how drivers reacted during the study in the crashes and the near-crashes you got. That's valid. So we pealed all those out. All of the drivers in the FOT also had a period of time where they weren't interacting, or they weren't using that drowsy technology. So we did some analyses where we just looked at those conditions, those baseline and control conditions.

So again, we parsed this data in basically 8 different ways for each of those analyses that I explained earlier.

Analysis One had little over 800 critical incidents. And you can see, I have broken them up for you there. We had 12 crashes, six of these the vehicle one, that's our truck driver was at fault. The other six our truck driver wasn't at fault. and of those, there were 3 deer hits. That was fairly common trip for our crashes—truck drivers hitting deer on the road. A little bit less severe, but again it's a contact with an obstacle is our tire strikes. We had 12 tire strikes where just the tire bumped up either against the curb or a pile on or cone or something. 85 near-crashes and 710 crash-relevant conflicts. So these were all collapsed over and included in our dataset.

Again, just to give you some background on this, the theory behind being able to do this. There's a theory called -- based online Heinrich's triangle that you may be familiar with it. If you're not, I suggest, you might kind of look that up, it was proposed for industry accidents. But the idea was that for every industrial accident that occurs you'll have maybe ten near events where the behavior of the individual is all the same but for one reason or another, a crash or an event where the industrial worker wasn't hurt didn't occur. And so again it's the same kind of concept where you have this relationship between crashes and near-crashes and that's what we're kind of pushing forward with this analysis.

[31:45]

SLIDE 14: KEY RESULTS

I'm going to kind of focus on some of the key results from the study.

That first analysis where we looked at driving hours 1 through 11. So again we looked at all of the dataset, we also looked at where just our truck driver was at fault. For each of those we conducted 8 sub-analyses, again parsing the data in different ways to help to ensure that we weren't missing something.

Now for each driving hour 1 through 11, we looked at how many critical incidents occurred and we also looked at an exposure measure. So, how many opportunities did the driver have to have an incident? And I think on this next slide this is explained in a little more detail.

[32:34]

SLIDE 15: RELATIVE FREQUENCY CALCULATION

So we calculated a relative frequency, or we can think of that as a rate. We looked at the number of critical incidents in any driving hour, divided by the total opportunities per driving hour. So you can see as an example there, for driving hour one, we had 122 critical incidents that occurred for this particular analysis, I think this is the analysis where our truck driver was at fault.

But, we had 4,748 trips if you will, that went into the first hour. So we had drivers driving into the first hour 4,748 times and we had drivers we had 122 critical incidents that occurred in that of those 4,748 opportunities. So, you just do some division and you get a rate of .026. We did this then for all of the hours.

There's another example for driving hour 11, where we had 1535 trips that went in to the 11th hour or 11 hour driving events, driving opportunities. Of those 1535, we had recorded 23 critical incidents and so your rate you can see is 0.015.

So, when you have these rates then you can conduct odds ratios. And those are just looking at whether there's a significant difference between those rates is essentially what the odds ratios were.

[34:11]

SLIDE 16: TIME-ON-TASK RESULTS: AT-FAULT

And here's an example of a plot of the data of those rates. This was a very common finding when we looked at, we did those eight sub-analyses and when we looked at all of the data and then we looked at only the data where drivers drove into the 11th hour. This is something, this was the pattern that we saw again and again and again, where we had this spike in the first hour of driving and then hours 2 through 11 were pretty much noise. They were pretty much even. When you conducted the odds ratio on this data, the only significant difference was that first hour for every other hour. But in general all the other hours weren't significantly different.

[35:07]

SLIDE 17: TIME-ON-TASK RESULTS: 11TH HOUR DRIVES (N=1535 TRIPS), AT-FAULT

Here's another result that gets into, this is the one where we only included drivers that drove 11-hour trips and so of that we had 1535, 11-hour trips. And this plot shows you where our driver was at fault. And again, I could've showed you and you'll see this when you see the report, any of these analyses, really the pattern of the rate data looks, they look the same. Again, you have the spike in the first hour and then everything else kind of is about the same.

[35:46]

SLIDE 18: LOGISTIC REGRESSION APPROACH

Now as I mentioned and I didn't really talk about this at TRB. Essentially, the end result, there is nothing really new from what I just showed you, but I think I had a little bit more time in this venue to get into this a little bit. We also used a logistic regression approach to look at this. And again, it's trying to be as thorough as we could with the data set. And so what we did with this analysis is we computed odds ratios using logistic regression modeling and you'll see this in other studies as well.

Now really the difference in the approach from analysis one and two where we just looked at odds ratios is something called an assumption of independence is not made. So, the logistic regression approach works around this through general estimates equations to account for any correlations that might exist, say within a driver, and there it gives you the formula for that.

[36:53]

SLIDE 19: LOGISTIC REGRESSION RESULTS: ALL DATA

Now the next slide here that I put up is the results of that. You can see essentially the same finding. We went through and we modeled the data in different ways. The end result was the same thing, spike in the first hour and then everything else was about the same. And again the odds rates associated with this were significant. You saw significant first hour versus hour 2, 1 versus 3, and 1 versus--all the way through 11 were significant. And in general 2 through 11 weren't significant.

I mentioned in the overview, that we often looked at shift, driving shift. And the bottom line on that is that we really didn't find anything that was consistent across the days of the week if you will or the shift that the drivers were engaged in. So I really haven't included in this presentation any findings on that. When the report comes out, which hopefully will be soon, you can kind of go through that. But, there's really nothing that was significant in terms of driving shift.

[37:56]

SLIDE 20: TIME-OF-DAY RESULTS

Time of day on the other hand was really interesting.

As I mentioned, we were looking at opportunities. So how do you normalize or how do you kind of ground your data, your critical incident data, is by looking at how many opportunities the driver had to get into a crash or a near-crash? This shows you some data based on time-of-day. You can see 24 hour clock on the X axis there and then the number of trips listed as well. Between, for instance, midnight and one in the morning, there was probably 3200 trips in our dataset where that occurred. And so you can kind of go through each hour and you can see the kind of pattern when most drivers were driving. They were driving around noon; 1 o'clock was when their peek was and driving less over all relatively speaking in the early morning hours.

[39:06]

SLIDE 21: TIME-OF-DAY RESULTS

Here are the critical incident results of that. So this would be essentially the numerator, this is the numerator in that equation that I showed you earlier. This is the frequency or the rate of events that occur as a function of time-of-day.

This is frequency divided by the opportunities before to get that rate value. You can see you do odds ratios on that and you've got significant findings all over the place because there's this uneven pattern across different hours. And so again a strong time-of-day affect. But like, what does it mean?

[39:53]

SLIDE 22: TIME-OF-DAY FOLLOW-UP ANALYSES

You kind of have to peel back to the next layer and say well let's look at this in a different light here. So what we did was we looked at the circadian lows. Maybe there's a circadian affect going on here where drivers are getting into more incidents during the low period as compared to the high period. We go through this analysis in the report and the bottom line is we didn't find anything significant.

[40:23]

SLIDE 23: TIME-OF-DAY/ TRAFFIC DENSITY RESULTS

The next thing we looked at was traffic density. We were able to find some data, it was from the mid 90s. We followed up with this researcher Festin. I think we tracked him down in Utah and asked if there was a more up-to-date data set, and in fact there wasn't. This was the most up-to-date dataset. We looked at essentially, traffic density as a function of hours. That's we plotted traffic density hour by hour.

You can see that now plotted in this plot that I just put up here, the traffic is overlaid, that's the black line, that's overlaid against this rate data that I showed you before. And it's the similarity between these patterns is really striking.

Now, the Festin data is national data. Obviously the data we had, most of our runs were on the east coast. But again you can see we're making some assumptions here that the patterns are very similar. We ran a correlation analysis across these two datasets and we had an R^2 of almost 0.7, which really shows a strong association between traffic and the critical incident rate that we found.

[42:00]

SLIDE 24: CONCLUSIONS

Okay, some conclusions then based on the study**.** The major findings I think, that's relevant to the assessment of these 2003 hours-of-service regulation. First and foremost, we found a statistically significant difference in critical incident relative frequencies or those rates between that first driving hour and all other driving hours, but there was really nothing between the hours 2 through 11.

[42:33]

SLIDE 25: CONSISTENT RESULTS

Now when we looked at some other data trying to explain this first hour spike, I looked through the Large Truck Crash Causation Study database, did a high-level cursory analysis of this as I am trying to develop, generate a hypotheses for why we're seeing what we're seeing. I was surprised to see in LTCCS, of all the hours, the first driving hour also had the highest raw percentage of crashes at 14.7%. It's really important to know that LTCCS doesn't account for exposure, but as I tried to hit home here, this current study that we did, did account for exposure. We looked at how many trips drivers made in each hour.

There's some consistency in our results with the Wylie study with regard to time-on-task. Basically that it's a poor predictor of crashes in general, but again except for the first hour we did find the first hour was associated with more crashes so you get -- you ask the researcher why are we seeing this?

[43:40]

SLIDE 26: NO DIFFERENCE IN HOURS 2-11

We did a little bit of research and came up with three hypotheses. Again, I want to underline, these are just best guesses as to what might be going on. These are areas that probably should be looked at in future research. Our study wasn't set up to look at these. So I can't really say, there's no cause and effect here. We're looking at correlations and potential relationships.

Here's three that I would throw out for consideration, anyway, for the reason for this first hour spike. There is something in the literature called Sleep Inertia. Researchers like David Dinges have done some great research on this. Essentially sleep inertia is a concept that most of us can associate with. Essentially, when you wake up in the morning you are groggy for a period of time. And researchers have found that maybe there's a performance decrement for maybe its 15, maybe it 30 minutes, maybe it's an hour after you wake up in the morning until you kind of get going. Now think about – I think about 75% of our truck drivers had sleepovers and a lot of them were sleeping on the road. Just the nature of that kind of operation where a truck driver goes from a sleeper berth maybe to the driver seat in a very short period of time. You may think that if sleep inertia is a really valid construct and it does have some implications for safety, that you would see in an operation where a driver is using a sleeper berth. So maybe not totally awake and alert by the time he gets from the sleeper berth to the driver's seat. That's one hypothesis.

The second one is something that we call "Take-off" and "Landing" effects. Ronald R. Knipling, as many of you may know, is doing some research and he's finding in some the studies that he's doing right now, something similar to this. But essentially what this means is that, okay, we saw the spike in the first hour, so what might be going on? Very often in our operations, that first hour drivers were in a more complex driving environment for one reason or another. For instance if they were just picking up a load, they may be in an urban environment, they maybe going through intersections, merging, just navigating a more complex set of situations. And then after that first hour maybe they're on the open road and they have less opportunity or there's less likelihood for them to get into a crash or a near-crash. That might explain the first hour of spike.

Now we didn't control when drivers completed their study, their shift. So some drivers ended after eight hours or after nine hours or ten or eleven. We didn't really control the landing affect part, obviously we didn't see a Landing effect. There was no spike at the end of the day. But again there's something that could be studied in future research.

The third kind of bullet shown by the time-of-day analysis that we did, is that there's certainly a correlation anyway, a strong correlation with traffic. And again, I think this is one of the findings where there's a lot of face validity. If you have a driver in a car or truck or anybody and you're operating in a high traffic density situation; you're just more likely to have a crash because it's exposure. There's more opportunities for you to interact with other vehicles. And the time-of-day -- when you look at time-of-day, it's more of time-of-day interaction with traffic that may be what's behind this increase that we're seeing here. So really, the bottom line for what we're looking at in this study. The study results don't support the hypothesis, that there's an increase risk from drivers in the 11th hour as compared to the 10th hour or really any driving hour.

As with any research, there are assumptions that are made, there are the limitations of the data, this is perhaps the best of it's kind, it really represents a small number of -- 100 drivers, that's a lot of drivers. But there's 3 million drivers out there. We had 46 trucks and there's something like 8 and a half million trucks out there and the billions of miles driven each year. And we had very few crashes and we're making this relationship between near-crashes and crashes which is another assumption made. I think it's a very good dataset, but it's limited like any of these studies that you are going to see are.

Again, I think where its strong is where there is some consistency with these other findings from this other research and it takes a pretty big leap in terms of understanding this time-on-task issue.

[48:55]

SLIDE 27

That was my last slide. You'll see here. We have time for questions people said we can stay over a little bit. I've got my email address there. Please don't hesitate to send me an email if we don't get to all the questions today. Or sometimes like me, you think of a question, maybe a day later, you want to send me an email, you can certainly go ahead and do so.

QUESTIONS AND ANSWERS

[49:19]

Dr. Hanowski Kirse, is it okay to just start going through the questions right now?

Kirse: Yeah, if you want to ask questions, you can submit them in the Q&A box which is at that left side of your screen or to ask questions over the phone, just press * 1 and you'll give you name to the recorded message. And when your line's open, our operator is going to announce you by name. So state your name pretty clearly for proper pronunciation. Questions are going to be answered in the order that they are received. And once again the presentations will be available after the webinar. If you have to leave, you can come back to this site later today and the presentations will be available.

Question: ***Did your actigraphy data include team driver operations?***

Dr. Hanowski: No. It did not. All of these drivers were single driver operations so we didn't have any teams as part of the study. No. That's a good study to do, maybe to do next.

Comment: ***There was a question about getting a copy of your video.***

Dr. Hanowski: We have confidentiality agreements, as you can imagine, with the drivers that participate in these studies. And so what I am allowed to do is, many of the drivers have written permission to allow me to present this data at conferences. Unfortunately, this kind of venue, doesn't let me control access or dissemination of the video. So, I couldn't show the videos today as part of that. But I guess, I would just look for conferences where I'm presenting, TRB was a good one, probably over the last three or four years, I've probably presented at a dozen different conferences where I've shown these videos. Unfortunately, you can't get a copy of it.

Martin: ***Hey Rich, can you address—we're trying to put some video up on the internet for defensive driving programs. Can you give a little overview of that study?***

Dr. Hanowski: Yes, absolutely. We've got a lot of questions like that—getting the videos—and again, they're just so compelling and really hit home at driver training, what drivers are doing wrong. We had a number of fleets that have seen these presentations, and again, say, "Boy, I would love to have a copy of this video to integrate into my training program." So FMCSA was really receptive to those requests and so we started a study last fall. It's on going right now, but the idea is to develop a website that has basically driver do's and don'ts. We're working with a number of different trucking fleets to come up with, not any new training program, there's a lot of great training programs out there, but essentially some supplemental information that uses this naturalistic data, including the videos to demonstrate what drivers are doing incorrectly and how looking off the side of the road for two or three seconds could lead to a rollover in just a blink of an eye. So, I'm hoping by fall this year that will be up and operational. I'm sure FMCSA is going to provide information when that is accessible. It will be part of FMCSA's website. But again, it would be kind of either a standalone—"truck driver do's and don'ts," but also something you could integrate if you are a fleet safety manager with your drivers.

[53:39]

Question: ***How does a safety department address the first hour issue?***

Dr. Hanowski: That's a really good question. Part of this study, we just kind of identified what the problems or issues are. But now, how do you tell your drivers that this may be something going on? I mean, perhaps just letting them know, this is a critical time, you are just coming on shift, you're may be more prone to alertness issues. It's kind of something that maybe just awareness for your drivers would help them to just understand that if I'm going to get in a crash today, there's a strong likelihood that it's going to happen in this first hour. But other than that, I don't know what else you can do except for acknowledging that this is a high risk time of the driver's shift.

Kirse: Okay—do we have questions on the line?

Operator: At this time we do not have any questions.

Question: ***What is the supposed disconnect between the traffic density data and the study results at the 7:00 a.m. period?***

Dr. Hanowski: Ok, let me flip back in slides here. Here you go, so the question kind of gets at this—look at this 7:00 a.m. You don't have these crashes. What I would guess is going on is, there's just not enough data, to kind of fill out this curve. But why drivers in this period of time aren't having—is it this spike now, it's not a completely nice curve? I don't know, maybe that's why R square isn't closer to one because of that. I have no idea why there's less crashes. You never going to find a perfectly smooth line. We're controlling for when drivers are driving or the time-of-day. This is just, and because it wasn't controlled, I think this just gives more credibility to the validity of the finding in this relationship. But again, I don't know the answer to that question.

Question: ***Of the 12 crashes, how many were DOT recordable and how serious were the accidents?***

Dr. Hanowski: That's a really good question. Now in the total study, we had—I'm asking Greg my coworker--how many crashes did we have in the total study? Like 20? I think across the whole data set around 25 crashes total. Of those, we didn't go through and look at police reports or -- I know the rollover crash certainly was, but I don't know, we haven't done. I guess, I don't know the answer to that question because we never went through and looked at them.

In terms of seriousness, it really ran the gamut from a deer hit, that was a fairly low severity, obviously not DOT reportable, it did property damage, knocked off offender in a couple of cases, did damage to the tractor, but obviously wasn't reportable. But there were other crashes, like I said, that were-- a back end crash was fairly serious, not injury but property damage. So it really kind of ran the whole gamut. And I guess the important take away from that is that, looking at it, we were more focused on the driver behaviors that led up to what ever the event was that led up to the crash, the near-crash, rather than the crash itself.

I think, what we're doing, we're running additional naturalistic studies like this. There are more studies—we just completed another on-road study, about the same scope as this one where we instrumented trucks, had drivers driving. That's a report that's due here in a month or so to FMCSA and would be released probably within the year. But what we're doing is we're building up this naturalistic dataset, realizing that it's limited in terms of numbers. And so ultimately we would like to get a large enough dataset where you had a large number of crashes and near-crashes, DOT reportable and you can look at that and have some confidence in your responses. I'm looking at 24-25 crashes now, that's not enough to do statistical analysis on. That's why we have to rely on these surrogates, these near crashes.

[59:24]

Question: ***Have you considered adding drivers suffering from deep disorders such as sleep apnea as a potential reason contributing to first hour of spike?***

Dr. Hanowski: We haven't done that. That's a really good idea. So if basically the thought there would be that drivers aren't getting enough sleep at night, that may have impacted that first hour, that would kind of lead to that first hypothesis, that there is type of sleep inertia going on. We didn't look at that at all.

Could you look at that? Sort of, I guess. We didn't screen drivers for sleep apnea to be in the study, so I don't know for sure if any of the drivers in the study did have sleep apnea or not. Any drivers that were participating, that I can remember weren't being treated for sleep apnea. So, none of the drivers that I know of, off the top of my head, had a CPAP, for instance, in their sleeper berth.

Now we are actually doing a study where we're looking at these drivers in terms of their BMI in NXi's, which are correlates of sleep apnea and so we are going to kind of look at that. But I'm not going to know whether or not apnea was a direct causal affect of that or not.

Question: ***Did you track the difference between long haul and line haul?***

Dr. Hanowski: We didn't for this study. We have broken that out in other analyses that we've done. But for this particular study no we didn't. We just kind of collapsed it all together, again to have a larger dataset. Again, when you start parsing the data, slicing it in different ways, the power, the statistical power that you have to conduct your analysis also decreases. So I guess, I'm hopeful as we have additional fleets that participate in these kind of studies will increase our dataset, that we can look at specific fleet types or industries or geographical areas, but for this study we did not.

Kirse: Are there any questions on the line?

Operator: We do not have any questions.

Kirse: We're going to stay on for about 10 more minutes.

Question: Does your data have any regional segmentation, or did we just ask that? Like southern versus northern states, urban versus rural, interstate versus local highway?

Dr. Hanowski: Another great question. For this analysis, we didn't parse it out like that.

Now I can tell you our fleets were all located in the Virginia, North Carolina area. We did have fleets that ran out to the west coast. By and large however, the fleets were on the eastern seaboard for the most part. Could we look at that? Absolutely. All of our trucks had GPS, so we know where the truck was and it would just be a matter then of identifying whatever parameters we were interested in, certain GPS coordinates for northern versus southern or for particular states, and binning those data in those types of ways, you could certainly do that.

We could certainly make strides, if FMCSA wanted to go that route, to doing that work, and maybe something, Again, all the data is there to do that. I think maybe that as our naturalistic dataset increases we'll just have more data to be able to maybe --Again as you parse it, as you look at different ways of slicing the data, your ability to make any statistical inferences from the data sets decrease. For instance, I know I have some trips that went into Texas. I don't have a lot of trips, so what kind of conclusions can I make about drivers that drove to Texas. Really nothing until I have some more data to support that. That's something that certainly can be done.

Question: Do you feel that you accurately represented the 'over the road' driver by looking at drivers who returned weekly, when an over the road driver is out weeks at a time?

Dr. Hanowski: I would say no we didn't. They weren't addressed. Hazmat operations weren't addressed. There's some research that says produce haulers are over represented in some types of crashes, those guys weren't addressed.

We had a question about the team operations. We didn't have teams addressed in this. There are, obviously the trucking industry in the U.S. is very diverse and you can only do so much in terms of instrumenting vehicles and including a study to collect this.

What I hope happens is that other fleets get involved in these types of studies and we build up this dataset so that more fleets can be represented, can be included, at least fleet types. The other question that comes up is, when I make the phone call, you can imagine being a fleet safety manager and calling somebody up and say hey, I want to put cameras and data collection equipment and track your drivers for 18 months. If I don't hear a click on the other end after I make that proposal--the fleets that are participating in these, these are really safe fleets. They are the best of the best. The other thing when we see these findings, these drivers have gone through finishing programs and safety is a big part of the corporate culture.

I would like to look at some high-risk fleets. But if you can convince them to put cameras in their trucks and let me watch them. So my bottom line is you're never going to have total representation across different fleets and unless you run a really large, and I can tell you it's going to be a really expensive study with thousands of trucks, you're really not going to know that.

[1:06:36]

Question: ***Did you see any peaks in the first hour of relay runs for the return trip?***

Dr. Hanowski: Yeah. First hour was -- I see, on like a slip – so if I interpret this right, maybe there's a line haul operation and when they go and maybe they drive for three or four or five hours and they drop off their load and then they come back.

No, because we counted that all as part of that first trip. So it's the first hour after the driver has had his long break, assumingly he's ten hours off duty.

Question: ***Were all fleets for-hire carriers, were any private fleets included in the study?***

Dr. Hanowski: These were all for-hire in this study. Again, it gets back to the idea of expanding this to include different fleets and different types of operations, which again, I'm hopeful that will happen over the years.

Question: ***Is the first hour of data affected by required load securements inspections after the driver has left the yard.***

Dr. Hanowski: I don't know that. Another limitation I guess of the current study is that we just had driving data. When the truck was on in motion, I was recording data, but I don't know what non-driving work the driver was involved in, if that kind of answered your question. But load securement inspections, if what you mean by that question, did we look at violations? That was included in our crash or near-crash and we didn't really have any record of that. I guess the answer is, I don't know. We just didn't have the data collected to answer that question.

Comment (from Jack Burrett): It's not unusual for drivers to not drive at rush hours and that's reflected at 7:00 a.m. and 5 p.m.

Kirse: We have another question and this will be our last question.

Question: Of the 25 crashes, how many were preventable for the driver. From the carrier's point of view, we are not at fault.

Dr. Hanowski: What we did is, again we have these videos and basically what it does is it provides an instant replay of what happened. Now I tried to go in to some detail of the rollover crash. When I asked the driver about that afterwards and I didn't have the police report but I asked him. I said, what did it say on the police report of what happened. He said, the reason was I was following too close. And if you look the video, he's not following anybody.

So, in terms of what a police report was or a police officer, or a responding official is going to look at the scene and try to say well, could the driver have prevented this or not? When it comes to things like driver behavior, they're really just making a guess. So what we have is, we have this video. This is researchers looking at this, we don't have a camera in the rear for instance, we don't know what was going on in the other vehicle if it's a two vehicle event, so I don't know if the other vehicle was asleep at the wheel or distracted. All we know is what's going on with our driver.

Now, I think it's on the order of in this study, I believe we do have a study out there that's looked at this. But it's on the order of 60% of 60/40 of it was the other vehicle at fault. So that's fairly consistent. We've done other studies where we found the light vehicle driver was in the order of 70% responsible for all their crashes that we had. This study was more like 60/40. Again part of that is because it seems like we have a lot of data, but as we add to this dataset that number, I think, will become more stable. I could feel safe saying more often than not it's not the truck driver's fault in these events, it's the other vehicle's fault.

Part of it too, I know, working with different fleets, what they say is preventable, may be defined differently from what say a police officer would define as preventable. I guess that's kind of a tough question for me to answer if I'm interpreting it correctly. But again, I've put my email on the last slide and I kind of welcome further dialogue or discussion and can give you what my insight is in to this and other questions that we didn't get to today.

Martin: Okay. Thank you Rich. We want to thank both Rich and his team of researchers at Virginia Tech for taking time today to participate in this Webinar. As we look to the future, FMCSA realizes that this agency alone cannot accomplish gains in safety in a nation's highway without your help. We plan to continue to provide information about FMCSA's Research, Analysis, and Technology programs in the future webinars and through other public venues where we will seek and welcome your information. As a result your evaluation of today's Webinar is important to us. It will help us shape our future programming to assure that we're responsive to our audience.

Thank you for our participation and interest. And I think Rich will stay on and the questions he did not get to, he'll be able to kind of respond as we are running out of time today.

Kirse: We'd like to ask you now to fill out a short evaluation, that's starting with our two anonymous polls on the right side of your screen. You can also submit any suggestions for future webinars, in the pod at the left by typing in the space at the bottom of the pod. Your comments submitted here can be seen by everyone in the meeting room. So if you'd like to make an anonymous comment, you need to click on the right side of the box and choose FMCSA host.

In order to download the presentations, just follow the instructions on the lower right side of this page. Rich is not going to be able to type in responses to those questions, but he'll still respond by email. We'll make sure and give him all those questions so he'll respond by email in the next day or so.

That concludes today's conference and thanks everyone for participating. Operator, can you please keep the presenter lines open so that we can wrap-up. Thanks again for participating folks.