

Transportation Research

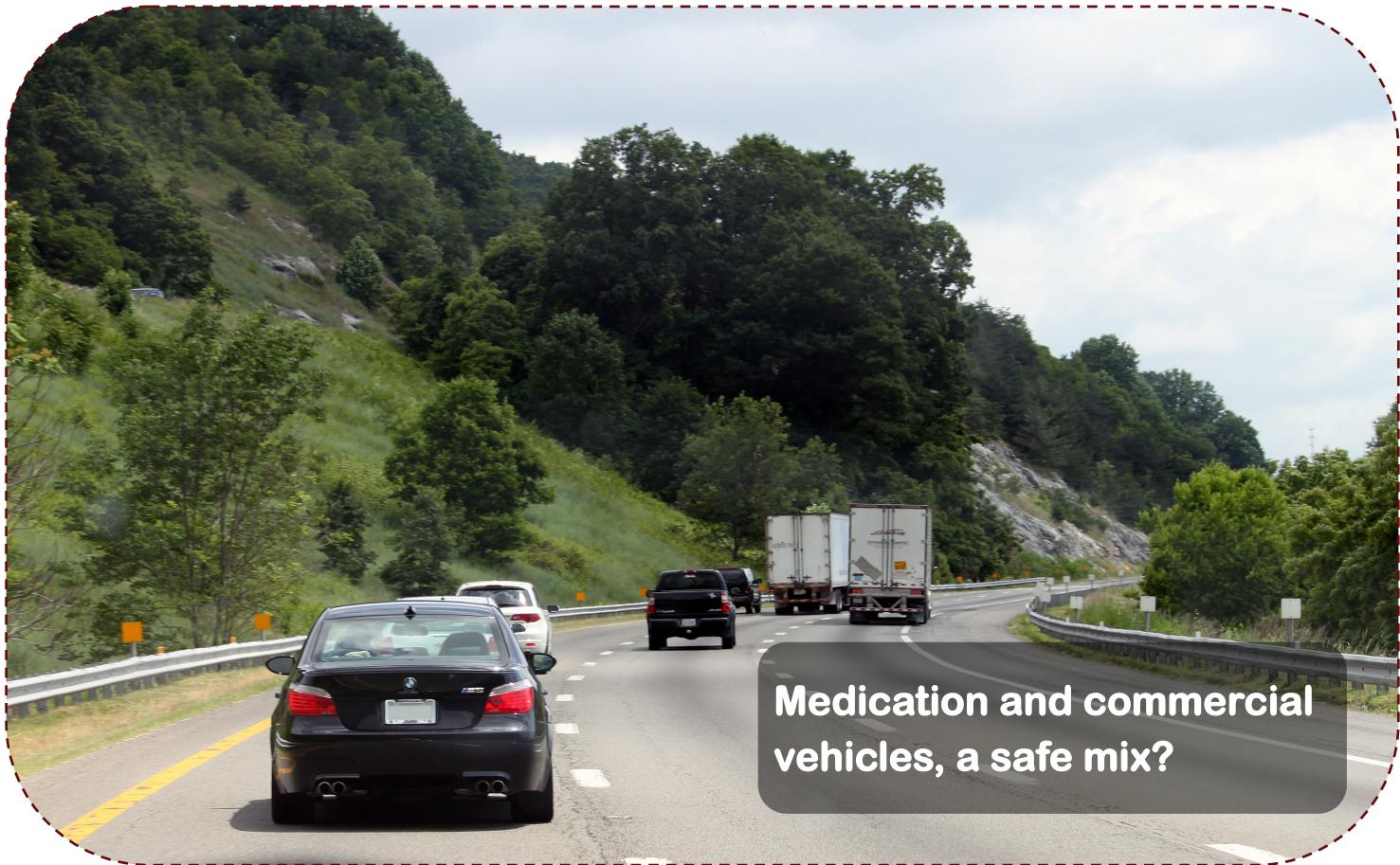
►►►►► *Today*

TECHNOLOGY

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Turning the research we do into information for you!

Also in this issue...

- ◆ NSTSCE Spotlight
- ◆ Older Driver Fitness to Drive
- ◆ Transportation Tidbit
- ◆ Researcher Profile
- ◆ Did You Know?
- ◆ Ongoing Research

NSTSCE

National Surface Transportation
Safety Center for Excellence



VirginiaTech
Transportation Institute

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About NSTSCE

The National Surface Transportation Safety Center for Excellence (NSTSCE) managed by the Virginia Tech Transportation Institute (VTTI) was established by the Federal Public Transportation Act of 2005 to develop and disseminate advanced transportation safety techniques and innovations in both rural and urban communities.

NSTSCE uses state-of-the-art technology, including the Virginia Smart Road, to focus on four main research areas:

1. Safety devices and techniques that enhance driver performance;
2. Evaluations of the built roadway environment and infrastructure-based safety systems;
3. Safe mobility for vulnerable road users; and
4. Driver impairment.

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Along for the Ride

A priority for NSTSCE is to lead research to improve the health, wellness, and safety of commercial vehicle drivers. In this issue of *Transportation Research Today* we discuss the impact of prescription and over-the-counter drugs in commercial motor vehicle (CMV) safety. If you have not looked at our CMV Driving Safety and Driving Healthy websites, please take a look at: <http://cmvdrivingsafety.org> and <http://www.drivinghealthy.org>. They are both very informative, even for those of us that only drive two- or four-wheelers!

In August, researchers from around the world gathered during the Fourth International Symposium on Naturalistic Driving Research. It was a great event where top researchers in the field of naturalistic driving shared their findings and analysis techniques. The event included two remarkable keynotes: from Kenneth Leonard, ITS JPO Director, and Ann Brach, SHRP 2 Director. If you would like to take a look at the presentations from that event, please visit our event archive at http://www.vtti.vt.edu/outreach/conferences_ndrs-2014/index.html. Dr. Jon Antin, the featured researcher in this issue, received the Best Poster Award for the event. We are also featuring an article related to this poster. Assessing an older driver's ability to safely drive is very important, and research performed by NSTSCE is informing researchers and practitioners how to make this possible.

Please feel free to contact us with your ideas and feedback at [NSTSCE Outreach@vtti.vt.edu](mailto:NSTSCE_Outreach@vtti.vt.edu). Safe travels!

Myra Blanco
Outreach Coordinator, NSTSCE



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Do Prescription and Over-the-Counter Drugs Play a Role in Commercial Driver Safety-Critical Events?

By Scott Tidwell

In previous work conducted by the Federal Motor Carrier Safety Administration (FMCSA, 2006), it was found that 30 percent of commercial motor vehicle (CMV) drivers involved in one truck/one passenger-vehicle crashes had a related crash factor of prescription (Rx) drug use and 19 percent had a related crash factor of over-the-counter (OTC) drug use. However, this FMCSA study did not dive deeper into the relationship between crash involvement and Rx and OTC drug use while driving. In this current study conducted by the National Surface Transportation Safety Center for Excellence (NSTSCE) titled *Prescription and Over-the-Counter Drug Use and its Relationship to Involvement in SCEs*, researchers used naturalistic data from the Naturalistic Truck Driving Study (Blanco et al., *in press*) to conduct an analysis of the impact of truck driver Rx and OTC drug use on safety-critical events (SCE). The goal of this study was to address two main questions:

1. What was the prevalence of Rx and OTC drug use among truck drivers?
2. Was there an association between Rx and OTC drug use and involvement in an SCE?

In addition to the naturalistic driving data that were used in this study, drivers' daily activity registers, including medication use, were also used.

The Drivers

A total of 100 CMV drivers participated in this study, with each driver participating for four weeks. In addition to the driving data, each driver filled out a daily activity register; 97 drivers completed the activity registers. Each day in the activity register corresponded to a 24-hour time period—from midnight to midnight. Drivers self-reported each activity performed (e.g.,

on-duty driving) along with any medication taken, the time of use, and the amount. It is important to understand that caffeine is considered a stimulant and therefore was classified as an OTC drug.

A total of 2,867 SCEs occurred during this study, which included 5 crashes, 60 near-crashes, 1,588 crash-relevant conflicts, 1,214 unintentional lane deviations, and 16 illegal maneuvers.

To analyze any effects the drug use may have had on CMV drivers, researchers first grouped Rx and OTC drugs by drug class (using the Physician's Desk Reference as a guide), then calculated the absorption rate of each type of drug, identified the drugs known to negatively affect driving performance, attention, and/or cognitive abilities, and documented the prevalence of each drug's use by CMV drivers.

Baseline periods (i.e., no documented drug use) were also reviewed and analyzed for these 97 CMV drivers to establish relevant comparisons between drug use and non-drug use.

The Facts

A total of 9,120 drug entries were made in the drivers' daily activity registers. Of these drug entries, 75 percent were OTC while 25 percent were Rx. While the majority of drivers reported no Rx drug use, 97 percent of the drivers did indicate OTC drug use. An interesting finding is that over half the drivers reported using OTC drugs in more than 90 percent of their driving shifts during the four-week period of the study.

Peak drug use (both Rx and OTC) was between 7:00 a.m. and 9:00 a.m., with another small peak in use between 6:00 p.m. and 9:00 p.m. OTC drugs were reported to be taken most often while on-duty, while Rx drugs were reported to be taken most often while off-duty.

The most frequently reported Rx drug classification, as reported by 45 percent of the drivers, was cardiac medication, while the most frequently reported OTC drug was caffeine (a stimulant). Of all of the drugs taken by drivers, 61 percent of the Rx drugs had potential performance-degrading qualities, while only 1 percent of the OTC drugs had potential performance-degrading qualities. A total of 10 different

CMV Driving Safety



CMV Driving Safety is a website developed and maintained by NSTSCE with the goal of helping truck and bus fleets improve their driving safety. The website includes six interactive modules that can be viewed online or downloaded. No sign-up required.

Begin improving your fleet safety today!



classifications of drugs were taken by the CMV drivers who participated in this study. Caffeine was the drug reported with the highest rate of consumption.

The Findings

In general, the results of this study indicate that Rx and OTC drug use by CMV drivers was not associated with an increased risk of being involved in an SCE. However, the researchers point out that these results should not be considered all-inclusive for all drugs given the sample size of drivers using certain drug classifications. In some instances, certain drug classifications were only represented by a few drivers (e.g., one drug classification was only used by two drivers in this study). One drug classification that stood out in these results was the stimulant classification (due to the large number of drivers using caffeine). CMV drivers that used caffeine were found to be half as likely to be involved in an SCE compared to CMV drivers that did not use caffeine. This is important to note, as CMV drivers typically work long, irregular hours and quite often drive at night. This is also consistent with previous studies that have found caffeine to be effective against driver fatigue, at least in the short term.

While this study was small-scale in nature (97 drivers), it did show the feasibility of using naturalistic data to assess the risk associated with Rx and OTC drug use while driving a CMV. Larger sample sizes of drivers could potentially yield more beneficial data regarding specific drug classifications and their relationship to SCEs. Another valuable insight gained from this study was the high percentage of CMV drivers that take some form of OTC and/or Rx drug. Nearly all (97 percent) of the CMV drivers reported taking an OTC drug during their driving shifts while 25 percent reported taking Rx drugs. From a safety and regulatory perspective, being able to fully understand the cause and effect relationships between different OTC and Rx drugs and how they affect CMV driving performance is a crucial piece of the puzzle to help further reduce the number of crashes involving heavy vehicles and, thus, saving lives.

This project falls under the NSTSCE focus area of Driver Impairment. The full report can be found at <http://vtechworks.lib.vt.edu/handle/10919/50549>

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Matt Camden was the project lead for Prescription and Over-the-Counter Drug Use and its Relationship to Involvement in SCEs.

Mr. Camden is a research associate in the Center for Truck & Bus Safety at VTTI.

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NSTSCE Spotlight

Many thanks to all attendees of the 4th International Symposium on Naturalistic Driving Research for helping make it a great success. One hundred fifty attendees representing the United States, Australia, Canada, China, Denmark, France, Germany, Japan, and Taiwan were on hand.

NSTSCE would also like to congratulate researchers Jon Antin, Feng Guo, and Youija Fang for being chosen by their peers in attendance at this year's symposium for Best Poster Presentation, *Senior Fitness-to-Drive Evaluation Using Naturalistic Data*.

NSTSCE is looking forward to seeing everyone again at the 5th International Symposium on Naturalistic Driving Research in 2016.

Assessing the Ability of Older Drivers to Safely Navigate the Roadways

By Tara Reel

They are the most experienced drivers on the road but, according to the Centers for Disease Control and Prevention (CDC), adult seniors are at the highest risk for crashes on roadways. Studies have shown that as we age we are at a higher risk of being in a crash and are more susceptible to injuries, which are often fatal (CDC, 2013). According to the Federal Highway Administration (FHWA, 2014), adults 65 and older accounted for 33 million licensed drivers in 2009. To further put this into perspective, the National Highway Traffic Safety Administration's National Center for Statistics and Analysis (2009) reported that 13 percent of the total United States resident population was represented by individuals age 65 and above. It is clear that a large majority of the population of older drivers are staying on the road. NHTSA also reported that 183,000 individuals aged 65 or older were injured in traffic accidents while accounting for 15 percent of all fatalities in the United States in 2008.

Given this substantial number of older drivers on the road, it is becoming more important to develop standards for evaluating and measuring fitness to drive for those responsible in making these determinations. This includes state driver's licensing authorities, physicians, occupational therapists, and certified rehabilitation specialists. A recent study, *Older Driver Fitness-to-Drive Evaluation Using Naturalistic Data*, was conducted by NSTSCE researchers with the goal of doing just that.

The evaluation of fitness to drive has been a hot topic for the past 50 years. This decision is most often determined by the family physician. Despite how that final decision may impact others on roadways, medical professionals have often been hesitant to make the call due to the impact on existing physician-patient relationships. While tools have been developed through the years to assist in evaluation, there has been no valid test for identifying specific medical conditions and how these conditions may relate to driving risk and behavior.

This NSTSCE project set out to predict safety-related outcomes based on functionality assessments while studying older drivers in a naturalistic driving setting. In naturalistic driving studies, cameras, data recorders, and other instrumentation are installed unobtrusively in vehicles in order to observe driving behaviors and events in their most natural state. This groundbreaking study was the first of its kind to use naturalistic driving as an evaluation tool for older driver fitness -to-drive. During the testing phases, more than 4,000 driving hours were logged by 20 participants. The study focused on several components, including the incident of crashes and near-crashes. A crash is defined as a vehicle making contact with another vehicle(s) and/or objects on or off the road. (This includes roadside barriers [guardrails], pedestrians, cyclists,

and animals.) A near-crash is a "rapid, evasive maneuver by a participant or any other vehicle" to avoid a crash (Guo, Fang, & Antin, 2014). While crashes are rare, near-crashes, on average, occur 10 times more frequently than crashes.

The main goal of this study was to evaluate the relationship between older drivers' fitness profiles and driving risk with the primary component being crash/near-crash events. There were three functional dimensions in the fitness model applied in this study: perceptual (vision), physical (strength), and visual (cognitive). These criteria are relevant given that reaction time to events tends to naturally slow as we age. During the naturalistic driving hours documented, 80 crash/near-crash events were documented and more than 1,000 risky behaviors were observed. The study found that crash/near-crash events are often connected to physical and mental states of the driver during those events. Further, it was found that a driver's visual contrast sensitivity has a significant impact on crash risk.

Additionally, the drivers were asked to perform a self-assessment of their driving performance. During the self-assessment, researchers observed that drivers who provided a realistic evaluation of their own driving performance tended to be more aware of their cognitive abilities; thus, they were aware of their limitations and adjusted their driving performance accordingly.

Article continued on Page 6

Transportation Tidbit

Did you know that there were 726 bicyclist fatalities and another 49,000 bicyclists injured in 2012?

National Highway Traffic Safety Administration. (2014). *Traffic Safety Facts, 2012 Data*. Washington, DC: NHTSA.

As a result of this project, future work with larger naturalistic driving populations will further refine and validate these findings, which can then be applied wherever older driver fitness-to-drive screenings are administered.

This project falls under the NSTSCE focus area of Safe Mobility for Vulnerable Road Users. The full report is currently in press and, once published, can be found at <http://vtechworks.lib.vt.edu/handle/10919/5529>

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[older_adult_drivers/adult-drivers_factsheet.html](#)



Feng Guo, Ph.D., served as the project lead for the *Older Driver Fitness-to-Drive Evaluation Using Naturalistic Data*.

Dr. Guo is a statistician at VTTI and has a joint appointment as an assistant professor in the Statistics Department at Virginia Tech.

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NSTSCE Researcher Profile



Jon Antin, Ph.D., CHFP, is the subject matter expert in the Vulnerable Road User area for the National Surface Transportation Safety Center for Excellence and the director of the Center for Vulnerable Road User Safety at VTTI. He currently leads several senior driver safety projects emphasizing fitness-to- drive modeling, intersection-related behavior, and senior driver training, as well as ongoing naturalistic driving study (NDS) efforts.

Dr. Antin earned his B.S. in Psychology at L.S.U. He then studied in the Vehicle Analysis and Simulation Laboratory at Virginia Tech, where he earned his M.S. and Ph.D. degrees in Industrial Engineering and Operations Research (Human Factors Option).

Did you know?

The Smart Road is 2.2-mile long, two-lane test track owned by VDOT and operated by VTTI that meets Federal Highway Administration specifications for interstate highways and contains a signalized four-way intersection that is fully programmable with both wired and wireless connectivity.

Ongoing Studies

There are currently more than 50 studies being conducted under the NSTSCE program; featured below and on the following page are two of these ongoing studies.

Safer Driving: Measuring the Impacts of Roadway Improvements

By: Tara Reel

The numbers are startling. The World Health Organization predicts that by 2020 road traffic crashes will account for 2.4 million deaths annually (World Health Organization, 2013). While human behavior is a contributing factor in crashes, a new study utilizing naturalistic driving data will focus on the environmental factors that may contribute to accidents, particularly in the realm of road improvements. Identifying the Impact of Roadway Improvements on Crashes through Naturalistic Data will evaluate how road improvements aid in the prevention of crashes.

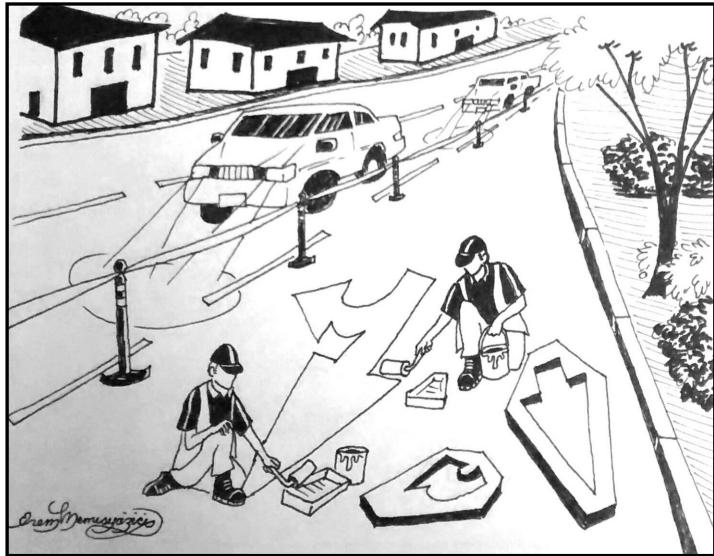
Often in the case of traffic collisions, blame is placed on a driver and road conditions are not generally considered. While human behavior can certainly lead to collisions, the roadway itself can be a significant contributing factor, as the existing infrastructure may affect drivers' ability to maintain control of their vehicle. According to an earlier study which analyzed infrastructure characteristics and road crashes, crash rates can be lowered through infrastructure improvements such as consistent alignment of road markings and structure, shoulder paving, construction of guardrails or other traffic-calming features, and the fortification of steep ditches (Polus, 2005). In fact, the study predicted that road improvements alone could reduce crashes by nearly half in comparison to highways with weaker infrastructure. Clearly, road improvements are important for incorporating safety features for accident prevention.

This NSTSCE project will evaluate the reduction of crashes as a result of roadway improvements through the use of naturalistic driving data. Prior to the utilization of this type of data collection, evaluation of road improvements often required long periods of data collection and host sites were needed for comparison. As a result, statistical data were weak. The current project will focus on the following tasks:

- Identify the potential overlap between improvements and the naturalistic driving database;
- Conduct a potential safety analysis evaluation based on the availability of events in the naturalistic database;

and

- Perform a sample safety analysis from a selection of the available data.



Naturalistic driving data provide a unique opportunity to evaluate roadway improvements. Investigating the overlap of naturalistic driving trips in areas where roadway improvements have been made can provide the needed data to assess the number of safety-critical events prior to and after roadway and infrastructure improvements. This research has the potential to provide new insight into the causal links between roadway improvements and safety. As a result, the infrastructure changes in a roadway can be prioritized in terms of safety.

This project falls under the NSTSCE focus area Roadway Environment and Infrastructure-Based Safety Systems.

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Naturalistic Driving Crossing International Borders

By: Paul Bartholomew

With more than 1.355 billion people, China has the largest population in the world. The total number of passenger cars in China is over 120 million as of 2012, and is still increasing dramatically. In fact, the number of cars that were added to the Chinese vehicle population last year was more than the entire car population in China in 1999 (Ho, 2013). Despite having a considerably lower number of passenger vehicles than the United States, the fatality rate of severe crashes is dramatically higher (about 5.1 per 10,000 vehicles, as compared with only 1.7 in the U.S.; Fang, 2011).

In its drive to promote safety and innovation, the Virginia Tech Transportation Institute (VTTI) has joined Tongji University and General Motors Corporation to conduct a major naturalistic study in one of the largest cities in China. Shanghai is home to over 20 million people and 2 million cars (Craig, 2012).

VTTI has a strong background in performing large-scale naturalistic studies to investigate driver behavior. According to Jon Hankey, Senior Associate Director of Research and Development at VTTI, "Naturalistic driving is the best method to truly understand the interaction between the driver and the driving environment in the 'real world,' ultimately leading to countermeasures that will improve safety."

VTTI's data acquisition system gives researchers the ability to simultaneously collect multiple video views along with data such as speed, acceleration, and braking. This system has been successfully implemented in multiple studies in the United States, including the nationwide Strategic Highway Research Program, which was the largest naturalistic driving study to date in the United States, with approximately 3,100



Photo: Downtown Shanghai, China. Credit: Johnson Controls

drivers. While the study in Shanghai will recruit just 90 participants, it is still a major large-scale effort. The participants will rotate through five General Motors vehicles that have been modified to include a data acquisition system. The vehicles will collect data on almost every aspect of driving in Shanghai; traffic flow, driver behavior, and traffic conditions are just some of the various components of driving that will be monitored.

Targeting the reasons for such a high fatality rate, this project is aimed at finding what causes the crashes in the first place. This international project will help to shape future traffic safety policy in China, potentially making the roads safer. This data will also give the researchers the chance to study any potential differences or similarities between the United States and China when it comes to being behind the wheel and on the road.

This project falls under the NSTSCE focus area Safety Devices and Techniques That Enhance Driver Performance and is expected to be completed in the second half of 2015.

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On Location

The Mile Marker 4 image on the cover was captured on Coastal Highway in South Bethany, DE by Scott Tidwell.



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