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## Study finds higher crash risk for truckers with untreated sleep apnea

Truck drivers who fail to adhere to treatment for obstructive sleep apnea (OSA) are five times more likely to be involved in serious, preventable crashes, according to a new study led by researchers at the University of Minnesota Morris (UMM). The project, sponsored in part by the Roadway Safety Institute (RSI), is the largest study of sleep apnea and crash risk among commercial motor vehicle drivers to date.

According to the American Academy of Sleep Medicine, OSA affects at least 25 million adults in the United States. A frequent warning sign is excessive daytime sleepiness, which can manifest as drowsy driving.

"This study emphasizes that untreated obstructive sleep apnea is a pervasive threat to transportation safety," says American Academy of Sleep Medicine President Dr. Nathaniel Watson. "It is critical for transportation companies to implement comprehensive sleep apnea screening and treatment programs to ensure that truck drivers stay awake at the wheel."

As part of the study, researchers compared more than 1,600 truck drivers with OSA to an equal number of drivers screened as unlikely to have OSA. Drivers with the disease were given a mask with an air pump worn while sleeping to keep the airway open (an

auto-adjusting positive airway pressure machine), and its use was electronically monitored. The rates of preventable serious truck crashes per 100,000 miles driven were compared across the study groups.

"To put our findings in context, if we look at 1,000 truck drivers each working for a year, the drivers with obstructive sleep apnea who refuse mandated treatment would have 70 preventable serious truck crashes, compared to 14 crashes experienced by both a control group and by drivers with sleep apnea who adhered to treatment," says Stephen Burks, lead author of the study and professor of economics and management at UMM.

Burks organizes the UMM's Truckers & Turnover Project (T&T), assisted by Jon Anderson, professor of statistics, and Rebecca Haider, research coordinator. T&T researchers performed the statistical analysis of the study data, acquired from Schneider National—the first major motor carrier to institute an internal OSA program—and its sleep apnea services provider, Precision Pulmonary Diagnostics.

"I expect our sleep apnea findings will be carefully considered in the rulemaking process on sleep ap-



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Stephen Burks



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nea standards for truck drivers and train operators just launched on March 8, 2016, by the U.S. Department of Transportation," Anderson says.

According to Burks, the study's findings stress the importance of adding OSA screening standards to the medical exam that commercial truck drivers take every two years.

T&T is a multi-year UMM research effort also involving faculty co-investigators at other institutions both in the United States and internationally. Funding for T&T was provided by Schneider National, RSI, and UMM. Additional funding for this research analysis was provided by the MacArthur Foundation, the Sloan Foundation, Harvard Catalyst/Harvard Clinical and Translational Science Center of Harvard University, and the National Surface Transportation Safety Center for Excellence.

## Improving safety of two-lane roundabouts

Adding roundabouts to intersections on busy roadways is becoming increasingly common in the United States, and while two-lane roundabouts almost always reduce fatal and severe crashes they can also lead to a substantial increase in minor crashes. To help combat this problem, researchers with the Roadway Safety Institute (RSI) are continuing to expand on previous research investigating solutions for reducing crashes at two-lane urban roundabouts.



*Researchers recommended changes to improve safety at this crash-prone roundabout in Richfield, MN.*

The research, funded by the Minnesota Department of Transportation, began in 2011 with a troublesome two-lane roundabout in Richfield, Minnesota—at the time, one of the few modern urban roundabouts in the Twin Cities. Following the roundabout's construction, the number of property-damage crashes increased substantially at the site. Experts at the Minnesota Traffic Observatory (MTO) were brought in to make improvements, then gauge their effectiveness, with a before-and-after study.

"With the assistance of local and national roundabout experts, we made a number of changes in the signs and lane markings at the roundabout," says MTO director John Hourdos, who is leading the research. These changes included adding lane designation signs upstream of the approach, removing fishhook-style arrows, extending the solid lane line upstream of the roundabout, eliminating the solid-and-skip lines, lowering signs to improve visibility, and adding crosswalk signs on the islands.

The effects of these changes were documented with a 360-degree camera mounted in the center of the roundabout; video was collected and logged before the changes, three months after the changes, and again one year later. Based on these data, the researchers concluded that a number of the changes had a significant, positive long-term effect.

"After the changes, lane-change violations decreased 20 percent, turn violations dropped more than 40 percent, and lefts from the outer lane—the most severe violation—were reduced 45 percent," Hourdos says. "One early clue that led us to believe that the changes were significant is that we immediately saw a 53 percent improvement in selecting the correct lane—which was sustained one year later."

Following the success of this single project, researchers wanted to extend the investigation to more roundabouts with different designs. "We knew this would allow us to solidify our ideas about what can be done to help improve roundabout safety."



*Image captured from camera mounted on pole above the roundabout*

In a new project, funded by the Minnesota Local Road Research Board, the research team is accomplishing this by studying four additional two-lane roundabouts in Minnesota that vary greatly in age, driving conditions, and built environment. Researchers have collected before-and-after data at all four roundabouts, and video analysis is currently under way, with results expected later this year. The project also includes the use of automated violation detection for the video analysis.

Hourdos says the team has adapted open-source code to automatically detect yield violations on the video collected. "Previously our students were watching the video and logging violations manually, so this change will allow us to analyze a lot more video and gather much more useful data."

Based on the results of the data analysis, researchers will develop guidance for Minnesota county and municipal engineers seeking to improve safety and reduce property damage crashes at their urban two-lane roundabouts.

"We made a lot of changes to our two-by-two roundabout in Washington County based largely on the results from the earlier Richfield study, and those changes had a big positive effect on turning violations, but we believe there is still room for improvement in yield violations," says Joe Gustafson, Washington's County's traffic engineer. "We're looking forward to seeing the results from this latest study to determine what additional treatments might be effective in reducing our crashes even more."

Once this latest project is complete, researchers hope results may pave the way for a larger, multi-state study.

### Visit puts focus on distracted driving research

Roadway Safety Institute distracted driving research was in the spotlight during a campus visit May 5 by U.S. Senator Amy Klobuchar, who toured RSI facilities along with Minnesota high school students, safety leaders, researchers, and advocates.



*Sen. Klobuchar, Vijay Dixit, area high school students, and others called attention to distracted driving during a campus visit.*

The Institute, along with the Center for Transportation Studies (CTS) at the University of Minnesota, hosted the event.

"As a mother of a 20-year-old driver, safety is always on my mind. But you don't need to be a parent to appreciate the importance of keeping kids'—and really all drivers'—eyes on the road," Klobuchar said. "We all know that 5 seconds—5 seconds—is the average time your eyes are off the road when you send a text, which means for a driver traveling 55 miles per hour, you actually are going the length of a football field blindfolded."

Klobuchar went on to cite the sobering statistics of deaths and injuries due to driver distraction, but then got much more personal. "Despite all those numbers that are so startling and so big, no one is with me here because of the statistics. They're here because of lost lives, because of their own family members, and because of those that they want to prevent from being injured or killed."

Klobuchar was joined by Nichole Morris, principal researcher with the U's HumanFIRST Laboratory; Max Donath, RSI director; Laurie McGinnis, CTS director; Donna Berger, director of the Office of Traffic Safety, Minnesota Department of Public Safety; Vijay Dixit, a leading distraction-free driving advocate and chair of the Shreya R. Dixit Memorial Foundation; Greg LaVallee, a driving safety advocate from Otsego, Minnesota (both Dixit and LaVallee lost teenage children in distracted driving crashes); and student representatives of distraction-free driving clubs at Edina and Eden Prairie high schools in Minnesota.

Following remarks, the group toured the University's HumanFIRST Lab, which uses the tools and methods of



*Researcher Nichole Morris and RSI director Max Donath show Sen. Klobuchar facilities for distracted driving research in the HumanFIRST Lab.*

psychology and human factors engineering to better understand driver performance. High school students from two of the distraction-free driving clubs launched by the Dixit Foundation took turns behind the wheel of the lab's state-of-the-art immersive driving simulator, which is used for researching driver distraction and impairment.

Morris discussed some of the ways research at the HumanFIRST Lab is addressing distracted driving. A smartphone-based app, for example, has been shown to be an effective solution for restricting teens, or drivers of any age, from interacting with their phone while driving, she said.

During the month of April, which was National Distracted Driving Awareness Month, Minnesota law enforcement issued nearly 1,000 citations for distracted driving. In 2015, texting and other forms of distracted driving contributed to 74 deaths on Minnesota roads.

Several of Klobuchar's key provisions to crack down on distracted driving were included in the Fixing America's Surface Transportation (FAST) Act, the first long-term transportation bill passed by Congress in a decade.



*Lee Munnich*

### Researcher spotlight: Lee Munnich

Lee Munnich brings more than 20 years of state and local government experience to the study of public policy issues at the Roadway Safety Institute. After recently retiring as director of the Humphrey School of Public Affairs' State and Local Policy Program at the University of Minnesota, he is now serving as a part-time senior fellow with the Humphrey School. Munnich's research focuses on a number of transportation issues including transportation's role in the community, congestion pricing, rural transportation safety, economic development, and evidence-based transportation safety countermeasures.

"Our research on rural roadway safety identified six evidence-based countermeasures that have the greatest potential for reducing fatalities—primary enforcement of seat belt use, universal motorcycle helmet use, sobriety checkpoints, graduated driver licensing program upgrades, mandatory ignition interlock implementation, and automated speed enforcement," Munnich says.

In addition, Munnich has studied the effectiveness of Toward Zero Deaths (TZD) programs adopted in many states. This research showed that the first four states to adopt TZD programs in the early 2000s each had a significantly greater reduction in traffic fatalities than the rest of the nation; findings also identified five key components of a successful state TZD program.

Currently, Munnich is conducting an RSI project with his research colleague Matt Schmit focusing on how the six states in the Institute's region have addressed the six evidence-based countermeasures proven to save lives and the extent to which these states have implemented a TZD program. The project includes development of a scorecard to rate each state on these goals, a review of each state's safety plan, interviews with legislators and roadway safety officials, and roundtables in each state to identify common issues as well as best practices. Once the final report is completed, researchers will revisit each of the states to discuss the findings and implications and to follow up with further interviews with state legislators and interest groups.

"Even though states made significant progress in reducing roadway fatalities and serious injuries in the 2000s, traffic deaths are on the rise again," says Munnich. "RSI projects like this one allow us to research life-and-death issues that can be addressed through better public policies and legislation."

Munnich received a bachelor's degree in economics from Georgetown University and conducted post-graduate work in economics and computer science at the University of Minnesota. He's served as a deputy commissioner of the Minnesota Department of Trade and Economic Development, research director for the Minnesota Business Partnership, economic consultant for the Minnesota House of Representatives, manager of the Midwest Research Institute's Center of Economic Studies, executive director of the Minnesota Tax Study Commission, and was twice elected to the Minneapolis City Council. In addition, Munnich served as director of the national Center for Excellence in Rural Safety established under SAFETEA-LU and has co-chaired the Transportation Research Board's Congestion Pricing Committee. This year Munnich was awarded the University of Minnesota President's Award for Outstanding Service and the Transportation Research Board's Congestion Pricing Committee Ed Sullivan Award for Excellence in Congestion Pricing Research.



*John Hourdos*

## Researcher spotlight: John Hourdos

Roadway Safety Institute researcher John Hourdos has extensive experience with the theoretical and practical aspects of traffic safety as well as traffic flow theory and modeling. His initial work focused on automatic incident detection on freeways, and he is internationally known for his work in microscopic simulation and modeling. During the last five years Hourdos has focused on research in traffic safety—especially in the early detection of crash-prone traffic conditions on freeways, the causal analysis of crashes, and the modeling of driver behavior related to crashes and near-crashes.

“I have shown that certain conditions are favorable to crashes and that it is possible to detect them in real time,” says Hourdos. “That work has recently achieved real-world application in the form of an automated queue warning system operation on I-94 westbound in the Twin Cities, which is already producing encouraging results.”

As director of the U of M’s Minnesota Traffic Observatory (MTO)—a high-tech transportation research facility affiliated with the RSI—Hourdos works to test and evaluate new transportation strategies and traveler information technologies using a network of video and radar detectors that turn westbound I-94 in Minneapolis into a fully instrumented field laboratory.

“The unforgiving conditions on this stretch of interstate show us that traffic is truly a collective phenomenon,” Hourdos says. “Our work in the MTO demonstrates that crashes bear a collective responsibility and are very rarely the result of the actions of one or two individual drivers. We see that our behavior as drivers can generate oscillations that travel upstream and generate impossible-to-avoid conditions five or even ten vehicles behind us.”

Currently, Hourdos is working on an RSI project to develop a connected vehicle testbed within the I-94 field lab and build on previous MnDOT-funded research that resulted in the development of an infrastructure-based queue warning system at this location.

“We are looking forward into the future and developing an environment where connected vehicles can be tested and safety applications developed and deployed in a real-world setting,” Hourdos says. “Ultimately, this research will help create a driving environment in which connected vehicles ‘talk’ to each other and warn their drivers about possible dangers ahead.”

In addition, Hourdos is working to debunk what he believes to be dangerous misconceptions about autonomous vehicles. “There is an unfortunate perception that autonomous and automated vehicles are going to solve all problems from road congestion to safety,” says Hourdos. “This is not directly true, and their effect on traffic individually as well their collective effect when their numbers increase needs to be understood and modeled in great detail in order to avoid making conditions even worse than they are today.”

Hourdos received his M.S. and Ph.D. in civil engineering from the University of Minnesota, where he has worked full time as a research associate since 1996. He is currently director of the MTO, a research associate professor in the U of M’s Department of Civil, Environmental, and Geo- Engineering, and a Center for Transportation Studies Research Scholar. Hourdos is affiliated with several professional organizations, including the Institute of Transportation Engineers, Engineering Society of Greece, European Ramp Metering Group, NCHRP Research Panel (member), Transportation Research Board (affiliate member), Traffic Simulation Subcommittee of the Transportation Research Board, Committee on Freeway Operations of the Transportation Research Board, Committee on Safety Data, Analysis, and Evaluation of the Transportation Research Board, and the American Society of Civil Engineering. He also serves a reviewer for the ASCE Journal of Transportation Engineering and the Journal of Intelligent Transportation Systems.

## Education efforts promote STEM to underrepresented groups

The Roadway Safety Institute works to increase participation by groups currently underrepresented in STEM fields, which includes women. In early 2016, the Institute awarded travel scholarships for two students to attend the WTS Central Region Conference held in Indianapolis February 19–20, 2016.

Nazanin Abbaszadeh Banaeiyan of the University of Minnesota Duluth and Fatemeh Baratian Ghorghi of Auburn University each received \$1500 toward their travel expenses.

"It was a great opportunity for me to learn about the transportation industry, especially the advancement of women, and to learn from senior leaders on the most recent transportation topics," Ghorghi says. She added that the networking opportunities were also highly valuable. The other women attending, she says, "were eager to help and answer any questions."

Banaeiyan says that being the only female in her work environment and a female in the field of engineering can be stressful, but through WTS and its regional conference, she finds the motivation she needs by learning about other successful women in the transportation field, she says.

On March 8, Institute staff taught sessions on basic traffic principles and pedestrian safety to 60 eighth-grade students from Woodbury, MN. The students visited the University of Minnesota as part of the AVID (Advancement Via Individual Determination) program, which promotes college and STEM careers for first-generation college students. RSI researcher Chen-Fu Liao gave students an introduction to traffic engineering, including a hands-on experience managing traffic flow using the online game *Gridlock Buster*. The pedestrian safety curriculum focused on retroreflectivity, which is also the focus of our museum exhibit in development at The Works.



*Eighth-graders learned about pedestrian safety and retroreflectivity on campus in March.*

## RSI researcher shares expertise on teen driving

Many parents underestimate the dangers of teen driving—and how involved they should be to make it safer. That was the message of two national news stories that featured RSI researcher Nichole Morris of the HumanFIRST Laboratory. In March, Morris, who has conducted extensive research on teen driving, was interviewed for the *New York Times* and the *NBC Today Show* for stories on the subject.

For 16- and 17-year olds, the number of deaths from motor vehicle crashes outstrips those from suicide, cancer, or other types of accidents, Morris said in the *Times* article. "Cars have gotten safer, roads have gotten safer, but teen drivers have not," she said. Among her recommendations: parents should do much more to supervise their teen's driving, including asking questions and having them drive on different types of roads in varied conditions.

"Our studies show that the more the parent is involved when a teen is learning, the lower their chances are for a crash."

In April, Morris presented on her teen driving research at the 2016 Lifesavers National Conference on Highway Safety Priorities, held in April in Long Beach, California. In a session titled "Talking to Teens about Distracted Driving in a Way that Makes a Difference," Morris discussed findings from the Teen Driver Support System field operational test, which used a smartphone application to alert teens to their unsafe driving behaviors.



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