University of Minnesota

ROADWAY SAFETY INSTITUTE NEWS

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Research explores how road sign alternatives might affect driver safety

The idea of fewer—or no—roadside signs holds appeal for highway departments (less maintenance) and drivers (less visual clutter). But if the information typically conveyed on signs—such as the speed limit—is given to drivers in another way, would it be safer? And how would drivers respond?

Researchers at the University of Minnesota's HumanFIRST Laboratory recently tested how in-vehicle signing—perhaps presented on a vehicle display—could warn drivers of changes in the environment and influence their behavior. Led by RSI researcher Nichole Morris, the project examined how driers react to in-vehicle sign (IVS) systems designed to prepare them for transitions in driving conditions such as speed zone changes, school zones, construction zones, and curves.

The project, sponsored by the Minnesota Local Road Research Board, arose from a previous Minnesota Department of Transportation study that looked at the feasibility of using smartphones for implementing connected vehicle programs. One of the questions that came out of that study was whether road signage could be eliminated from the roadside and displayed in the vehicle instead. Doing so could save tax dollars related to sign installation and maintenance, improve landscapes, and make it easier to keep signage up-to-date.

Researchers began by developing a simulated route for the HumanFIRST Lab's driving simulator using a real roadway network from southern Minnesota. Forty participants were asked to drive the 24-mile simulated route (which included freeways, two-lane rural roads, and towns) with and without the IVS system activated. As they drove, performance measures were collected.

Nichole Morris

The researchers found that an IVS system would affect driving in several ways. When only in-vehicle signs were used, speeding and speed variability increased. "Safety across all crash types was significantly reduced when in-vehicle warnings were used without external signs," Morris says.

However, speeds did not increase when both IVS systems and external signs were used, and speed variability declined slightly. "This suggests that as a supplement to external signs, the IVS system might reduce traffic speed variability and improve safety," she says.

Victor Lund, a traffic engineer with St. Louis County, MN, and the technical liaison for the study, says traffic engineers are concerned about the negative impact on safety of people driving at different speeds.

"An IVS system might help reduce speed differentials, and we get really excited when we see something constructive toward that end."

Another key finding from the study: IVS systems did not appear to distract drivers. "Sometimes smartphones are the cause of driver distraction," Morris says. "An IVS system might be a tool to break that distraction by showing the driver there's something important ahead and to change speed."

The researchers also evaluated the usability of the technology. Test participants reported that the mental workload required to drive when an IVS was used instead of external signs was greater than under baseline conditions. Driver satisfaction with the IVS was also lower when it was used alone.

Based on the results, the researchers offer several recommendations. "Although using IVS systems instead of external signs would presumably save money on infrastructure costs, we do not recommend this," Morris says. "However, we do believe that using these systems in conjunction with external signs has the potential to reduce speeding and crashes and needs to be explored further."

Researchers hope to see this work expanded to examine the role of emerging IVS systems that could deliver important safety information between connected vehicles, such as speeds at intersections and work zones. In addition, understanding how drivers respond to IVS systems could help emergency vehicles create a cleared path and encourage drivers to comply with "move over" laws, Morris says.

Institute teaches transportation concepts, safety to summer campers

In June, more than 40 White Earth Nation (Minnesota) students were introduced to a variety of transportation topics in a daylong session offered by the Roadway Safety Institute (RSI).

The session was part of the White Earth Indian Reservation Summer Academy of Math and Science, a two-week day camp for reservation youth in grades 4 to 8. The camp focuses on hands-on learning and uses Indian culture and heritage as a vehicle for studying math, science, and engineering. It is offered in partnership by the White Earth Nation and the University of Minnesota Extension.

"This is a unique program that has been a great way to meet RSI's objectives of teaching safety and building tribal partnerships," says Colleen O'Connor Toberman, program coordinator with RSI.
Image of students talking with police officer

This year, staff led students through a variety of interactive activities to spark their interest in transportation, engineering, and safety.

In a lesson on road sign design, students learned about sign retroreflectivity, shape, and color before creating their own road signs using the Ojibwe names for local places.

Students experienced the dangers of distraction by getting behind the wheel of pedal carts in a lesson co-taught by Minnesota Toward Zero Deaths program regional coordinator Tom Nixon. The lesson demonstrated how distractions and multitasking impair essential concentration while driving and walking. Nixon also engaged students in discussions about booster seats and seat belt use, sharing ideas to help students encourage their friends and relatives to buckle up.

"Just knowing how high the [roadway] death rate is in our reservation communities…anything we can incorporate into our curriculum to try and keep our young people safe is a very worthwhile part of the program," says Deb Zak, regional director of the U of M Extension's Northwest District.

Nixon hopes students will make safer driving choices in the future based on what they learned. "The great opportunity we had today was to talk to them before they become drivers," he says. "We wanted them to learn about what their actions will lead to and the limitations of their abilities [when they're distracted]. The more educated they are, the more aware they'll be of what their choices will mean."

The Roadway Safety Institute also sponsored a day focused on safety at the second annual National Summer Transportation Institute (NSTI) hosted by the Center for Transportation Studies in July on

the University of Minnesota campus. The interactive two-week day camp for students in grades 7 to 9 featured classroom and lab sessions with transportation experts as well as field trips to facilities across the Twin Cities.

The day began with RSI researcher Nichole Morris giving campers an introduction to human factors. Later, the students tried navigating a pedal cart obstacle course to learn about the dangers of distracted driving, wore specialized goggles to experience the impairing effects of alcohol, and explored a UMPD vehicle with a campus police officer.

Investigator Aaron Churness of the U of MN PD talks safety with NTSI campers.

Overall, camper evaluations indicate that the program helped students become more aware of the wide range of possible careers in transportation. Parents reported that students not only enjoyed the camp but also took the lessons they learned to heart.

"[My daughter] became more aware of the importance of road safety," one parent said. "She's constantly making sure we are not touching our phones while we're driving."

NSTI is part of a national program designed to attract a diverse range of students to education and career opportunities in transportation. It was sponsored by CTS with funding from the Federal Highway Administration administered by MnDOT.

Workshops highlight innovative applications of LIDAR

Earlier this year, RSI researcher Brian Davis helped lead two workshops for practitioners as part of a research project sponsored by the Minnesota Local Road Research Board.

The "Innovative Technology Workshops on LIDAR" provided information to city and county engineers and GIS professionals who were interested in learning more about LIDAR (light detection and ranging) and its potential traffic applications. The workshops were held in Dakota County (West Saint Paul, MN) and Saint Louis County (Duluth, MN) and featured both a classroom component and a live demonstration of 3D LIDAR technology collecting data at a test site.

Brian Davis demonstrated the LIDAR system, here mounted on a University vehicle.

Kaye Bieniek, Olmsted County Engineer, praised Davis's work on the LIDAR research project and the workshops. "[Brian] gave terrific explanations when many questions were asked [and was] thorough in the information generated," she said.

LIDAR is becoming a more frequently used tool among state and county DOTs—for instance, to collect information about the geometry of objects in its field of view such as roadway and roadside features and the relative position and trajectories taken by vehicles. LIDAR scanning can be useful in a number of applications, including real-time driver-assist systems, vehicle and pedestrian counting and trajectory data collection, surveying and construction, and facilities inspection and asset management.

Researcher spotlight: Brian Davis

Brian Davis is a research fellow with the Department of Mechanical Engineering at the University of Minnesota (U of M) and a researcher for the Roadway Safety Institute. His interests focus on using emerging technologies, or established technologies in new ways, to create novel solutions that improve the safety and efficacy of the transportation system. This work has included the development and integration of systems such as GPS/GNSS, cellular networks, LIDAR, radar, embedded computing,


Brian Davis

machine learning, and computer vision for applications in roadway mapping, driver assist and lane-departure warning, vehicle tracking, work-zone safety, and connected vehicles.

Davis is currently working on a technology transfer project centered on the Teen Driver Support System (TDSS) smartphone app—an app designed to help teen drivers by providing real-time, in-vehicle feedback if they engage in risky driving behaviors and reporting those behaviors to parents if teens disregard the system warnings. In a field operational test involving 300 newly licensed Minnesota teens, the TDSS app was recently evaluated and found to be effective in reducing risky behaviors in teen drivers. Davis says the work is now focusing on updating the app's name and appearance, enhancing and refining some of its features, and identifying partners interested in continuing to develop and deploy the system.

Another technology transfer effort Davis helped facilitate was two workshops on mobile LIDAR scanning held in Minnesota last winter for public transportation and GIS professionals (see related article).

Davis holds bachelor and master of science degrees in mechanical engineering from the U of M. Always interested in transportation, Davis had the opportunity in graduate school to work with ME professor (and current RSI director) Max Donath on a project with the Intelligent Vehicles Lab. He enjoyed the work—so much so, that he accepted a full-time position afterwards.

"I like performing research in the intelligent transportation field because it involves working on challenging problems whose solutions allow me to work with a wide variety of technologies," he says. One emerging transportation challenge is how best to ensure the safety of travelers as automated and autonomous vehicles begin to enter the fleet in more significant numbers, Davis says. "It will be important to understand and quantify the risks of using these vehicles and in doing so, develop meaningful safety standards for these systems. This could involve evaluating these systems in different environments to better characterize sensor limitations, working to ensure the human-machine interface is intuitive and provides enough information for the driver to take over in an emergency, and developing methods to detect and mitigate cyber-security issues with connected vehicles."

New videos highlight Institute work

The Roadway Safety Institute is working to reduce crashes and save lives on our nation's roadways—and has created a video highlighting these efforts.

The video features interviews with RSI director Max Donath and researchers from across the region whose projects range from reducing crashes at rail grade crossings to investigating roadway safety issues on tribal lands. The video also gives a look at some of the Institute's education efforts, including the development of a museum exhibit designed to introduce preteens to safety concepts. It can be viewed at youtube.com/watch?v=fa0hp8hHvHc.

Another new video guides practitioners through the use of a spreadsheet tool that can help determine when it's safe to use flashing yellow arrows. The tool was developed as part of a project sponsored by the Minnesota Local Road Research Board and led by RSI researcher Gary Davis, a professor in the Department of Civil, Environmental, and Geo- Engineering at the University of Minnesota. Davis's project developed guidelines for time-of-day use of permitted left-turn phasing.

Traffic engineers can use the spreadsheet tool to determine at which times of day crash risk is sufficiently low for flashing yellow arrows to be implemented safely to allow left turns at a specific intersection. The instructional video helps users understand the methodology behind the spreadsheet tool as well as how to use it. An instructor walks users through an example intersection, describes the inputs needed, and explains how to interpret the results. The video is available at youtube.com/watch?v=evcFZm1nyrg.

Mark your calendar: seminar series resumes this fall

Join us this fall as we once again offer our Institute seminar series. Seminars cover a wide range of disciplines and are free and open to anyone interested in learning more about transportation safety research. Can't attend in person? Watch live online—or later at your convenience. This fall's topics include California tribal road safety with David Ragland of UC Berkeley and bike/pedestrian safety with Jason Cao of the University of MN. The series begins on September 8. Visit the Institute's seminar web page for the full schedule at roadwaysafety.umn.edu/events/seminars/index.html.

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