Researchers target driver behavior to improve pedestrian safety

Pedestrian-car crashes have been on the rise across the United States—a trend that has manifested in the Twin Cities. In the hopes of preventing crashes, researchers from the University of Minnesota have been collaborating with city and state officials on a project aimed at reminding drivers to watch out for pedestrians.

Lessons on reducing driving and lowering emissions from the ‘Land of Freeways’

Many states, including California and Minnesota, have identified reducing driving as an essential strategy to meet their targets for lowering greenhouse gas emissions. How to achieve this strategy, however, remains a question. The rise of ride-hailing services, automated vehicles, and other innovations could add to this challenge.

In the opening session of the 2018 CTS Research Conference, Professor Susan Handy discussed how she and her colleagues with the Institute of Transportation Studies at the University of
Automated vehicles hold promise to reduce congestion, crashes, pollution, and parking demand. But this promise can’t be realized without advanced technology that lets a vehicle “see” its surroundings and operate safely under all conditions.

Julie Schoenfeld founded a company—Strobe Inc.—to produce one such technology, an advanced LiDAR sensor. Schoenfeld, now vice president of technical program management with GM Cruise Automation, discussed this technology and shared her journey as a serial entrepreneur at the CTS Research Conference on November 1.

Schoenfeld decided to launch Strobe when she read a Wall Street Journal article in 2014 that said the size and price of LiDAR technology would have to fall for autonomous vehicles to thrive. “When technology hits the Wall Street Journal, that’s when it’s time to act,” she said. “As an entrepreneur, you don’t want to be too early or too late.”

LiDAR (for light detection and ranging) is one of four types of sensors used by autonomous vehicles to see the world, Schoenfeld explained. LiDAR is critical to autonomous vehicle safety, but it is very expensive because of what has been the small market size; efforts to reduce its cost have resulted in performance decreases. “The self-driving car market changes the economics for LiDAR, creating a huge market that will attract large investment,” she says.

Strobe set out to solve the LiDAR price-performance challenges. Based on its co-founder’s experience in an earlier start-up, Strobe developed and patented a breakthrough laser technology that slashes costs and sensor size while improving performance and guarding against hacking. Strobe was acquired by GM in October 2017.

“But it’s not enough to have great technology,” Schoenfeld said. “You also have to have a great market.” U.S. commuters waste a full week each year in traffic, and cars sit parked 95 percent of the time. But the paramount case for automation is safety: 94 percent of crashes are caused by humans. “Safety is the gating metric,” she said.

Today, owning and operating a car costs about $0.58 per mile, while ride sharing in U.S. urban areas costs $2 to $3 per mile, according to an analysis from AAA. Removing the driver from ride-sharing services could ultimately cut the costs of an autonomous ride to less than $1 per mile, she said.

Less than 1 percent of U.S. miles traveled are currently handled by ride sharing, for a market size of about $20 billion. Cutting the cost to $1 per mile opens about a $750 billion market; below $1 per mile, the market rises to $1.6 trillion. “The culture is shifting,” Schoenfeld said. “That’s why there’s so much interest.”

In terms of partnerships for testing automated vehicles, the goal for companies is to “be everywhere” to understand the various challenges—such as operating in snow and different weather conditions. Right now, companies are consulting with communities that are open to working with them. If cities are eager, “it could happen fast,” she said.

In closing, Schoenfeld offered lessons learned from founding Strobe: Be just ahead of a wave, choose big markets, have a clear value proposition and differentiation, hire domain experts, and understand the resources and information it takes to be successful. “And never, ever, give up.”
A Boeing 757 touches down at Rochester Airport five days per week. Inside are boxes containing more than 35,000 biologic specimens intended for diagnostic testing at Mayo Medical Labs. But sometimes the specimens don’t reach their destination as intended. The culprit? Fog.

Every year, 4 to 12 percent of all inbound flights to Rochester Airport are diverted to Minneapolis–Saint Paul (MSP) International Airport. Specimens like those going to Mayo Medical Labs can spoil, and these delays cost shippers $633,000 each year and result in $5 million in regional economic loss from diverted flights.

These are some of the findings from a recent study by researchers in the Humphrey School of Public Affairs. The team’s report indicates that Minnesota’s medical industry is increasingly relying on airports to ship everything from biologic specimens to high-tech surgical implants.

“Even though Minnesota doesn’t necessarily handle a ton of volume in medical goods, the value of those medical goods is among the most valuable in the state,” explains Travis Fried, who graduated in May from the Humphrey School’s Master of Geographic Information Science (GIS) program. “It makes sense that they’re going by airplane.”

Fried’s work is part of research funded under the U’s Transportation and Economic Competitiveness (TPEC) Program; TPEC director Lee Munnich and researcher Tom Horan are the lead investigators. “This research on Minnesota’s highly competitive healthcare and medical device industry clusters demonstrates the importance of air transportation in the movement of high-value, time-sensitive freight for medical supply chains,” Munnich says. “This in turn helps us understand the importance of Minnesota’s transportation network to this vital part of Minnesota’s economy.”

Medical goods represent the highest value-per-ton commodity in the state, Fried says. In 2015, pharmaceuticals and precision medical instruments accounted for $52.5 billion in traded goods in Minnesota. Together with electronics, these low-volume/high-value commodities made up over 70 percent of the freight-value moved by state airports. And while the volume of air cargo in Minnesota peaked in 2008, the value of air-transported medical goods has increased by nearly 400 percent.

“Air cargo handles about 3 percent of the volume of merchandise globally but 36 percent of the total value,” Fried adds. MSP handles $8.6 billion annually in medical goods—92 percent of the state’s total.

Hospitals like Mayo Clinic and medical device companies such as Medtronic are turning to air travel for their shipping needs for several reasons, Fried says. Speed is the main advantage. Ordering products as-needed with state-of-the-art “just-in-time” delivery networks reduces the steep cost of maintaining on-the-shelf inventory. Using this approach, Mayo Clinic worked with FedEx, its primary shipping partner, to shrink its inventory by 75 percent, reducing supply chain costs 25 percent.

Minnesota is a hub for medical device company headquarters, and Mayo Clinic is one of the most renowned health care facilities in the world. Mayo’s Destination Medical Center expansion—a 20-year, multi-billion-dollar development project backed by state funding—underscores the importance of improving this crucial supply chain.

State transportation officials are looking at how they can improve the state’s freight systems, including upgrading the instrument landing system at Rochester Airport to help planes land during foggy conditions. “Simple investments that improve resiliency at airport cargo operations are beneficial to the Minnesota medical economy,” says John Reed, executive director of Rochester International Airport.
A key goal for CTS is to share research about innovative transportation technologies. On November 1, for example, speakers at the CTS Research Conference discussed how innovations in vehicle automation and ride sharing could reduce congestion and emissions (see related articles on pages 1 and 7).

Looking further afield, another important part of this goal is to stay informed of research outside the United States. The Energy Efficiency Innovation Seminar Series on smart transportation aimed to do just that by bringing together German and U.S. innovators in the transportation sector to exchange ideas.

“We want to bring together German companies with the leaders of tomorrow,” said Svenja Schroeder, representative from the German-American Chamber of Commerce of the Midwest (GACC Midwest). “Overall, our goal is to foster trade and investment with the U.S. and Germany across all industries.”

The seminar at the University of Minnesota, held November 5, was cosponsored by CTS, the Institute on the Environment, and the GACC Midwest. Presenters included representatives from the U of M and from a variety of German transportation technology companies.

Dr. Thoralf Knoten from the Fraunhofer Institute for Transportation and Infrastructure Systems was the first researcher to present his work. His organization, which supports German companies with the development of new products, has been working on the challenge of charging electric vehicles. He discussed designing the chargers themselves, planning distribution of the chargers, and determining the best way to introduce this technology to the market.

Knote was followed by Fabian Koark from the technology consulting company INVENSITY Inc. Koark discussed the computer systems and data that are at work in automated vehicle systems—including the gathering and flow of data, system troubleshooting, and data security. Next, Jan Schulte from Cleverciti Systems Corp. presented his company’s newly developed electronic sign system for locating and pointing out parking spaces to frustrated drivers.

The last presenter was Frank Douma from the Humphrey School of Public Affairs, who gave an overview of U of M research related to the topics raised by the German researchers. He discussed ongoing efforts to electrify Twin Cities vehicle fleets, methods being explored to reduce traffic in downtown Minneapolis, and issues in data privacy.

Minnesota Senator David Senjem was one of the seminar’s attendees. His intention, he said, was to gather ideas that could be applied to his hometown of Rochester, Minnesota, which is currently undergoing changes as the Mayo Clinic expands.

“The whole issue of traffic and how we move people is at the forefront in terms of planning for the new downtown Rochester,” Senjem said. Listening to the researchers at the seminar, he said, gave him ideas—particularly in terms of parking and vehicle electrification.

The presenters reconvened as a panel to answer audience questions. One thread touched on how fundamental differences between Germany and the U.S. drive transportation research in different directions. Public transportation is more widely utilized in Germany, for example, but the U.S. was quicker to adopt ride-sharing apps like Uber and Lyft.

Collaboration, the panelists concluded, is important in sharing the innovations that come from these differences. The best way to collaborate, ultimately, is to meet and exchange ideas. “Go to other countries,” Knoten said. “Accept that there are different approaches, but learn from each other.”
“The main premise of the study is to measure and enhance the efficacy of high-visibility enforcement for driver compliance to the crosswalk law in Saint Paul,” says Nichole Morris, director of the U of M HumanFIRST Laboratory and principal investigator of the study.

Researchers began collecting data in September 2017 with the original intention of evaluating the effectiveness of the “Stop for Me” campaign, an existing education/outreach pedestrian safety program in Saint Paul. With the help of Roadway Safety Institute researcher Ron Van Houten, Morris decided to take the study to another level.

“Instead of just measuring whether the Stop for Me campaign was effective, we wanted to ask, ‘Is it effective and can we improve it?’” Morris says. With funding from the Minnesota Department of Transportation (MnDOT) and in conjunction with the City of Saint Paul, the HumanFIRST Lab began working on a multi-step study exploring the effects of increased education, high-visibility police enforcement, and low-cost engineering on driving behavior.

The project started with the distribution of educational flyers warning about what Morris calls “multiple-threat crashes,” in which one car will stop for a pedestrian at a crosswalk only to be passed by another car from behind. In May 2018, Saint Paul police began stationing themselves near eight crosswalks to catch and warn drivers who failed to stop for pedestrians. In June, they began giving out tickets; at the same time, HumanFIRST researchers put up “feedback signs” that displayed the weekly percentage of drivers who stopped for pedestrians. Data collection continued through the end of October, and findings so far have been positive. Since September 2017, the average compliance rate of drivers at the eight treated sites jumped from 32 to 77 percent. Results were less dramatic at the eight untreated sites, but compliance still rose to 55 percent.

Melissa Barnes, former state pedestrian and bicycle safety engineer at MnDOT (now the Metro District north area engineer) working with the U of M on the project, says that the data this study gathered on driver behavior will be highly useful in reducing pedestrian traffic fatalities.

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“This project will provide a template for successful implementation of a multi-faceted program that will increase pedestrian safety within communities of many different sizes,” Barnes says. “I would encourage communities to consider using it if they have pedestrian safety concerns.”

Moving forward, U of M researchers need to further analyze the crossing data to determine the influence of various characteristics of each crosswalk, the sustainability of the results, and which of the countermeasures was most effective. A final report on the study, including the findings from this analysis, will be published next year.

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California Davis are addressing these issues with a series of groundbreaking projects.

“California is known as the Land of Freeways, and while we may celebrate them in the movies the reality is much grimmer—you can run into congestion at any time of the day on any day of the week, and the greenhouse gases this produces exacerbate climate change with forest fires, droughts, and flooding,” Handy says.

To address this serious threat, California has set ambitious greenhouse gas reduction targets; reducing vehicle-miles traveled (VMT) is one key aspect of that legislation, and the research community is playing an important part in helping the state achieve its emission-reduction goals. Research efforts by Handy and her colleagues include synthesizing existing research to help policymakers and planners identify the most effective strategies for VMT reduction and developing planning tools to assess the VMT impacts of transportation, land use, and development projects.

“In addition, we are conducting before-and-after studies when communities adopt a strategy intending to reduce VMT,” Handy says. “These are hard studies to do, but the results are extremely important. For example, we were able to document a VMT reduction following the opening of a light-rail line in Los Angeles and another after a Target store was opened in a community that had previously banned big-box stores.”

Though researchers are helping to answer many questions, new technology has created an uncertain future. “Automated vehicles in particular mean our current forecasting tools may not work as well in the future, because this technology is so different from anything we have seen,” Handy says.

Handy believes there are two possible outcomes with automated vehicles: an ideal vision in which the adoption of the “three revolutions”—electrification, automation, and shared mobility—leads to reduced emissions, and a much darker scenario in which automated vehicles lead to additional vehicle-miles traveled and increased urban sprawl. Through the “3Revolutions” project (3rev.ucdavis.edu), the UC Davis Institute of Transportation Studies is working to avoid a potential “doomsday” future.

“Automated vehicles and other technological innovations are both a threat and an opportunity for our communities,” Handy says. “Our goal is to think about what policies we need to put into place to push things away from the nightmare version and toward the dream version of the three revolutions. It is just technology until we decide how to use it, and we can choose to put the right policies in place for the future.”

Three Revolutions in Urban Transportation

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<th>Business-as-Usual Scenario</th>
<th>2 Revolutions (2R) Scenario</th>
<th>3 Revolutions (3R) Scenario</th>
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<td>20th Century Technology</td>
<td>Electrification + Automation</td>
<td>Electrification + Automation + Sharing</td>
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<td>Through 2050, we continue to use vehicles with internal combustion engines at an increased rate, and use transit and shared vehicles at the current rate, as population and income grow over time.</td>
<td>We embrace more technology. Electric vehicles become common by 2030, and automated electric vehicles become dominant by 2040. However, we continue our current embrace of single-occupancy vehicles, with even more car travel than in the BAU.</td>
<td>We take the embrace of technology in the 2R scenario and then maximize the use of shared vehicle trips. By 2030, there is widespread ride sharing, increased transit performance—with on-demand availability—and strengthened infrastructure for walking and cycling, allowing maximum energy efficiency.</td>
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Following Susan Handy’s opening presentation at CTS’s 2018 research conference (see page 1), a panel of Minnesota leaders and experts took the stage to discuss greenhouse gas reduction from the state and regional perspective, particularly in light of the future landscape surrounding transportation technologies and innovations.

**Tim Sexton, Chief Sustainability Officer, Minnesota Department of Transportation**

“We’re focused on three main areas. The first is looking internally and trying to increase the sustainability of our own operations, the second is looking at greenhouse gases more broadly within Minnesota’s transportation sector, and the third is working to increase the resilience of our transportation system given projected increases in extreme weather and the risks that poses. We’re doing this now because recent data show climate change is happening faster than we thought and some of the changes are going to be more devastating than we thought, giving us a new sense of urgency.”

**James Erkel, Environmental Attorney, formerly with the Minnesota Center for Environmental Advocacy**

“Currently, there are challenges and barriers to scaling up electrification and making it viable on a large scale. If we went directly into electrified vehicles right now we would crash the grid, but there will be a long ramp-up, so we have the opportunity to fix and smarten the grid as we go along. We still use a lot of coal to make electricity—changing that mix is important. Overall, the question becomes, What kind of revolutions are we going to have? If we have the first revolution of electrification and the second revolution of autonomous vehicles, but we don’t hit the third shared mobility revolution, it could still be very bad for the grid itself.”

**Kjersti Monson, Principal, Chief Executive Officer, and Civic Studio Director, Duval Companies**

“There is a regulatory aspect to this as well, and accommodating these new technologies in our regulatory environments and among utilities is at the forefront of the battle. Challenges include the difficulties our regulatory environment has been dealing with on a district-level scale, the hard time fully built-out cities have with adopting these new types of technologies, and the evolving relationship between public and private. We’re moving into a time with the sharing economy where the lines between public and private are getting more blurred and complex.”

**Frank Douma, Director, State and Local Policy Program, Humphrey School of Public Affairs**

“We’re seeing a new world of interaction between the public and private sectors, leaving the public sector working to determine its role. For example, with ride hailing and car sharing, private companies now have a financial incentive to move the most amount of people at the lowest cost, and that suddenly sounds a lot like what the public sector is trying to do. In addition, we need to think about how, with users paying for each trip, the public sector can collect revenues to pay for the infrastructure these transportation providers are using. Now we pay for infrastructure in various ways, such as the fuel tax and motor vehicle sales tax. With shared mobility, it’s a much different world.”

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