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Accelerating the pace of transportation innovation

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Policies needed to ensure the promise of self-driving vehicles for those unable to drive

One of the predicted benefits of self-driving vehicles (SDVs) is improved mobility and access for those unable to drive. The extent to which this happens, however, will depend not just on marketplace competition, but also on public policy decisions that ensure an equitable transportation system.

This is the conclusion of a new analysis by Frank Douma, director of the State and Local Policy

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How equitable is bicycling infrastructure?

As the movement to promote bicycling as a means of transportation has grown, so has the amount of money governments and nonprofit organizations are investing in the nation's urban bicycling infrastructure. A concern, however, is whether these investments are distributed equitably among neighborhoods. In a new study, U of M researchers looked at this issue using Minneapolis as a case study and found that though inequities still exist, equity is improving.

"Our analyses showed that bikeways are not distributed equally. For example, we found that urban trails are more likely to be in wealthier neighborhoods with a higher percentage of white residents," says Jueyu Wang, a doctoral candidate in the Humphrey School of Public Affairs and the

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U of M students gain first-hand view of Chinese transportation in study-abroad course



The Global Transit Innovations (GTI) program coordinated a study-abroad course in spring semester 2017 that included visits to five cities in the Yangtze and Pearl River Delta regions in China. The course—PA 5880: High-Density Urban and Regional Development in China—was offered by the Humphrey School of Public Affairs.

Led by GTI director Yingling Fan, U of M coordinators took 16 students to Shanghai, Suzhou, Nanjing, Shenzhen, and Hong Kong for the intensive two-week course in May.

“The course gave students first-hand experiences in two of the most densely populated regions on earth,” Fan says. “These two regions are at the center of Chinese economic development, surpassing other regions in levels of economic growth and productivity.”

Through lectures and site visits, the course explored how Chinese cities are working to satisfy the mobility and accessibility needs of the largest urban population in the world. “We looked at every aspect of urban planning, from affordable housing provisions to parking management,” says Fan, an associate professor in the Humphrey School.

In one course assignment, U of M students were paired with 16 students from Southeast University in Nanjing. Each student group (made up of two American students and two Chinese students) was assigned to a place in the city to explore globalization and rapid urbanization. “They were asked to bring what they saw and what they felt into the classroom using photos and short narratives,” Fan says. “It was a very successful activity to reflect on cross-cultural and cross-country perspectives.”

Other activities included lectures from prominent Chinese transportation

and urban planning scholars; visits to universities, transport agencies, and transit facilities; and high-speed rail trips between cities (at 350 kilometers per hour).

Trip coordinators included Sherry Gray, director of the Humphrey School’s International Fellows and Scholars Program, and Dawn Spanhake, CTS associate director for development and finance. “The trip was a great opportunity to build relationships with Chinese university faculty and agency staff as we continue to build new partnerships and grow GTI’s global reach,” Spanhake says.

Fan adds that “the trip invigorated networks at various universities and research institutions involved in ongoing and future transportation research and exchanges with the U of M.” One of the host organizations, the Shenzhen Urban Transportation Planning Center (SUTPC), is sponsoring Fan’s research on travel behavior and emotional well-being (*Catalyst* will include a story about this research in a future issue).

GTI is an affiliated program of CTS. Its education component aims to attract bright minds to the transit-planning field and educate practitioners and agency staff. More about GTI is at gti.umn.edu.



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Students deliver fresh look at Brooklyn Park transportation issues

Pedestrian safety and access to healthful foods were some of the issues tackled by U of M students during the 2016–2017 academic year as part of the U’s Resilient Communities Project (RCP).

In its fifth year, RCP—a program of the Center for Urban and Regional Affairs—partnered with the City of Brooklyn Park to advance an array of the city’s strategic priorities. RCP (rcp.umn.edu) connects communities in Minnesota with U of M faculty and students through collaborative, course-based projects. Communities are chosen in a competitive process.

More than 250 students in dozens of courses worked on projects with Brooklyn Park staff, community members, and other organizations. One of the courses—DES 3331: Street Life and Urban Design Seminar—was taught by Carrie Christensen, adjunct faculty in the College of Design. “It meant a lot to the students to know that their work was not just theoretical, but was going to be applied to actual projects that the city staff were working to move forward,” she says.

Angelica Klebsch, business development coordinator for Brooklyn Park and the city’s RCP project facilitator, also shares some highlights.

What were some projects related to transportation?

One project explored design concepts and ideas to make the Zane Avenue Corridor safe and walkable and connect residents to transit, nearby services, and neighborhood amenities and parks. The corridor also has areas that are identified as food deserts. We asked students to identify improvements to increase equitable access and consumption of healthful food.

In another project, we were seeking guidance about shared-use mobility. For example, we wanted to know more about ways to ensure that car-share or bike-share programs are accessible to people without smartphones or bank accounts.

How else was transportation a factor?

Because the Bottineau light-rail transit (LRT) line is coming to Brooklyn Park, with construction starting next year, we found that other projects needed to include that as a critical factor in their evaluations. For instance, one project asked students to offer recommendations on the best use of a

or project histories as requested by the students. Most courses invited staff to give feedback halfway through the semester to ensure the deliverables we received were useful.

How does Brooklyn Park plan to use the recommendations?

We will receive final reports from the University, which will be made



parcel of land owned by North Hennepin Community College. The parcel is within short walking distance from one of the proposed LRT stations, and students took that into consideration when they recommended a mixed-use development that included housing and grocery services.

How did students and staff interact?

The students spent a lot of time in Brooklyn Park understanding the layout, traffic patterns, access to amenities, and general feel of our neighborhoods. Staff also organized several tours and stayed heavily involved throughout the projects to answer questions and provide data

public on our website as well as on the RCP site. City leadership and staff involved in the projects will examine the recommendations for feasibility of implementation over the coming weeks. We will be tracking anything we do with the findings from all the projects, and we’ll submit a report to the University next year indicating what those activities were.

Noise-canceling stethoscope will improve treatment of patients during transport



For more than 200 years, the stethoscope has been one of the medical profession's most useful tools. However, high noise levels can make the use of a stethoscope nearly impossible, creating challenges for medical professionals treating patients in busy emergency departments, surgical wards, ambulances, helicopters, and airplanes.

"For example, when an injured soldier is being evacuated by helicopter, it is often necessary for a medic to listen to chest sounds to decide if the soldier's lung has collapsed, because a collapsed lung requires an immediate tracheotomy," says Rajesh Rajamani, a professor in the Department of Mechanical Engineering. "Currently, it's

not possible to use a stethoscope on military evacuation helicopters because of extremely high noise levels. Proper medical relief of collapsed lungs could significantly reduce the number of preventable deaths on the battlefield."

In a recent project, Rajamani and doctoral candidate Garrett Nelson designed a custom-instrumented stethoscope using a novel adaptive acoustic control system. By combining active noise cancellation with passive acoustic shielding, their approach makes it possible to successfully use a stethoscope in noisy, high-vibration transportation settings.

They began their project by measuring the quality of the noise

levels on a Black Hawk helicopter, noting that the noise had both an acoustic and vibrational component. "Previous studies have relied on the use of a reference microphone for active noise control, and we realized that this method is incapable of successfully capturing noise transmitted structurally through vibrations," says Nelson, now a postdoctoral appointee with Sandia National Laboratories.

Next, the research team simulated the vibration and acoustic noise environment of a Black Hawk helicopter using a laboratory test platform and tested the active noise-control capability of their customized stethoscope equipped with a reference accelerometer. Then, they compared those test results with tests of a microphone-based system.

"In the frequency range critical for the measurement of heart and lung sounds, our proposed system was capable of providing significantly superior performance to a microphone-based system—making the use of a stethoscope possible for the first time in this military aircraft environment," says Rajamani.

Their work, funded by the US Army and 3M's Infection Prevention Division, is summarized in *IEEE/ASME Transactions on Mechatronics*, Volume: 22, Issue: 2, pp. 994-1003, April 2017.

Catalyst Year in Review

During the past year, these were our most-read stories online:

- #1: BICYCLE COMMUTING IMPROVES PUBLIC HEALTH, REDUCES MEDICAL COSTS**
- #2: NEW DRONE TAKES A HYBRID APPROACH TO SOLAR-POWERED FLIGHT**
- #3: UNDERSTANDING THE DIFFERENCES BETWEEN BIKING AND WALKING COULD IMPROVE TRANSPORTATION PLANS**

If you missed them, the stories are available online in the *Catalyst* archive.

Minnesota LTAP brings hands-on training across the state

This summer, the Minnesota Local Technical Assistance Program (LTAP), a program within CTS, is bringing motor-grader training to more than 125 operators in locations across the state. The hands-on workshops include classroom and field sessions that teach city and county staff about proper gravel road maintenance using motor graders.

Since its establishment in 1992, Minnesota LTAP has worked to improve the skills and knowledge of local transportation agency staff through training, technical assistance, and technology transfer.

In its first year, the program held 10 workshops in 15 Minnesota cities. Since then, Minnesota LTAP's course catalog

has expanded to include more than 30 in-person workshops, online courses, and customized trainings. In the past year, more than 8,370 local agency staff have participated in these LTAP training opportunities.



Save the date: CTS Research Conference

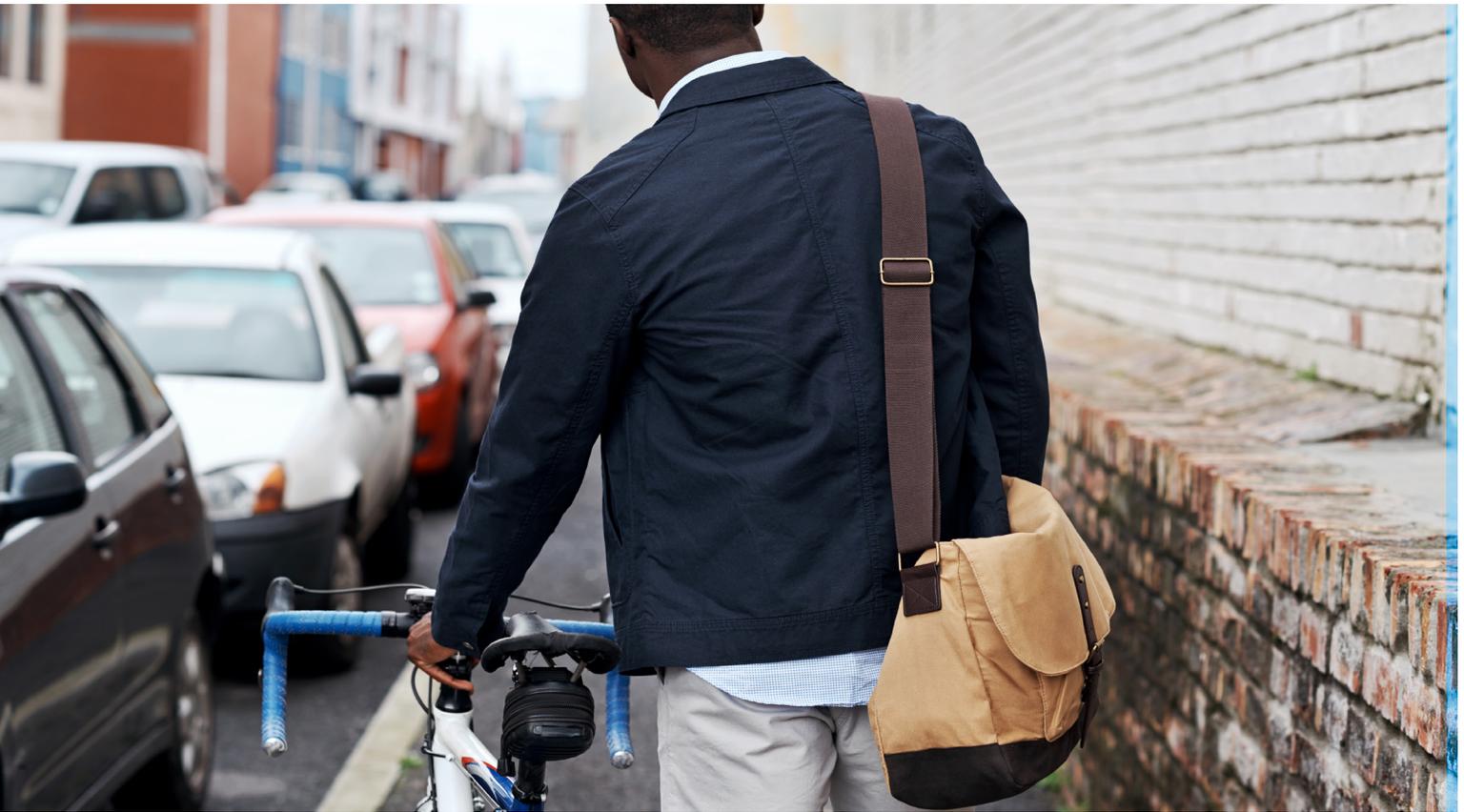
Mark your calendar for the 28th Annual Transportation Research Conference, scheduled for November 2, 2017, at The Commons Hotel on the U of M campus in Minneapolis.

The conference convenes researchers and practitioners to highlight new learning, emerging ideas, and the latest innovations in transportation. Attendees will learn about research findings, implementation efforts, and engagement activities related to a variety of transportation topics.

Plenary session speakers at this year's conference will be Joung Lee, policy director at AASHTO, and

Joshua Schank, chief innovation officer at the Los Angeles Metropolitan Transportation Authority (LA Metro). In the opening session, Lee will explore how we pay for transportation infrastructure and the value proposition for the traveling public. At the conference luncheon, Schank will discuss LA Metro's experiences with transportation policy innovation.

More program information and registration will be available in late summer on the CTS website.



study's principal author. "The good news is that investments made in bikeway infrastructure between 2010 and 2014 increased the equity of the bikeway distribution, indicating that the city has made progress."

The study used two measures to assess both the "horizontal" and "vertical" equity of the bicycling infrastructure in Minneapolis. Under horizontal equity, bicycling infrastructure is equitable when it is equally distributed and various subgroups have the same access regardless of their needs or preferences. Under vertical equity, the focus is on the implications or outcomes for disadvantaged groups; in transportation, it is often assumed that lower-income individuals need greater access to public transit and that this is equitable, Wang explains.

The first measure researchers considered, known as a "Gini coefficient," provides a single flexible measure that allows comparisons within and between groups. The second measure, a "bikeway penalty," is calculated as the loss of job accessibility resulting from the choice

to use bike paths and "low-stress" street networks for commuting. Calculation of the bikeway penalty for neighborhoods across the city is an innovative way to assess levels of connectivity via bikeways and allows comparison across different groups. Minneapolis was chosen as a case study because the city is making substantial investments in bicycling infrastructure and because data with which to assess changes in equity over time are available, Wang says.

Findings indicate that the equity of access to trails did not change over time, but they also show that growth in miles of bikeways increased horizontal equity for all groups. In addition, the researchers found evidence of vertical equity in terms of access to jobs via low-stress networks. Specifically, the bikeway penalty was lower for disadvantaged groups, which the team suggests may be associated with the concentration of their residential location near downtown.

Going forward, these measures can be used to inform planning for and investments in bicycling facilities and to assess and compare the bicycling

infrastructure of cities. "The tools we developed provide simple and easy-to-apply measures of bicycling equity," said Professor Greg Lindsey, Wang's advisor. "Projects that use this approach can begin to establish comparative equity between cities, and the use of these new performance measures will be valuable for the assessment of the equity of bicycle facility distribution."

**READ
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ONLINE**

for links to research reports and other resources.

Program (SLPP) at the Humphrey School of Public Affairs; Adeel Lari, director of innovative financing at SLPP; and Kory Andersen, graduate student in urban and regional planning. The research was conducted under the Transportation Policy and Economic Competitiveness Program, which is led by SLPP.

“The benefits of self-driving vehicles for the disadvantaged won’t happen automatically,” Douma says. “For example, just because a self-driving vehicle can transport a person that is physically unable to drive, it doesn’t mean that the person will be able to easily enter and exit the vehicle, nor easily interact with it, unless the vehicle has been specifically designed to meet the needs of these users.”

The development of self-driving cars is fast-paced and proprietary, Douma adds, and it’s unclear what physical form and design elements SDVs will have. Cognitive and other disabilities also pose challenges that need to be considered.

Although accessible prototypes have been developed, deployment is uncertain. The researchers suggest that tax incentives could be created to prompt vehicle manufacturers to further develop and promote SDVs to serve people with disabilities.

Another challenge to making SDVs benefit all people is keeping the costs affordable. Manufacturing costs are still relatively high, mostly because of SDV safety technology. “If SDVs enter the market as available for private purchase, only the most well-off individuals would reap the safety and mobility benefits,” Douma says.

This private ownership model also assumes that individuals would absorb the costs that public transit agencies currently incur for on-demand

paratransit services. The per-trip costs of these services are often three or more times those of fixed-route transit services. “If disabled individuals can transport themselves, public services and costs could be greatly reduced,” Andersen says.

An alternative, the researchers say, is moving toward a model in which fleets of SDVs function as a circulatory system for the population at large, providing mobility benefits to more people at lower costs. “The fleet model eliminates any large up-front cost barriers,” Lari says. “Instead, individuals pay by trip, which makes it easier to budget.” Discounted payment rates could be offered to disabled individuals and seniors.

However, without policy changes, “it is not clear if there are incentives for car manufacturers to develop SDVs for anything other than private ownership,” Douma says. To encourage development of an SDV fleet system, states could reform existing legislation or enact new policy. Minnesota, for example, could consider reducing or eliminating its sales tax on car-sharing services, he says.



“The Legal Obligations, Obstacles, and Opportunities for Automated and Connected Vehicles to Improve Mobility and Access for People Unable to Drive” was published in the *Michigan State Law Review* (Issue 1, 2017).

Task force examines strategies for Minnesota

Researchers in the U’s Transportation Policy and Economic Competitiveness Program (TPEC) convened a task force to examine the potential impacts of self-driving vehicles on people who are “transportation disadvantaged.” The task force is working to identify strategies that ensure seniors, the disabled, and other disadvantaged communities fully enjoy the mobility offered by SDVs. It is made up of representatives from the Minnesota Department of Transportation, Metro Mobility, metro-area counties, nonprofits, and organizations from Greater Minnesota.

“Minnesota is well-positioned and clearly has the momentum to drive local and national SDV policy,” says Frank Douma, director of the State and Local Policy Program at the Humphrey School and a TPEC researcher. “In coming months, we are preparing to take our task force’s message on the road to engage with local politicians and communities.”

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transportation innovation



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