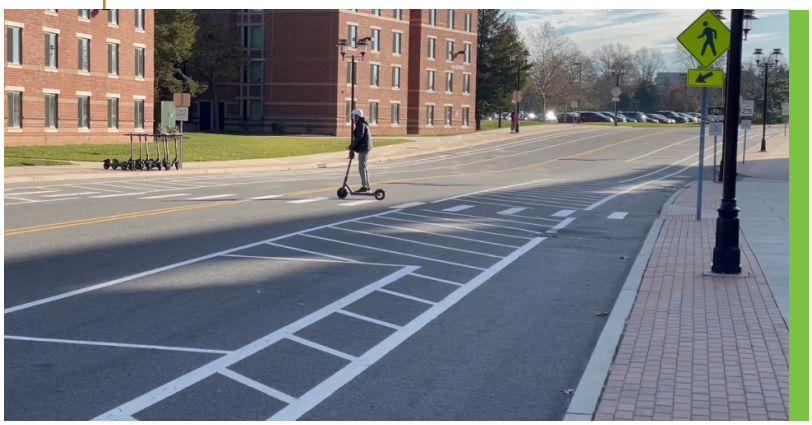
EXPLORATORY ADVANCED RESEARCH

MAKING MICROMOBILITY SMARTER AND SAFER

August 2022

The growth of micromobility vehicles (transportation devices such as pedal-driven and electric-assist bicycles as well as electric-assist scooters) in the United States over the past decade has been staggering. From 2010 to 2019, shared micromobility vehicle ridership ballooned from 321,000 trips annually in 2010 to 136 million annually in 2019.[1] In 2020, travelers in the United States took an estimated 67.9 million trips on shared micromobility vehicles.[2]



© 2021 Rutgers University. A person uses an e-scooter to cross the street.

Driven by the rise of shared rentals deployed by municipalities and private companies, micromobility vehicles have become a popular transportation alternative for individuals in cities and, increasingly, in smaller towns and suburbs throughout the Nation.

FACT SHEET

The types of micromobility vehicles available for use have also increased. As a result, policymakers and researchers have grappled with the implications of this growing mode of transit. In particular, public safety for micromobility vehicle users as well as the pedestrians and drivers they encounter has become an increasing concern. The Federal Highway Administration's (FHWA) Exploratory Advanced Research Program (EAR) Program and the U.S. National Science Foundation (NSF) are funding a 3-yr study titled "Making Micromobility Smarter and Safer" to address this issue. This project, run by a Rutgers University research team, seeks to gather better data and create technological tools that help improve safety for pedestrians and micromobility vehicle users.

STATE OF MICROMOBILITY AND SAFETY

FHWA defines micromobility vehicles as "any small, low speed, human or electric-powered transportation device, including bicycles, scooters, electric-assist bicycles (e-bikes), electric-assist scooters (e-scooters), and other small, lightweight, wheeled conveyances."[3]

Since their introduction in 2007, shared micromobility vehicles have rapidly proliferated throughout the United States. Between 2018 and 2019 alone, micromobility vehicle ridership increased 60 percent.[1]

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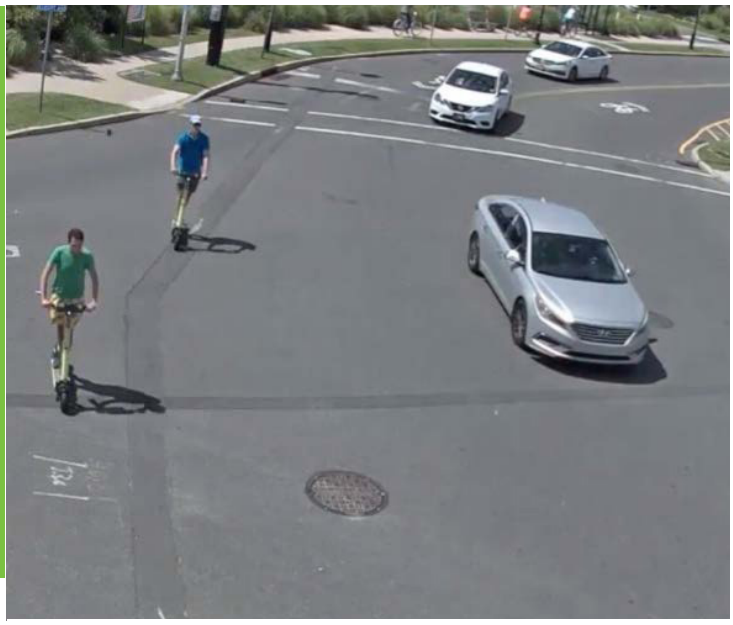

© 2021 Rutgers University. E-scooters being used alongside car traffic.

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The types of shared micromobility vehicles available for use have diversified as well. Beginning with docked (required to be returned to a station) pedal-driven bicycles in 2007, options now available in cities throughout the Nation include dockless bicycles, e-bikes, and e-scooters.[3] Micromobility vehicles have also evolved to be more accessible. In Portland, OR, two micromobility vehicle providers now offer e-scooters that have a seat.[4] In 2018, a Detroit bikeshare program started offering 13 different types of cycles (including recumbent, upright cargo, hand, and tandem tricycles).[4]

The rapid proliferation and diversification of micromobility vehicles in the past decade has also created significant public concern about rider safety. In particular, the dramatic rise of e-scooter deployment and use after 2018 has been the subject of significant media coverage.[4] Between 2014 and 2018, e-scooter-related injuries jumped 226 percent, and hospital admissions jumped 365 percent.[4] A study found that rates of head trauma for injured e-scooter riders was double that of bicyclists.[4] E-scooters have also posed a risk to pedestrians, leading some cities to ban them from sidewalks.[4]

FHWA'S ROLE IN MICROMOBILIITY

As the number of micromobility vehicle users has grown, FHWA's Office of Planning, Environment, and Realty (HEP) has worked to advance related research and practice. In late 2018, HEP conducted interviews with 25 staff across 11 FHWA offices to establish FHWA's definition of micromobility; consider the role of Federal, State, and local entities in this emerging area; and develop questions for future research.[5] In early 2020, HEP also interviewed 27 staff from 9 Federal agencies to share micromobility research activities and help identify potential research gaps.[5] HEP currently leads an internal working group that coordinates research efforts on micromobility across the U.S. Department of Transportation (USDOT). As a result of these coordination efforts, HEP developed:

- A *Micromobility* fact sheet.
- Two handouts about USDOT and FHWA activities (which will likely be updated in the near future).[5]

HEP has also collaborated with partners and stakeholders to promote and support micromobility research. HEP worked with the Pedestrian Bicycle Information Center to develop two micromobility information briefs and organize micromobility-related outreach efforts, such as a half-day workshop at the 2019 Institute of Transportation Engineers (ITE) Annual Meeting in Austin, TX.[4,6] In 2021, in collaboration with ITE and FHWA's Office of Freight Management and Operations, HEP published the *Curbside Inventory Report,* which explores how communities can better assess, prioritize, and optimize curb space considerations for accessibility, pedestrian and delivery access, transit priority, electric and autonomous vehicles, and shared mobility and micromobility.[7] HEP also coordinates with the FHWA EAR Program to support micromobility and other transportation-related research awarded under the NSF Smart and Connected

U.S. Department of Transportation
Federal Highway Administration

FACT SHEET

Communities Program.[8] Recently, HEP released a *Shared Micromobility and Equity Primer* publication, illustrating how micromobility vehicles can be used to serve transportation needs in disadvantaged communities.[9]

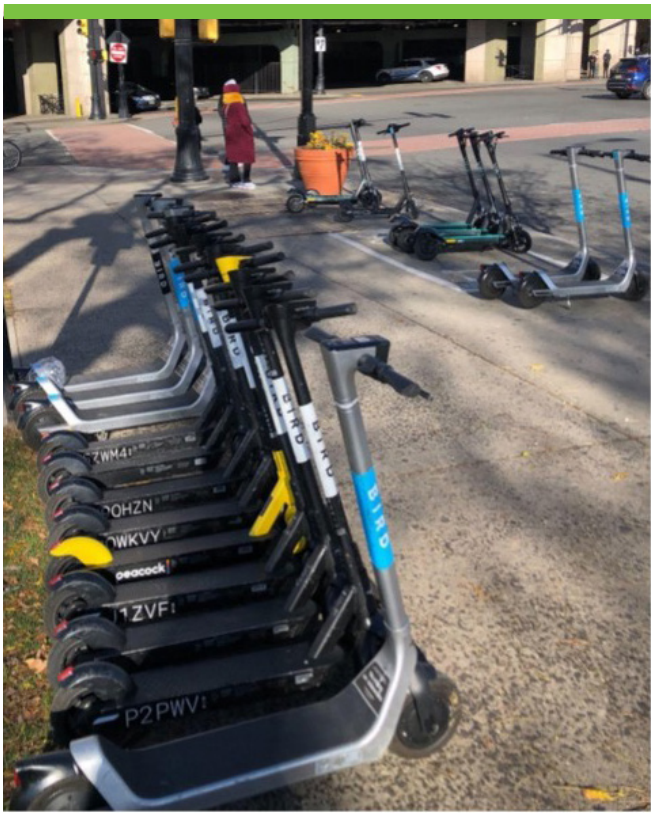
OVERVIEW OF EAR PROGRAM STUDY

A team of Rutgers University researchers is developing tools that illustrate how growing micromobility options on the road impact the safety of micromobility users and pedestrians. This project focuses on "near misses" between motor vehicles, pedestrians, e-scooters, e-bikes, and bicycles. The objectives of this project are as follows:

- Use new methods to gather better data on what determines pedestrian and micromobility risk.
- Create tools that deliver more integrated solutions in collaboration with a private micromobility vehicle provider.
- Test the tools with real users in New Jersey communities, starting with Asbury Park, NJ.

These tools will explicitly integrate both social and technology solutions to improve safety. Project tasks include:

- Creating an enhanced near-miss detection capability using multiple visual sensors, advanced computer vision techniques, and virtual reality simulations.
- Performing behavioral experiments using both traditional tools (e.g, signage, temporary road reconfigurations) and smart-city tools (e.g., sensor-equipped and networked mobile actors and intersections).
- Conducting technological experiments integrated into a prototype mobile-phone-based app for pedestrians, e-scooters, e-bikes, and drivers.
- Convening a community deliberation process to inform the development of a local smart transportation plan.



© 2021 Rutgers University. E-scooters located outside of Penn Station in Newark, NJ.

Creating Near-Miss Detection Capability

Essential to this research project is clarifying and quantifying near misses, which the researchers define as "incidents that nearly result in close physical conflicts and may be an indicator of unsafe conditions." By understanding these incidents, the research team can develop a mechanism to reduce fatalities and crashes. The team will first gather and analyze video data from intersection traffic cameras. Such data will be translated into three-dimensional modeling for systematically measuring and labeling near-miss incidents. From this data modeling baseline, the research team plans to create computer vision and machine-learning algorithms that can predict near-miss incidents.

MAKING MICROMOBILITY SMARTER AND SAFER

FACT SHEET

Performing Social Experiments

For this part of the project, the research team will evaluate the current infrastructure for signage, educational material, and events related to pedestrian and micromobility rider safety in the communities surrounding the Rutgers University camspus and other communities in New Jersey, such as Asbury Park and Newark. The researchers will also experiment with alternative low-cost road design approaches to reduce hazardous road conditions for pedestrians and micromobility users, such as employing traffic cones and restriping traffic lines. These behavioral interventions will be evaluated with video imaging.

© 2021 Rutgers University. The three-dimensional simulation system for detecting near-miss incidents being developed in the Rutgers University research project.

Conducting Technological Experiments

For these experiments, the research team seeks to apply its near-miss detection technologies in realtime through the creation of a virtual reality environment that simulates connected traffic cameras as well as pedestrian, e-scooter, and driver apps. These cameras and smartphone apps identify pedestrian, e-scooter, and vehicle locations; predict their moving trajectories; determine potential collision danger; and provide warning alerts to pedestrians and drivers of e-scooters and motor vehicles. The e-scooter app can also potentially regulate e-scooter speed.

© 2021 Rutgers University. This map of New Jerseys shows locations where the Rutgers University research team may operate during its 3-yr project.

Convening a Community Deliberation Process

Working with community stakeholders, the research team will explore the best strategies for improving micromobility vehicle user and pedestrian safety. First, researchers will develop a virtual reality simulation model for partner communities using previous project data gathering and analysis work. The research team will then use the model to investigate local barriers to reducing pedestrian and micromobility user risk with community stakeholders and summarize lessons learned.

The research team will also work with host communities to update their local planning documents to better integrate micromobility safety strategies. Such local engagement will enrich understanding of the application of smart safety solutions being developed in this project and improve community decisionmaking related to pedestrian and micromobility user safety measures.

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Federal Highway Administration

FACT SHEET

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What Is the EAR Program?

The EAR Program supports longer term, higher risk research with the potential for transformative improvements to the U.S. transportation system. The EAR Program seeks to leverage promising expertise and advances in science and engineering to create breakthrough solutions to highway transportation issues.

LEARN MORE

To learn more about the EAR Program, visit https://highways.dot.gov/research/exploratory-advanced-research. The website features information on research solicitations, updates on ongoing research, links to published materials, summaries of past EAR Program events, and details on upcoming events.

CONTACT

For more information about this EAR Program project, please contact **Danielle Blackshear** at 202-366-064, (email: danielle.blackshear@dot.gov) in the FHWA Office of Human Environment.

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