

Where To?

Autonomous vehicles are still in various stages of development, but they hold great promise to help people with disabilities travel faster, safer and more easily.

by Rory A. Cooper, PhD, & Brad Dicianno, MD

Throughout much of the United States, the capacity to drive opens the door to greater participation in life, job opportunities, access to health care, education and a general sense of freedom.

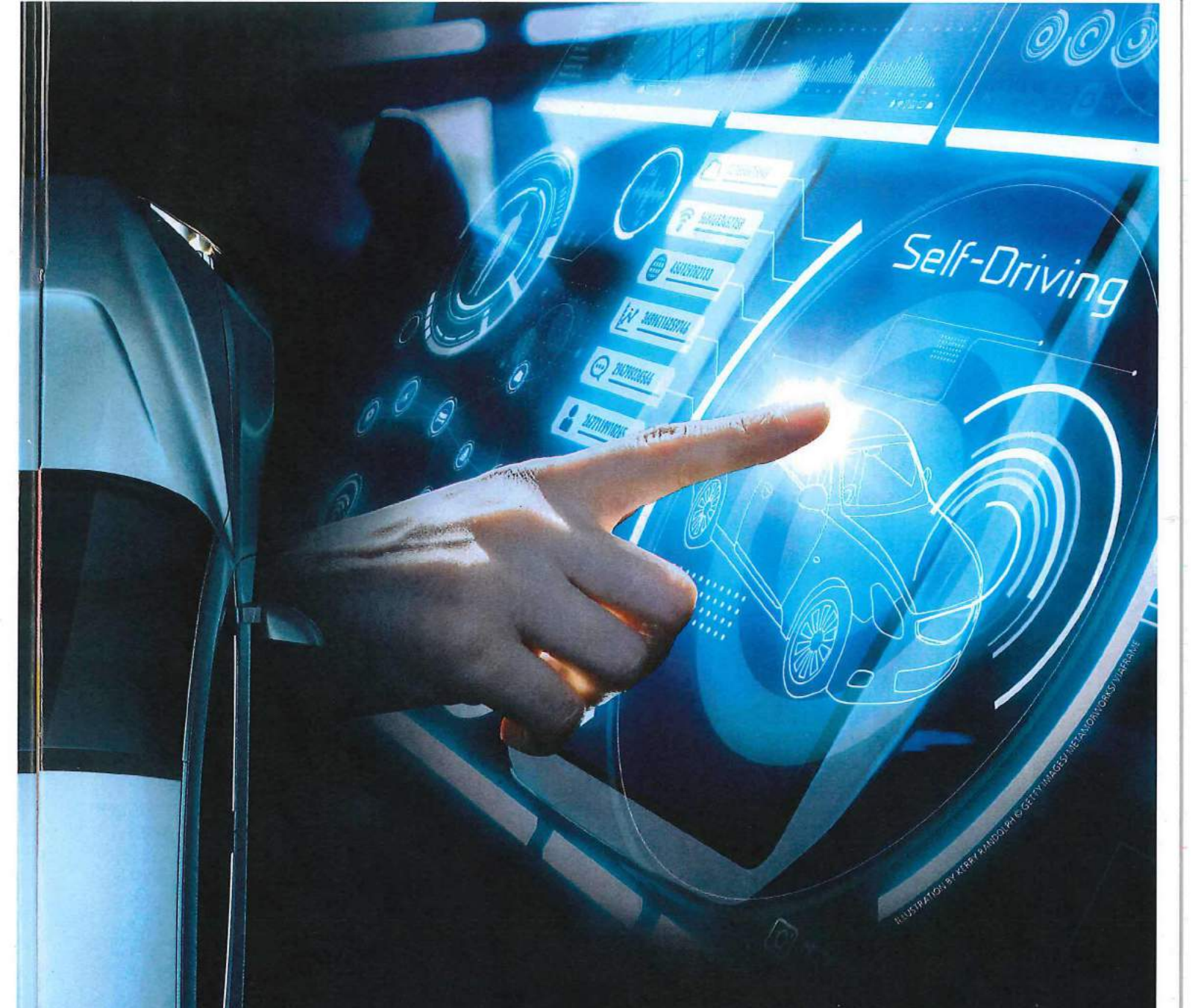
However, those same opportunities can be really restricted for people with disabilities such as spinal-cord injury and disease (SCI/D). There are some who don't drive, don't have easy access to a ride or live in a metropolitan area with limited public transportation options.

Additionally, with the ever-growing retirement of the baby boomer generation, who largely want to "age in place," there's an increasing need for accessible and enabling personal transportation.

The transportation industry is in the middle of one of its largest transformations, with unprecedented investment and advancements in electric and autonomous vehicle (AV) technologies.

Since 2009, the vast majority of the \$14 billion invested in AV technology has been spent in pursuit of mass market driverless cars. These efforts have produced significant advances, but the technological, psychological and regulatory constraints that remain will likely make widespread AV market adoption a decade or more away.

Despite the billions invested and rapid technological advances, the transportation options for older adults and persons with disabilities remains largely the same.



Incorporating Accessibility

A 2015 report from the National Council on Disability titled *Self-Driving Cars: Mapping Access to a Technology Revolution* explored the “emerging revolution in automobile technology and the promise it holds for people with disabilities, as well as the obstacles the disability community faces to realize that promise.” It makes several key recommendations:

- Research and development of AVs and their components should include a requirement that demonstrates that any resulting products incorporate accessibility of people with diverse disabilities, and these technologies should be required to comply with Section 508 of the Rehabilitation Act of 1973.
- Guidelines are needed for how people with disabilities can safely interact with and use AVs.
- All types of common and public use AVs must be fully accessible.

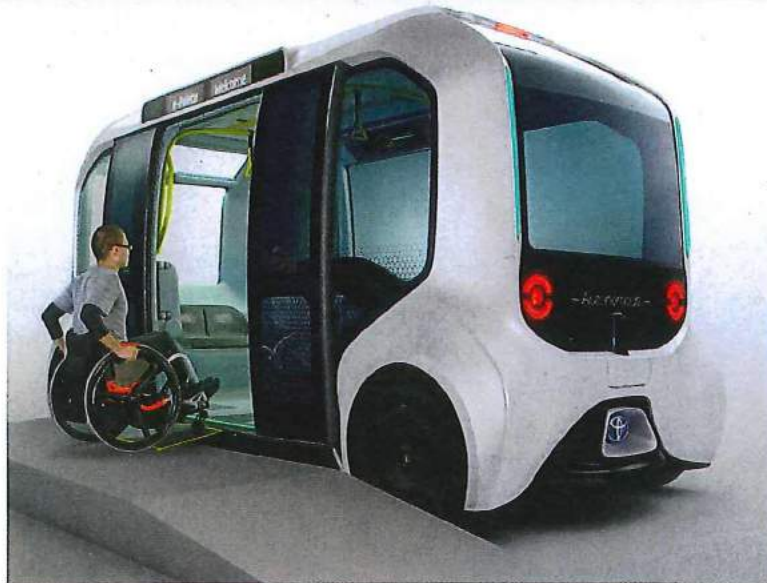


The Human Engineering Research Laboratories (HERL) at the University of Pittsburgh and the U.S. Department of Veterans Affairs was recently funded by the Department of Transportation to create the Automated vehicle Service for People with disabilities – Involved Responsive Engineering (ASPIRE) Center.

The ASPIRE Center is investigating the implications of accessible automated vehicles and mobility services for people with disabilities and their caregivers.

A 2017 survey from the Bureau of Transportation Statistics found that 6 million people with a disability have difficulty getting the transportation they need. There have been no overarching federal laws specifically governing AVs, but the National Highway Traffic Safety Administration released federal guidance on the issue in 2019.

The Society of Automotive Engineers (SAE) international standard J3016 provides a common

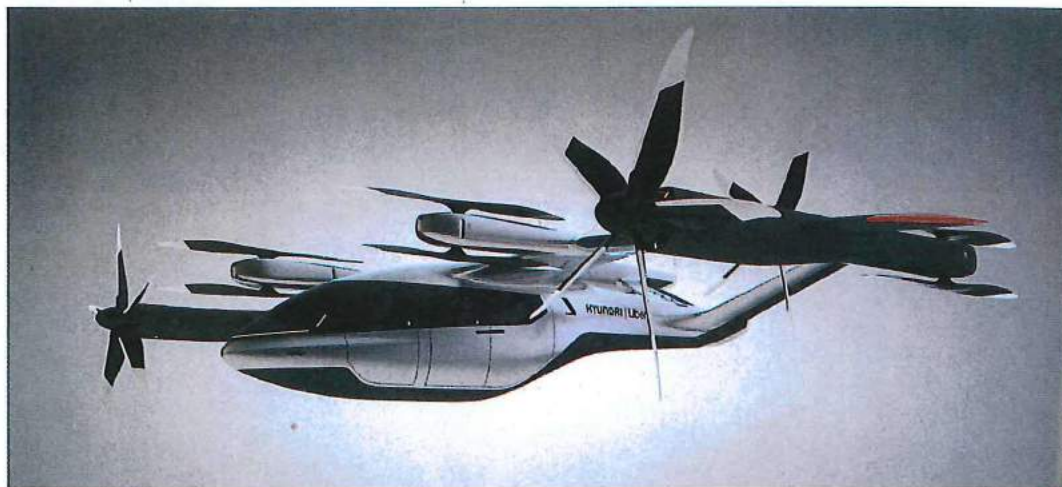


Toyota is among the vehicle manufacturers trying to develop and test autonomous vehicles.

taxonomy and definitions for automated driving to simplify communication and facilitate collaboration within technical and policy domains.

The SAE defines more than a dozen key terms and provides full descriptions and examples for each level of autonomy. Unfortunately, it doesn't address usability and accessibility for people with disabilities.

Ford, Toyota, Hyundai, Mercedes-Benz, Tesla, Google and Uber, among others, are developing AVs that are either currently being tested on American roadways or will be within the next five years.



Hyundai plans to produce and deploy air vehicles in collaboration with Uber through a ground and aerial rideshare network.

COURTESY OF HUMAN ENGINEERING RESEARCH LABORATORIES

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Self-driving personal vehicles could potentially provide a hands-free autopilot driving mode.

Of course, not all AVs are intended for roads. Hyundai is working with the city of Los Angeles to introduce accessible flying AVs as an urban air mobility solution. Hyundai has adopted a NASA strategy by publicly releasing its design concepts to inspire people to use them to innovate emerging engineering technologies.

Hyundai plans to produce and deploy air vehicles in collaboration with Uber through a ground and aerial rideshare network. A collaborative infrastructure is being developed to support this on-demand AV transportation system.

Eliminating Barriers

Different levels of automation pose distinct possibilities and challenges for people with disabilities. Therefore, accessibility research needs to be driven by and for people with disabilities to assure that their needs and preferences are incorporated.

As noted by the National Council on Disability's 2017 report, *Self-Driving Cars: The Impact on People with Disabilities*, "The disability community knows better than any other how being involved in the

planning from day one is critical to a successfully accessible product, regardless of how many years in the future it lies."

The report found that mitigating transportation-related barriers for people with disabilities would enable new employment opportunities for approximately 2 million

This self-driving vehicle is used for test drives conducted by Uber Technologies Inc.





people with disabilities and save \$19 billion annually in health care expenditures from missed medical appointments alone.

Most people with disabilities have only three viable transportation options:

- Operate a personal vehicle
- Rely on the services of others
- Use accessible public transportation

For people with disabilities who don't live in urban areas, owning and operating a personal vehicle or relying on friends and family are the only realistic options. In multiple studies to identify unmet needs of individuals with disabilities receiving community-based services, transportation has been consistently highlighted as an issue.

HERL investigators surveyed the opinions of more than 1,000 users of mobility devices and assistive technology to identify a research and development road map. The survey focused on advancements in mobility-related assistive technologies and asked about the

importance of developing futuristic technologies related to transportation.

This work indicates that advancements in technologies related to transportation are very important to individuals with disabilities and represent a significant unmet need. More than 60% of respondents rated the importance of technology in meeting their personal mobility needs as "critical," and over 40% thought that traveling freely was also "critical."

Some survey participants provided additional comments, with approximately 12% mentioning transportation as being critical and "self-driving" vehicles being included in nearly 50% of those comments.

Making An Impact

There are risks and challenges associated with both AVs and accessible vehicles.

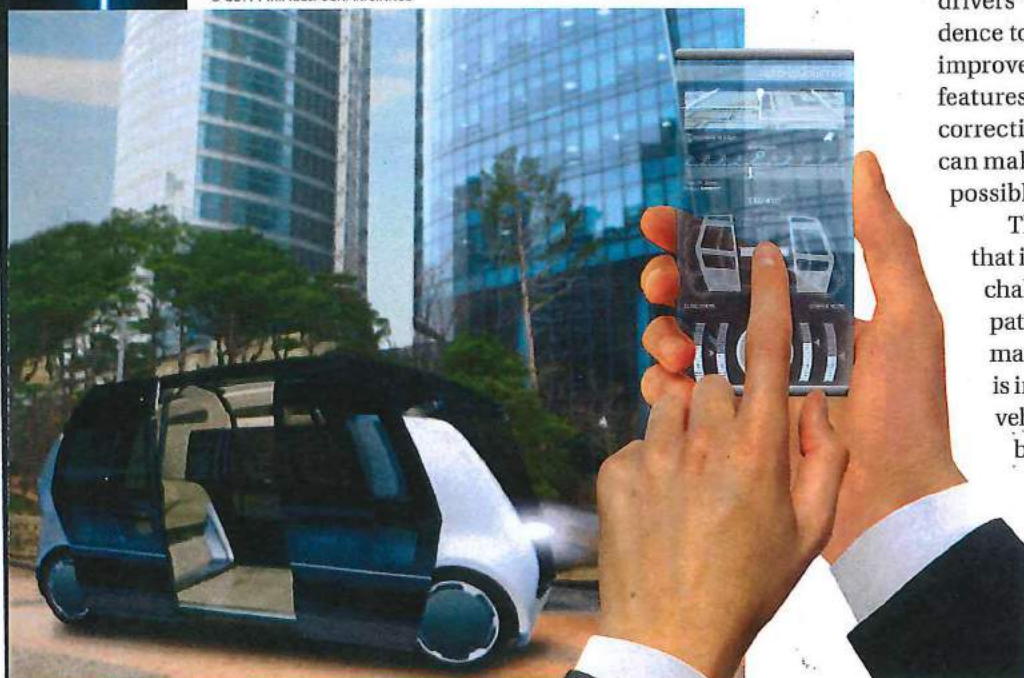
The experiences gathered through the University of Pittsburgh Medical Center's Center for Assistive Technology show that current levels of autonomy available in commercially available vehicles can have an impact.

For example, older drivers or "insecure drivers" can (re)gain the safety and confidence to drive, and driving instructions can improve through quantitative data. Such features as rear collision/obstacle avoidance, corrective steering and blind-spot warnings can make all drivers safer and make driving possible for others.

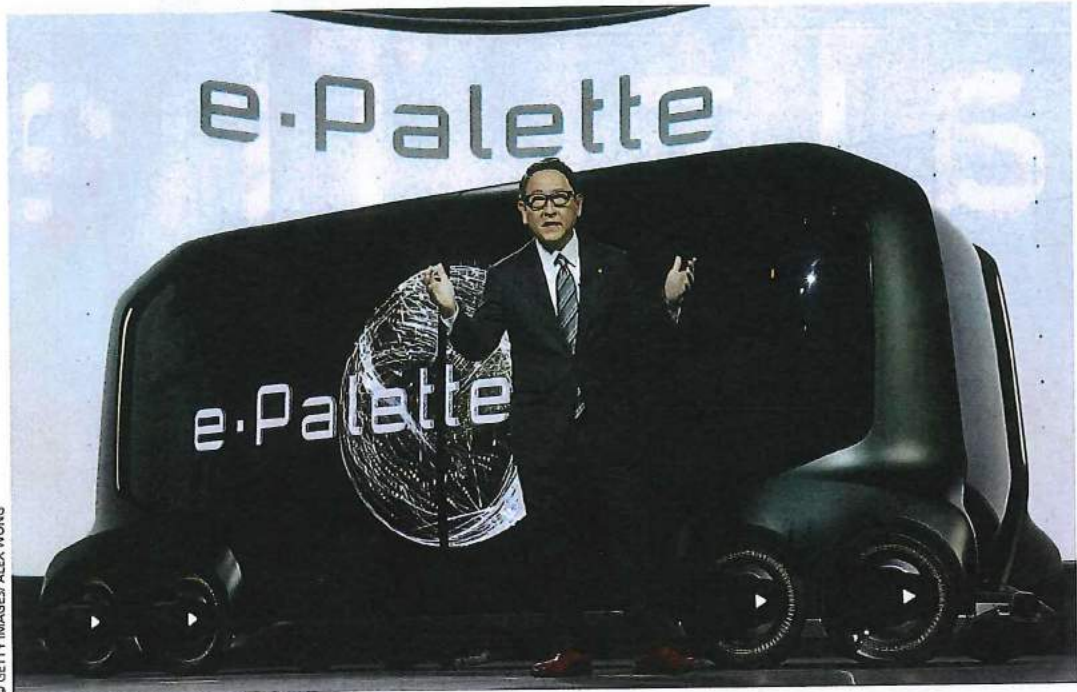
The Merlin Co-pilot is an AV technology that is intended to mitigate the risks and challenges by providing capabilities compatible with newer accessible vehicles to make them more autonomous. The system is integrated into the vehicle to access vehicle functions and features, including braking, signaling and others that are essential for safe vehicle control. It adds autonomous features to people's existing accessible vehicles.

This is particularly important because accessible vehicle modifications can be expensive, ranging from as low as \$1,500 to as high as \$100,000, excluding the cost of the vehicle. People tend to keep

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To be successful, automated vehicle technology needs extreme reliability, especially if it's the only means a person has to drive safely.



Toyota Motor Corp. President Akio Toyoda speaks in front of the e-Palette Concept Vehicle, a fully autonomous, battery-electric vehicle, during a press event for the consumer electronics trade show known as CES in Las Vegas in 2018.

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their modified accessible vehicles as long as it is feasible. For people who use adaptive vehicles to eventually adopt AVs, the technology has to be available, affordable and compatible with vehicle access needs.

It's likely to be over a decade before this is possible, and even people with disabilities who buy an accessible vehicle today will probably be using that same vehicle even as other customers start to transition to AVs.

Moving Forward

Most AVs are based on electric vehicle chassis. Some electric vehicles that could be accessible to people present challenges because they don't include, for example, traditional handholds used to help transfer in/out of the vehicle.

For people who use their wheelchairs as seats in motor vehicles, the ability to use wheelchair tie-downs and occupant restraints needs to be considered. By upgrading existing modified vans, this barrier could be lowered at least until manufacturers start producing purpose-built vehicles.

To be successful, AV technology needs extreme reliability, especially if it's the only means a person has to drive safely. Cost is also a notable issue. Devices and systems that are too costly will essentially be inaccessible to

many people with disabilities. Moreover, the need to buy a new vehicle is a significant hurdle for many people with disabilities.

Currently, accessible personal electric vehicles, the likely future for autonomous vehicles, are in various stages of research and development. Toyota Motor Corp. plans to deploy an accessible autonomous transportation system for this summer's Olympic and Paralympic Games in Tokyo.

The system will include a wide range of vehicles to travel within and between venues. This should prove an important milestone in accessible AV progress and provide important information for moving forward.

Autonomous vehicle technologies have the potential to drastically improve access for people with SCI/D, as well as for people who have vision, hearing, intellectual and developmental disabilities. People with disabilities need to be engaged in and help guide the development of AV technologies.

For more information on HERL, visit herl.pitt.edu.

Rory A. Cooper, PhD, is the founder and director of HERL, while Brad Dicianno, MD, serves as the organization's medical director and chief operating officer. ■