What does a driverless future look like?

December 2 2016, by Caroline Newman

Imagine a commute where, instead of steering yourself through traffic, you can sip your coffee, get some work done or even nap while your self-driving vehicle makes your commute for you. Or perhaps your whole family could pile into a hotel-like car, sleeping through the night while your car takes you home for the holidays.

It sounds futuristic, but experts at the University of Virginia are already thinking about the implications as companies like Google, Amazon, Uber and Tesla design and test their first self-driving cars. Google's autonomous vehicles have hit the streets in California, and the startup NuTonomy just announced that it will begin testing a U.S. fleet in Boston after successful tests in Singapore. In October, Uber put the first autonomous truck on the nation's highways, transferring 50,000 cans of Budweiser from a brewery in Fort Collins, Colorado to Colorado Springs, 120 miles away.

Urbanization vs. 'Hyper-Sprawl'

At UVA, Andrew Mondschein, an assistant professor of urban and environmental planning in the School of Architecture, is one of several professors studying how these vehicles could impact everything from the design of our cities and roadways to the quality of our environment.

According to Mondschein, there are two ways the future could go: "a very sustainable, very urban-oriented future, or something that is basically hyper-sprawl."

In the first scenario, Mondschein said, shared fleets of self-driving cars could shuttle people around cities and reduce the need for privately owned vehicles, thereby reducing vehicle emissions. More people might also walk, cycle or use public transit for short distances while hiring self-driving cars for longer distances.

His colleague in the School of Engineering, assistant professor of civil and environmental engineering Donna Chen, found that, compared to current transportation modes, a fleet of self-driving vehicles could offer price-competitive transportation making around 22 trips per day, roughly four to seven times the rate of individually owned, driver-operated vehicles. If a ride-sharing program were instituted, she said, that rate could double.

"Self-driving vehicles could be a perfect option for overcoming barriers currently limiting car-sharing and green vehicle adoption," Chen said.

In his second scenario, Mondschein points out that self-driving cars could exacerbate suburban sprawl, because people could be more productive while commuting and more willing to undertake longer commutes and move further from their jobs. Cars could function as extended living spaces, where people spend more and more of their time.

"Already, we are seeing both of these trends develop, as our cities are getting denser and using a mix of walking, biking and transit, while people are also moving further away from their jobs in search of affordable places to live," Mondschein said. "We will probably confront an even more bifurcated way of thinking about our cities and how we get around."

New Choices in Urban Design

The choice between those two futures could be up to planners and public

officials in individual cities, Mondschein said.

He points to London as one example. There, city officials chose to use revenue from a congestion charge to narrow central London's roadways, leaving less room for cars and more for cyclists and pedestrians.

"Some drivers complained, but it did create a much higher level of service for pedestrians, cyclists and transit riders," Mondschein said.

Because self-driving cars are expected to be more accurate than human drivers, widespread adoption could lead to more highway capacity, narrower lanes and more space.

"We will need to decide if we want to use the surplus road width to pack more cars in or to widen sidewalks and bike lanes. Every city is empowered to make those choices," Mondschein said. "I think there is a lot of potential to make gains in efficiencies."

Certain infrastructure changes will also depend on exactly how the technology develops. Some companies, like Google, are developing autonomous vehicles that drive independently of any network, relying on very detailed mapping programs. Others are developing connected vehicles, which rely on external infrastructure – such as sensors and alert systems – to provide information about speed, terrain and obstacles.

"Right now, there is a lot of research surrounding both models," Mondschein said. "There are important differences between the two that will affect how we build our cities."

Social and Ethical Dilemmas

Of course, such decisions carry significant social and ethical consequences. Mondschein has already given a presentation to the U.S.

Marines discussing the potential security implications of self-driving cars.

"They had a lot of specific concerns about, for example, what happens when no one grows up knowing how to drive," he said. "What if the self-driving systems fail or are shut down? How could we be more resilient?"

For citizens, self-driving cars could significantly improve the lives of those currently facing limited mobility, such as senior citizens. On the other hand, Mondschein pointed out that there are significant ethical concerns about, for example, having self-driving cars drop children off at school.

"Ultimately, we will have to look at this from a social point of view," he said. "Discussions on the ethics of driverless cars have already begun."

The Engineering School's Chen also pointed out potential benefits for a group she calls "captive riders" – those who are forced to rely on public transportation because they cannot afford to own a car. Those riders are fairly well-served in large urban areas, she said, but often endure long waits and irregular service in less-urban settings. Self-driving cars could improve their mobility, provided that the services are not cost-prohibitive.

"We would need to think about cooperation between public agencies and private entities, who might own and operate self-driving fleets, and what might happen to those who cannot afford the price per trip," Chen said.

Chen also said that the proliferation of self-driving cars could change the housing landscape by reducing the need to live so close to major transit hubs and thus reducing price hikes in those areas.

"It could challenge ideas of gentrification and dilute land value so that it

is not quite as extreme," she said.

Both Mondschein and Chen acknowledge that answers to many of these questions remain unknown. The technology is simply not there yet, though both believe it is coming.

"I am not skeptical that this will eventually happen, because it does seem that many things are lining up to facilitate this future," he said. "But, there is a lot to go through first. There are a lot of systems that have to be developed in order for this driverless future to occur."

Provided by University of Virginia