

Policy Briefing

Autonomous Vehicles for Small Towns: Exploring Perception, Mobility, and Safety

Project #: 05-109

Safe-D National UTC

Texas A&M Transportation Institute



Executive Summary

As of 2021, there were 18,696 small towns in the US with a population of less than 50,000. These communities typically have a low population density, few public transport services, and limited accessibility to daily services. This can pose significant challenges for residents trying to fulfill essential travel needs and access healthcare. Autonomous vehicles (AVs) have the potential to provide a convenient and safe way for people to get around as they do not require human drivers, making them a promising transportation solution for these small towns. AV technology can become a first-line mobility option for people who are unable to drive, such as older adults and those with disabilities, while also reducing the cost of transportation for both individuals with special needs and municipalities. The report includes our research findings on 1) how residents in small towns perceive AV, including both positive and negative aspects; 2) the impacts of ENDEAVRide – a novel “Transport + Telemedicine 2-in-1” microtransit service delivered on a self-driving van in central Texas – on older adults’ travel and quality of life; and 3) the potential safety implications of AVs in small towns. This report will help municipal leaders, transportation professionals, and researchers gain a better understanding of how AV deployment can serve small towns.

Introduction

As of 2021, there were 18,696 small towns in the US with a population of less than 50,000; they are home to about 80 million [1]. These communities typically have a low population density, few public transport services, and limited accessibility to daily services [2-4]. This can pose significant challenges for residents trying to fulfill essential travel needs and access healthcare. Studies have also demonstrated that small and rural areas account for a disproportionately high rate (53 percent) of road fatalities [5, 6]. However, since the COVID-19 pandemic, there is a considerable spike in populations moving out of metro areas, leading to a noticeable population growth in small and rural communities [7]. Such communities are attractive because of the lower living costs, relaxed lifestyles, scenic beauty, and lower crime rates [7]. Population increase in these small communities has also led to economic revitalization [7]. This trend highlights the importance of small towns as future activity centers, thus necessitating critical transportation planning interventions to improve existing transportation services and infrastructure.

Autonomous vehicles (AVs) have the potential to provide a convenient and safe means to get around without requiring human drivers, making them a promising transportation solution for these small towns. AV technology can become a first-line mobility option for people who are unable to drive, such as older adults or people with disabilities, while also reducing the cost of transportation for both individuals with special needs and municipalities. As with most technologically advanced equipment/devices, current AV research has been carried out primarily in dense, urban contexts, overlooking the perspectives of people from small and rural communities. As a result, such communities have often fallen out of the radar of public sector investment and for-profit competitors in the AV technology space [6].

The report aims to address such a gap by presenting our research findings on 1) how residents in small towns perceive AV, including both positive and negative aspects; 2) the impacts of ENDEAVRide – a novel microtransit service delivered on an autonomous van in central Texas – on older adults’ travel and quality of life; and 3) the potential safety implications of AVs in small towns. This report will help municipal leaders, transportation professionals, and researchers gain a better understanding of how AV deployment can serve small towns.

Method

Our cross-sectoral, interdisciplinary team aims to answer the following convergence research questions:

1. [PERCEPTION] How do residents in small towns perceive the safety and societal impacts of AVs?
2. [MOBILITY] How does ENDEAVRide – a novel microtransit service delivered on an autonomous van – impact older adults’ travel and quality of life?
3. [SAFETY] How can traffic safety be enhanced in small towns with the adoption of AVs?

In order to answer the above questions, our team has carried out the following major activities.

To answer the above questions, we carried out a baseline survey, a 2.5-month travel studies, focus groups, interviews, and safety analysis.

Results and Discussion

Small Towns Are Unique

We have observed several significant differences between our results with the nationwide studies regarding the perceptions of AVs. First, the level of enthusiasm for AVs among rural residents of Texas seems much higher than their national counterparts, i.e., 76% vs. 40% [8]. This could be due to the predominant, automobile-centric nature of small cities in Texas. Having very limited public transportation services, participants in our study area would find themselves more dependent on automobiles than those from the national sample [9]. Correspondingly, our participants were more enthusiastic about automobile-related technological advancements. At the same time, our participants are slightly more worried about AVs than others in previous studies, i.e., 65% vs. 53% [8]. This result also shows that the idea of a future with AVs as a transportation option has already trickled down from large metropolitan areas to small and rural communities. This is also indicative of the awareness of people from small and rural communities towards driverless technologies and beckons to the future where people from such areas will have their transportation needs fulfilled by AVs.

Furthermore, participants of 65+ years are the most enthusiastic and less worried about AVs. This finding warrants attention as the existing literature shows that older people as being less enthusiastic and express wariness about the development of technology, including AVs [8, 10-12]; for example, a recent Pew Research Center study revealed that 53% of the people of 50 years and older view AVs as not good for society and argue that these vehicles would increase traffic fatalities and injuries [12]. Positive responses in our study can be attributed to the potential benefit of AVs that they can empower small-town older residents [13] with more independence. This is one of the major findings of this study and can have policy implications for the deployment of AVs in small towns.

Older people are often limited regarding travel options; if they cannot drive, they are dependent on others for their travel needs or on public transit. In the case of small and rural communities, the population is usually scarce and spread out, activity points are few and far between, and public transit service is mostly neither available nor viable. As such, older residents in these communities are often dependent on others for their travel needs. AVs present a unique

and futuristic option to help these people to be more mobile and independent in their daily lives, which is reflected in their enthusiasm for AVs.

AV-Enabled Microtransit for Small Towns

The results presented in this report demonstrate positive impacts of the ENDEAVRide pilot program on improving accessibility for older adults and people with disabilities. Currently, the City of Nolanville, in collaboration with ENDEAVR Institute and the Hill Country Transit District, is maintaining the service. Our pilot program has shown the viability of such a service model for small and rural towns, effectively meeting the local travel demand. However, it should be noted that the lack of transit stations at destinations poses a challenge, as Nolanville only has one FRT station located next to the train track, making it less accessible and less preferred by residents. Moreover, one notable success story from our services involves a participant who landed a new job after being transported to multiple job interviews, which were previously inaccessible to her. During the focus group meetings and individual interviews, significant concerns were raised regarding the safety and operation of driverless on-demand transit. These findings align with previous research on the perception of driverless vehicles. However, our results contribute to the field by specifically addressing the responses of older adults and people with disabilities towards driverless vehicle services integrated with smartphone applications.

Safety Implications

To ensure that the future deployment of small-town AV programs lead to desirable safety outcomes, we need to keep in mind of the significant factors affecting traffic safety and the match between perceived and objective safety measures. Roadway intersections had high match rates, consistent with previous studies. However, heavy traffic volume reduced successful matches. Respondents in rural communities did not perceive increased vehicle miles traveled (VMT) as hazardous, despite actual crashes. Exposure to traffic incidents decreased successful matches, indicating higher risk-taking among those involved in accidents due to the transportation environment.

While planning for the deployment of AVs programs for small-town America, policy makers need to develop targeted safety education programs for residents to enhance their ability to recognize hazardous scenarios. The number of household cars was significantly related to match rates, reflecting the association between car accessibility, driving experience, and detecting dangerous transportation environments. High-income neighborhoods lacked dangerous traffic scenarios, leading to misaligned risk perception. Interventions should prioritize low-income neighborhoods with fewer cars, such as implementing Complete Streets Policies to reduce accidents and improve public health. Neighborhood vitality factors like employment, household entropy, and population density increased traffic risk match rates, indicating heightened risk awareness. Planners should model these neighborhoods to reduce accidents in areas with confusing risk levels. Low-wage employment neighborhoods showed misalignment in traffic risk, suggesting economically disadvantaged commercial districts with sparse population density. Interventions could include site-specific road safety messages for employers and through-travelers.

Recommendations

The report has documented evidence about how AVs are perceived in small-town America and their implications for mobility and safety. Overall, study participants agreed with AVs' stated

impacts such as increased independence for older people and individuals with disabilities, potential job loss for those who drive professionally, and the need for safety drivers onboard. This positive reception is significant as it reflects views from disadvantaged populations with limited transportation options. Surprisingly, older people in the study communities showed enthusiasm for AVs, contrary to previous research. These insights shed light on AV acceptance in small and rural communities and emphasize the need for further research, policy innovations, and engineering solutions to effectively implement AVs in these areas. AVs have the potential to enhance mobility, accessibility, affordability, and public transit in these communities, while also promoting equity and reducing traffic congestion.

To better understand AVs' safety implications, we developed GIS-based instruments to measure and compare perceived traffic safety risk locations with observed traffic risks in Texas small towns. We found that perceived risk locations do not always align with high crash rates, suggesting unreported traffic events in certain regions. Personal factors such as having a valid driving license and recent crash involvement influenced individuals' sensitivity to perceive crash-intensive areas. Additionally, the built environment factors, including density, diversity, walkability, and location efficiency, influenced the alignment between perceived and observed risk locations. Our binary logistic regression model could determine whether a perceived risk location matches the observed risk locations with high accuracy, demonstrating the potential of perception data for road safety assessments. Our human-centered transportation dashboard for small towns, developed using heterogeneous datasets and AI techniques, offers enhanced road information, navigation tools, and visualizations, empowering transportation managers to make informed decisions. It showcases the potential of AI and video data in developing interactive transportation dashboards for small towns and paves the way for future research in this field. It holds promise for optimizing traffic management, reducing accidents, and improving transportation efficiency, contributing to safer and more efficient transportation systems in small towns.

Small and rural communities, including suburbs, have experienced an increase in population as more people adapt to flexible and remote work arrangements. This trend has led individuals to seek refuge from the busy urban environment, opting for quieter and more affordable small communities. Innovative programs like ENDEAVRide could contribute to sustaining the small-town renaissance. This pilot program was supported mainly by local funding, volunteers, and private donations. Its significant impacts on participants' travel and accessibility to essential services are encouraging evidence that emerging technologies such as AVs could lead to affordable mobility solutions for small towns. The program's positive impacts on and acceptance by residents are built upon strong partnerships among local stakeholders, nonprofits, and the industry.

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