Smart and Resilient Transportation

Exploring attitudes and perceptions regarding a self-driving demonstration

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Abstract

Purpose – Public opinion regarding autonomous vehicles (AV) heavily influences how quickly the technology will be implemented and adopted in the future. However, there is a dearth of empirical evaluations in the literature about riders' perceptions toward service characteristics of shared autonomous vehicles (SAVs) and their attitudes toward developing AVs. Therefore, the aim of this study is to identify attitudes, views and concerns regarding a self-driving demonstration called RAPID (Rideshare, Automation and Payment Integration Demonstration) incorporated with an already-existing on-demand ridesharing service in Arlington, Texas.

Design/methodology/approach – This study developed a ridership survey to collect data from those who had experience using the service at least once during the service deployment. As the RAPID service operations were restricted to the areas near the University of Texas at Arlington (UTA) campus, sample population of this study is highly skewed with all participants being affiliated with UTA.

Findings – Findings indicated that survey respondents positively perceived the service features, including comfort, boarding the vehicles, ride safety, booking and scheduling, vehicle speed, climate control and service cost. To complement the survey results, the authors conducted interviews and a focus group study and used conventional content analysis to gain more in-depth insights about RAPID service operations from the

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perspectives of users and non-users in the post-implementation period. The results indicated that geographic accessibility, service availability and trip cost were the primary concerns of the focus group participants.

Originality/value – This study offers critical insights into individual attitudes and perceptions toward shared AVs (SAVs) that will assist local, state and federal transit authorities and planners in formulating policies and transportation strategies to target SAV ridership when the service is more widespread.

Keywords Benefits, Challenges, Attitudes, Perceptions, Autonomous vehicles, Shared autonomous vehicles

Paper type Research paper

Introduction

Emerging technologies like autonomous vehicles (AVs), and electric vehicles are anticipated to bring a paradigm shift in future transport mobility (Hilgarter and Granig, 2020; Pamidimukkala *et al.*, 2024). AVs will alter the transportation industry particularly in consumer experiences, and transportation modes (Chan, 2017; Khan *et al.*, 2023a). The emergence of AVs will disrupt travel patterns, vehicle ownership, residential patterns and vehicle miles/kilometers traveled (Patel *et al.*, 2023; Zmud and Sener, 2017). In the USA, the prevailing means of transportation is the private car or small truck with around 24% of households possessing three or more automobiles (Center for Sustainable Systems, 2021). This prevalence of privately owned automobiles contributes to issues such as traffic jams, greenhouse gases and deadly accidents. The USA documented a total 5.47 million vehicular accidents in 2020, which led to around 2.48 million minor injuries and 36,428 fatalities (Bureau of Transportation Statistics, 2022). AVs are anticipated to yield numerous advantages by reduction of traffic congestion, enhancement of fuel savings, decrease of pollution, prevention of deadly accidents and advancing mobility for individuals with disabilities (Fagnant and Kockelman, 2015; Khan *et al.*, 2023b; Patel *et al.*, 2021). According Litman (2020) analysis of the market penetration of autonomous cars, half of all new vehicle sales by 2045 and half of the fleet by 2060 will be AVs. The National Highway Traffic Safety Administration has classified AVs into six classification levels: level 0 (momentary driver assistance) to level 5 (full automation) (National Highway Traffic Safety Administration, 2022). Over the past few years, 17 shared AV [shared autonomous vehicles (SAV)] pilot projects have been successfully deployed across the USA with operations on public highways or planned neighborhoods. Nevertheless, due to limited presence of AVs on public roads, with the exception of a few AV testing and pilot initiatives, accurately predicting the impacts of AVs remains a challenging risk (Zmud and Sener, 2017).

Past studies have focused on the factors influencing the acceptance of AVs with predominant emphasis on sociodemographic aspects such as age, gender, education and income (Krueger *et al.*, 2016; Haboucha *et al.*, 2017; Hulse *et al.*, 2018; Zoellick *et al.*, 2019). Age was found to be a significant factor influencing the SAV adoption in most research, indicating that individuals who are below the age of 50 are more receptive to AV technology than older individuals (Krueger *et al.*, 2016). According to studies by Wang and Akar (2019) and Wang and Zhao (2019), it has been revealed that women exhibit a higher level of apprehension regarding the safety and security aspects of AVs, which consequently leads to a decreased likelihood of their adoption and utilization of this technology. According to few studies, individuals with higher levels of education and income, residing in metropolitan areas with more exposure to traffic accidents, tend to be early adopters for AVs and pay for SAVs (Schoettle and Sivak, 2015; Shabanpour *et al.*, 2018).

Scholars have also underscored the significance of attitude on the AV adoption (Bansal *et al.*, 2016; Liu *et al.*, 2019; Zhang, 2019; Asgari and Jin, 2019) looked at the factors that influence people's willingness to pay for AVs and found people are ready to pay for them if the ride saves them money and time. Several studies have emphasized the significance of service qualities in the adoption of AVs including cost of the service, travel and wait time, safety and mobility which were identified as crucial indicators that influence the acceptability of SAVs (Krueger *et al.*, 2016; Jing *et al.*, 2020). Most of the recent studies have also used a quantitative method to study the adoption of AVs (Etminani-Ghasrodashti *et al.*, 2023; Gurumurthy and Kockelman, 2020; Penmetsa *et al.*, 2019). Nevertheless, most of this research was primarily on individuals without any prior AV ridership experience.

Based on the available literature, it appears that only three studies have looked at people's attitudes and perspectives after having first-hand experience with AV technology (Nordhoff *et al.*, 2019; Salonen and Haavisto, 2019; Hilgarter and Granig, 2020) evaluated the perception of urban and rural inhabitants who experienced a Level 3 AV and discovered that the users recognize them as an additional means of transport instead of a substitute for existing transportation options. Nordhoff *et al.* (2019) concluded similar findings, indicating that AV users were inclined to use AVs as a supplementary service for transportation. According to Salonen and Haavisto (2019), individuals experience a sense of security while using autonomous shuttles but exhibit lower levels of tolerance of AV-induced mishaps than those caused by human drivers.

While previous research has yielded insights into consumer concerns, and preferences around AVs, and key factors influencing the adoption of SAVs, there remain unanswered research questions. There is a dearth of empirical evaluations in the literature about riders' perceptions toward service characteristics of SAVs and their attitudes toward developing AVs. This lack of research can be attributed to the predominant focus on potential riders who have not yet had the opportunity to experience SAVs firsthand. Consequently, studies need to examine the perspectives of actual SAV riders since these insights are crucial for understanding and predicting future SAV adoption rates. Our objective is to fill this void in the existing body of research by providing answers to the following questions:

Q1. How do users perceive an SAV service integrated with the existing transportation system?

Q2. What are the user and non-user attitudes toward the challenges and benefits of future AVs?

Q3. What are user and non-user preferences for future SAV services?

Q4. What are the crucial barriers to SAV adoption?

This study aims at providing a thorough comprehension of the perceptions and attitudes of users' and potential users' through the analysis of data collected from a survey on ridership experiences, personal interviews and a focus group. These research methods will provide valuable insights into the realistic views held by people regarding AVs.

Research methodology

SAV demonstration

This research focuses on the Rideshare, Automation and Payment Integration Demonstration (RAPID), a pilot project that operates self-driving shuttles in Arlington, TX that operated from March 2021 for one year. The major stakeholder in the RAPID SAV pilot project were

May Mobility, Via Transportation and the University of Texas at Arlington (UTA) and the city of Arlington. Within the scope of this project, AVs provided service to the UTA campus and downtown Arlington (see Figure 1), giving complimentary trips to students from 7:00 a.m. to 7:00 p.m. Monday through Friday. The service consists of a fleet comprising four Lexus RX 450 h hybrid vehicles and one WAV Polaris GEM specifically designed to accommodate wheelchair users, capable of reaching up to 25 mph speeds.

Data collection

Ridership experience survey. This study developed a ridership experience survey to collect information from the users to rate their experience riding the RAPID SAVs. The study's target population comprised individuals aged 18 and above who have used the RAPID service at least once. The questionnaire compromised of a range of questions pertaining to the many aspects of the RAPID service including ride safety, price, comfort, speed, waiting time and booking and scheduling. The survey also asked for sociodemographic information like gender, age, ethnicity and household income. The survey was distributed with the help of Via Transportation through their app. About 402 people submitted the survey, and 261 (65%) completed responses were collected. The average amount of time required to complete the survey was around two minutes.

Interview study. The team designed a structured interview guide with questions about individual travel behavior, attitudes toward AV technology, perception of SAV service and sociodemographic factors. Additionally, a screening questionnaire was created and disseminated through a variety of channels, to identify potential interview participants. The online interviews were administrated via the Microsoft Teams platform with 11 individuals (7 students and 4 UTA faculty or staff), who expressed their interest in taking part in this study by completing the screening survey. The average time taken for an interview session was 29 min.

Focus group study. Following the same methodology adopted in the interview study, we conducted a focus group study. The focus group session was facilitated using the Microsoft teams Platform with two UTA faculty or staff and two students who expressed their interest in taking part in this study by completing the screening survey. At the beginning of the focus group

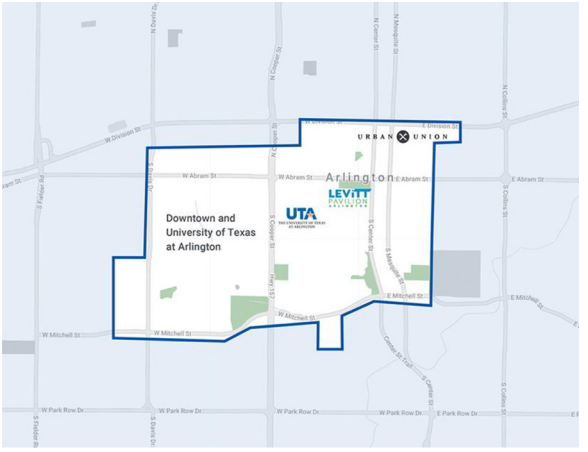

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Figure 1. RAPID SAV service area

discussion, the facilitator provided individuals with succinct details regarding the goals of the study and procured their verbal approval to participate. The duration of the study was around 52 min.

Results

Survey data analysis

Descriptive analysis of survey responses. The descriptive statistics of ridership survey respondents indicated that 66.3% of them were females and 28.0% were males. A large majority (90.4%) of the participants were under the age of 35 years. More than half (56.7%) of the participants were Asian, followed by African American (20.3%) and white (12.3%) respectively. Almost 70% of these riders were from a low-income household with annual income of less than $35,000. Almost one-third (32.2%) of the survey participants had used the RAPID service just once, while 42.2% of participants used RAPID at least once a week, as shown in Figure 2.

Survey results. The RAPID users were requested to assess their perception of RAPID service attributes based on a 6-point agreement scale for this ride. A majority of the respondents showed a high level of satisfaction with their experience riding the RAPID SAV service, as shown in Figure 3. Results indicated that respondents highly rated (agree or strongly agree) the seating comfort (93%), boarding vehicle (91%) and ride safety (83%). Booking and scheduling (81%), vehicle speed (80%), climate control (79%) and service cost (78%) were also well rated among the RAPID service attributes. Moreover, respondents rated waiting time (62%) and appropriate pick-up and drop-off location (62%) as the lowest rated attributes of the RAPID service. One possible explanation for these low ratings might be the elevated demand observed during certain hours of the day and the inherent characteristics of shared rides involving condensed pickup and drop-off points. Only 60% of riders agreed they felt safe while sharing the ride with other passengers, but it is worth noting that 24% of respondents did not share their ride with any other passenger. Interestingly, 89% of the respondents agreed to ride the RAPID service again.

To explore how user's perception of RAPID service attributes affected the users' adoption of RAPID in the future, we used a regression model. The users' adoption of RAPID in the future depends on how RAPID users perceive service attributes (see variables in Figure 3). Since the adoption of RAPID in the future was measured based on a Likert scale from 1 = strongly disagree to 5 strongly agree, we used an ordinal regression analysis.

Ordinal logistic regression is used to predict an ordinal dependent variable using interactions between independent variables. Before running ordinal regression assumptions, we checked to make sure no multicollinearity exists between independent variables. We first tested the model by evaluating the Goodness-of-Fit. The Cox and Snell R^2 value of 0.563 suggests that the ordinal regression model accounts for about 56.3% of the variation in the dependent variable and explains a significant portion of the variability in the dependent variable. Nagelkerke's R^2 value of 0.669 suggests that the model explains a substantial portion of the variability in the dependent variable, considering the predictors used. a McFadden value of 0.448 suggests that the model explains a moderate portion of the variability in the dependent variable, considering the predictors used.

The ordinal regression analysis explored various determinants influencing the prospective adoption of RAPID SAVs. Within this analysis, critical determinants contributing to the likelihood of future adoption were identified. Users' perceptions of SAV ride safety and the convenience of booking/scheduling rides were highlighted as notably significant factors that positively influence the inclination of users toward adopting RAPID SAVs. Moreover, the analysis revealed that speed and ride costs also play pivotal roles in determining the likelihood of SAV adoption, emphasizing their impact on user choices. Additionally, factors

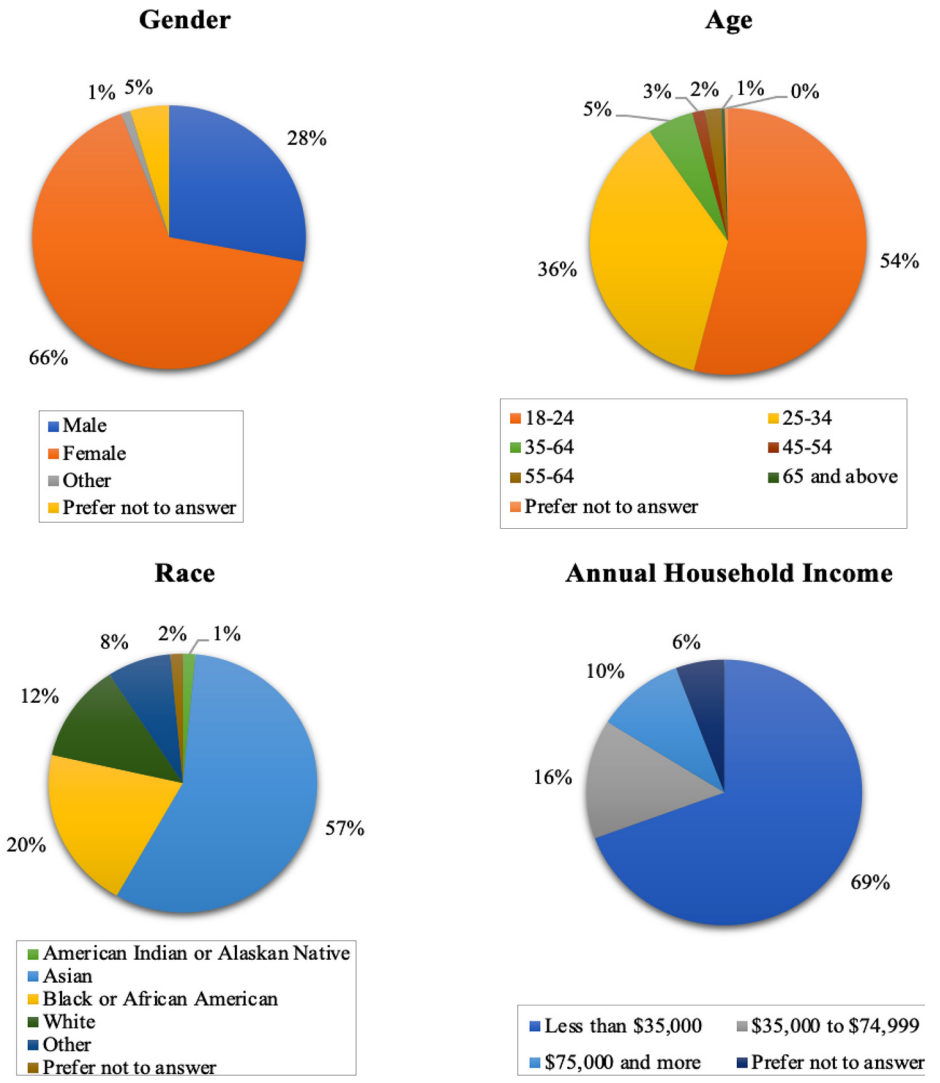

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Figure 2. Descriptive statistics of survey participants

such as the ease of boarding and the presence of appropriate climate control in the vehicle were observed as influential factors contributing to the probability of future SAV adoption among users. Furthermore, the regression model meticulously accounted for respondents' sociodemographic attributes, uncovering their influence on the potential adoption of SAV services. Particularly, the results demonstrated that race showed a positive association with the acceptance of future SAV services. It's noteworthy that Asian respondents exhibited the

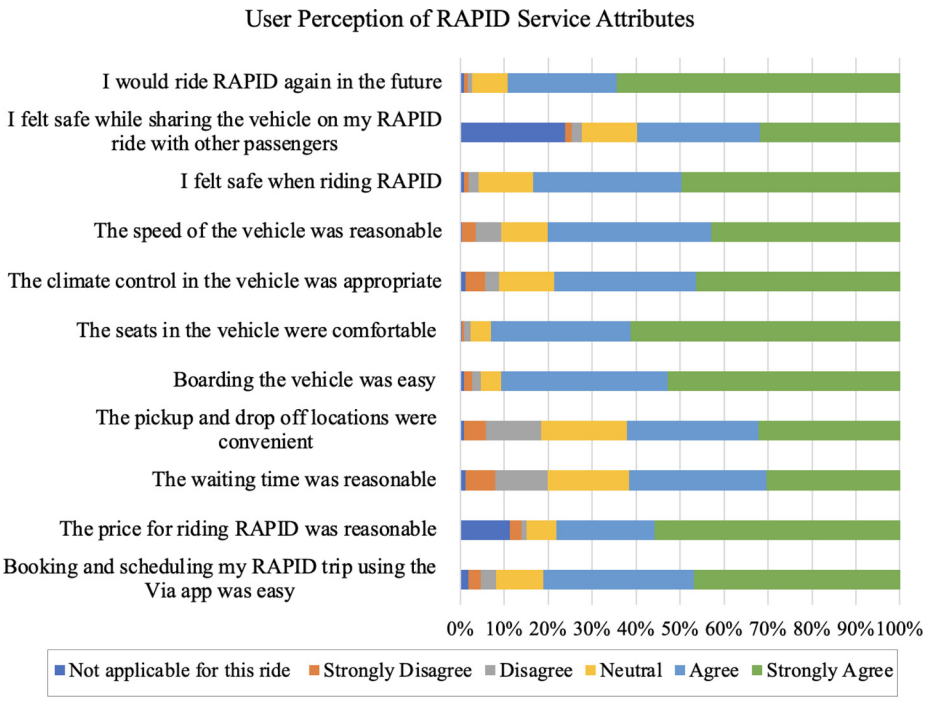

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Figure 3. User perception of RAPID service attributes (n = 294)

highest probability of adopting SAVs in the future, followed by white and black/African American individuals. Additionally, the analysis unveiled a slight, yet negative, association between male respondents and their inclination toward the adoption of future SAVs. These detailed findings shed comprehensive light on the multifaceted aspects and societal influences shaping the probability of users' future adoption of RAPID SAVs. See Table 1.

Descriptive statistics of focus group and interview participants

- Interview Participants

The interview study included a sample size of 11 participants. Seven out of 11 individuals were females. More than half (55%) of these participants were living off-campus. Seven individuals had a driving permit and owned at least one vehicle for transportation. Similarly, seven individuals had used the RAPID SAVs while the other four individuals had not used RAPID, as shown in Table 2.

- Focus Group Participants

The focus group study included a sample size of four participants. Three out of four individuals were females. A majority (75%) of these participants resided off-campus, while

Table 1. Results from regression analysis

	Estimate	Std. error	Wald	df	Sig	95% confidence interval Lower bound	Upper bound
V1. EasyBooking	0.565	0.206	7.483	1	*0.006*	0.160	0.969
V2. RidePrice	0.277	0.117	5.633	1	*0.018*	0.048	0.506
V3. WaitingTime	0.191	0.183	1.091	1	0.296	−0.167	0.549
V4. Convenient_PickDropp	0.174	0.194	0.803	1	0.370	−0.207	0.555
V5. EasyBoarding	0.536	0.251	4.567	1	*0.033*	0.044	1.028
V6. ComfortableSeat	0.351	0.331	1.128	1	0.288	−0.297	0.999
V7. AppropriateClimateCtrl	0.412	0.193	4.561	1	*0.033*	0.034	0.791
V8. ReasonableSpeed	0.627	0.250	6.297	1	*0.012*	0.137	1.117
V9. RideSafety	0.864	0.290	8.856	1	*0.003*	0.295	1.432
V10. RideshareSafety	−0.023	0.112	0.043	1	0.836	−0.243	0.196
Age	−0.214	0.291	0.544	1	0.461	−0.784	0.355
Household income	0.096	0.139	0.481	1	0.488	−0.176	0.369
Gender = Female	−1.232	1.226	1.010	1	0.315	−3.634	1.170
Gender = Male	−2.052	1.227	2.794	1	*0.095*	−4.457	0.354
Gender = Other	1.028	1.947	0.279	1	0.597	−2.788	4.845
Race = American Indian or Alaska Native	4.058	1.983	4.188	1	*0.041*	0.171	7.944
Race = Asian	2.870	1.001	8.218	1	*0.004*	0.908	4.832
Race = white	2.305	1.059	4.740	1	*0.029*	0.230	4.379
Race = black or African American	2.432	1.374	3.134	1	*0.077*	−0.261	5.124

Notes: V1 = Booking and scheduling my RAPID trip using the Via app was easy; V2 = The price for riding RAPID was reasonable; V3 = The waiting time was reasonable; V4 = The pickup and drop off locations were convenient; V5 = Boarding the vehicle was easy; V6 = The seats in the vehicle were comfortable; V7 = The climate control in the vehicle was appropriate; V8 = The speed of the vehicle was reasonable; V9 = I felt safe when riding RAPID; V10 = I felt safe while sharing the vehicle on my RAPID ride with other passengers
Source: Table created by authors

25% lived on-campus. All these individuals had an authorized driving permit and owned at least one automobile for transportation. All these individuals were highly educated. However, only one individual had ridden the RAPID SAVs.

Content analysis

The focus group and interview session were all audio and video recorded and translated using the Microsoft Teams. The recordings were processed and examined using the MAXQDA software. The researchers used the usual content analysis to examine the material from open-ended questions in the focus group and interview sessions (Forman and Damschroder, 2007). The primary topics addressed by the individuals in the sessions were categorized into themes, which encompassed areas including the perception of service attributes, apprehensions regarding current SAVs, attitudes toward SAV technology and inclinations for future SAVs. Every subject and sub-theme contained numerous quotations. However, for the sake of clarity, just a select few statements were paraphrased and succinctly defined.

Interview results

Users' perception about SAV service quality. Interview participants were not satisfied with the pre-programmed pick-up and drop-off locations of RAPID SAVs as they had to walk part of the way to reach their intended location. When asked about the waiting time of the RAPID service, a few interviewees stated they experienced a long wait time of 5–30 min. The authors have analyzed the operational data to compare the wait times and it was revealed that

Table 2. Personal characteristics of focus group participants

#	Gender	Age	Residential location	Valid driver's license	Vehicles in household	RAPID usage	Education level
Interview participants							
1	Male	DNA	Off-campus	Yes	1	Yes	Undergraduate
2	Male	25	Off-campus	No	0	Yes	Graduate
3	Female	DNA	On-campus	Yes	1	Yes	PhD
4	Female	22	On-campus	No	0	Yes	Undergraduate
5	Male	24	On-campus	Yes	0	Yes	Graduate
6	Female	21	On-campus	No	1	Yes	Undergraduate
7	Male	18	On-campus	Yes	2	Yes	Undergraduate
8	Female	DNA	Off-campus	Yes	1	No	Graduate
9	Male	22	Off-campus	Yes	1	No	Undergraduate
10	Female	57	Off-campus	Yes	2	No	Graduate
11	Female	DNA	On-campus	No	1	No	Graduate
Focus group participants							
1	Male	24	On-campus	Yes	1	Yes	Graduate
2	Female	57	Off-campus	Yes	1	No	Graduate
3	Female	26	Off-campus	Yes	2	No	Graduate
4	Female	51	Off-campus	Yes	1	No	Undergraduate

Note: DNA = did not answer
Source: Table created by authors

the average estimated wait time after the ride is booked ranged from 5 min to 15 min. For few rides the wait time also reached to 20–25 min based on the day of the week and time of the day. The content analysis revealed that regular users of the service usually share their rides with others, while those who have only used the service one or two times have not. Most interview participants had a positive outlook toward the features, like approximate waiting time, real-time location of the vehicles and service boundary integrated into the Via application used to book the SAV ride. The results revealed that the individuals who were interviewed expressed a sense of ease and satisfaction with regards to the seating arrangement and sanitary protocols implemented in service operations throughout the COVID-19 outbreak. One of the primary concerns expressed by participants, as seen in Table 3, pertained to the capacity of AVs to execute sharp turns at intersections.

Interview participants were not satisfied with the pre-programmed pick-up and drop-off locations of RAPID SAVs as they had to walk part of the way to reach their intended location. When asked about the waiting time of the RAPID service, a few interviewees stated they experienced a long wait time of 5–30 min. The authors have analyzed the operational data to compare the wait times and it was revealed that the average estimated wait time after the ride is booked ranged from 5 min to 15 min. For few rides the wait time also reached to 20–25 min based on the day of the week and time of the day. The content analysis revealed that regular users of the service usually share their rides with others, while those who have only used the service one or two times have not. Most interview participants had a positive outlook toward the features, like approximate waiting time, real-time location of the vehicles and service boundary integrated into the Via application used to book the SAV ride. The results revealed that the individuals who were interviewed expressed a sense of ease and satisfaction with regards to the seating arrangement and sanitary protocols implemented in service operations throughout the COVID-19 outbreak. One of the primary concerns

Table 3. Perceptions about quality of the SAV service quality

Theme	Sub-themes	Description
Users' perception	Pick-up and drop-off locations	- Riders had to walk further down the street to get to their destination because the SAVs would only stop at the pre-programmed pick-up and drop-off locations - The pick-up area differs from the one displayed on the app - Via offers no flexibility in selecting a preferred pick-up or drop-off location like Lyft and Uber
	Waiting time	- The waiting time for SAV users varies between 3 to 28 min
	Sharing ride with others	- Few riders did not have any passengers accompanying them within the vehicle typically - Some riders shared the ride a couple of times - A few riders had a shared ride every time
	SAV app	- The wait time displayed on the app was precise - The app has a high degree of user-friendliness - The app facilitates the payment processing easily and clearly displays the pick-up and drop-off spots
	Ride comfort	- The ride experience was characterized by high level of comfort, cleanliness, and spaciousness - The vehicle is sanitized before pick-up and after drop-off taking all precautions - There is not enough space for passengers to put their belongings inside the car
	Ride safety	- The car cannot take certain turns and goes straight - The ride was like via or uber, wherein a normal human operator is responsible for controlling the vehicle - Riders feel reassured and more comfortable by the presence of a human attendant operating the vehicle - The riders are worried about their safety because they are unaware of the safety systems and procedures - The car has safety issues for taking steep turns at intersections, necessitating the driver's intervention to execute such maneuvers successfully

Source: Table created by authors

expressed by participants, as seen in Table 2, pertained to the capacity of AVs to execute sharp turns at intersections.

Attitude toward autonomous vehicle technology. The content analysis revealed a notable absence of trust in technology, which is a significant challenge to the widespread use of AV technology. One SAV user expressed her concern about smooth communication between the passenger and the AV in the future. A few interview participants stated that the predictions of the waiting time to reach the pick-up and drop-off location was inaccurate. Results revealed that many participants were worried about the safety of AV technology and their ability to operate on public roads and the environment.

One participant stated that multitasking, such as using phone, and performing work-related tasks while traveling in AVs was a major advantage for its users. Two interview participants believed that introducing SAVs would increase access to transport for a marginalized community. Cost effectiveness was a significant advantage for SAVs, as per the interview participants. One participant revealed that crash mitigation is significant advantage of AV technology. Two interview participants also emphasized the environmental advantages of SAVs in terms of ridesharing as shown in Table 4.

Focus group results
Users' perception about SAV service quality:

- Service attributes

When asked regarding waiting time for RAPID SAVs, an SAV user mentioned he would book a ride 20–30 min in advance because the ride might be late. Participants were not satisfied with the pick-up and drop-off points of the service. An SAV user stated that the RAPID SAV does not go inside his apartment complex and instead picks him up or drops him off at the street even though the apartments have plenty of space for vehicles and parking. As a result, he has to walk about 2–3 min to reach his final destination.

We asked participants about the experience while booking a RAPID ride on the Via app. One SAV user mentioned that the Via application used to book the RAPID SAV rides lags when providing accurate information to the customers about their rides. A non-user participant revealed that using the Via application was easy as the user interface was relatively similar to other services. When asked about ride comfort, an SAV user expressed contentment with the seating configuration and climate control of the AV as shown in Table 5:

- RAPID Concerns

One of the major concerns raised by focus group participants was the availability of the SAV service. One focus group participant stated that he and his friends, who were regular users of RAPID SAVs, found it difficult to get a RAPID SAV ride within the timeframe of 2:00 and 3:00 p.m. on weekdays.

Participants also conveyed their concern about geographic accessibility. One participant stated that she would be open to using RAPID SAV if it offered service to one of the commuter train stations like Via serves. Another person added that if RAPID offered service to surrounding cities, more people would take advantage of it.

According to a participant, one of the primary concerns was the higher service cost for short distances. RAPID costs $3 to $4 for short-distance rides, and he proposed making use of RAPID SAVs on the UTA campus free for students. It is worth mentioning that the provision of the service to university students during the initial year of implementation was made available at no cost, facilitated by the grant received from the Federal Transit

Table 4. Attitudes toward future SAVs

Themes	Sub-themes	Description
AV challenges	Distrust toward technology	- The acceptance of AV technology among individuals is expected to take longer despite its potential benefits
	Lack of communication	- The AVs will lack personal communication with the riders while picking up and dropping off multiple people
	Technology reliability	- The wait time shown on the application must be stable and not keep on changing - The SAV is very slow in comparison to a human-driven car - The vehicle's capability to arrive at the pick-up and drop-off points in a specific time frame
	Technology safety	- The AV technology is not yet fully evolved to begin rolled out completely - The vehicle would do quirks like stopping far back from the intersection or maybe just above the stop sign raising safety concerns - Riders did not feel safe riding AVs outside of the university premises
AV benefits	Multitasking	- It will be beneficial to work efficiently due to the absence of vehicle monitoring
	Cost efficiency	- It is economical as I can share the ride with my friends - It is more economical as compared to other services
	Transportation affordability	- It would be beneficial for those with disabilities - A significant benefit is the ability of those who may not have a vehicle to travel around
	Crash mitigation	- AVs would avoid car crashes due to less human intervention
	Environmentally friendly	- The environment benefits from ridesharing because it reduces carbon emissions and promotes sharing - People going to the same destination may be encouraged to carpool

Source: Table created by authors

Administration. Following the first year, the RAPID service started offering $1 discounted rides to UTA students:

- Reasons for not riding RAPID

We asked non-users about the reasons they did not choose to ride RAPID. A participant stated that she attempted using the RAPID service once, but the pick-up point was very far away when she tried to book RAPID, so she booked an Uber to drop her off at her final destination. Another participant said that because she was a new student at UTA, she lacked awareness regarding the activities offered by the RAPID program:

Attitude toward SAV technology.

- Future SAV Adoption

Comfort and price were mentioned as critical factors for the future SAV adoption. One respondent mentioned that since Arlington does not have public transit, people are inclined to using application-based on-demand services like Uber because they have no other option. However, in the future, if an SAV service provides comfortable rides at better prices, people will use them regularly. Another participant mentioned that she is optimistic about SAVs being used as a mode of public transport due to their enhanced flexibility compared to traditional fixed route services as shown in Table 6:

- SAV Concerns

Table 5. Perceptions about quality of the RAPID SAV service

Theme	Sub-themes	Description
Service attributes	Wait time	- I will make my reservation about 20 to 30 min in advance because the ride can be running late occasionally
	Mobile app	- App lags to deliver accurate details to the rider
		- It's moderately simple, particularly if you've used a similar app before
	Pick-up and drop-off points	- The preferred pick-up and drop-off points are far away
		- Riders need to walk two or three blocks to reach the pick-up or desired drop-off points
	Ride comfort	- It was a comfortable ride and I had a positive overall experience
RAPID concerns	Service availability	- It is hard to access the service after 3:00 PM
		- Ride available after 15 min
	Cost of the service	- It charges $3 to $4 for a very short distance from my west campus flat to the central library
	Geographic accessibility	- RAPID does not provide access to the nearby train station (CentrePort)
		- The service coverage is limited to certain parts of Arlington
		- It initially showed me that via was not available around this area, but fifteen minutes later, I was able to book the ride for the same destination
		- If they expand the RAPID service area, students can use RAPID to travel instead of Uber or Lyft
		- It is not available for certain locations because of the small fleet and traffic
Reason for not riding RAPID	Lack of awareness	- A newly enrolled student was unaware of the service for the first few months
	Lack of accessibility	- Non-riders did not book RAPID because the pickup point was three blocks away so she ultimately decided to call an Uber

Source: Table created by authors

Table 6. Attitudes toward SAV technology

Theme	Sub-themes	Example quotes
Future SAV adoption	Comfort and price	- People will use it more frequently if the price is lower and they are comfortable using it - SAVs are more economical with low emissions as an added benefit
	Flexibility	- The prospect of AVs or SAVs serving as a mode of public transportation excites riders due to its flexibility compared to a fixed route system
SAV concerns	Lack of trust	- Human concern that it might do something wrong requires you to maintain a continual eye on the road
	Loss of connection	- Riders were concerned about the loss of connection between the vehicle and the operator
SAV benefits	Mobility for unlicensed	- It will increase mobility for international students without a license
	Environment friendly	- It will be advantageous for reducing gas emissions
Future SAV preferences	Wide service area	- It would be better if the service is offered off-campus as most people stay around the campus
	Discounted rides	- The pricing structure for on-campus transport should be free or provide few credits to students who travel often
	Improved mobile application	- The team can concentrate to enhance the users' app experience through the provision of precise information

Source: Table created by authors

Absence of faith in the technology was a major concern for using SAVs. One participant mentioned that she is comfortable riding SAVs but will always be anxious about SAVs doing something unexpected. Loss of connection between AVs was another concern mentioned by the participants. One participant stated that she was concerned regarding the intercommunication capabilities of AVs:

- SAV Benefits

Increasing mobility options for transportation disadvantaged people and communities was a major benefit stated by participants. An SAV user participant mentioned that SAVs increase the mobility options for unlicensed people like international students and people with disabilities. Another participant also highlighted the environmental benefits of using SAVs. She stated it would help reduce harmful gas emissions in the environment:

- Future SAV Preferences

One SAV non-user suggested expanding the service area of RAPID, so more people living off campus can take advantage of the service. Another user who faced issues using the Via mobile application stated that the app was unable to provide accurate information to the customer and suggested improving the app experience for future SAV customers. Moreover, he also suggested providing rides with reduced fares or credits to students who use RAPID frequently around campus.

Discussion

This study analyzed user perspectives regarding the quality of an existing SAV service by using data acquired from a survey focused on riding experiences. Additionally, using the conventional

content analysis, we analyzed users' and potential users' perceptions about the existing SAV service, reasons for not riding the SAVs and their attitudes and preferences toward future SAVs.

Results indicated that SAV users experienced long waiting times, and the pick-up and drop-off location was far from the actual location of passengers. One possible explanation for this is the real-time sharing offered by RAPID SAVs. Accordingly, vehicles may receive a ride request from other riders in the middle of a trip, thereby resulting in an extended waiting period for existing riders. To reduce passenger waiting times and encourage the adoption and use of ridesharing, one potential approach would be to expand the existing fleet capacity of these services in accordance with the demand patterns (Hörl *et al.*, 2019).

We found that people who did not use the RAPID service faced two significant barriers: limited accessibility and inadequate understanding of the RAPID service. Asgari and Jin (2019) developed the Media Based Perception Model and found that both social and mass media exerted a significant impact on the public's inclination to accept AVs. Therefore, forthcoming SAV services may use strategic marketing initiatives to effectively communicate the benefits of using SAVs, thereby augmenting their clientele.

The study's findings indicate that the primary determinants for adopting future SAVs, as reported by the participants, are price and comfort. Specifically, people may exhibit a greater inclination to use the SAVs in the future if future SAVs are more comfortable and affordable as compared to existing services. Moreover, we found that participants were excited about the opportunity to ride SAVs as a form of public transportation because it would provide more flexibility as compared to fixed transit. These findings implied that a significant number of individuals may adopt SAVs in the coming years, contingent upon their perception that this technology will enhance the comfort and convenience of travel (Lee *et al.*, 2018; Malokin *et al.*, 2021).

Users must possess a substantial level of trust to embrace AVs (Adnan *et al.*, 2018). The findings of the survey revealed that a majority (83%) of the SAV users felt safe while riding the RAPID service, and most of them were willing to ride it again. People's perceptions of AVs increase when they can experience the technology in a secure, safe and real-world environment. Transit authorities could consider starting pilot programs and the deployment of AVs in a small region to acquaint the public with the AV technology before integrating them with the current transportation system.

The findings of this study indicated that environmental friendliness was a significant advantage of using the SAVs. Participants believed that SAVs will contribute to the reduction of emissions through the facilitation of ridesharing. This is in line with Woldeamanuel and Nguyen (2018), who found that reduction in greenhouse gas emissions is the primary benefit of AVs.

The research underscores the significance of personal attitudes toward the successful acceptance of SAVs (Asgari and Jin, 2019; Liu *et al.*, 2019). Consequently, we asked participants to share their preferences for future SAVs in the city. Results indicated that both SAV users and non-users are more likely to accept and use future SAVs if the current transportation service expands its geographic reach and capacity. Results also revealed that participants demanded discounted rides for frequent SAV users to promote the service. Future SAV services could offer discounted rides by providing monthly or quarterly passes to frequent riders to promote the use of SAVs and increase SAV ridership.

Conclusion

The rate of implementation and adoption of new technology is significantly influenced by the perspectives and level of acceptability among the general audience. Therefore, it is essential to assess the existing patterns of travel, challenges, apprehensions and preferences connected

to AV pilot projects. This study provides significant insights into people's perceptions, attitudes, preferences and concerns for future SAVs.

According to the survey findings, seating comfort (93%), boarding vehicle (91%) and ride safety (83%) are the top-rated attributes of RAPID service. Although the survey participants highly rated the ride safety, the interview participants were having major concerns over the AVs' capability to execute sharp turns at crossings. Additionally, the results of the survey indicated that waiting time (62%) and appropriate pick-up and drop-off location (62%) as the lowest rated attributes of the RAPID service. This is consistent with results of focus group and interviews as few participants were not satisfied with the pre-programmed pick-up and drop-off locations and long wait times.

The results of this research indicate that comfort, lower service cost and wider geographic accessibility are most preferred when it comes to the adoption of SAVs in the future. As a result, future SAV service providers should focus on developing pricing policies for the transit-dependent population by providing discounted rides to regular users of the service. Moreover, the primary challenges impeding the utilization of SAVs are a dearth of knowledge and limited availability. Consequently, SAV stakeholders can use advertising strategies to emphasize the benefits of using AV technology to attract more customers. In addition, transit agencies that aim to incorporate SAVs into existing transportation systems should prioritize the implementation of pilot experiments. These demonstrations serve the purpose of acquainting individuals with AV technology and offering researchers and policymakers the chance to comprehend the various factors that influence the adoption of SAVs within a given region.

There are a few drawbacks of this study: (a) The sample population of this study is homogeneous with all participants being affiliated with UTA. One explanation for this is because RAPID service area was restricted near the UTA campus; (b) The sample size of focus group participants was very small as it was held virtually on the Microsoft Teams platform, so participants with limited technological proficiency were unable to engage in the conversation (c) the door-to-door operations were not considered for SAV service as it is a public transit service.

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