UTTRI

Research Report

City of Toronto West Rouge Automated Transit Project: Pre-deployment Community Survey Analysis

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The City of Toronto's Automated Transit Shuttle Pilot Project

"West Rouge Automated Transit Project"

Pre-deployment Community Survey Analysis

University of Toronto Transportation Research Institute (UTTRI)

Centre for Automated and Transformative Transportation (CATTS)

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CATTS CENTRE FOR AUTOMATED AND TRANSFORMATIVE TRANSPORTATION SYSTEMS

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Executive Summary

The Centre for Automated and Transformative Transportation (CATTS) has been launched under the University of Toronto Transportation Research Institute (UTTRI) in 2017 with the vision of analyzing and quantifying transformation within transportation systems in the era of vehicle connectivity and automation. The centre was created to guide societal transformation in a positive direction, avoid the emergence of counterproductive travel trends, and embolden Canadian cities as transportation leaders in North America and the world. CATTS has assembled a multidisciplinary team to create data analytics, methods, models, and decision support systems to quantify the impacts of transformative transportation technologies, such as connected and automated vehicles (CAV) on transportation demand, system performance, health, the environment, and society at large.

The City of Toronto has been researching and studying the potential impacts of CAV technology on the City's services and residents. The City recognizes that there are potential benefits in harnessing CAV opportunity to advance community goals in liveability, equity, sustainability, and economic development. In 2017, the City of Toronto, in conjunction with the Toronto Transit Commission (TTC) and Metrolinx, submitted a proposal to Transport Canada's Program to Advance Connectivity and Automation in the Transportation System (ACATS). The proposal, titled "Minding the Gap: Advancing Toronto's Transit System through Automation", called for a trial of an automated shuttle on a fixed route on public roads in the City of Toronto. Transport Canada approved the proposal and provided the requested funding.

The City of Toronto has retained UTTRI to evaluate the shuttle project throughout its various stages, particularly during the service launch and evaluation stages. In 2019, the City and UTTRI signed an agreement to perform data analysis and evaluation of shuttle performance and interactions. The agreement originally stated that the UTTRI team will 1) provide technical support to the City staff for designing the customer experience/perception and community panel surveys, 2) undertake descriptive analyses of the data from the surveys at various time stages: before, during and after the pilot project with the objective of improving the understanding and knowledge of the human response to automated shuttle service, and 3) undertake an analysis of the shuttle performance, interactions with existing traffic control devices, and interactions with other road users. The CATTS team, being the research centre under UTTRI that focuses on automation and transformative transportation, took the lead on this project to support the City in the project's various stages.

CATTS has provided the City with technical support for the design of passenger and the three community surveys (pre-deployment, mid-deployment and post- deployment). In January 2022, the City of Toronto terminated the project before the shuttle service opened to the public. Accordingly, the agreement with UTTRI has been revised and reduced to perform only a descriptive analysis of the pre-deployment community survey data. This report acts as the final deliverable of the City's automated transit shuttle project that includes detailed descriptive analysis of the survey data, and documentation of results and insights.

Introduction

Automated shuttles are an emerging transit option, with trials having been completed in various places across the globe, including Asia [1], Europe [2], and North America [3]. While some automated shuttles have been trialled on closed tracks, e.g., [1], several trials have been conducted in mixed traffic conditions, e.g., [3], [4]. One of the benefits of introducing automated shuttles in mixed traffic is that they can connect people to other existing transit options (e.g., first-/last-mile service).

The City of Toronto in collaboration with Toronto Transit Commission (TTC), and Metrolinx received funding from Transport Canada's program to Advance Connectivity and Automation in Transportation Systems (ACATS) to support the West Rouge automated transit shuttle pilot. The goal of this project was to test a low-speed, electric, automated shuttle vehicle that would connect Rouge Hill GO Station to destinations in the West Rouge community in south-east Scarborough. This trial was an opportunity to learn how a small neighbourhood shuttle service might connect residents to rapid transit. It was also meant to serve as a first-hand experience of how it feels to ride an automated vehicle and to interact with it on public roads.

One important factor in the success of such a project is whether people are willing to try the shuttle and if they intend to use such a service on an ongoing basis. Previous research has investigated various constructs that may influence intention to use an automated shuttle, including: attitude [1], perceived usefulness [1], [5], [6], perceived safety [5], [7], [8], and trust [9], [10]. Studies have also found that intention to use an automated shuttle may be influenced by demographic factors like age and gender [7], [8]. Tech-savvy individuals are more likely to find automated shuttles to be useful [4], and thus they may also have a higher intention to use such shuttles. Finally, current travel behaviour, specifically car use, has also been found to influence intention to use automated public transit [4].

The "pre-deployment" community survey was distributed before the shuttle was available for use by the public on August 30th, 2021, for a period of six weeks, to collect data that reflect public perceptions of the shuttle service before its deployment for public use. The objective was to investigate public perceptions about the proposed West Rouge automated shuttle service – particularly, the intention to use the automated shuttle and the constructs of attitude, perceived usefulness, perceived safety, and trust, which were identified as predictors of intention to use in previous work. Partway through data collection, the shuttle began operating on the shuttle route for operator training and shuttle testing, so some participants may have seen the shuttle prior to responding to the survey. The shuttle was eventually discontinued before opening it to public use.

This report provides a descriptive analysis of the survey responses, and analysis of the results highlighting the major findings. In our analysis, we compared survey responses before and after the shuttle began testing to examine if perceptions may have been affected by seeing the shuttle testing in the community. Demographic information (e.g., age, gender, tendency to adopt new

technologies) and current travel behaviour were also collected to explore whether these factors influenced perceptions of the shuttle service.

Materials and methods

Study Design and Procedure

The survey was designed based on a review of previous surveys of automated vehicle (AV) shuttles [1], [2], [4]–[8], [10]–[13]. In collaboration with the City of Toronto, several constructs of interest were identified (see Table 1), and items related to each construct were developed for the launched survey. The full survey can be found in APPENDIX A.

For the item assessing tendency to adopt new technologies, participants were asked to select which statement best reflected them:

1. I am skeptical of new technologies and use them only when I have to
2. I am usually one of the last people I know to use new technologies
3. I use new technologies when most of the people I know use them
4. I like new technologies and use them before most people I know
5. I love new technologies and am among the first to experiment and use them

Responses were categorized into lower (option 1 or 2), average (option 3), and higher (option 4 or 5) tendency to adopt new technologies. For car/public transit use, participants were asked to report how frequently they travelled in a car as a driver or passenger, and how frequently they travelled by public transit. Respondents were categorized based on whether they travelled more frequently by car or public transit. The categories are: uses cars more, uses transit more, same frequency of use.

Table 1. Constructs captured by the survey, related survey item numbers, and citations of previous studies

Construct	**Survey question number(s)***	**Examples of previous AV shuttle surveys using the construct**
Attitude	Q1	[1]
Behavioural intention to use	Q2, Q5	[1], [5], [8]
Perceived usefulness	Q3a–g	[1], [5], [6]
Trust	Q4	[1], [10]
Perceived safety	Q6, Q9, Q11, Q12	[6]–[8]
Other		
Environmental friendliness	Q3h	[5]
Noise	Q3i	
Perceived enjoyment	Q3j	[1], [5]
Privacy	Q3k	
Tendency to adopt new technologies	Q15	[4], [8]
Car/public transit use	Q22, Q23	[4], [8]

**Refer to APPENDIX A for the full list of questions*

The shuttle service was scheduled to begin in November 2021. The data included in this report was collected between August 30 and November 1, 2021, before the shuttle service began offering rides to the public. However, approximately midway through data collection (on September 23), the shuttle began operating along the route for training and testing, so some participants may have seen the shuttle operating in the community. The data were divided accordingly to pre and post shuttle testing to capture any influence this might have on the perception of technology use.

Participants and demographics

A total of 365 participants started the survey by indicating whether they wanted to be included in a panel, for which they would be invited to complete the survey again during and after the shuttle trial. However, only 293 participants completed at least one question after that point, with 217 participants reaching the end of the survey. Of the 293 respondents, 104 (35%) reported living in the service area (either self-reported living on the shuttle route or reported living at one of the postal codes in the area). Of the participants who reported living in the area, 52 participants reported living on the shuttle route.

For the demographic breakdown of participants, the percentages reported here reflect the percentage of responses for each question. For example, 195 participants filled out the age question, of which 78% were aged 25-64. Just over half of the respondents (56%) were men, and 11% identified as a person with a disability. Most respondents (75%) had two or more licensed drivers in their household, and 57% travelled in a car (either as a driver or passenger) at least four times a week. Only 28% of respondents used any form of public transit (TTC, GO Transit, other) four or more times a week. Most respondents (59%) travelled by car more than transit, whereas 26% travelled by transit more frequently, and 15% reported using both methods with the same frequency. These percentages are similar to those in the 2016 Transportation Tomorrow Survey (TTS) summary report [14] , for ward 44 that contains the West Rouge area, which states that 59% of the trips made by residents of this ward are done by car drivers, and 14% are done by transit. It is worth mentioning here that the TTS data may not be an accurate representation of the West Rouge neighbourhood as its data are presented on the ward level, which covers a larger geographic area and is more economically diverse. In terms of tendency to adopt new technologies, 66% of participants were on the higher end of the scale (i.e., they either reported to use new technology before most people they know or be among the first people to experiment with new technology).

There were differences in demographics between people who reported living in the service area and the rest of the participants. A slightly higher proportion of those aged 45+ reported living in the service area (Figure 1), and those who used a car more frequently than transit (Figure 2). Of the participants who did not report living in the shuttle area, there was a higher proportion of men (Figure 3), and those who identified as having a disability (Figure 4). In terms of tendency to adopt new technologies, participants who did not live in the shuttle area had a lower proportion of responses in the average category and higher ones in the lower category (Figure 5).

The proportion of responses with higher tendency to adopt new technologies was similar for those who reported living in the service area and all other participants (Figure 5).

Of the 293 participants who completed at least one question, two thirds completed the survey before the shuttle began testing along the route. Chi-square analysis revealed no significant differences in demographics before and after the shuttle began testing. The full breakdown of respondent demographics can be found in APPENDIX B in Tables 2-9.

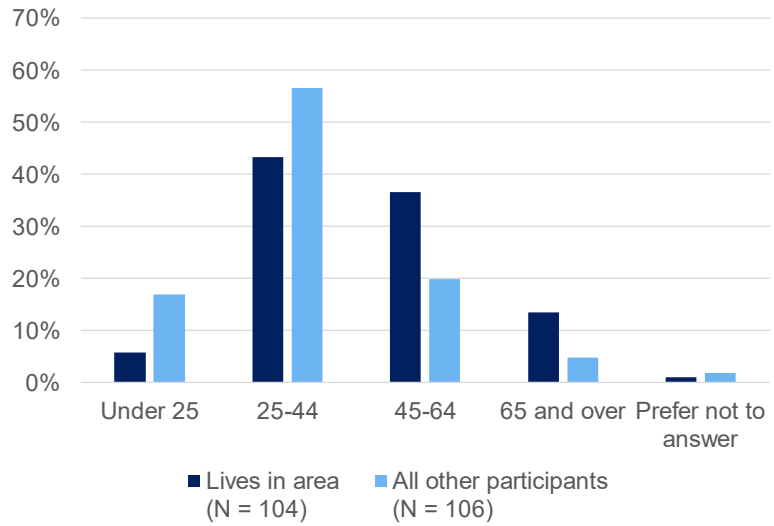

Figure 1. Age distribution for those who reported living in the service area and all other participants

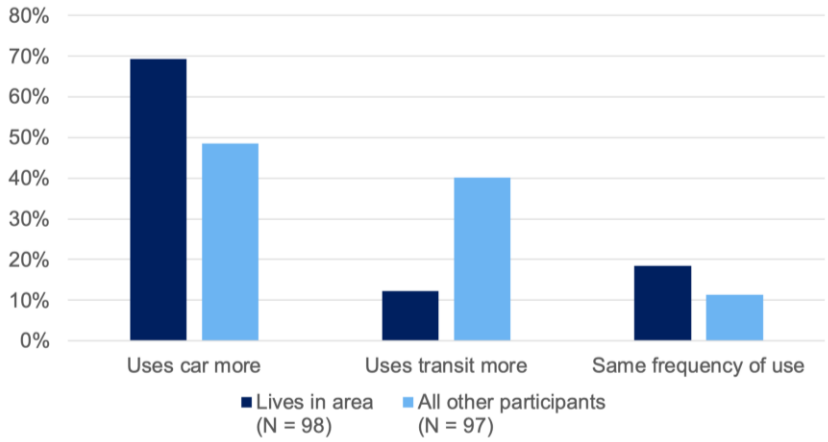

Figure 2. Distribution of car versus transit use for those who reported living in the service area and all other participants

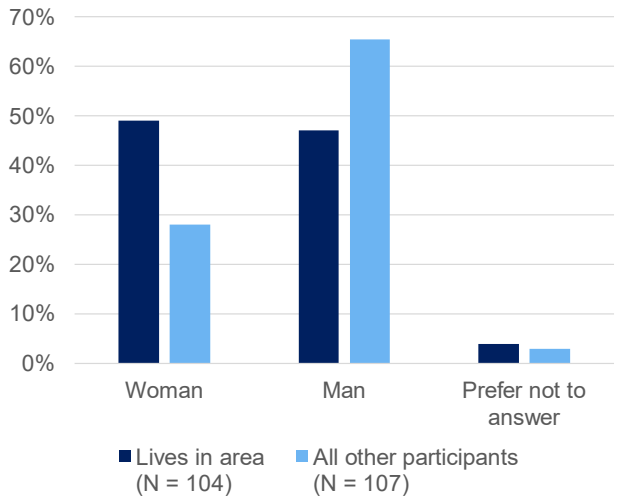

Figure 3. Gender distribution for those who reported living in the service area and all other participants

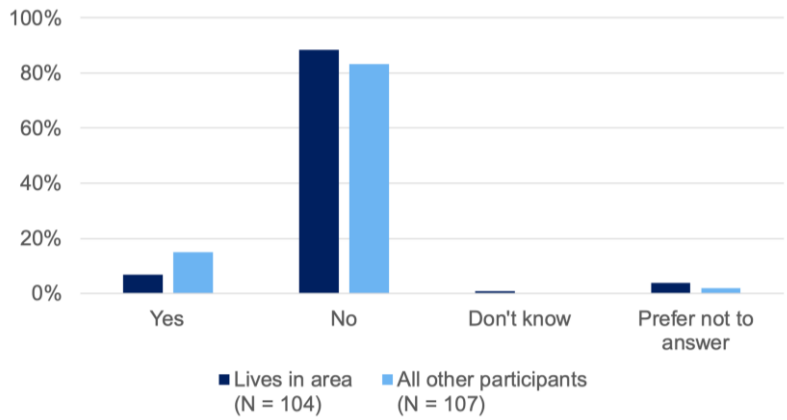

Figure 4. Distribution of disability status for those who reported living in the service area and all other participants

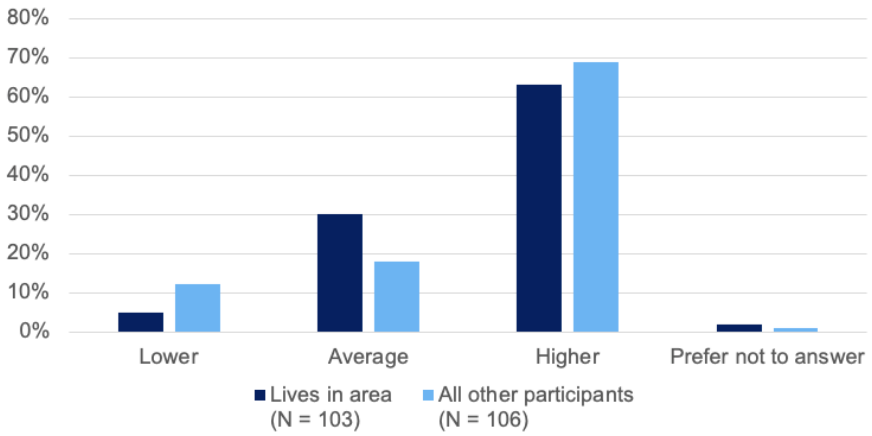

Figure 5. Distribution of tendency to adopt new technologies for those who reported living in the service area and all other participants. *Lower = "I am skeptical of new technologies and use them only when I have to" or "I am usually one of the last people I know to use new technologies". Average = "I use new technologies when most of the people I know use them". Higher = "I like new technologies and use them before most people I know" or "I love new technologies and am among the first to experiment and use them".*

Data analysis

Responses for each survey question are summarized in the results section below. For some questions where responses may have been affected by seeing the shuttle in the community, results were compared before and after shuttle testing and training began on September 23, 2021. Results were also compared between participants who reported living in the service area and all other participants. For ordinal responses, chi-square analysis was conducted to analyze whether there was a statistically significant relationship between living in the service area (yes vs. no) and the categorical response levels. The perceived usefulness, trust, and perceived safety constructs were measured using several questions/items each, as explained earlier in Table 1. For these constructs, the items were averaged, and t-tests were used to assess whether there were statistically significant differences in average ratings before and after shuttle testing, and for participants who lived in the service area compared to all other participants. Results for these (and all other) statistical tests will be presented in the next section of the report.

As mentioned in the introduction, attitude, perceived usefulness, trust, and perceived safety have all been investigated in previous research as potential predictors of intention to use automated shuttles. However, research also suggests that these constructs may have interacting effects and their effects may be moderated by individual differences like demographics and travel behaviour [4], [15], [16]. Statistical modeling, e.g., structural equation modeling, is planned as a future research step to explore the relationships between intention to use the automated shuttle service, and the various constructs and demographic factors in the current study. However, as a first step in exploring these associations, we computed Spearman correlations between intention to use (likelihood to try, and intention of ongoing use if the service was delivered with an AV) and the constructs of attitude, perceived usefulness, trust, and perceived safety. Because the intention to use variables are ordinal (i.e., have discrete response options that are in a meaningful order),

Spearman correlations were used, which can assess the relationship between ordinal and continuous variables [16]. Further, as a preliminary exploration of demographic effects, we analyzed each construct by age, gender, tendency to adopt new technologies, and car versus transit use. For constructs with ordinal responses, chi-square tests were used to test whether there was a statistically significant relationship between a construct and each demographic factor. For all chi-square tests, Fisher's exact test was used if any minimum expected frequencies were less than five. For constructs with approximately normal outcome variables (i.e., trust, perceived safety, and perceived usefulness), t-tests were used to test whether there were statistically significant differences between men and women. The remaining demographic factors had more than two levels (e.g., age was split into four groups). For these demographic factors, analysis of variance (ANOVA) was used to assess whether there was a significant main effect on each construct. If significant main effects were found, follow-up t-tests were used to test which levels differed significantly from each other.

Several survey items also allowed participants to provide additional information in open-ended text format. These responses were reviewed and coded by two researchers. Responses were reviewed independently by each researcher and coded based on categories identified across all responses. Each response could have several themes. The researchers then discussed the identified categories and finalized a code structure for the different questions (see APPENDIX C).

Results and Discussion

Behavioural intention to use

Overall, most participants reported being likely or very likely to try the automated shuttle (Figure 6). Chi-square analysis showed that there was a significant association between when participants completed the survey (before or after shuttle testing began) and likelihood of trying the shuttle, $\chi^2(4) = 11.62$, $p = 0.02$. There was a higher proportion of participants who reported being very likely to try the shuttle after shuttle testing on the route began compared to before (Figure 6). There was no significant difference between participants who lived in the service area and all other participants.

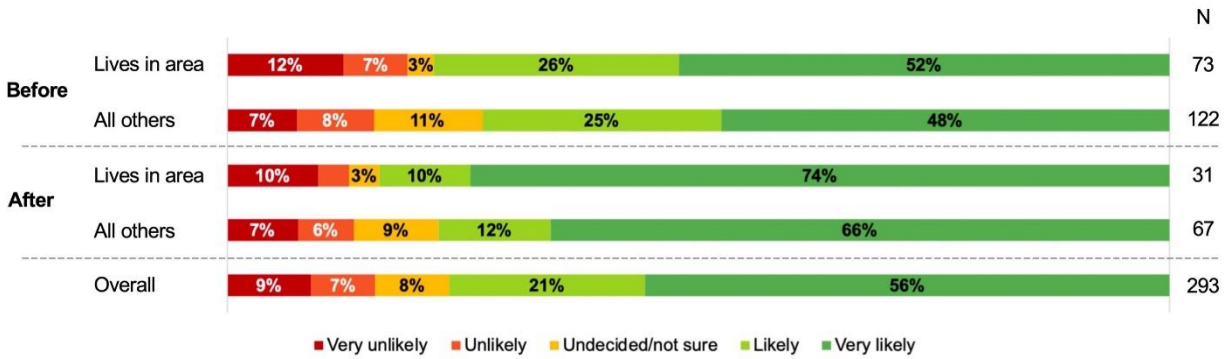

Figure 6. Likelihood to try the shuttle before and after the shuttle began testing, categorized by those who live in the shuttle area and the rest of participants

For participants who reported that they were likely or very likely to try the shuttle, the most common reasons participants reported for why they were likely to try the shuttle were because they were interested in experiencing the technology (60%), and because the shuttle was electric (40%) and free (36%) (Table 11). The breakdown of the travel mode(s) they would have otherwise used if they were to try the shuttle can be found in

Table 13. The most common modes were driving alone (49%), TTC (38%), and walking (37%).

For participants who reported that they were unlikely or very unlikely to try the shuttle, the most common reasons were that the shuttle did not travel to destinations that were relevant to them (49%), that the shuttle was not driven by a person (29%), and "Other, please specify" (29%), of which a majority (7/12) were related to the shuttle route not being in their area (

Table 14, Table 15).

For participants who reported that they were not sure about trying the shuttle, the most common reasons reported were that the shuttle did not travel to destinations that were relevant to them (63%), that the idea of booking ahead seemed like a hassle (42%), and that it would depend on their travel needs during the trial period (42%) (Table 16). When asked what mode(s) of travel they would have otherwise used for a given trip if they were to try the shuttle, for participants who lived in the service area, the responses were driving alone (100%), driving with others (67%), or walking (67%). For participants who did not report living in the service area, the most common responses were TTC (60%), walking (40%), and cycling (33%) (Table 18).

When asked how frequently they would take the shuttle if it were to become permanent, a larger proportion of participants reported that they would take the shuttle frequently if it were with an automated vehicle than a conventional vehicle (Figure 7). The distribution of responses was similar for participants who lived in the service area and all other participants (Figure 7). To the best of our knowledge, previous research has not distinguished trying the shuttle (which may be a one-time occurrence to experience the technology) from intended ongoing use of the shuttle. However, our results indicate a high proportion of respondents who would try the automated shuttle and use it at least occasionally if it were to become permanent. These results are consistent with previous work showing that, on average, people intend to use an automated shuttle if it were available to them [1], [7]. Nordhoff et al. [5] found that 66% of participants reported that they would use an automated shuttle at least once a week. However, their sample consisted of people who had experienced the automated shuttle in their trial, which may explain the higher proportion of frequent use than was found in the current survey.

It should be noted that we did not specify the type of the conventional vehicle for this question. It is possible that some people imagined a similar-sized shuttle bus with a human driver, while others imagined a typical-sized transit bus, which may have affected intended frequency of ongoing use if the service was delivered with a conventional vehicle.

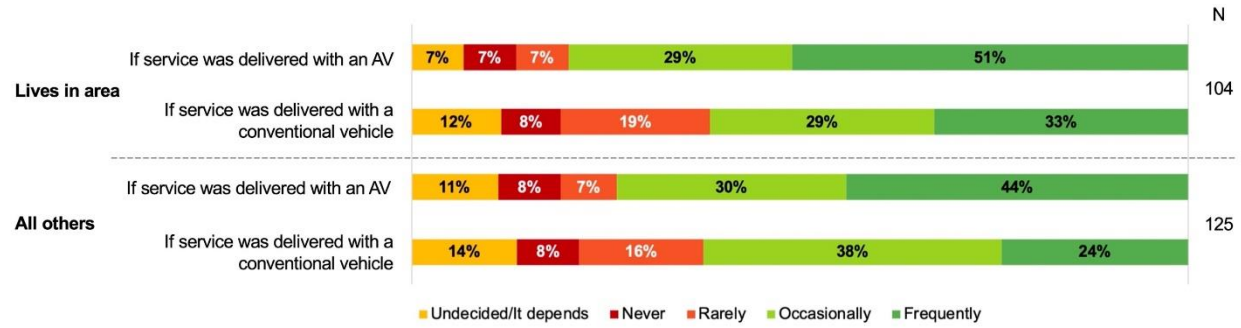

Figure 7. Intended frequency of ongoing use categorized by participant reported living in the service area and all other participants

Attitude

Participants overall had a positive attitude towards the shuttle, with over 75% having a positive or very positive feeling about the project (Figure 8). Attitudes were similar before and after testing began and for participants who lived in the service area compared to all other participants. Previous research has found that after trying an automated shuttle, people had an overall positive attitude towards using an automated shuttle [1]. Our results suggest that people have positive attitudes towards this type of service even before they can experience it themselves.

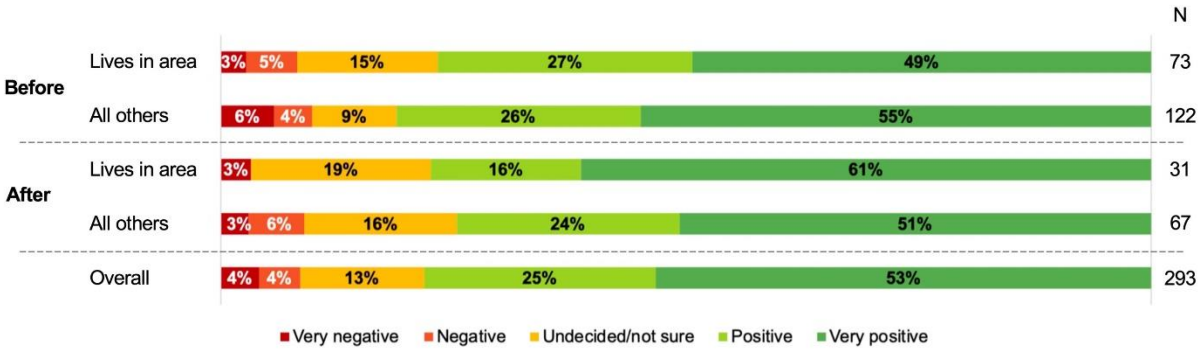

Figure 8. Attitude towards the project for before and after the shuttle began testing categorized by participant reported living in the service area and all others.

Perceived usefulness

Regardless of whether participants reported living in the service area or not, the items with the lowest perceived usefulness were related to the location of the shuttle stops and frustration with the slow shuttle speed (Figure 9). Less than 50% of the participants who reported living in the service area agreed that the stops were in convenient locations. As expected, this percentage was even lower for respondents who did not report living in the service area (19%). Around one-third of participants reported that they would be frustrated with the slow driving speed if they were riding in the shuttle, and around half of the participants reported that they would be frustrated driving behind the shuttle due to the low speed. These proportions were similar for those who reported living in the shuttle area and all other participants (Figure 9).

Comments related to the stops not being in convenient locations and frustration with the slow shuttle speed were also common in the responses to the open-ended survey questions. Twenty-one percent of participants who provided an open-ended response suggested service area expansion and/or additional stops, while 19% had concerns about the slow shuttle speed (e.g., frustration, added congestion, safety). For example:

- "I hope there are plans for pilot for automated shuttles elsewhere in Toronto" (P2002)
- "I feel the speed is too slow, the frustration of surrounding drivers could cause negative results with chances taken in traffic due to unsafe passing. Some of the road speeds in Toronto are already too slow as it is." (P2096)

See APPENDIX C for the full breakdown of themes identified in the open-ended text responses.

These results are consistent with previous research indicating that the slow speed of automated shuttles is generally perceived negatively [5], [11]. However, a report that reviewed various automated shuttle pilot surveys highlighted that the slow speed may have a negative influence on perceived usefulness, but a positive influence on perceived safety [13]. In the open-ended responses in the current study, one participant (P2075) did mention the slow speed as a positive aspect of the shuttle, in terms of safety having the shuttle interacting with other road users in the community. They said, "*while I generally have concerns about automated vehicles and their response to pedestrians (which can, at times, be less than great) there's a lot to be said about an operator as a fail-safe. Also the speed is easy to move out of the way of.*"

The two items related to frustration with the shuttle's slow driving speed were analyzed by time point, as these may have been affected by seeing the shuttle speed firsthand once it began testing. There was a significant association between time point and participants' reported frustration if they were driving behind the shuttle, $\chi^2(4) = 10.60$, $p = 0.04$. However, when the categories were collapsed (strongly disagree/disagree, neutral, agree/strongly agree), the effect was only marginally significant, $\chi^2(2) = 4.64$, $p = 0.098$. After testing began, there was a lower proportion of participants who reported that they would be frustrated driving behind the shuttle due to its low speed (i.e., lower proportion who disagreed that they would not be frustrated by the low speed; Figure 10). There was no significant association between time point and frustration riding in the shuttle due to the low speed.

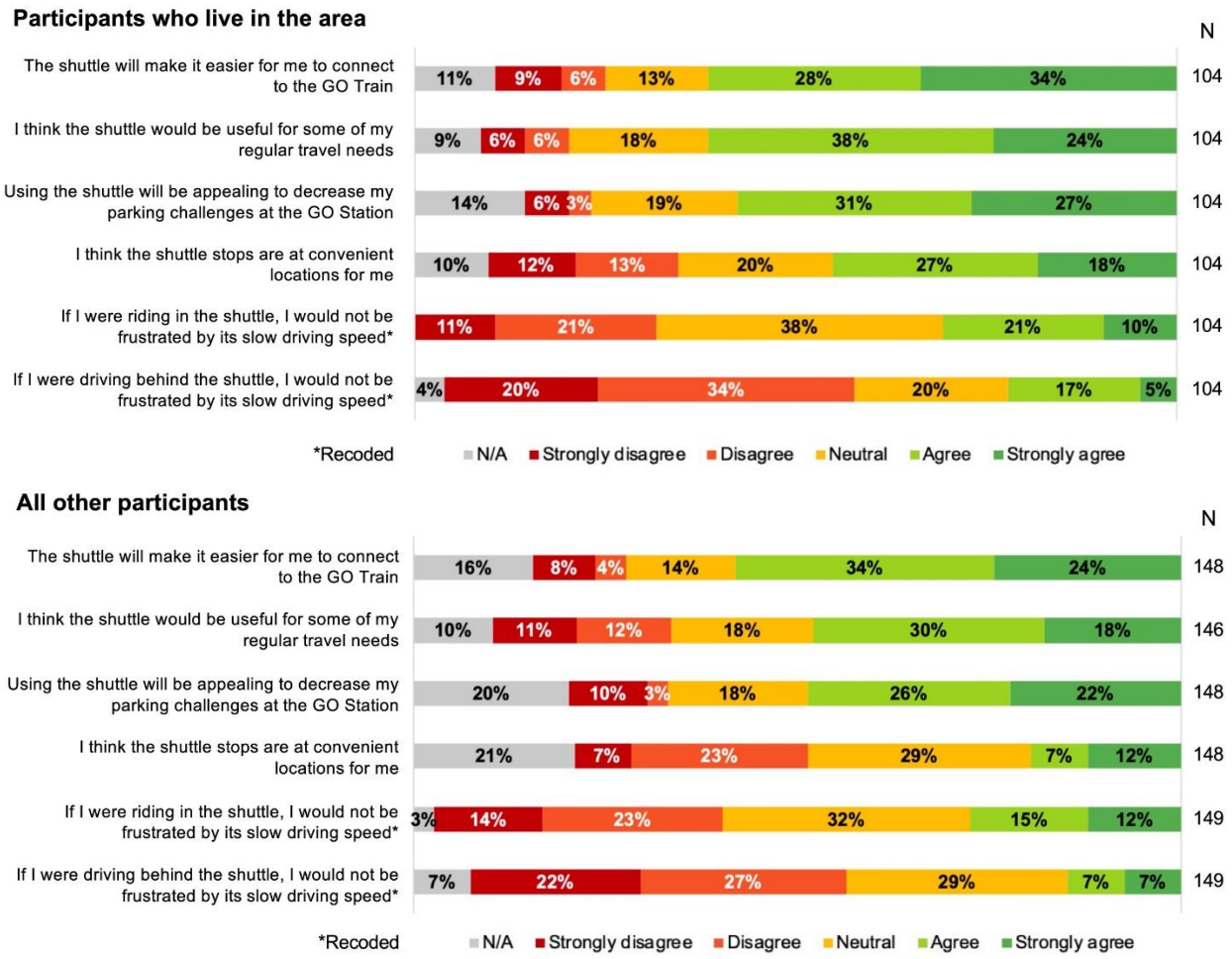

Figure 9. Responses to perceived usefulness items. In the survey, the two items related to frustration were presented as, "*If I were riding in the shuttle I would be frustrated by its slow driving speed*", and "*If I were driving behind the shuttle, I would be frustrated by its slow driving speed*". For this figure, the two frustration items were recoded to present the inverse so that they reflected a positive statement, to be consistent with the other perceived usefulness items.

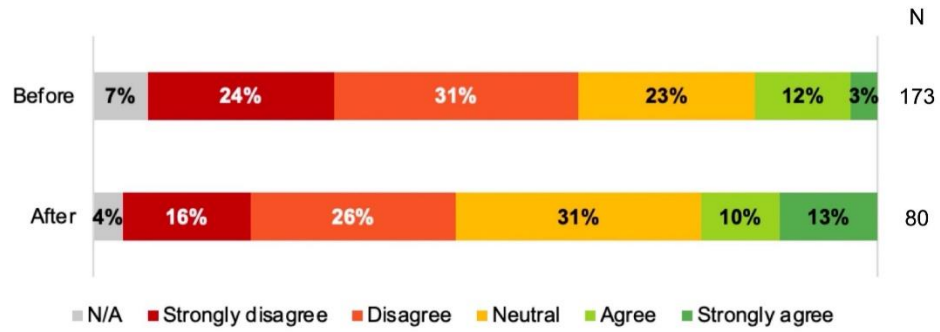

Figure 10. Responses to the item "If I were driving behind the shuttle, I would not be frustrated by its slow driving speed" by time point.

Trust

Most participants trusted the shuttle to navigate safely around stationary obstacles, other motor vehicles, and people in the community (Figure 11). Fewer participants trusted the shuttle's ability to navigate in poor weather, which can hinder the technology's capabilities. T-test analyses were conducted to compare average trust (from 1 to 5) across the four trust items before and after testing. Results showed that there was a marginally significant difference, t (142.4) = 1.80, p = 0.07. Average trust was higher before (M = 3.70, SD = 0.94) compared to after (M = 3.46, SD = 0.95) the shuttle began testing. There was no significant difference in average trust between participants who reported living in the shuttle area and all other participants.

Average trust in the current study was slightly lower than previous research that surveyed individuals who experienced an automated shuttle. In their surveys, Nordhoff et al. [10] found average trust in the automated shuttle to be around 4.5 on a 6-point scale, while average trust in Chen's study [1] was 4.24 on a 5-point scale. The slightly higher trust may be due to participants' experience using the shuttle, as research shows that trust in automated shuttles increases after firsthand experience [18].

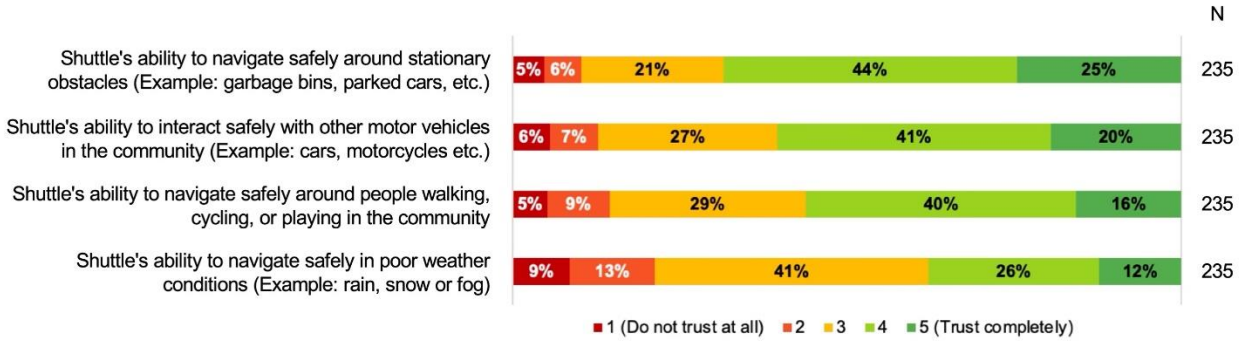

Figure 11. Responses to trust items. *Participants were asked to rate how much they trusted each of the above capabilities of the shuttle from 1 (do not trust at all) to 5 (trust completely).*

Perceived safety

Most of the participants reported that they would feel safe riding in the shuttle and having the shuttle in their community (Figure 12). Table 19 shows how various shuttle characteristics would impact participants' feeling of safety while riding in the shuttle. Of the six characteristics presented, most participants reported that the following five reasons made them feel more safe:

- The booking system prevents sharing the shuttle with passengers not in their household
- Presence of a human operator on board who can take control if needed
- Vehicle speed of under 20 km/h
- Cameras on board which are blurred to protect their privacy
- Automated navigation system that removes human error

Only 36% of participants stated that the fact that the shuttle would travel on roads with other traffic would make them feel more safe, while 44% responded in the neutral position, and 20% responded that it would make them feel less safe.

Table 20 shows how various shuttle characteristics would impact how safe participants thought it would be to have the shuttle in their community. Most participants reported that the following six characteristics (out of the seven presented) would make it more safe:

- Presence of a human operator on board who can take control if needed
- Safety check of vehicle done before and after each shift
- Vehicle speed of under 20 km/h
- Cameras inside and outside the shuttle
- Knowing the shuttle is quiet and emissions-free
- The shuttle service will help reduce the need for parking at the GO station.

Similar to the results related to perceived safety of riding in the shuttle, the only characteristic that was not associated with higher perceived safety was the fact that the shuttle would be travelling on roads with other traffic. Forty-five percent of participants thought that this characteristic would make it more safe, while 33% responded in the neutral position, and 22% responded that it would make it less safe to have the shuttle in their community. However, it should be noted that for the neutral position for the questions presented in Tables 19 and 20, the full text was supposed to read “I would feel a similar level of safety”. Due to an error in the survey software, only “I would feel” was displayed to participants, which may have affected the results for these items. However, it is likely that participants were still able to infer what this anchor point meant because all the other anchor points were labelled correctly.

Previous research also indicates positive perceived safety when it comes to automated shuttles, though perceived safety appears to be higher for passengers than other road users. Chee et al. [8] found that 63% of their sample (who had tried the automated shuttle) rated onboard safety with a steward to be safe or extremely safe, compared to 46% if there was no steward. However, perceived safety of the shuttle interacting with other vehicles was lower, with only 48% reporting that they felt it was safe or extremely safe. Another study also found that participants were more concerned about the safety of other road users than their personal safety riding in the shuttle [19]. These results are consistent with our findings that a higher percentage of respondents would feel safe riding in the shuttle compared to the percentage who felt it would be safe having the vehicle travelling on roads near them (Figure 12).

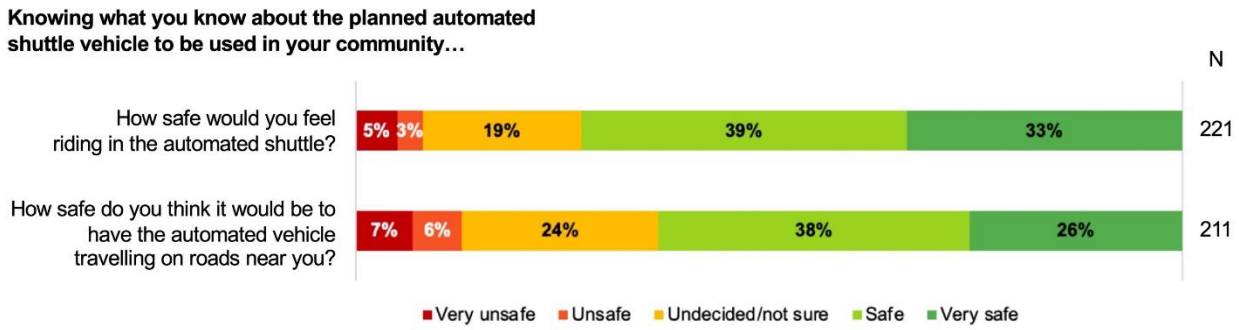

Figure 12. Responses for questions relating to safety riding in the shuttle or having it in the community

With respect to how safe they would feel walking or cycling near an AV compared to conventional motor traffic, just under 40% of participants reported that they would feel safer around an AV, and round 30% reported that they would feel a similar level of safety (Figure 13). Around 25% of participants reported that they would feel less safe crossing in front of an AV compared to a conventional vehicle, while 17% of participants reported that they would be less safe cycling near an AV compared to a conventional vehicle.

Previous survey findings suggest that pedestrians may be more cautious crossing in front of an automated shuttle compared to human drivers, due to lack of trust in the shuttle and an inability to ensure the shuttle has detected them, which would normally be done by making eye contact with a human driver [19]. In the open-ended questions, one participant (P1146) mentioned a similar idea: "*there needs to be something to indicate the vehicle is coming to a complete stop. As a pedestrian that would make me feel much more safer knowing that it [is] proceeding to slow down*."

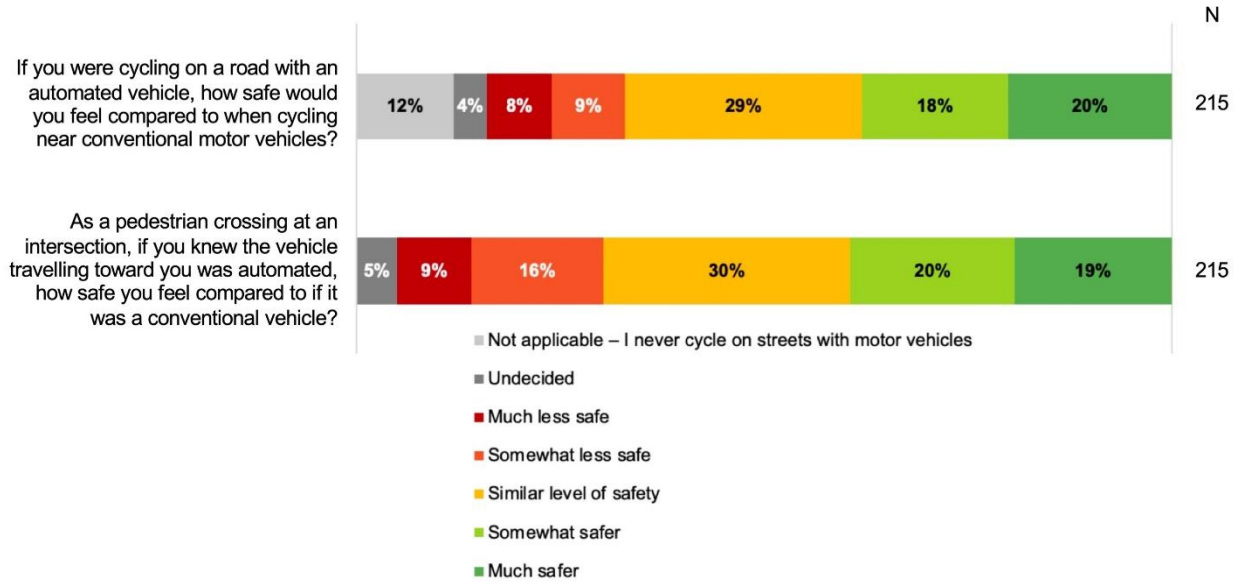

Figure 13. Responses for questions relating to safety interacting with the shuttle as a vulnerable road user. *Participants were asked to rate how safe they would feel relative to if they were interacting with a conventional motor vehicle.*

In the open-ended survey questions, participants were asked if there was any other information that would help them feel safer as a passenger in the shuttle. Of the participants who provided a response, 24% mentioned wanting to know more about the emergency procedures. For example:

- "Knowing what will happen in the event of an emergency caused by another vehicle" (P1078)
- "Maybe extra security like a buzzer could help out in case someone needs help" (P1109)
- Provide a first aid kit within the vehicle. How would this vehicle respond in collisions? What would be there to protect passengers? (P1112)

Nordhoff et al. [19] also found that participants in their study wanted to know more about emergency procedures. In their automated shuttle trial, where participants were allowed to press the emergency stop button, the emergency button was pressed in 45% of trips, because passengers wanted to test how shuttle would respond.

Thirteen percent of participants who provided a response wanted more information about onboard security/safety. Consistent with previous research e.g., [19], several participants (7%) mentioned concerns about onboard security/safety related to ride-sharing, and others were concerned specifically about nighttime operations (4%). For example:

- "A bit nervous about strangers and people boarding not according to the specified boarding schedule." (P2184)
- "I'm wondering how the system works that someone wouldn't be able to come on with me. And down the line would it allow for strangers to be in the same shuttle. Makes me

> wonder about my personal safety being locked in an automated shuttle, traveling at night." (P1082)

However, one participant (P1067) did mention that they would be comfortable sharing the shuttle with a few people, "I appreciate the one household, but also I think if it's only two or three people needing it (currently only that many people ride the 54a to the Starspray loop with me after getting off go train), [that] would be fine too." Nordhoff et al. [5] also found that participants in their study were willing to share the shuttle with 6-8 passengers (the maximum number of passengers for their shuttle was 12).

Participants were also asked if there was any other information that would help them decide whether it would be safe to have the automated shuttle in their community. The most common responses were related to the shuttle's capabilities (23%) and pedestrian/cyclist safety (20%). Lack of sidewalks were mentioned as a specific concern in 7% of responses. Example quotations related to these themes are below:

- "Unreasonable to expect us to feel anything but less than safe until the technology has been demonstrated to the community for some trial period of time." (P1132)
- "Side by side comparison on traffic incidents with humans vs AI. Show the proof AI is safer." (P1058)
- "Our community lacks sidewalks on Rouge Hills Dr, which is a large section of the shuttle's route. Having lived in the community for years, I have noticed that pedestrians and cyclists feel highly unsafe when regular cars pass by. Especially in the summer months when traffic is increasingly higher because of the direct access that the road has to the beach. With the automated shuttle, I feel this will only make pedestrians and cyclists feel much more unsafe on their routes." (P1020)

As previously mentioned, other studies have also found greater concern for pedestrian and cyclist safety compared to passenger safety [19], and that firsthand experience with an automated shuttle is associated with higher levels of trust [18]. In addition, our results suggest that providing data from the results of the shuttle trial may also increase trust in the service. The full breakdown of themes identified in the open-ended text responses can be found in APPENDIX C.

Other responses

Several other items of interest were included which were answered favourably by most of the participants (Figure 14). For example, consistent with previous research [5] participants generally liked the fact that the shuttle is electric and emissions-free, and thought that using the shuttle would be enjoyable.

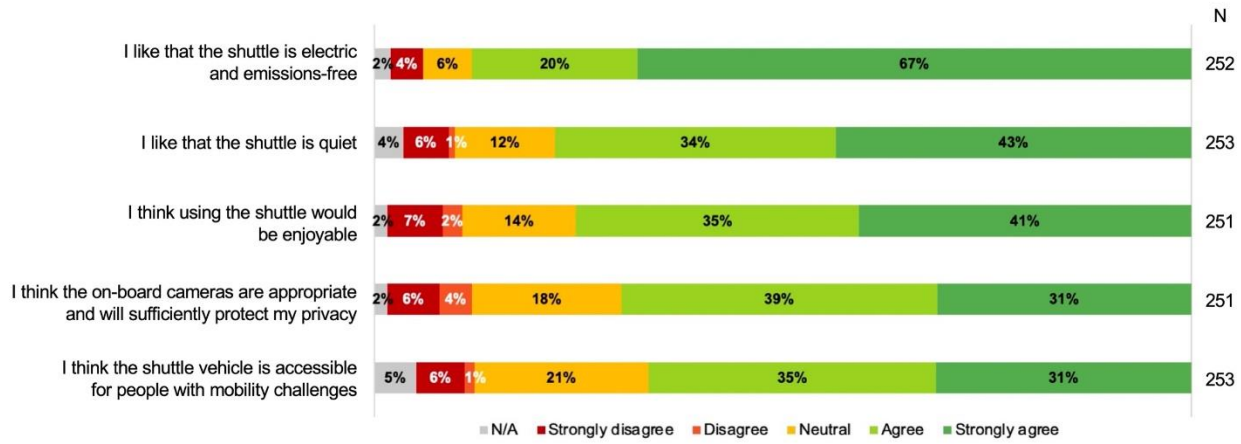

Figure 14. Responses to survey items not related to a specific construct

A final open-ended question asked participants if there were any other questions, concerns or comments they had about the automated shuttle in their community. Similar to the responses in the previous open-ended questions, comments about service area expansion and slow shuttle speed were the most common (29% and 14% of the responses, respectively). Two responses (out of 49) also mentioned concerns related to people waiting for the shuttle in front of or on their property, likely related to the lack of sidewalks in the area that was mentioned in previous responses.

Correlations Between Constructs and Exploration of Demographic Effects

Overall attitude, perceived usefulness, trust, and perceived safety were all significantly correlated with likelihood to try the shuttle and intended frequency of using an AV shuttle if it were to become permanent (Table 2). The correlations ranged from 0.42 to 0.55 ($p < .001$ for all), indicating moderate to strong correlations (e.g., [20]).

Table 2. Spearman correlations between intention to use measures and overall attitude, perceived usefulness, trust, and perceived safety

		Overall Attitude	Perceived Usefulness	Trust	Perceived Safety
Intention to Use	**Likelihood to Try**	0.49	0.42	0.44	0.43
	Intended Frequency of Use – If Delivered with AV	0.55	0.54	0.51	0.53

All correlations are significant at $p < .001$.

Age was significantly associated with likelihood to try the shuttle, $\chi^2(6) = 13.86$, $p = 0.02$, and intended frequency of ongoing use, $\chi^2(3) = 12.57$, $p = 0.01$. For the chi-square analysis, likelihood to try the shuttle was split into three categories: 1) likely or very likely, 2) undecided/not sure, and 3) unlikely or very unlikely. For intended frequency of ongoing use, the responses were split into two categories: 1) frequently and 2) all other responses. The 65+ age

group had a lower proportion of respondents who were likely or very likely to try shuttle (Figure 15) and who reported that they would take the shuttle frequently if it became permanent (Figure 16). Only 21% of respondents in the 65+ age group reported that they would take the shuttle frequently, compared to 42-60% in the other age groups.

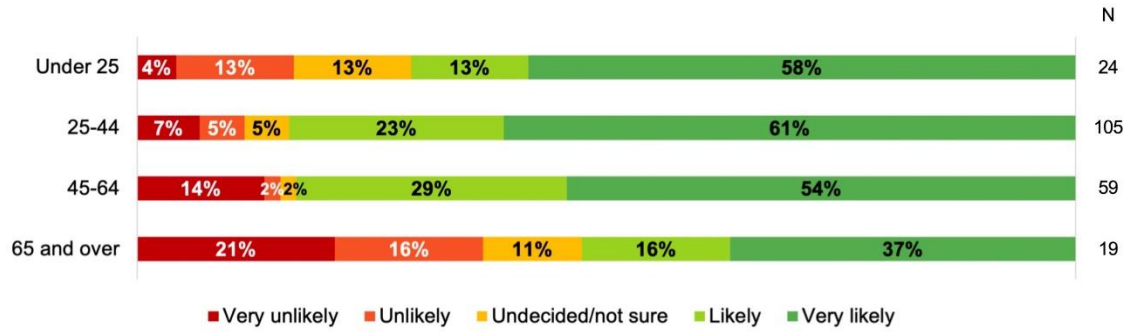

Figure 15. Likelihood to try the shuttle by age. Note: this is the same data presented in Figure 6, in this case, split by age.

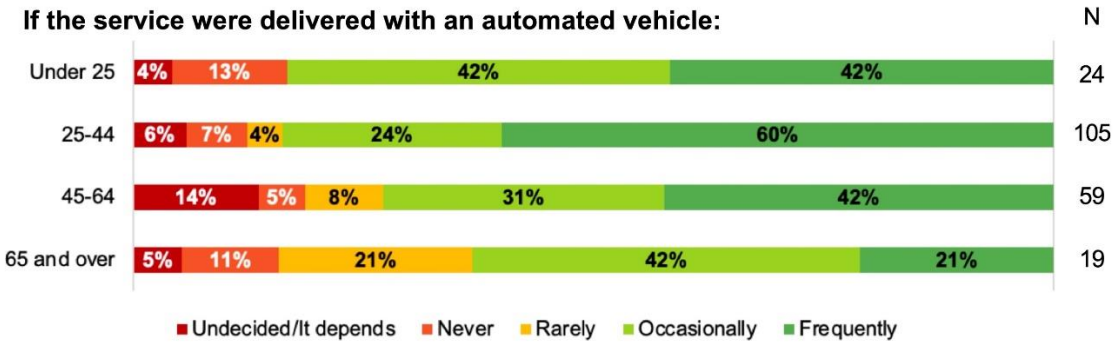

Figure 16. Intended frequency of ongoing use if the service were delivered by an AV, by age. Note: this is the same data presented in Figure 7, in this case, split by age.

For attitude towards the service, due to a limited number of negative and very negative responses, the data was split into two categories: 1) positive or very positive and 2) undecided/not sure, negative, or very negative. There was no significant association between age and attitude towards the service. The 65+ age group had the lowest proportion of participants who reported a positive attitude towards the project (Figure 17); however, there were still many participants in that group (64%) who reported a positive or very positive attitude.

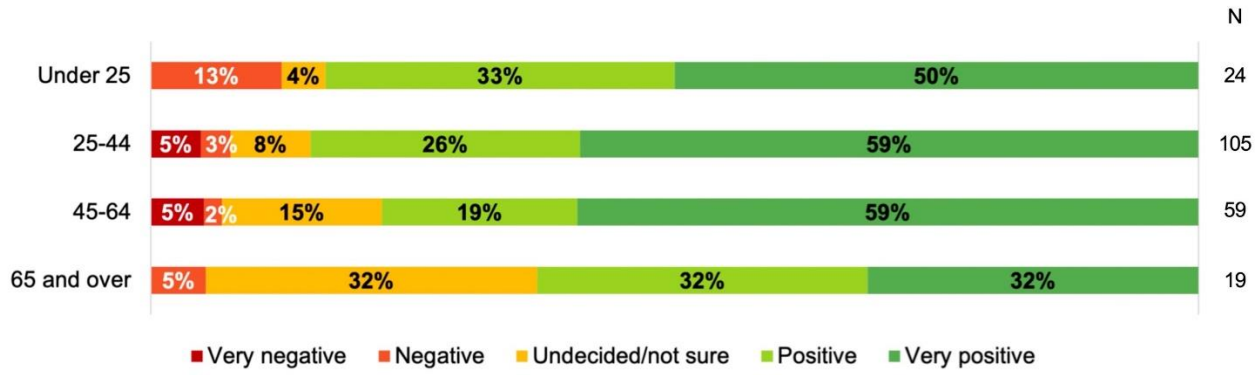

Figure 17. Attitude towards the project by age. Note: this is the same data presented in Figure 8, in this case, split by age.

An ANOVA showed a significant effect of age on trust, F (3, 203) = 3.45, p = 0.02. Follow-up t-tests indicate that the 65+ age group had significantly lower trust than the under 25 and 25-44 age groups (Figure 18). The 65+ age group also had the lowest ratings for perceived safety and perceived usefulness (Figure 18), but there was no significant main effect of age on either of these constructs.

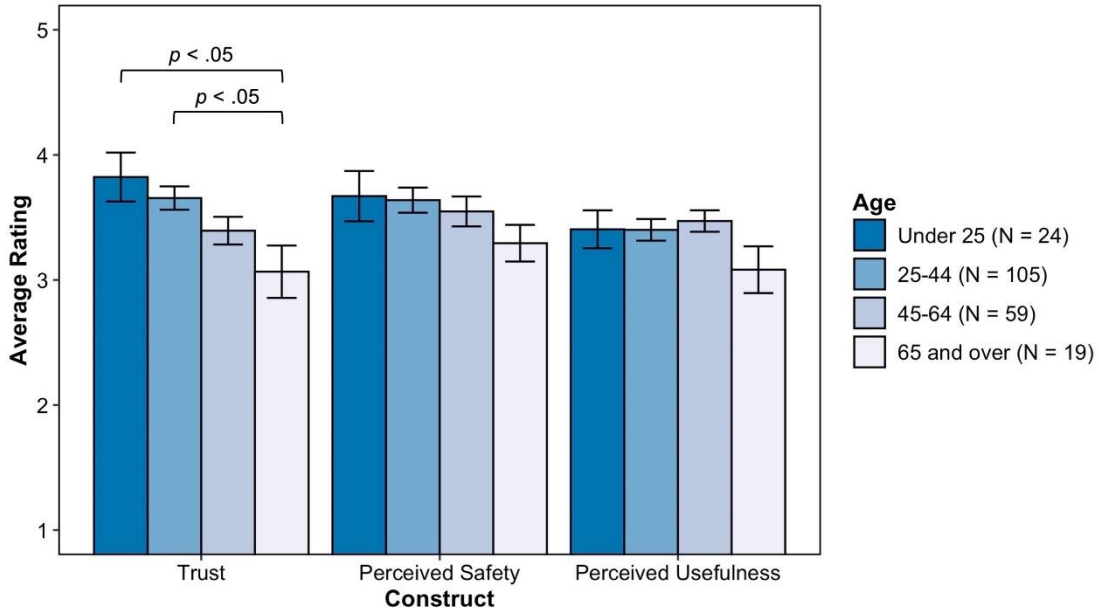

Figure 18. Average ratings for trust, perceived safety, and perceived usefulness by age.

There was a significant association between tendency to adopt new technologies and likelihood to try the shuttle, $\chi^2(8) = 15.58$, $p = 0.048$. Most participants in the lower and higher technology adoption groups were very likely to try the shuttle, compared to only 38% in the average

technology adoption group (Figure 19). The percentage of people who would take the AV shuttle frequently increased with tendency to adopt new technologies (Figure 20); however, the chi-square test showed that this association was not significant. The proportion of participants who reported a very positive attitude towards the project also increased with higher tendency to adopt new technologies (Figure 21), and in this case there was a significant association, $\chi^2(8) = 17.64$, $p = 0.047$.

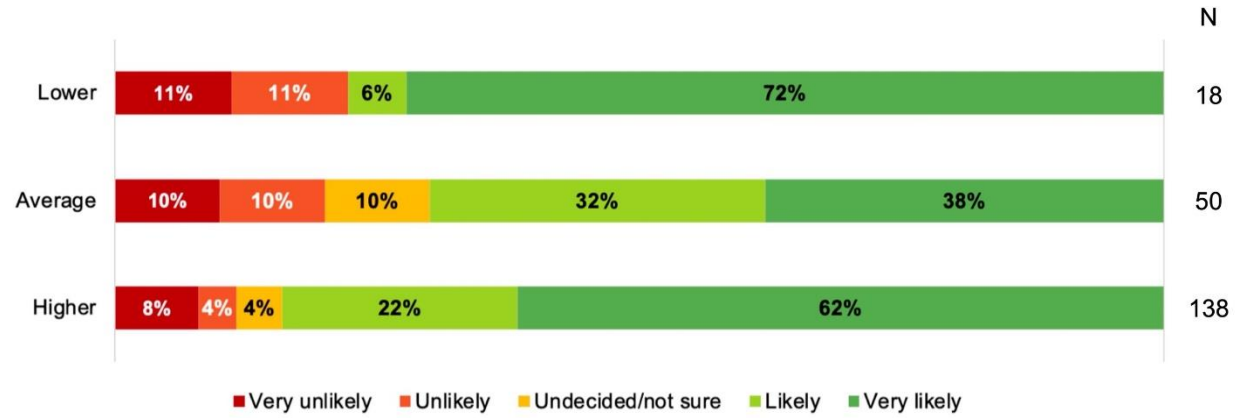

Figure 19. Likelihood to try the shuttle by tendency to adopt new technologies. *Lower = "I am skeptical of new technologies and use them only when I have to" or "I am usually one of the last people I know to use new technologies". Average = "I use new technologies when most of the people I know use them". Higher = "I like new technologies and use them before most people I know" or "I love new technologies and am among the first to experiment and use them".* Note: this is the same data presented in Figure 6, in this case, split by tendency to adopt new technologies.

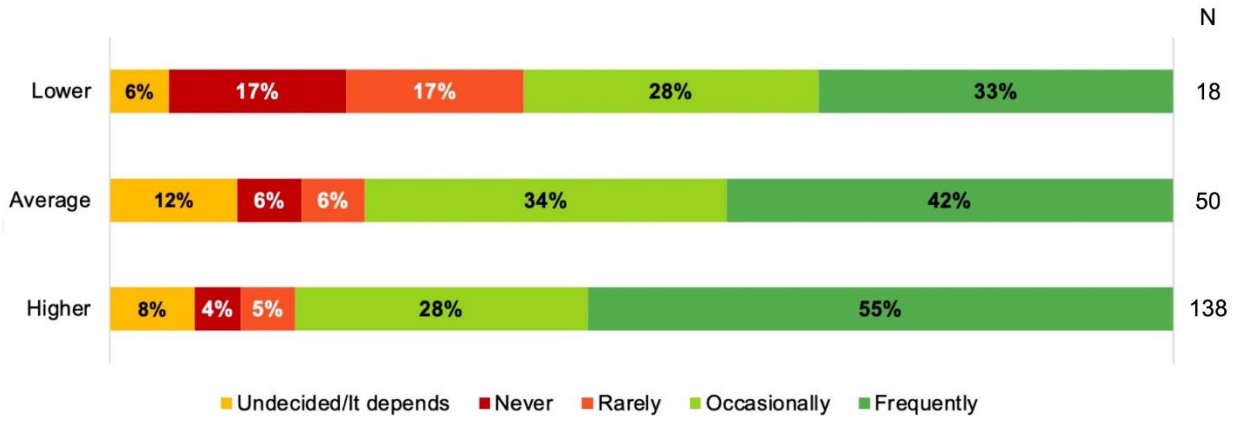

Figure 20. Intended frequency of ongoing use if the service were delivered by an AV, by tendency to adopt new technologies. *Lower = "I am skeptical of new technologies and use them only when I have to" or "I am usually one of the last people I know to use new technologies". Average = "I use new technologies when most of the people I know use them". Higher = "I like new technologies and use them before most people I know" or "I love new technologies and am among the first to experiment and use them".* Note: this is the same data presented in Figure 7, in this case, split by tendency to adopt new technologies.

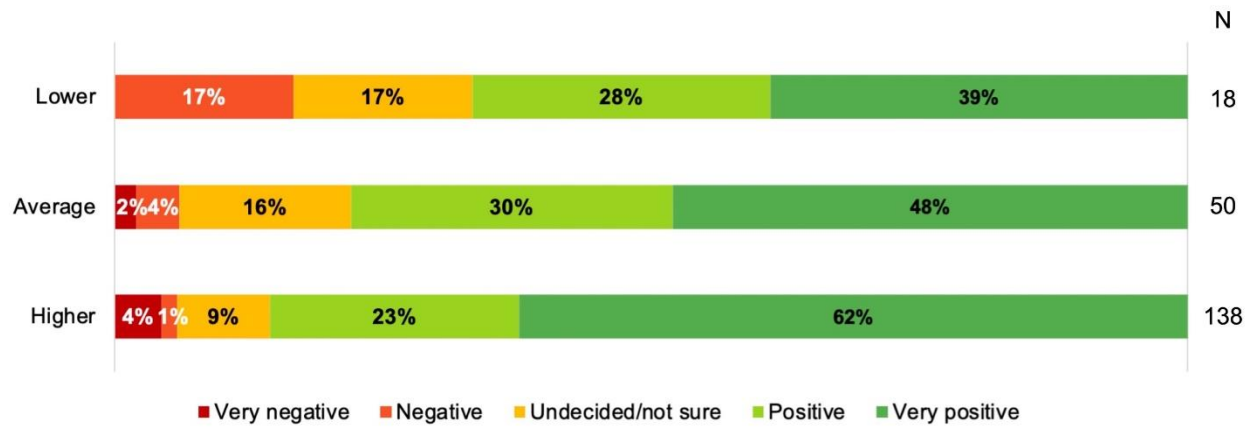

Figure 21. Attitude towards the project by tendency to adopt new technologies. *Lower = "I am skeptical of new technologies and use them only when I have to" or "I am usually one of the last people I know to use new technologies". Average = "I use new technologies when most of the people I know use them". Higher = "I like new technologies and use them before most people I know" or "I love new technologies and am among the first to experiment and use them".* Note: this is the same data presented in Figure 8, in this case, split by tendency to adopt new technologies.

Out of the remaining constructs (trust, perceived safety, and perceived usefulness), tendency to adopt new technologies only had a significant association with perceived usefulness, F (2, 203) = 4.05, p = 0.02. Participants with a higher tendency to adopt new technologies had significantly higher perceived usefulness ratings than those with average or lower tendency to adopt new technologies (Figure 22).

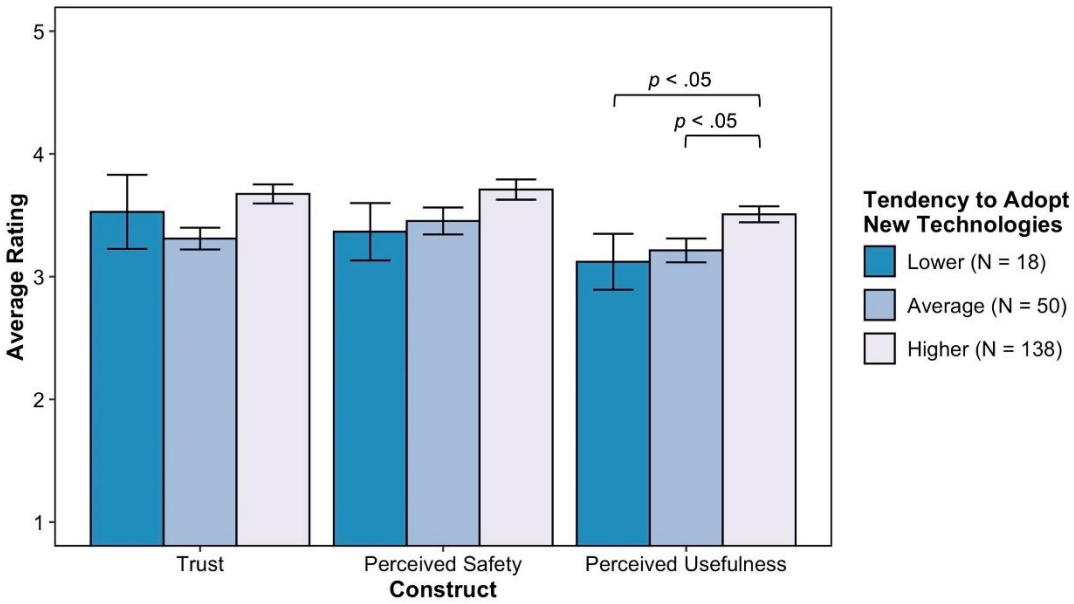

Figure 22. Average ratings for trust, perceived safety, and perceived usefulness by tendency to adopt new technologies

Finally, we investigated whether frequency of car versus transit use influenced respondents' intention to use the shuttle and overall attitude towards the project. Frequency of car versus transit use was not significantly associated with likelihood to try the shuttle or overall attitude towards the project. For all groups (uses cars more, uses transit more, and same frequency of use), 79-80% of respondents reported being likely or very likely to try the shuttle (Figure 23). However, the "uses transit more" group had the highest percentage of participants who reported that they would be very likely to try the shuttle (Figure 23), and the highest percentage of participants who reported a positive or very positive attitude towards the project (Figure 24).

There was a significant association between car/transit use and frequency of intended use if the service was delivered with an AV, $\chi^2(2) = 7.98$, $p = 0.02$. Similar to the chi-square test between frequency of intended use and age, the responses were split into two categories: 1) frequently, and 2) all other responses. Participants who currently use cars more were least likely to report that they would use the shuttle frequently (Figure 25). However, it is worth nothing that 40% of car users report that they would take the AV shuttle frequently, and 78% would take it at least occasionally (top bar in Figure 25). Further, these percentages were higher than frequency of intended use if the service was delivered with a conventional vehicle. For car users, only 22% of respondents would use the service frequently if it were a conventional vehicle, and only 59% would use it at least occasionally (Figure 25), suggesting that the AV aspect of the shuttle appeals to drivers.

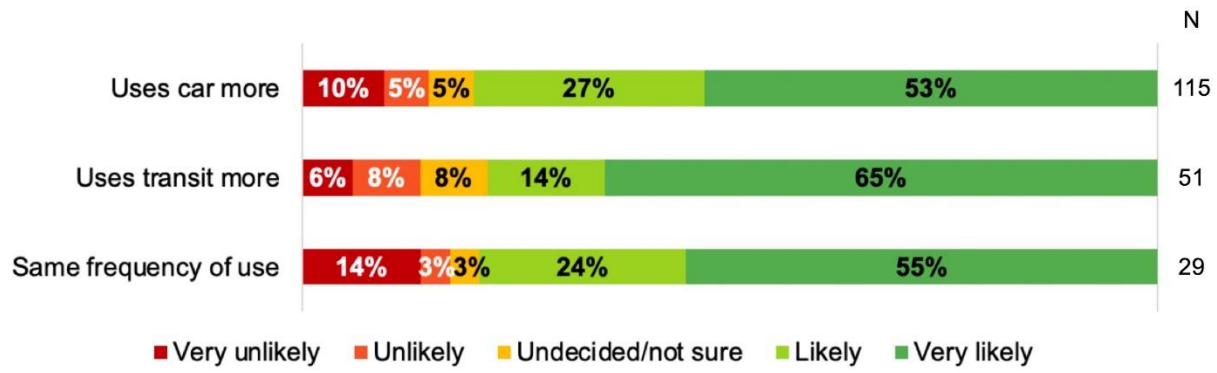

Figure 23. Likelihood to try the shuttle by whether the respondent reported travelling by car or transit more frequently. Note: this is the same data presented in Figure 6, in this case, split by frequency of car versus transit use.

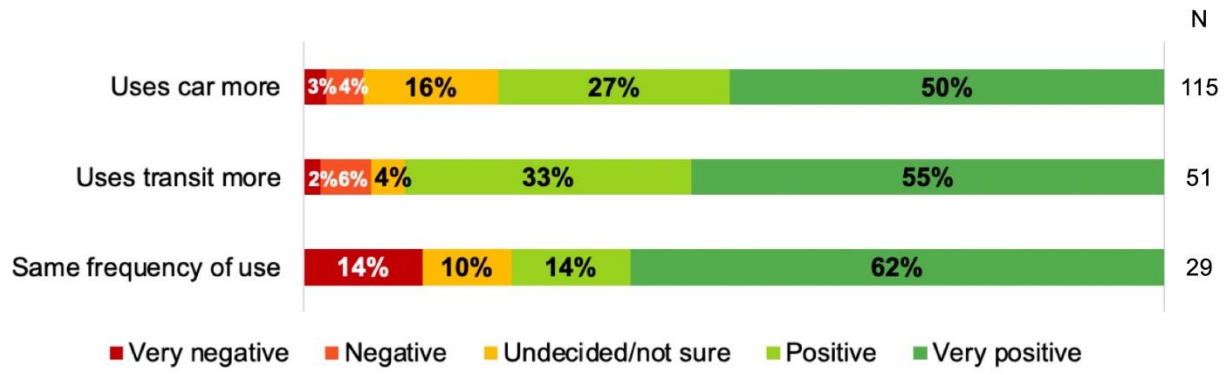

Figure 24. Overall attitude towards the project by whether the respondent reported travelling by car or transit more frequently. Note: this is the same data presented in Figure 8, in this case, split by frequency of car versus transit use.

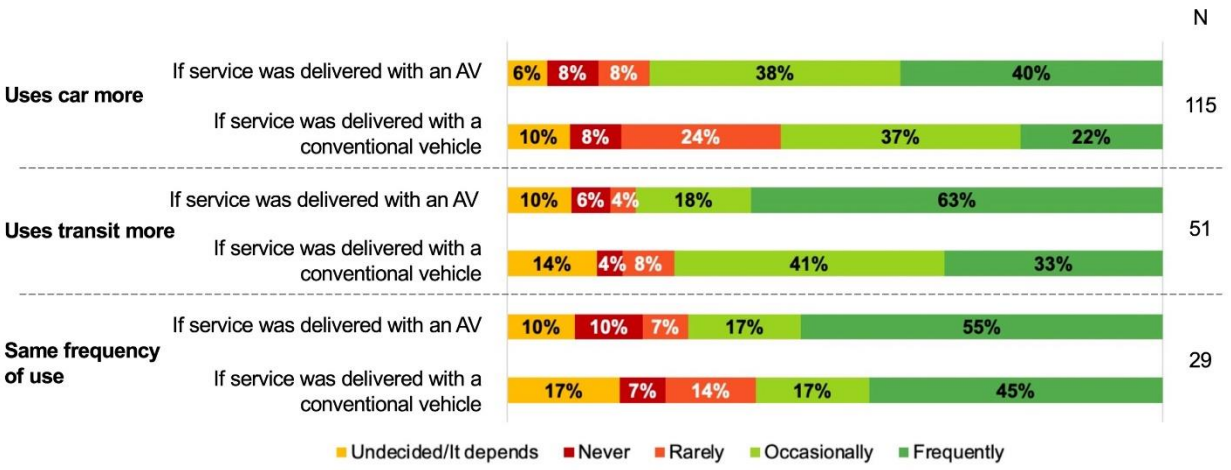

Figure 25. Intended frequency of ongoing use by whether the respondent reported travelling by car or transit more frequently. Note: this is the same data presented in Figure 7, in this case, split by frequency of car versus transit use.

The West Rouge area was chosen for the shuttle trial as its existing transit access is limited. In addition, the data from the current survey shows that around 70% of people who reported living in the area use cars more than transit (Figure 2). To explore whether car users in the service area would use the shuttle if it were to become permanent, we further broke down the "uses cars more" group by whether the respondent reported living in the service area (Figure 26). Results show that 49% of respondents who live in the service area would take the shuttle frequently if it were delivered with an AV, while only 26% reported that they would take it frequently if it were a conventional vehicle (Figure 26). This finding is inline with a study in Toronto by Idris [21] which highlights that some car users may shift to public transit when a proper service is provided (25.47% for car drivers and 32.53% for car passengers and carpoolers).

However, as mentioned previously, participants may have interpreted "conventional vehicle" in different ways (e.g., shuttle with human driver versus typical transit bus). While our results

suggest that people would take the shuttle more frequently if it was an AV than conventional vehicle, it is possible that some participants responded in this way because they prefer the small shuttle to a large transit bus. Further, it is worth noting that while intention to use transit in the future has been found to be a significant predictor of self-reported actual transit use (e.g., [22]), it is possible that participants overestimated how frequently they may take the AV shuttle if it were to become permanent. Some studies attributed reluctance to change travel mode to some psychological aspects (e.g., habits and, attitudes) [23], [24] and the strong formation of habits and correlation of previous travel choices [25]. Since our study is based on a stated preference survey, this may result in some inaccurate predictions of the actual use of the provided service. A revealed preference survey following the launch and actual usage of the service might give better representation of its actual usage.

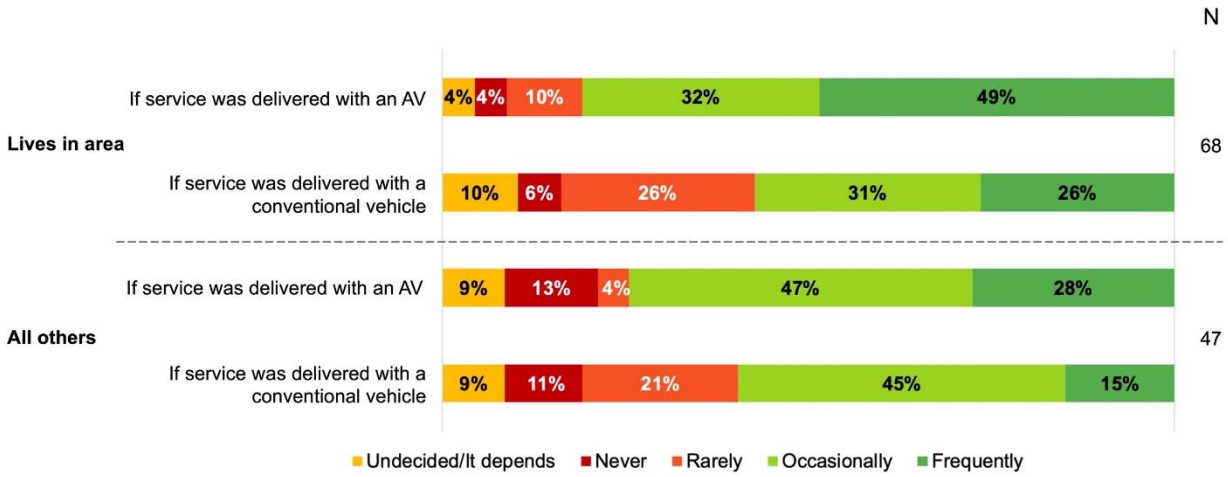

Figure 26. Intended frequency of ongoing use for respondents who use cars more, by whether the respondent reported living in the service area

Overall, our results are consistent with previous research suggesting relationships between intention to use an automated shuttle and attitude, trust, perceived safety, and perceived usefulness [1], [7], [9]. Further, similar to prior work, we found that these constructs may be influenced by age, tendency to adopt new technologies, and frequency of car use [4],[8], with younger individuals, those with a higher tendency to adopt new technologies, and current transit users having higher intention to use an AV shuttle. However, the effects of age on intention to use automated shuttles is mixed. Nordhoff et al. [5] also found an association between age and intention to use; however, in contrast to our results, their study suggested that older respondents had a higher intention to use an automated shuttle. Previous work also found that gender and age did not have a moderating effect on models to predict intention to use an automated shuttle [2], [12]. Similarly, we did not find an association between gender and any of the constructs in the current study; however, other research shows that males tend to have more favourable views of AVs [3], which may affect intention to use. This report presents only a preliminary exploration of demographic effects. Statistical modeling is required to investigate the relationships between

constructs and demographic factors, and how these variables influence intention to use in the current sample.

Summary and Conclusions

The City of Toronto surveyed the public about a proposed automated shuttle trial in the West Rouge neighbourhood of Toronto. Responses were collected before the shuttle began offering rides to the public, and thus reflect their perceptions before having any experience with the shuttle. In this section a summary of the key findings of the survey data analysis is provided followed by a discussion on the limitations and implications of this study.

Summary of the results

1. **Positive public perceptions of the shuttle**
    - The results show that around 77% of respondents reported being likely to try the shuttle. More respondents reported being very likely to try the shuttle after the shuttle began testing on the route, both for participants who reported living in the service area and all other participants.
    - Overall, a positive attitude towards the project is observed. Around 78% of respondents indicated they have a positive/very positive attitude towards the project.
    - Results suggest trust in the vehicle technology. Most participants trusted the shuttle's abilities to navigate around stationary obstacles (69%), other motor vehicles (61%), and vulnerable road users (56%).
    - Generally, the automated shuttle service is perceived to be safe. Most participants thought the shuttle would be safe to ride in (72%) and have in the community (64%). Around two thirds of participants reported they would feel a similar level of safety or more safe cycling around or crossing in front of an AV shuttle compared to a conventional vehicle.
    - Most respondents also thought using the shuttle would be enjoyable (76%), and they liked that it was electric/emissions-free and quiet (87%).
2. **Older individuals trusted the shuttle less and were less likely to use it**
    - Older respondents (65 and over) had significantly lower trust in the shuttle's abilities compared to respondents who were under 45.
    - A lower proportion of the older age group reported being likely to try the shuttle (53% compared to over 70-84% in the other age groups) and intending to use it frequently (21% compared to 42-60% in the other age groups).
    - A lower proportion of the older age group reported having a positive attitude towards the shuttle project. However, a majority of the older age group still had a positive attitude (64% in the older age group compared to 78-85% in the other age groups).

3. **Higher tendency to adopt new technologies was generally associated with more positive ratings**
    - People with higher tendency to adopt new technologies had rated the perceived usefulness of the shuttle to be higher than those with average or lower tendency to adopt new technologies.
    - The percentage of people who would take the AV shuttle frequently increased with tendency to adopt new technologies (from 33% for those in the lower technology adoption group to 55% in the higher group).
    - The proportion of participants who reported a very positive attitude towards the project also increased with higher tendency to adopt new technologies (from 39% in the lower group to 62% in the higher group).
    - Most participants in the higher technology adoption group (62%) were very likely to try the shuttle, compared to only 38% in the average technology adoption group. However, unlike the other constructs, for this variable, the lower tendency to adopt new technologies group had a higher proportion of positive responses (72% were very likely to try the shuttle).
4. **Car users were less likely to use the shuttle frequently, but still a relatively large proportion intended to use it**
    - Participants who travel more frequently by car than transit were least likely to report that they would use the AV shuttle frequently (40% of respondents, compared to 63% of those who used transit more frequently, and 55% of those who used cars and transit with similar frequency).
    - However, 40% of car users is a relatively large proportion, and 78% of these participants reported that they would use the shuttle service at least occasionally if it were delivered with an AV.
5. **Transit users were slightly more likely to try the shuttle and to have a positive attitude towards the project**
    - Nearly 65% of participants who used transit more than cars were very likely to try the shuttle, compared to 53% of those who used cars more, and 55% of those who had a similar frequency of use between cars and transit.
    - Around 88% of participants who used transit more had a positive attitude towards the project compared to 77% of those who used cars more, and 76% of those who had a similar frequency of use between cars and transit.
6. **Appeal of the automated driving technology**
    - Respondents reported that they would take the shuttle more frequently if it was delivered with an AV compared to a conventional vehicle, suggesting that part of the motivation for taking the shuttle may be the AV technology itself. This pattern was

observed for participants who travelled by cars more frequently than transit, those who used transit more frequently than cars, and those who had the same frequency of use between cars and transit.

- Of the respondents who travel more frequently by car than transit, 40% reported that they would take the shuttle frequently if it was delivered with an AV compared to only 20% who said that they would take the shuttle frequently if it were delivered with a conventional vehicle. These results suggest that implementation of an automated shuttle may shift some car users to public transit for some of their trips.
- Of the respondents who travel more frequently by car than transit and live in the service area, 49% reported that they would take the shuttle frequently if it were delivered with an AV, compared to only 26% who reported that they would take it frequently if it were delivered with a conventional vehicle.

7. Concerns about slow shuttle speed and safety

- One of the main concerns related to the shuttle appears to be its slow operating speed. Frustration with the slow shuttle speed as a driver and passenger were rated as the least useful aspects of the shuttle, by both people who live in the service area and all other participants. However, after the shuttle began testing, there was a lower proportion of respondents who reported being frustrated by the shuttle speed (42%, compared to 55% before testing began).
- Participants also had safety concerns about the slow shuttle speed. While one participant did mention that this was a positive safety aspect, others mentioned that it could negatively affect safety (e.g., drivers engaging in unsafe maneuvers to pass the shuttle because they were frustrated by its slow speed) and increase congestion.
- Other participants commented that they were concerned about safety/security on the shuttle, uncertainty about emergency procedures, and the technology's capabilities, especially around vulnerable road users.

8. Concerns based on context

- People who were familiar with the shuttle route appeared to have additional concerns about the shuttle service, based on additional context. For example, respondents mentioned safety concerns about the lack of sidewalks in the area, which may lead to unsafe interactions between the shuttle and pedestrians.
- Other respondents mentioned concerns about shuttle users potentially waiting on private property given the lack of sidewalks or waiting areas.
- Several respondents also had concerns about increased congestion given the narrow roads and existing congestion in the area.

9. Statistical modeling is needed to determine the strongest predictors of intention to use

Our preliminary statistical analysis indicated that overall attitude, perceived usefulness, trust, and perceived safety were significantly correlated with likelihood to try the shuttle and intended frequency of using an AV shuttle if it were to become permanent. Further, the constructs were influenced by demographic factors and travel behaviour. Therefore, future work for this study should involve statistical modelling to investigate the relationships between constructs and potential moderating effects of demographics and travel behaviour.

Limitations

One major limitation of this study is that we were unable to assess how responses may have changed after experience using the shuttle or seeing it operating in the community. The presented conclusions in this report only reflect people's opinions and perceptions regarding the technology without having any firsthand experience with it. Such opinions may change after trying the shuttle or seeing it operating in their community on a regular basis. Further, reports of an automated shuttle crash in Whitby in December 2021 [19] may have also affected public perceptions of the shuttle service. Unfortunately, we did not have any data from after the Whitby crash, and thus we were unable to investigate whether there were any changes in people's attitude and perception of the shuttle in terms of trust and safety.

Implications and recommendations

- The results indicate that the addition of an AV shuttle may potentially increase public transit use. It was observed that more car users would take the shuttle frequently if it was an AV.
- Campaigns could be beneficial to increase public awareness of the shuttle service and technology, and intention to use.
    - The observed correlations between constructs and intention to use an AV shuttle suggest that campaigns to increase awareness of the perceived usefulness and trust in the automated technology could potentially increase intention to use the shuttle.
    - The concerns about onboard safety/security and emergency procedures that were reported in the survey suggest that introducing campaigns to increase public awareness of relevant service information may potentially increase willingness to use the shuttle.
    - Targeted campaigns to older age groups (65+) about the shuttle service and the automated vehicle technologies in general is suggested. It was observed from the results that older age groups had a lower likelihood to try the service, and significantly lower trust levels than respondents under 45.

References

[1] C. F. Chen, "Factors affecting the decision to use autonomous shuttle services: Evidence from a scooter-dominant urban context," *Transp. Res. Part F Traffic Psychol. Behav.*, vol. 67, pp. 195–204, 2019.

[2] R. Madigan, T. Louw, M. Wilbrink, A. Schieben, and N. Merat, "What influences the decision to use automated public transport? Using UTAUT to understand public acceptance of automated road transport systems," *Transp. Res. Part F Traffic Psychol. Behav.*, vol. 50, pp. 55–64, 2017.

[3] S. Dennis, A. Paz, and T. Yigitcanlar, "Perceptions and attitudes towards the deployment of autonomous and connected vehicles: Insights from Las Vegas, Nevada," *J. Urban Technol.*, vol. 28, no. 3–4, pp. 75–95, 2021.

[4] S. Nordhoff, R. Madigan, B. Van Arem, N. Merat, and R. Happee, "Interrelationships among predictors of automated vehicle acceptance: A structural equation modelling approach," *Theor. Issues Ergon. Sci.*, vol. 22, no. 4, pp. 383–408, 2020.

[5] S. Nordhoff, J. de Winter, R. Madigan, N. Merat, B. van Arem, and R. Happee, "User acceptance of automated shuttles in Berlin-Schöneberg: A questionnaire study," *Transp. Res. Part F Traffic Psychol. Behav.*, vol. 58, pp. 843–854, 2018.

[6] J. Mason, S. Classen, J. Wersal, and V. P. Sisiopiku, "Establishing face and content validity of a survey to assess users' perceptions of automated vehicles," *Transp. Res. Rec.*, vol. 2674, no. 9, pp. 47–538, 2020.

[7] C. Bernhard, D. Oberfeld, C. Hoffmann, D. Weismüller, and H. Hecht, "User acceptance of automated public transport: Valence of an autonomous minibus experience," *Transp. Res. Part F Traffic Psychol. Behav.*, vol. 70, pp. 109–123, 2020.

[8] P. N. E. Chee, Y. O. Susilo, and Y. D. Wong, "Determinants of intention-to-use first-/last-mile automated bus service," *Transp. Res. Part A Policy Pract.*, vol. 139, pp. 350–375, 2020.

[9] S. A. Kaye, I. Lewis, L. Buckley, C. Gauld, and A. Rakotonirainy, "To share or not to share: A theoretically guided investigation of factors predicting intentions to use fully automated shared passenger shuttles," *Transp. Res. Part F Traffic Psychol. Behav.*, vol. 75, pp. 203–213, 2020.

[10] S. Nordhoff, V. Malmsten, B. van Arem, P. Liu, and R. Happee, "A structural equation modeling approach for the acceptance of driverless automated shuttles based on constructs from the Unified Theory of Acceptance and Use of Technology and the Diffusion of Innovation Theory," *Transp. Res. Part F Traffic Psychol. Behav.*, vol. 78, pp. 58–73, 2021.

[11] D. D. Heikoop, J. P. Nuñez Velasco, R. Boersma, T. Bjørnskau, and M. P. Hagenzieker, "Automated bus systems in Europe: A systematic review of passenger experience and road user interaction," in *Advances in Transport Policy and Planning*, 1st ed., vol. 5, D. Milakis, N. Thomopoulos, and B. van Wee, Eds. Elsevier Inc., 2020, pp. 51–71.

[12] R. Madigan *et al.*, "Acceptance of automated road transport systems (ARTS): An

adaptation of the UTAUT model," *Transp. Res. Procedia*, vol. 14, pp. 2217–2226, 2016.

[13] E. Machek and S. Peirce, "Survey Research for Automated Shuttle Pilots: Issues and Challenges (FTA Report No. 0193)," Washington, DC, 2021.

[14] R. A. M. & A. Ltd., "[Report Title] [Report Tag Line] TTS 2016 CITY OF TORONTO SUMMARY BY WARD," Toronto, ON, 2016.

[15] S. Nordhoff, M. Kyriakidis, B. van Arem, and R. Happee, "A multi-level model on automated vehicle acceptance (MAVA): A review-based study," *Theor. Issues Ergon. Sci.*, vol. 20, no. 6, pp. 682–710, 2019.

[16] Y. Xing, S. Handy, G. Circella, Y. Wang, and F. Alemi, "Exploring the role of attitude in the acceptance of self-driving shuttles (Report No. NCST-UCD-RR-20-14)," Davis, CA, 2020.

[17] H. Khamis, "Measures of association: How to choose?," *J. Diagnostic Med. Sonogr.*, vol. 24, no. 3, pp. 155–162, 2008.

[18] D. Paddeu, G. Parkhurst, and I. Shergold, "Passenger comfort and trust on first-time use of a shared autonomous shuttle vehicle," *Transp. Res. Part C Emerg. Technol.*, vol. 115, p. 102604, 2020.

[19] S. Nordhoff, J. Stapel, B. van Arem, and R. Happee, "Passenger opinions of the perceived safety and interaction with automated shuttles: A test ride study with 'hidden' safety steward," *Transp. Res. Part A Policy Pract.*, vol. 138, pp. 508–524, 2020.

[20] M. L. McHugh, "Spearman Correlation Coefficient," in *The SAGE Encyclopedia of Educational Research, Measurement, and Evaluation*, B. B. Frey, Ed. Thousand Oaks, CA: SAGE Publications Inc., 2018, pp. 1555–1558.

[21] A. O. Idris, "Modal Shift Forecasting Models for Transit Service Planning," University of Toronto, 2013.

[22] Y. Heath and R. Gifford, "Extending the theory of planned behavior: Predicting the use of public transportation," *J. Appl. Soc. Psychol.*, vol. 32, no. 10, pp. 2154–2189, 2002.

[23] C. Domarchi, A. Tudela, and A. González, "Effect of attitudes, habit and affective appraisal on mode choice: An application to university workers," *Transportation (Amst).*, vol. 35, no. 5, pp. 585–599, 2008.

[24] R. Behrens and R. Del Mistro, "Shocking habits: Methodological issues in analyzing changing personal travel behavior over time," *Int. J. Sustain. Transp.*, vol. 4, no. 5, pp. 253–271, 2010.

[25] V. Cantillo, J. De Dios Ortúzar, and H. C. W. L. Williams, "Modeling discrete choices in the presence of inertia and serial correlation," *Transp. Sci.*, vol. 41, no. 2, pp. 195–205, 2007.

APPENDIX A: The Survey

First Questions

Please do not provide any personal information about yourself or other individuals in any of your responses.

Q1. Given what you know about the City of Toronto's Automated Shuttle Trial, what is your overall feeling about the project?

Very positive
Positive
Undecided/not sure
Negative
Very negative

Q2. How likely will you be to try the West Rouge Automated Shuttle service?

Very likely
Likely
Undecided/not sure
Unlikely
Very unlikely

[If Q2 = Very likely OR Likely]
Q2BL. I am likely to try the shuttle because… (choose up to 3) [options in random order]

I am interested in experiencing the automated vehicle (AV) technology
It is hard to find parking at the GO Station
The shuttle is free
The shuttle is electric (emissions-free)
I can relax on the trip
I believe the AV shuttle will operate safely for its passengers
I believe the AV shuttle provides a secured environment (e.g., harassment-free)
I like having a shuttle stop so close to home
The frequency and timing of the service are convenient for my travel needs
I like that I can book my ride ahead of time
It will be useful on rainy days compared to my usual mode of transport
I regularly use the Rouge Hill GO Station
Risk of Covid-19 is appropriately managed
The shuttle is more convenient than my usual travel mode
Other, please specify

[If Q2 = Very likely OR Likely]
Q2CL. For trips when you take the shuttle, what mode of travel would you have otherwise used for that trip if the shuttle was not available? (Choose all that apply)

Driving alone
Driving with others
TTC
Walking
Cycling
I would not have taken the trip without the shuttle
Other, please specify

[If Q2 = Very unlikely OR Unlikely]
Q2BU. I am unlikely to try the shuttle because… (choose up to 3) [options in random order]

I am not interested in the automated vehicle (AV) technology
The shuttle does not travel to destinations that are relevant to me
The service is not frequent
Risk of Covid-19 is appropriately managed
The shuttle is not driven by a person
I don't have enough information about the safety of AVs
The vehicle travels at very low speeds
There is no Wi-Fi on board
The shuttle is not convenient compared to my usual travel mode
The idea of booking ahead seems like a hassle
The frequency and timing of the service are not convenient for my travel needs
I am not sure about the reliability of the service to get me to the train station on time
Other, please specify

[If Q2 = Undecided/not sure]
Q2BN. I am not sure about trying the shuttle because… (choose up to 3) [options in random order]

I am not interested in the automated vehicle (AV) technology
The shuttle does not travel to destinations that are relevant to me
It depends what travel needs I have during the trial period
The service is not frequent
Risk of Covid-19 is appropriately managed
The shuttle is not driven by a person
I don't have enough information about the safety of AVs
I am unsure if the frequency and timing of the schedule will meet my travel needs
The vehicle travels at very low speeds
There is no Wi-Fi on board
The shuttle is not convenient compared to my usual travel mode
The idea of booking ahead seems like a hassle
I am not sure about the reliability of the service to get me to the train station on time
Other, please specify

[If Q2 = Undecided/not sure]
Q2CN. If you did decide to take the shuttle, what mode of travel would you have otherwise used for that trip if the shuttle was not available? (Choose all that apply)

Driving alone
Driving with others
TTC
Walking
Cycling
Other, please specify

Q3. Please rate your agreement with the following statements [statements in random order]
Strongly disagree – Disagree – Neutral – Agree – Strongly agree – N/A

- **a.** I think the shuttle vehicle is accessible for people with mobility challenges
- **b.** Using the shuttle will be appealing to decrease my parking challenges at the GO Station
- **c.** The shuttle will make it easier for me to connect to the GO Train
- **d.** I think the shuttle stops are at convenient locations for me
- **e.** I think the shuttle would be useful for some of my regular travel needs

f. If I were riding in the shuttle, I would be frustrated by its slow driving speed
g. If I were driving behind the shuttle, I would be frustrated by its slow driving speed
h. I like that the shuttle is electric and is emissions-free
i. I like that the shuttle is quiet
j. I think using the shuttle would be enjoyable
k. I think the on-board cameras are appropriate and will sufficiently protect my privacy

Q4. Please rate how much you trust the following capabilities of the shuttle:
1 (Do not trust at all) – 2 – 3 – 4 – 5 (Trust completely)

a. Shuttle's ability to navigate safely around people walking, cycling, or playing in the community
b. Shuttle's ability to interact safely with other motor vehicles in the community (Example: cars, motorcycles etc.)
c. Shuttle's ability to navigate safely around stationary obstacles (Example: garbage bins, parked cars, etc.)
d. Shuttle's ability to navigate safely in poor weather conditions (Example: rain, snow or fog)

At this time there is no plan to make the shuttle a permanent service. However, for the purpose of the next question, please consider how frequently you would take a shuttle service in your neighbourhood that connects to the GO Station if it were to become permanent.

Q5A. If this service were delivered with an automated vehicle:

Frequently
Occasionally
Rarely
Never
Undecided/It depends

Q5B. If this service were delivered by a conventional vehicle:

Frequently
Occasionally
Rarely
Never
Undecided/It depends

As a Passenger

For the following questions, think about how you would feel as a passenger **riding in the shuttle**. You will be asked later about your perceptions of the shuttle as a resident interacting with the shuttle.

Q6. Knowing what you know about the planned automated shuttle vehicle to be used in your community, how safe would you feel riding in the automated shuttle?

Very safe
Safe
Undecided/not sure
Unsafe
Very unsafe

Q7. How do the following shuttle characteristics affect how safe you would feel riding in the automated shuttle?

Much less safe – Less safe – I would feel* – More safe – Much more safe
* Due to an error on the survey site, the full text of this item was cut off

- **a.** The booking system prevents sharing the shuttle with passengers not in your household
- **b.** Presence of a human operator on board who can take control if needed
- **c.** Vehicle speed of under 20 km/h
- **d.** Having the shuttle travel on roads with other traffic (Example: cars, pedestrians, cyclists)
- **e.** There are cameras on board which are blurred to protect privacy
- **f.** Automated navigation system that removes human error

Q8. Is there any other information that would help you feel safer as a passenger on the automated shuttle? (Please do not provide any personal information about yourself or other individuals in your response)

[Text entry field]

In Your Community

For the following questions, think about seeing and interacting with the shuttle as it travels through your community.

Q9. Knowing what you know about the planned automated shuttle vehicle to be used in your community, how safe do you think it would be to have the automated vehicle travelling on roads near you?

Very safe
Safe
Undecided/not sure
Unsafe
Very unsafe

Q10. How do the following shuttle characteristics affect how safe you think it is to have the automated shuttle in your community?
Much less safe – Less safe – I would feel* – More safe – Much more safe
* Due to an error on the survey site, the full text of this item was cut off

- **a.** Presence of a human operator on board who can take control if needed
- **b.** Safety check of vehicle done before and after each shift
- **c.** Vehicle speed of under 20 km/h
- **d.** Having the shuttle travel on roads with other traffic (Example: cars, pedestrians, cyclists)
- **e.** There are cameras inside and outside the shuttle
- **f.** Knowing the shuttle is quiet and emissions-free
- **g.** The shuttle service will help reduce the need for parking at the GO station

Q11. If you were cycling on a road with an automated vehicle, how safe would you feel compared to when cycling near conventional motor vehicles?

Much safer
Somewhat safer
Similar level of safety
Somewhat less safe
Much less safe
Undecided
Not applicable – I never cycle on streets with motor vehicles

Q12. As a pedestrian crossing at an intersection, if you knew the vehicle travelling toward you was automated, how safe you feel compared to if it was a conventional vehicle?

Much safer
Somewhat safer
Similar level of safety
Somewhat less safe
Much less safe
Undecided

Q13. Is there any other information that would help you decide whether it would be safe to have the automated shuttle in your community? (Please do not provide any personal information about yourself or other individuals in your response)

[Text entry field]

Q14. Are there any other questions, concerns or comments that you have about the automated shuttle in your community. (Please do not provide any personal information about yourself or other individuals in your response)

[Text entry field]

About You (optional)

All questions are optional.

Q15. When it comes to new technology, what best describes you?

I am skeptical of new technologies and use them only when I have to
I am usually one of the last people I know to use new technologies
I use new technologies when most of the people I know use them
I like new technologies and use them before most people I know
I love new technologies and am among the first to experiment and use them
Prefer not to answer

Q16. Please provide the first 3 characters of your postal code:

[Text entry field]

Q17. Do you live on the shuttle route?

Yes
No
Prefer not to answer

Q18. What is your age?

Under 16
16-24
25-44
45-64
65 and over
Prefer not to answer

Gender identity is the gender that people identify with or how they perceive themselves, which may be different from their birth-assigned sex.

Q19. What best describes your gender?

Woman
Man
Trans woman
Trans man
Gender non-binary
Two-Spirit
Not listed, please describe
Prefer not to answer

Disability is understood as any physical, mental, developmental, cognitive, learning, communication, sight, hearing or functional limitation that, in interaction with a barrier, hinders a person's full and equal participation in society. A disability can be permanent, temporary or episodic, and visible or invisible.

Q20. Do you identify as a person with a disability?

Yes
No
Don't know
Prefer not to answer

Q21. Including yourself, how many people in your household are licensed drivers?

1
2
3
4
5 or more
Prefer not to answer

Q22. How frequently do you travel in a car as a driver or a passenger?

Never drive a car
Less than once per month
1-4 times per month
2-3 times per week
4-5 times per week
More than 5 times per week
Prefer not to answer

Q23. How frequently do you use any form of public transport (TTC, GO Train, DRT)?

Less than once per month
1-4 times per month
2-3 times per week
4-5 times per week
More than 5 times per week
Prefer not to answer

APPENDIX B: Survey Results

Table 3. "Do you live on the shuttle route?"

	Overall	
	Count (N)	**% of Responses**
Yes	52	25%
No	140	68%
Prefer not to answer	14	7%
Total	**206**	**100%**

Table 4. Age

	Count (N)	**% of responses**
Under 16	2	1%
16-24	22	10%
25-44	105	50%
45-64	59	28%
65 and over	19	9%
Prefer not to answer	3	1%
Total	**210**	**100%**

Table 5. Gender

	Count (N)	**% of responses**
Woman	81	38%
Man	119	56%
Trans woman	1	0%
Trans man	0	0%
Gender non-binary	1	0%
Two-Spirit	0	0%
Not listed, please describe	2	1%
Prefer not to answer	7	3%
Total	**211**	**100%**

Table 6. "Do you identify as a person with a disability?"

	Count (N)	**% of responses**
Yes	23	11%
No	181	86%
Don't know	1	0%
Prefer not to answer	6	3%
Total	**211**	**100%**

Table 7. "Including yourself, how many people in your household are licensed drivers?"

	Count (N)	% of responses
1	34	16%
2	100	48%
3	29	14%
4	19	9%
5 or more	9	4%
Prefer not to answer	18	9%
Total	**209**	**100%**

Table 8. "How frequently do you travel in a car as a driver or a passenger?"

	Count (N)	% of responses
Never drive a car	9	4%
Less than once per month	10	5%
1-4 times per month	29	14%
2-3 times per week	37	18%
4-5 times per week	28	13%
More than 5 times per week	92	44%
Prefer not to answer	4	2%
Total	**209**	**100%**

Table 9. "How frequently do you use any form of public transport (TTC, GO Train, DRT)?"

	Count (N)	% of responses
Less than once per month	50	24%
1-4 times per month	51	24%
2-3 times per week	36	17%
4-5 times per week	23	11%
More than 5 times per week	36	17%
Prefer not to answer	13	6%
Total	**209**	**100%**

Table 10. "When it comes to new technology, what best describes you?"

	Count (N)	% of responses
I am skeptical of new technologies and use them only when I have to	6	3%
I am usually one of the last people I know to use new technologies	12	6%
I use new technologies when most of the people I know use them	50	24%
I like new technologies and use them before most people I know	77	37%
I love new technologies and am among the first to experiment and use them	61	29%
Prefer not to answer	3	1%
Total	**209**	**100%**

Table 11. "I am likely to try the shuttle because… (choose up to 3)"

	Count (N)	% of total participants (N = 213)
I am interested in experiencing the automated vehicle (AV) technology	130	61%
The shuttle is electric (emissions-free)	85	40%
The shuttle is free	77	36%
I like that I can book my ride ahead of time	40	19%
I believe the AV shuttle will operate safely for its passengers	38	18%
I regularly use the Rouge Hill GO Station	36	17%
I like having a shuttle stop so close to home	30	14%
I can relax on the trip	24	11%
The shuttle is more convenient than my usual travel mode	20	9%
It is hard to find parking at the GO Station	19	9%
It will be useful on rainy days compared to my usual mode of transport	18	8%
The frequency and timing of the service are convenient for my travel needs	14	7%
Other, please specify	12	6%
I believe the AV shuttle provides a secured environment (e.g., harassment-free)	10	5%
Risk of Covid-19 is appropriately managed	9	4%

Table 12. Themes identified in the responses to "Other - please specify" from Table 11. Total count may not match the count from Table 11 as some participants' responses may have covered more than one theme.

Theme	Count (N)
Interest in technology	5
Interest in public transit	3
A new mode servicing current travel demand	2
Environmentally friendly	2
Enjoyment	1
Improved traffic operations	1
Shuttle accessibility	1

Table 13. "For trips when you take the shuttle, what mode of travel would you have otherwise used for that trip if the shuttle was not available? (choose all that apply)."

	Lives in area		All other participants		Total	
	Count (N)	**% of participants (N = 83)**	**Count (N)**	**% of participants (N = 127)**	**Count (N)**	**% of participants (N = 210)**
Driving alone	53	64%	50	39%	103	49%
TTC	24	29%	55	43%	79	38%
Walking	37	45%	41	32%	78	37%
Driving with others	25	30%	28	22%	53	25%
Cycling	11	13%	30	24%	41	20%
I would not have taken the trip without the shuttle	6	7%	17	13%	23	11%
Other, please specify	2	2%	7	6%	9	4%

Table 14. "I am unlikely to try the shuttle because… (choose up to 3)"

	Count (N)	**% of total participants (N = 41)**
The shuttle does not travel to destinations that are relevant to me	20	49%
The shuttle is not driven by a person	12	29%
Other, please specify	12	29%
The idea of booking ahead seems like a hassle	11	27%
I am not interested in the automated vehicle (AV) technology	6	15%
I don't have enough information about the safety of AVs	6	15%
The shuttle is not convenient compared to my usual travel mode	3	7%
The frequency and timing of the service are not convenient for my travel needs	3	7%
The vehicle travels at very low speeds	2	5%
I am not sure about the reliability of the service to get me to the train station on time	2	5%
The service is not frequent	1	2%
Risk of Covid-19 is appropriately managed	1	2%
There is no Wi-Fi on board	0	0%

Table 15. Themes identified in the responses to "Other, please specify" from Table **14**. Total count may not match the count from Table 14 as some participants' responses may have covered more than one theme.

Theme	**Count (N)**
Route is not servicing my area	7
Lack of trust in technology's abilities	4
Unsafe	2
Driver job loss	1

No dedicated lanes	1
Not convenient	1
Not good use of city resources	1

Table 16. "I am not sure about trying the shuttle because… (choose up to 3)"

	Count (N)	**% of total participants (N = 19)**
The shuttle does not travel to destinations that are relevant to me	12	63%
It depends what travel needs I have during the trial period	8	42%
The idea of booking ahead seems like a hassle	8	42%
The vehicle travels at very low speeds	4	21%
The shuttle is not convenient compared to my usual travel mode	4	21%
I am unsure if the frequency and timing of the schedule will meet my travel needs	3	16%
I don't have enough information about the safety of AVs	2	11%
I am not interested in the automated vehicle (AV) technology	1	5%
The shuttle is not driven by a person	1	5%
There is no Wi-Fi on board	1	5%
I am not sure about the reliability of the service to get me to the train station on time	1	5%
Other, please specify	1	5%
The service is not frequent	0	0%
Risk of Covid-19 is appropriately managed	0	0%

Table 17. Themes identified in the responses to "Other, please specify" from Table 16. Total count may not match the count from Table 16 as some participants' responses may have covered more than one theme

Theme	**Count (N)**
Lack of sidewalks, no pedestrian waiting area	1
Narrow road	1

Table 18. "If you did decide to take the shuttle, what mode of travel would you have otherwise used for that trip if the shuttle was not available? (choose all that apply)"

	Lives in area		**All other participants**		**Total**	
	Count (N)	**% of participants (N = 3)**	**Count (N)**	**% of participants (N = 15)**	**Count (N)**	**% of participants (N = 18)**
TTC	0	0%	9	60%	9	50%
Walking	2	67%	6	40%	8	44%
Driving alone	3	100%	4	27%	7	39%
Cycling	0	0%	5	33%	5	28%
Driving with others	2	67%	2	13%	4	22%
Other, please specify	0	0%	0	0%	0	0%

Table 19. "How do the following shuttle characteristics affect how safe you would feel riding in the automated shuttle?" *Note: the full text for the "Similar level of safety" option was "I would feel a similar level of safety". However, due to an issue with the survey tool, only "I would feel" was displayed.*

	Much less safe	Less safe	Similar level of safety	More safe	Much more safe	Total N
The booking system prevents sharing the shuttle with passengers not in your household	2%	4%	24%	41%	29%	220
Presence of a human operator on board who can take control if needed	2%	2%	17%	42%	37%	221
Vehicle speed of under 20 km/h	6%	10%	32%	37%	15%	221
Having the shuttle travel on roads with other traffic (Example: cars, pedestrians, cyclists)	6%	14%	44%	26%	10%	222
There are cameras on board which are blurred to protect privacy	5%	9%	21%	43%	21%	222
Automated navigation system that removes human error	6%	5%	20%	39%	29%	222

Table 20. "How do the following shuttle characteristics affect how safe you think it is to have the automated shuttle in your community?" *Note: the full text for the "Similar level of safety" option was "I would feel a similar level of safety". However, due to an issue with the survey tool, only "I would feel" was displayed.*

	Much less safe	Less safe	Similar level of safety	More safe	Much more safe	Total N
Presence of a human operator on board who can take control if needed	1%	4%	14%	46%	35%	214
Safety check of vehicle done before and after each shift	1%	0%	8%	45%	46%	215
Vehicle speed of under 20 km/h	5%	14%	29%	36%	15%	214
Having the shuttle travel on roads with other traffic (Example: cars, pedestrians, cyclists)	4%	18%	33%	30%	15%	214
There are cameras inside and outside the shuttle	2%	4%	14%	43%	36%	215
Knowing the shuttle is quiet and emissions-free	2%	3%	21%	32%	42%	214
The shuttle service will help reduce the need for parking at the GO station	2%	1%	22%	39%	36%	215

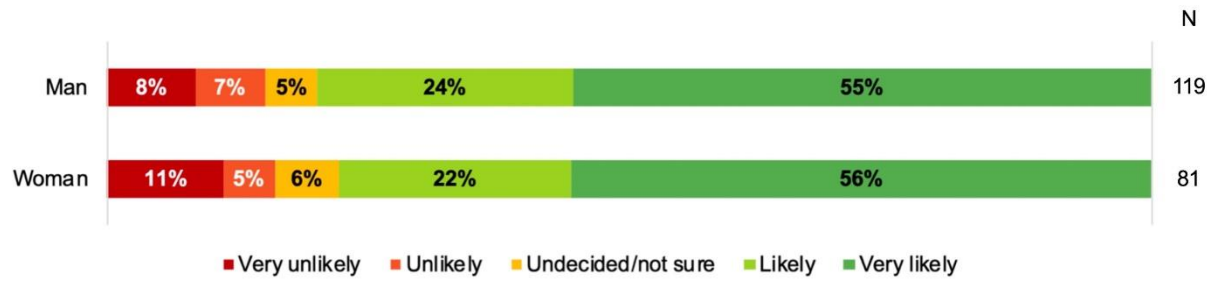

Figure 27. Likelihood to try the shuttle by gender. Note: this is the same data presented in Figure 6, in this case, split by gender.

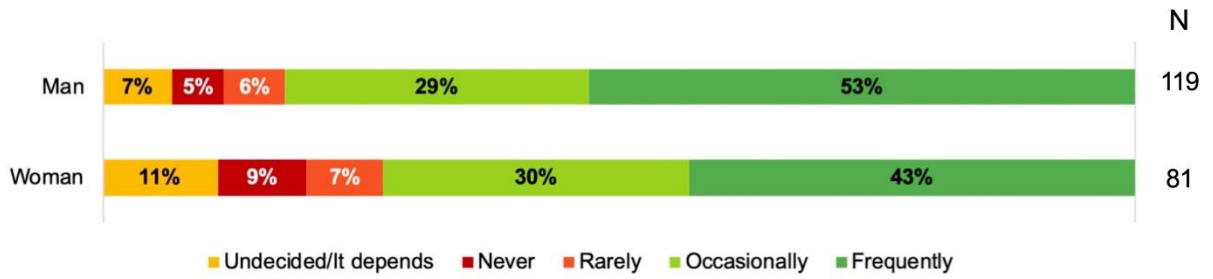

Figure 28. Intended frequency of ongoing use if the service were delivered by an AV, by gender. Note: this is the same data presented in Figure 7, in this case, split by gender.

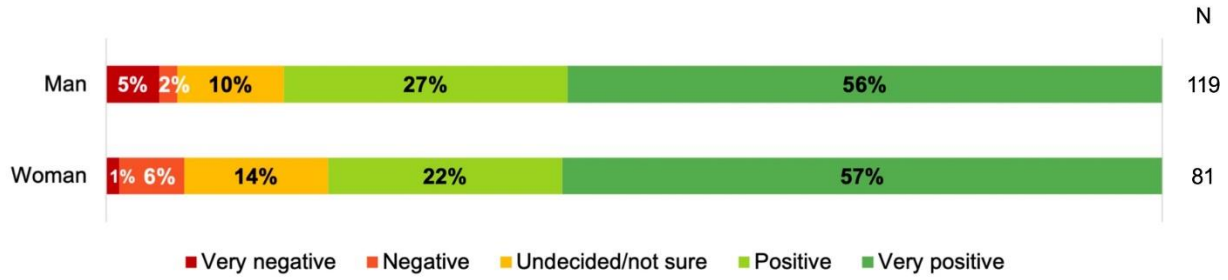

Figure 29. Attitude towards the project by gender. Note: this is the same data presented in Figure 8, in this case, split by gender.

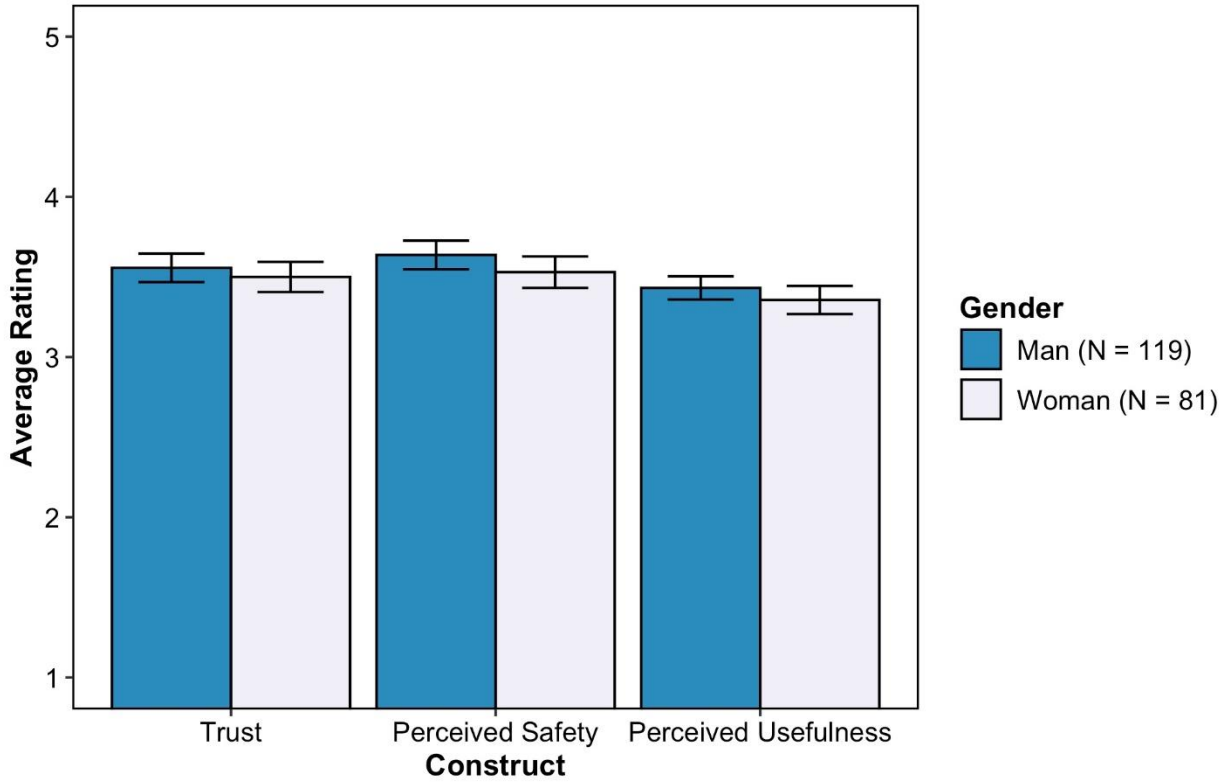

Figure 30. Average ratings for trust, perceived safety, and perceived usefulness by gender

APPENDIX C: Response Coding for Open Ended Questions

Table 21. Themes identified in the responses to the open-ended question: "Is there any other information that would help you feel safer as a passenger on the automated shuttle?"

Theme	Sub-theme (if applicable)	Number of participants	Percentage of participants (N = 46)
Emergency procedures		**11**	**24%**
Service design		**7**	**15%**
	Poor choice of piloting area	1	2%
	Service area expansion, more stops	5	11%
	Stops using private property	1	2%
Slow shuttle speed		**6**	**13%**
	Congestion, impeding traffic	2	4%
	Frustration	3	7%
	Not specified	1	2%
	Safety	4	9%
Onboard security, safety		**6**	**13%**
	General	3	7%
	Ridesharing*	3	7%
Ridesharing		**6**	**13%**
	Negative view (safety/security) *	3	7%
	Negative view (not specified)	1	2%
	Positive view	1	2%
	COVID specific considerations	1	2%
Infrastructure		**3**	**7%**
	Dedicated lanes	2	4%
	Lack of sidewalks, no pedestrian waiting area	1	2%
Interactions with other road users and the environment		**3**	**7%**
	Other vehicles	2	4%
	VRUs	3	7%
Use of cameras		**3**	**7%**
	External (enhanced performance, liability)	1	2%
	More (not specified)	1	2%
	Onboard safety, security	1	2%
Booking system		**2**	**4%**
	Enforcement	1	2%
	Remove	1	2%
Communication		**2**	**4%**
	External	1	2%
	To passengers	1	2%
Presence of human driver		**2**	**4%**
	Improves safety	2	4%

Safety during nighttime operations		**2**	**4%**
Service information		**2**	**4%**
	General, on-board	2	4%
Driver job loss		**1**	**2%**
General distrust of transit services		**1**	**2%**
Shuttle accessibility		**1**	**2%**
Shuttle attendant duties		**1**	**2%**
Shuttle experience		**1**	**2%**
	Firsthand	1	2%
Technology abilities		**1**	**2%**
	Lack of trust in abilities	1	2%
Transit equity		**1**	**2%**
TOTAL		**46**	**100%**

* Categories contain the same participants

Table 22. Themes identified in the responses to the open-ended question: "Is there any other information that would help you decide whether it would be safe to have the automated shuttle in your community?"

Theme	Sub-theme (if applicable)	Number of participants	Percentage of participants (N = 30)
Interactions with other road users and the environment		**8**	**27%**
	VRUs	5	17%
	Other vehicles	2	7%
	GO parking spots	1	3%
	Jaywalkers	1	3%
Technology abilities		**7**	**23%**
	Need more information	5	17%
	Lack of trust in abilities	2	7%
Slow shuttle speed		**5**	**17%**
	Safety (negative)	4	13%
	Safety (positive)	1	3%
	Congestion, impeding traffic	2	7%
	Punctuality	1	3%
Infrastructure		**5**	**17%**
	Dedicated lanes	2	7%
	Lack of sidewalks, no pedestrian waiting area	2	7%
	Narrow road	1	3%
Shuttle experience		**4**	**13%**
	Trial results	3	10%
	Firsthand	1	3%
Service design		**4**	**13%**
	Poor choice of piloting area	1	3%

	Service area expansion, more stops	1	3%
	Shuttle frequency, scheduling	1	3%
	Signage	1	3%
Communication		**3**	**10%**
	External	2	7%
	To passengers	1	3%
Operations		**2**	**7%**
	Inspection and testing	1	3%
	Project legality, service legitimacy	1	3%
	Safety regulations	1	3%
Service information		**2**	**7%**
	Increase public awareness	1	3%
	Software	1	3%
Emergency procedures		**1**	**3%**
Noise		**1**	**3%**
	Disturbance	1	3%
Booking system		**1**	**3%**
	Needs improvement	1	3%
Presence of human driver		**1**	**3%**
	Improves safety	1	3%
Ridesharing		**1**	**3%**
	Positive view	1	3%
TOTAL		**30**	**100%**

Table 23. Themes identified in the responses to the open-ended question: "Are there any other questions, concerns or comments that you have about the automated shuttle in your community?"

Theme	Sub-theme (if applicable)	Number of participants	Percentage of participants (N = 49)
Service design		**14**	**29%**
	Service area expansion, more stops	10	20%
	Poor choice of piloting area	2	4%
	Stops using private property	2	4%
	Make permanent	1	2%
Slow shuttle speed		**7**	**14%**
	Congestion, impeding traffic	6	12%
	Safety	3	6%
	Frustration	1	2%
	Not specified	1	2%
Technology abilities		**7**	**14%**
	Lack of trust in abilities	3	6%
	Need more information	2	4%
	Trust in abilities	2	4%
A new mode servicing current travel demand		**5**	**10%**
Interactions with other road users and the environment		**5**	**10%**
	VRUs	3	6%
	Jaywalkers	1	2%
	Other vehicles	1	2%
	Stationary objects	1	2%
Infrastructure		**4**	**8%**
	Dedicated lanes	2	4%
	Narrow road	2	4%
	Bike lanes	1	2%
	Lack of sidewalks, no pedestrian waiting area	1	2%
Service information		**4**	**8%**
	General, on-board	3	6%
	Booking system	1	2%
	Increase public awareness	1	2%
Shuttle experience		**2**	**4%**
	Firsthand	1	2%
	Trial results	1	2%
Booking system		**2**	**4%**
	Enforcement	1	2%
	Remove	1	2%

Driver job loss		**2**	**4%**
Onboard security, safety		**2**	**4%**
Additional shuttle features		**1**	**2%**
	Bike racks	1	2%
Availability in early and late hours		**1**	**2%**
Communication		**1**	**2%**
	External	1	2%
Enjoyment		**1**	**2%**
Environmentally friendly		**1**	**2%**
Ethical production of shuttle parts		**1**	**2%**
Interest in public transit		**1**	**2%**
Interest in technology		**1**	**2%**
Noise		**1**	**2%**
	Safety concern	1	2%
Not a public transit user		**1**	**2%**
Presence of human driver		**1**	**2%**
	Reduces safety	1	2%
Procedures in case of breakdown obstructing traffic		**1**	**2%**
Public attitudes		**1**	**2%**
Safety and security of the neighbourhood		**1**	**2%**
Shuttle accessibility		**1**	**2%**
Traffic enforcement to prevent impeding shuttle operations		**1**	**2%**
Use of cameras		**1**	**2%**
	Onboard safety, security	1	2%
TOTAL		**49**	**100%**