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Application of a parsimonious Shared Automated Vehicle Acceptance model using empirical data

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Abstract

Shared automated vehicles (SAVs) can only contribute to future mobility systems if travellers are willing to accept and use them. This study examines whether a lean Shared Automated Vehicle Acceptance (SAVA) model, consisting of trust, perceived utility, and social comfort, can capture meaningful variation in users' intentions in an operational setting. The case study involved a permanently deployed, stewardless SAE Level 4 shuttle service at Terhills, a large tourist site in Belgium. After using the service, 677 respondents were recruited at shuttle stops and completed a brief tablet-based survey covering ride experiences, disruptive events, background characteristics, the three SAVA indicators, and intention to use similar vehicles in everyday life. Hierarchical regression analyses showed that the SAVA indicators explained 75% of the variance in intention. Perceived utility was by far the strongest predictor, while trust made a small positive contribution and social comfort was not independently associated with intention. Negative events, including unexplained braking, prolonged stops, and long waiting times, were associated with lower trust, utility, and intention, whereas smooth and positively evaluated rides were associated with more favourable acceptance. Trip frequency did not add explanatory value. The findings suggest that a parsimonious acceptance framework can be useful for rapid, repeatable monitoring in real-world SAV deployments. However, the results are specific to experienced users in a leisure setting and should not be interpreted as population-level estimates of adoption. Replication across service types, operational environments, and longitudinal deployments is needed.

1 Introduction

Automated vehicles (AVs) are an emerging technology that promises great improvements in infrastructure, traffic safety, and greenhouse gas emissions (Hult et al., 2016; Othman, 2020). Because of this promise, there is widespread optimism about vehicle automation. There have recently been significant developments in the field of automated driving, and several services seek to offer robotaxi rides in countries such as the USA and China (Elias & Kolodny, 2025; Zhanhang & Jingyang, 2024). These have been met with some apprehension and resistance from the local population (Jin & Roy, 2024). Although increasing research has investigated the acceptance of AVs, there still seems to be work to be done to create a widely accepted service. Furthermore, additional questions remain regarding shared AVs (SAVs). SAVs are AV implementations thought to generate the most societal benefit due to the inherent efficiency gains compared to private car use. However, such a service may engender additional discomfort for riders (Dolins et al., 2023; Moody et al., 2019; Sanguinetti et al., 2019). SAVs remain less extensively studied than privately owned AVs, particularly in research based on theory and data from realistic operational services (Greifstein, 2024). The present paper addresses this gap by examining empirical data from an operational SAV service. We use theory as a foundation for selecting a small set of acceptance indicators rather than for validating or extending acceptance theory.

While still a young field, psychological research on user acceptance of new technologies has attracted widespread attention. Research on technology acceptance has produced a wide range of theoretical frameworks. However, their application in real-world transport pilots is often constrained by practical considerations. Field studies of SAVs frequently rely on intercept surveys conducted immediately after use, which pose critical limitations regarding questionnaire length, respondent fatigue, and comparability across deployments. Many established acceptance frameworks, such as the Unified Theory of Acceptance and Use of Technology (UTAUT), were designed to provide comprehensive explanations of technology uptake and typically require extensive survey questionnaires (Blut et al., 2022; Venkatesh et al., 2003). While influential and widely applied, such models are difficult to implement consistently in applied surveys and repeated monitoring of operational services. As a result, there is a need for validated short-form acceptance instruments that can be deployed among actual users in permanent SAV deployments, enabling reliable evaluation of user perceptions under real operating conditions. Existing models further offer limited specificity for SAV services, which differ from privately owned automated cars in their social and operational characteristics. The present study addresses this gap by evaluating a brief set of acceptance indicators among users of a permanently deployed, self-driving SAV service, focusing on their relationship with ride experiences and usage intentions.

Several studies have adapted technology acceptance frameworks to the context of automated vehicles (Bellet & Banet, 2023; Nordhoff et al., 2019). These models typically include a large number of constructs and items and are presented as requiring case-specific specification and validation. While such approaches offer comprehensive coverage, their length and complexity pose challenges for applied field research, particularly in settings where data must be collected immediately after use from a heterogeneous flow of users. Moreover, several existing frameworks were developed primarily with privately owned or hypothetical automated vehicles in mind and may not fully reflect the operational and social characteristics of SAV services. Recent empirical work suggests that acceptance indicators in AV research are often highly correlated and that a reduced set of items may capture much of the systematic variation observed in usage intentions (Aasvik, Ulleberg, et al., 2024, 2025; de Winter & Nordhoff, 2022; Nees & Zhang, 2020). Acceptance is typically defined as the potential users' intention to use the service. In applied deployments, a "suitable" acceptance instrument is therefore one that is brief, interpretable, and feasible to administer repeatedly, rather than one that maximises theoretical coverage. This consideration is particularly relevant when studying actual users of operational services. To address these practical constraints, we employ a simplified acceptance framework grounded in prior empirical findings (Aasvik, Ulleberg, et al., 2025). The Shared Automated Vehicle Acceptance (SAVA) model was recently proposed as a short-

form instrument that focuses on trust, utility, and social comfort, but has not yet been tested with data from a permanent SAV deployment (Aasvik, Ulleberg, et al., 2025). The conceptual SAVA-model is presented in Figure 1, with the added step of impact from real user testing of a SAV service before the main intention determinants.

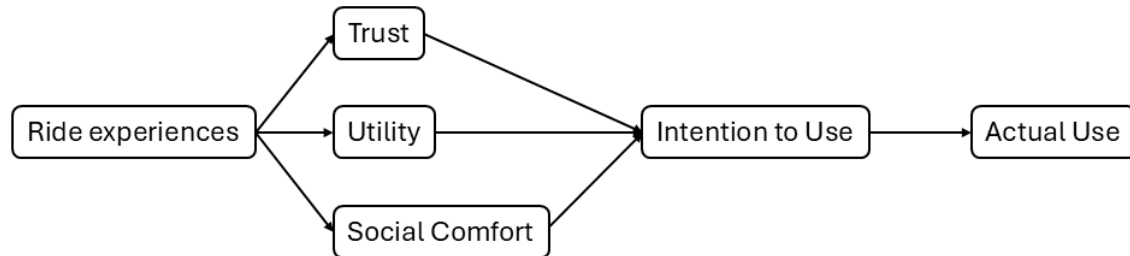


Figure 1. The SAVA model. It assumes prediction of behaviour through intention to use. Usage intentions are predicted from trust, utility, and social comfort. This model is conceptual, not statistical, and correlations between predictors are expected. Here, we are interested in how these determinants are affected by experiences with a real SAV service.

In the present paper, we treat trust, utility (perceived usefulness), and social comfort as a small set of high-salience indicators that recur across these frameworks, rather than as a competing comprehensive theory. Trust is one of the core tenets of AV acceptance. Some recent work positions trust as an early precondition for acceptance (Nordhoff et al., 2023). Trust has a long research tradition, both as a fundamental human trait and as a predictor of technology acceptance (Choi & Ji, 2015; Harrison McKnight & Chervany, 2001; Schwing et al., 2025). It is often identified as one of the most important predictors of intentions to use AVs (Aasvik, Ulleberg, et al., 2024; Choi & Ji, 2015; Hegner et al., 2019; Zhang et al., 2023). The transdisciplinary nature of research in the field has contributed to the lack of a succinct, clear definition. We choose to rely on works that have been influential over the last few decades, suggesting that trust in automation depends on perceived competence/reliability, understandability/predictability, and developers' intentions (Körber, 2019; Lee & See, 2004; Mayer et al., 1995). This suggests that people's trust in SAVs will increase if they are perceived as competent, predictable, and benevolent actors in the traffic system. Safety and trust are often combined in AV research, and a capable digital driver will be perceived as safer and more trustworthy (Aasvik, Hagenzieker, et al., 2024; Etminani-Ghasrodashti et al., 2023). Despite its vital importance, trust has been largely neglected in previous technology acceptance research, such as in the TAM and UTAUT (Davis, 1986; Venkatesh et al., 2003). Trust is likely to be increasingly important for AVs because riding an AV involves a greater element of risk than other forms of technology use (Mayer et al., 1995). Finding ways to design for optimal trust will increase acceptance rates of SAVs.

Improved utility is consistently one of the most coveted features of automation. It can take the form of improved mobility for travellers, decreased travel costs or increased productivity while riding. Unlike trust, utility or perceived usefulness has a long tradition in technology acceptance research (Davis, 1986; Nordhoff et al., 2019; Venkatesh et al., 2003). Besides trusting the vehicles, perceiving them as an upgrade over one's existing travel mode seems key to getting people to use the service (Aasvik, Ulleberg, et al., 2024; Asgari & Jin, 2019; Bellet & Banet, 2023; Hansen & Sener, 2023; Zeithaml, 1988). This is also positioned as an early step in a recently proposed, exploratory "pyramid of user acceptance" (Nordhoff et al., 2023). The usefulness that respondents report AVs will bring to their lives is thus closely tied to their intention to use such vehicles in the future. For SAVs, utility may be particularly important because the shared service may need to cater to the needs of multiple people simultaneously, for example, by taking detours to pick up other passengers. Travel efficiency is an important consideration for people considering SAVs, as many pilot projects have been conducted at low speeds (Hagenzieker et al., 2021; Hansen & Sener, 2023; Krueger et al., 2016; Lavieri et al., 2017; Pokorny et al., 2022). Perceived utility has recently been

found to be crucial for the continued use of SAVs in real-world settings, underscoring its importance (Guo et al., 2025).

The social situation aboard small, shared vehicles may be important for the acceptance of shared AV (SAV), particularly when no driver or safety steward is on board. While most research focuses on AV acceptance more generally, less is known about sharing a robotaxi (Dolins, 2021; Greifenstein, 2024; Sanguinetti et al., 2019). This is also a point where the UTAUT and MAVA frameworks fall short, as they fail to address this issue. Discriminatory attitudes can reduce ridesharing satisfaction and may be a significant hurdle to people using SAVs at all (Moody et al., 2019). Such attitudes are similar to those in other models of intergroup prejudice, such as social dominance orientation, and can be considered relatively stable individual differences that predict a range of attitudes (Kleppestø et al., 2020). SAVs have been “diagnosed” with a sharing problem, meaning that this remains an unsolved issue for the widespread adoption of such services (Dolins et al., 2023). Comfort with sharing is one of the important predictors of willingness to use SAVs (Aasvik, Hagenzieker, et al., 2025; Aasvik, Ulleberg, et al., 2024; Nordhoff et al., 2021; Patel et al., 2023). This social comfort can thus encompass both a dislike for the intimate proximity of strangers, as theorised by proxemics, a disinclination towards certain groups of people, or fear of uncomfortable social situations on board. The novel social situation arising within SAVs may need a new set of social norms that describe and prescribe acceptable behaviour (Dolins et al., 2023). Including a set of items to capture people’s perception of the social situation within SAVs, thus seems pertinent.

There is some research on real-life tests of SAVs. This research is often done without reliance on clear theoretical frameworks (Greifenstein, 2024). However, some trends have emerged. Respondents with experience using ride-hailing apps and public transport are more inclined toward ridesharing AVs (Bakioglu et al., 2022; Rahman & Thill, 2025). This suggests that framing the vehicle as public transport may increase acceptance. Trust and comfort increase with SAV experience, perhaps indicating that the technology takes some getting used to (Gold et al., 2015; Paddeu et al., 2020, 2021). Information and knowledge can also be a positive factor in achieving appropriate trust levels in automation (Khastgir et al., 2018). Testing can positively impact perceptions (Weschke et al., 2021). However, some find that testing of immature technology may not have this desired effect (Aasvik, Hagenzieker, et al., 2024; Bjørnskau et al., 2023; Pokorny et al., 2022). Nevertheless, experience appears to be a robust predictor of AV acceptance (Goldbach et al., 2022). Field tests using on-board data collection have suggested that, although participants were enthusiastic, they were initially doubtful of the utility, and this scepticism persisted after the test ride (Smith et al., 2019). Indeed, perceived usefulness is targeted as a key factor in attracting new users to SAV services (Etminani-Ghasrodashti et al., 2023; Rahman & Thill, 2025). However, further research is needed to apply sound theoretical frameworks to real-life tests of SAVs, thereby building a solid understanding of what drives their acceptance.

The reviewed research indicates that, while several frameworks have been developed to explain acceptance of automated vehicles, they typically involve numerous constructs and measurement items. This limits their practicality for applied field research, particularly in settings where data must be collected quickly from actual users and where repeated measurement over time is desirable. At the same time, prior work consistently highlights a small set of acceptance-related factors as especially salient. Further research is therefore needed to examine whether a simplified model can capture meaningful variation in acceptance in SAV contexts while remaining feasible for real-world deployment.

Thus, our research question is how well the SAVA-model tracks people’s perceptions of an SAV service. There is a lack of research that combines theoretical advancements with real test users of SAV services, and we seek to fill this gap by investigating a real-life implementation of a SAV service. We will explore the events and experiences that impact perceptions of SAVs using the SAVA model. We will also explore the precursors to SAV usage intentions.

2 Materials and methods

2.1 Case

Terhills is a former coal mine site in Belgium that has been redeveloped into a major tourist destination. The 365-hectare Terhills site now accommodates, among others, a resort with 250 cottages, a large wellness complex, a hotel with 59 rooms, an event area, an outlet shopping centre, a national park visitor's centre, a cable ski and hiking and cycling paths. Visitors to Terhills are therefore a combination of (recurring) day visitors and overnight national and international guests. An automated transport system consisting of three self-driving shuttles connects the different points of interest at the site. "Self-driving" implies that no on-board safety steward/operator is present. The shuttles operate autonomously without any active human input, but are connected to a remote supervision centre from where the transport system is monitored passively, meaning that the supervisor is not actively monitoring the shuttles but only reacts when a shuttle triggers an alert when it encounters an issue (e.g., obstacle on the roadway, an emergency stop was triggered, a shuttle is overloaded, a technical issue). For issues that cannot be remotely resolved from the remote supervision centre, a field operator is available at all times to perform a field intervention on a stranded vehicle within 10 minutes. The shuttles are SAE level 4 EasyMile EZ10 shuttles.

The shuttles operate in both directions on a 2.25km track, meaning an entire tour is 4.5km long. Five sheltered bus stops are present along the route. The shuttle track is physically separated from an adjacent shared-use path for cycling and walking. Other road users are prohibited from using the shuttle track, but several marked crossings are present, and in practice, there is sporadic misuse of the shuttle track by other road users. A full 4.5km loop takes approximately 30 min. This implies that the average shuttle frequency is once every 10 min, although the headway between shuttles is not automatically maintained and is therefore somewhat variable. Each shuttle stop includes a screen that displays real-time travel information (estimated time of arrival of the next shuttles). The maximum operating speed of the shuttles is 18km/h. The system has been in place since May 2024 as a permanent deployment.

2.2 Sampling

Participant recruitment was conducted by research assistants. Data collection took place in March and April 2025. Research assistants were stationed at the bus stops with an internet-connected tablet. As soon as passengers exited the shuttle, they were approached by a research assistant who asked whether they would be willing to share their travel experience in a brief survey. If they agreed to complete the survey, they were either given the tablet to complete independently or had the assistant ask the questions and enter the responses on the tablet, depending on the respondent's preferences.

Additionally, when time permitted, the assistant asked guests waiting at the bus stop whether they had previously used the automated shuttle. If they had already completed at least one earlier trip with the automated shuttles, they were also asked to complete the survey. During the day, the research assistant moved several times between shuttle stops to ensure that all visitor types were adequately represented in the sample.

2.3 Survey design

The survey was designed to be completed quickly while respondents were disembarking from a trip. Therefore, brevity was an important consideration in the survey design. The survey began with demographic information, including participants' age, gender, highest educational level, and frequency of use of various transportation modes. It then presented information about what an SAV service may look like in a future when it is available for everyday use. Then, four questions were used to measure SAVA items: trust, utility, social comfort, and intention to use. Trust was phrased as "Overall, I trust such vehicles". Utility was phrased: "Beyond the Terhills context, such

vehicles could help me with my everyday travel needs". Social comfort was phrased as "I feel uncomfortable sharing such vehicles with people that I do not know". Intention to use was phrased as "I want to use such vehicles in my everyday life when available". These were measured on a seven-point Likert scale ranging from "disagree" to "agree". Trip frequency was measured on a frequency scale.

The survey also included six binary items that measured experiences during trips. These were events captured as exogenous experiential inputs rather than acceptance constructs. These items indicate whether users experienced hard braking with a valid reason, hard braking without an apparent reason, an obstacle in the road, the shuttle standing still for more than five minutes, unusual waiting times, or none of these events. We also included four semantic differentials measuring how people experienced their trip: pleasant vs unpleasant, comfortable vs uncomfortable, safe vs unsafe, and efficient vs inefficient. These were measured on a scale of 1 to 5.

All English wordings of the survey items and their answer options are presented in Appendix.

2.4 Analysis

We collected a total of 718 responses before data cleaning. Responses were excluded based on several criteria. First, we removed cases where participants declined GDPR consent, as these could not be processed or stored legally. Second, we excluded incomplete responses. All analyses were thus based on complete cases to ensure consistency in model estimation. Two responses with “other” marked in gender were excluded from analyses due to the difficulty in statistical interpretation. We ended with 677 responses carried forward for analysis.

For regression analyses, we used ordinary least squares regression. These were run in succession to investigate the effects of including additional predictor variables and of omitted-variable bias. Bivariate correlations were calculated to investigate relationships between key variables. We used the RStudio version 2024.12.1 statistical software for data analysis.

3 Results

3.1 Descriptive statistics

Descriptive statistics are presented in Table 1.

Table 1. Descriptive statistics of the study variables, N= 677.

Variables	Mean	SD	Median	Min	Max	Skew	Kurtosis
Background information							
Age	45.3	15.6	44	18	89	0.27	-0.67
Gender (0=female, 1=male)	0.35	0.48	0	0	1	0.65	-1.58
Education	2.80	0.79	3	1	4	-0.11	-0.57
<i>No degree / primary education</i>	<i>(4 %)</i>						
<i>Secondary education</i>	<i>(31 %)</i>						
<i>Bachelor (or equivalent)</i>	<i>(46 %)</i>						
<i>Master (or equivalent), or higher</i>	<i>(19 %)</i>						
Public Transport use freq.	1.75	0.96	1	1	5	1.23	0.82
Events							
Brake valid reason	0.05	0.22	0	0	1	3.97	13.81
Brake without reason	0.12	0.33	0	0	1	2.32	3.38
Obstacle on the road	0.01	0.11	0	0	1	8.48	70.02
Stopping more than 5 min	0.13	0.34	0	0	1	2.14	2.58
Long waiting time	0.17	0.38	0	0	1	1.75	1.08
No events	0.67	0.47	0	0	1	-0.72	-1.49
Experience							

Variables	Mean	SD	Median	Min	Max	Skew	Kurtosis
Pleasant	4.44	0.91	5	1	5	-1.86	3.39
Comfort	4.43	0.90	5	1	5	-1.80	3.23
Safe	4.55	0.85	5	1	5	-2.31	5.49
Efficient	4.49	0.97	5	1	5	-2.14	4.09
SAVA							
Trust	5.80	1.46	6	1	7	-1.57	2.35
Utility	4.10	2.05	4	1	7	-0.17	-1.31
Social comfort	4.60	2.36	6	1	7	-0.49	-1.40
Intention	4.08	2.13	4	1	7	-0.07	-1.38
Experience							
Trip frequency	4.39	8.60	2	1	100	6.54	55.6

Note. Categorical variables with percentages in italics.

The sample consisted of participants who were, on average, middle-aged, with a slightly skewed gender distribution and a moderately skewed educational attainment distribution. The frequency of public transport use was relatively infrequent and positively skewed, indicating that many participants reported low use. These characteristics were approximately normally distributed, with skew and kurtosis values for age, gender, and education within typical ranges. The frequency of public transport use was more unevenly distributed, reflecting a long right tail.

While almost two-thirds of respondents reported no disruptive events, a substantial minority experienced one or more types of service disruption, indicating that negative experiences were not isolated to a small number of users. Reports of vehicle events indicated that unexpected occurrences such as unjustified braking, prolonged stops, or extended wait times were relatively rare, whereas smooth trips without events were most common. Distributional statistics for events reflected the dichotomous nature of these variables, with strong skewness and high kurtosis.

Evaluations of ride experience were consistently positive. Ratings of pleasantness, comfort, safety, and efficiency all clustered toward the top of the scale, with strong negative skew and elevated kurtosis, suggesting ceiling effects in participants' judgments of ride quality.

Mean scores on psychological acceptance measures showed a generally positive pattern. Trust and social comfort were skewed toward the upper end of the scale, suggesting most respondents expressed high levels of confidence in and comfort with the shuttle. In contrast, utility and intention scores were closer to the midpoint and less skewed, indicating a more varied range of opinions on the perceived usefulness of the shuttle and future use intentions.

Finally, the shuttle's trip frequency was highly variable and extremely positively skewed. While the majority of participants reported very few rides, a small group used the service frequently, creating a markedly long-tailed distribution.

3.2 Bivariate correlations

Table 2 presents the bivariate Pearson correlations between intention to use, trust, utility, social comfort, and a range of event-related, experiential, and background information. Negative ride events consistently undermined intention to use. Experiencing such events related to lower trust and diminished usefulness, as well as intentions to use. Conversely, when rides proceeded smoothly without disruptions, acceptance indicators improved. For experience, all four measures (pleasantness, comfort, safety, and efficiency) were positively correlated with intention to use, trust, and utility. No significant relationships were found between social comfort and any other variables, aside from age, education, and public transport use. For background information, gender showed small but significant correlations with intention to use, trust, and utility. Within the SAVA model, intention to use was strongly correlated with utility and moderately with trust. Social comfort correlated positively with trust but not with intention to use or utility.

Table 2. Bivariate Pearson correlation between key SAVA factors and other contextual factors, N = 677.

Factors	Intention to use		Trust		Utility		Social Comfort	
	Pearson's R	p	Pearson's R	p	Pearson's R	p	Pearson's R	p
Events								
Brake valid reason	0.00	0.992	-0.00	0.913	0.00	0.964	-0.05	0.154
Brake without reason	-0.14	< .001	-0.07	0.065	-0.17	< .001	-0.01	0.869
Obstacle on the road	0.02	0.605	-0.09	0.018	-0.01	0.760	-0.02	0.628
Stopping more than 5 min	-0.15	< .001	-0.19	< .001	-0.13	0.001	0.06	0.148
Long waiting time	-0.13	< .001	-0.15	< .001	-0.11	0.004	-0.04	0.316
No events	0.12	0.001	0.09	0.014	0.10	0.007	0.01	0.764
Experience								
Pleasant	0.28	< .001	0.47	< .001	0.30	< .001	0.01	0.744
Comfort	0.23	< .001	0.40	< .001	0.27	< .001	0.02	0.577
Safe	0.24	< .001	0.49	< .001	0.28	< .001	0.02	0.550
Efficient	0.20	< .001	0.41	< .001	0.25	< .001	0.04	0.264
Background information								
Age	-0.06	0.136	-0.02	0.670	-0.08	0.034	0.12	0.003
Gender	0.11	0.004	0.05	0.224	0.08	0.038	-0.08	0.038
Education	0.04	0.255	-0.01	0.816	0.05	0.200	-0.12	0.002
Public Transport use freq.	0.03	0.470	0.00	0.956	0.07	0.069	-0.26	< .001
SAVA								
Intention to use								
Trust	0.37	< .001						
Utility	0.87	< .001	0.37	< .001				
Social Comfort	-0.00	0.942	0.14	< .001	-0.05	0.217		

Note. Bold = Significant at $p < 0.01$ level.

3.3 Regression analyses predicting intention

To investigate the effect of different predictor sets, we conducted three cumulative regression analyses. This hierarchical analysis was conducted to examine how demographic characteristics, travel behaviour, psychological constructs, and trip frequency contribute to participants' intention to use the automated shuttle. This is presented in **Error! Reference source not found.**

Table 3. Hierarchical linear regressions predicting intentions to use SAVs in everyday life, N = 677.

Predictors	Beta	CI 95%	p	Beta	CI 95%	p	Beta	CI 95%	p
Age	-0.06	-0.14 – 0.01	0.110	0.00	-0.04 – 0.04	0.881	0.00	-0.04 – 0.04	0.885
Gender (0=female, 1=male)	0.12	0.04 – 0.19	0.003	0.04	0.00 – 0.08	0.029	0.04	0.00 – 0.08	0.031
Education	0.04	-0.03 – 0.12	0.290	0.01	-0.03 – 0.05	0.691	0.01	-0.03 – 0.05	0.699
Public Transport use frequency	0.02	-0.06 – 0.09	0.675	-0.02	-0.06 – 0.02	0.228	-0.02	-0.06 – 0.02	0.236
Trust				0.04	0.00 – 0.09	0.034	0.04	0.00 – 0.09	0.033
Utility				0.85	0.81 – 0.89	<0.001	0.85	0.81 – 0.89	<0.001
Social comfort				0.03	-0.01 – 0.07	0.155	0.03	-0.01 – 0.07	0.159
Trip Frequency							0.00	-0.03 – 0.04	0.833
R2 adjusted	0.013			0.753			0.753		
AIC	2942			2006			2008		

Note. Bold = Significant at $p < 0.05$ level.

The models demonstrated a clear improvement in explanatory power from the first to the second, with the adjusted R^2 increasing significantly after the inclusion of psychological predictors. There was no additional gain from the trip frequency predictor in Model 3, as the adjusted R^2 remained unchanged.

In the first block, gender was the only significant predictor, with men reporting a higher intention to use the shuttle.

The second model introduced the psychological constructs of trust, utility, and social comfort. Model fit improved substantially, and perceived utility emerged as the dominant predictor. Trust had a small but statistically significant positive effect, indicating that those who trusted SAVs more were slightly more inclined to express intent to reuse them. Social comfort did not significantly predict intention in our models. With the addition of psychological variables, the gender effect was markedly reduced, indicating that much of the initially observed difference between men and women was accounted for by attitudinal factors, even though gender remained a small but statistically significant predictor.

The third model included shuttle trip frequency as a behavioural variable. This was done because the frequency with which passengers use the shuttles at Terhills may affect their future usage intentions, as these questions were framed. It did not significantly predict intention and did not change model fit. This pattern suggests that the decision to use a SAV in everyday life may not be influenced by the frequency of past shuttle use at Terhills.

4 Discussion

This study aimed to investigate user acceptance of a fully operational shared automated vehicle (SAV) service. We employed a parsimonious theoretical model that foregrounds trust, utility, and social comfort, known as the Shared Automated Vehicle Acceptance (SAVA) model. Using post-ride data from a tourist site, we examined whether three short acceptance indicators (trust, utility, social comfort) capture meaningful variation in intention to use among experienced users. We found that utility appears to be the most important factor for intentions in our sample. Furthermore, the nature of one's previous experience with SAVs is important for the formation of acceptance and future usage intentions in everyday life.

4.1 *Experiences shape acceptance*

A significant contribution of this study lies in its examination of the relationships among concrete ride events, subjective ride experiences, and the acceptance of SAVs. Much previous research has relied on stated-preference surveys or hypothetical scenarios, often without integrating operational data or real-world experience (Greifenstein, 2024; Rahman & Thill, 2025). Our analysis reveals that the experience during a trip, including abrupt braking, prolonged stops, or smooth, uninterrupted rides, is directly linked to users' evaluations of trust, utility, and willingness to use the service. This finding is consistent with earlier work that highlights operational reliability as a core determinant of acceptance in real-world trials (Goldbach et al., 2022; Paddeu et al., 2020). It also corroborates the claim that testing technology that underperforms in riders' perceptions may work to undermine the service's impression (Aasvik, Hagenzieker, et al., 2024; Bjørnskau et al., 2023; Pokorný et al., 2022). This paper is among the first to quantify these effects by deploying an SAV in a publicly available area.

Disruptive events, such as unnecessary hard braking or delays, were systematically associated with lower trust and utility. This suggests that passengers interpret irregular system behaviour not only as inconvenient but also as evidence of incompetence and unreliability in future AV scenarios, which are central dimensions of trust in automation (Körber, 2019; Lee & See, 2004). These effects were observed in a leisure setting with limited travel stakes, suggesting that they may be even more pronounced in everyday commuting contexts, where delays or disruptions carry higher

costs. Trust has indeed been argued to be more important in the AV context due to the increased perceived personal risk it entails (Zhang et al., 2023). In contrast, trips without events were positively associated with acceptance constructs, suggesting that predictability and smoothness reinforce trust calibration in automated systems, consistent with prevailing theories of trust. The most impactful events were stopping for more than 5 minutes, braking without reason, and long waiting times, which showed the strongest and most consistent negative correlations with trust, utility, and intention. The utility also experienced negative events, such as braking without cause. This pattern aligns with earlier research showing that while pilot rides can generate enthusiasm, they do not necessarily lead to habitual use unless the service consistently demonstrates reliability and added value (Smith et al., 2019). Utility may have been affected because delays and disruptions undermine perceptions of efficiency, a core benefit expected from automation. When the service fails to provide a reliable or time-saving alternative, passengers are less likely to view it as an improvement over existing travel modes.

Beyond discrete events, subjective ride experiences emerged as consistently important. Participants who rated their trip as pleasant, comfortable, safe, and efficient also reported higher levels of trust, utility, and intention to use. These results align with previous findings that favourable direct exposure to automated shuttles improves attitudes and enhances willingness to adopt (Gold et al., 2015; Weschke et al., 2021). They also suggest that experiential quality may play a more significant role than background variables, many of which showed limited associations in our sample. This has also been previously documented (Nordhoff et al., 2019). Repeated exposure may be required to consolidate positive impressions and to translate them into long-term behavioural adoption (Paddeu et al., 2021).

Taken together, these findings demonstrate that the characteristics of the rider experience constitute a vital layer in the formation of SAV acceptance. While theoretical frameworks such as UTAUT or MAVA focus on psychological constructs, our results emphasise the significance of ride-level characteristics that influence acceptance in practice. This supports calls for acceptance research that combines theory with operational data from real deployments (Blut et al., 2022; Greifenstein, 2024). Future studies should extend beyond cross-sectional analyses to track how repeated exposure to both positive and negative experiences accumulates over time, and whether early disruptions exert a lasting influence on adoption trajectories. The results go beyond other pioneering research on SAV deployments by identifying which experiences actually shape perceptions of the service, using a novel theoretical approach. This study provides early evidence that acceptance is not only a matter of abstract beliefs but also of concrete service quality. Minimising adverse events and maximising perceived comfort, safety, and efficiency in every trip may be as important as broader trust-building strategies for the long-term success of SAV services.

4.2 *Perceived utility dominates the prediction of intention*

Consistent with the Technology Acceptance Model's "perceived usefulness" and recent extensions to AVs, utility emerged as the overwhelming predictor of intention (Asgari & Jin, 2019; Bellet & Banet, 2023; Davis, 1986). Even trust, long considered foundational for the acceptance of automation (Lee & See, 2004; Nordhoff et al., 2023), made only a modest contribution. Social comfort was non-significant once the other two constructs were controlled for. Background information variables were largely irrelevant for usage intentions, except for gender effects, which were attenuated once psychological constructs were introduced. This trend has also been noted previously (Aasvik, Hagenzieker, et al., 2024; Aasvik, Ulleberg, et al., 2024; Nordhoff et al., 2019). Surprisingly, there was no effect of public transport use, suggesting that the frequency of conventional mass transit use does not straightforwardly translate into enthusiasm for novel automated services in leisure settings. On the other hand, this also suggests that using public transport is not a necessary precursor for strong SAV usage intentions.

This pattern supports the argument that travellers approach SAVs with a pragmatic cost-benefit calculus. For planners and service designers, this emphasises the importance of aligning SAV offerings not only with future visions but with users' current travel needs. A recurring finding in the literature is that automated shuttles often lack perceived added value when integrated into already walkable or transit-rich environments (Goldbach *et al.*, 2022; Smith *et al.*, 2019). By contrast, SAVs that extend the catchment area of public transport, address first- or last-mile gaps, or serve underconnected zones may score higher on the very utility dimensions identified here as most decisive for user intentions. If the service is perceived as a genuine upgrade over existing options, expressed willingness to adopt follows. For practitioners, investing in tangible service attributes that enhance perceived usefulness, frequency, coverage, and integration with ticketing may yield larger gains in ridership intentions than abstract trust-building campaigns alone. Given that previous research on the general population suggests that trust is foundational, we are hesitant to disregard its potential impact. Rather, we suggest that this may be because our sample consisted solely of people who had already tried SAVs. It cannot be ruled out that these might be the kinds of people for whom trust is less important. Such a sampling effect seems more likely than disregarding trust as an important step towards SAV adoption. Our measure of trust was more general than the phrasing of the utility item, perhaps giving utility greater contextual salience, since the intention item also referenced everyday life.

In this Terhills setting, social comfort did not independently predict intention after accounting for trust and utility. This may reflect context characteristics (tourist environment, group travel, and shuttle-as-public-transport framing), and the role of social comfort may be larger in urban robotaxi-like services or commuting contexts. Although sharing AVs may present a novel circumstance for riders, this does not indicate reduced intention among our sample. This contrasts with work that identifies the "sharing problem" as a key hurdle to SAV adoption (Dolins *et al.*, 2023). In line with Aasvik *et al.* (2024), the current study does not find this variable to be a significant independent predictor of usage intentions. This may be partly explained by the perception that the shuttles at Terhills are more closely aligned with traditional public transport than other SAVs. This difference in perception has been found to be important, and services that more closely resemble robotaxis than public transport may have lower acceptance (Chng *et al.*, 2022; Clayton *et al.*, 2020). The appearance of the shuttles may thus have dampened the "sharing anxiety" of respondents (Dolins, 2021). Future research should continue to investigate the factors that drive evaluations of the social situation in shared AVs and how best to mitigate unwanted perceptions. By analysing several hundred trips at a permanent deployment, this study complements earlier Wizard-of-Oz or short-term demonstration trials and thereby provides a rare validation of theory with actual users rather than hypothetical surveys (Paddeu *et al.*, 2020; Smith *et al.*, 2019). For policymakers, the message is optimistic: most survey respondents in our analysis were positive about trying SAVs in their everyday lives. However, they are not necessarily translated automatically into habitual users unless the service offers clear, repeatable utility in travellers' daily lives.

4.3 Parsimonious acceptance modelling

Our findings support recent calls to shift from complex acceptance models toward a General Acceptance Factor (GAF) approach, such as the SAVA model (Aasvik, Ulleberg, *et al.*, 2024; Bagozzi, 2007; de Winter & Nordhoff, 2022). Three single-item indicators accounted for a large proportion of the variance in intention within this sample. This demonstrates that long measurement batteries may not be necessary in real-world pilot settings, where questionnaires must be completed within minutes. Importantly, the ability of short-form instruments to approximate more elaborate models presents a pragmatic benefit in high-throughput survey environments. However, it also risks conceptual flattening if important subdimensions of trust, utility, or social comfort are ignored. For example, earlier studies have distinguished between competence-based trust, understandability-based trust, and trust in developers (Körber, 2019; Lee & See, 2004). Different trust bases may predict acceptance to varying degrees depending on service

characteristics. Follow-up work might assess whether extending our single-item indicators into brief multi-item batteries yields better explanatory resolution without sacrificing brevity. This research highlights the importance of being mindful of the differences between leisure settings and everyday travel needs.

A further benefit of a lean SAVA model is its suitability for measuring invariance across heterogeneous samples and deployment stages. Because the model comprises only three to five items, it can be used frequently without fatiguing respondents, allowing operators to track shifts in latent acceptance as service attributes change. This high sampling cadence, in turn, enables validation that guards against the “overfitting by theory” critique levelled at earlier omnibus frameworks (Bagozzi, 2007; Blut *et al.*, 2022). Finally, reducing the number of latent constructs mitigates the risk of multicollinearity, which often plagues acceptance models of AVs, and ensures that results remain interpretable across studies, facilitating meta-analytic cumulation and evidence-based policymaking.

4.4 Limitations

The Terhills setting involves tourists making discretionary trips in a confined area. Generalisation to commuters or urban residents must be made with caution, as our analyses also suggest. Another limitation concerns the possibility of self-selection bias. Participants who agreed to ride and respond to the survey may have held more positive predispositions toward automation than the general population (De Ceunynck & Cools, 2023). This can attenuate variance in acceptance constructs and artificially deflate predictors, such as trust or social comfort. Moreover, the confined nature of the Terhills shuttle loop, with limited route complexity and interaction with mixed traffic, may downplay challenges that would arise in denser urban or multimodal contexts. Replicating this model in less controlled environments is thus necessary for robust generalisation.

While generalisation should be done cautiously, our approach has benefits. This study is designed to evaluate user acceptance of an operational SAV service. We do not model population-wide adoption or reasons for non-use at the site. Instead, we focus on how experienced users appraise the service and how ride quality relates to acceptance indicators. This aligns with a practical need for rapid, repeatable monitoring instruments for deployments in which respondents are recruited immediately after use. The intention item referred to “everyday life” and “when available” without specifying the operational design domain (e.g., separated right-of-way vs mixed traffic). Respondents may therefore have envisioned different deployment contexts. Future surveys should anchor intention to clearly described operational conditions.

The adjusted R^2 is high in our measurement of usage intentions. This should be interpreted as descriptive of relationships within a single-source, experienced-user intercept survey, in which items were measured using similar response formats and respondents had just undergone the same service experience. One of the items was reversed to mitigate common method bias, but some degree of this bias may still be present. However, if this had been a major concern in our paper, we would have observed substantial correlations among all study variables, and Social Comfort would have shown several such correlations. The aim here is not to claim a population-level adoption model, but to test whether a brief set of indicators captures systematic variation in user intentions in a real deployment. Replication using multi-item measures, additional behavioural outcomes, and samples including non-users is needed to assess generalisability.

The high R^2 observed in the intention models, like in the current paper, should also be interpreted in light of the conceptual proximity of the measured constructs in this study. Although respondents had just experienced a specific SAV service in a leisure context, questions about trust, perceived utility, and intention to use were framed in terms of future everyday use. For many respondents, these evaluations may therefore have been perceived as closely related judgments about the same underlying appraisal of the service, thereby inflating associations in single-source, post-experience intercept surveys. Methodological work has long noted that very high explained variance in such

designs does not necessarily indicate superior explanatory power, but may reflect shared framing, common method variance, and restricted contextual interpretation (Kenny, 1979). High R^2 values are common in this line of research. In fact, this is one of the key strengths of the UTAUT-based frameworks (Blut et al., 2022). However, these results should be regarded as specific to this sample and study context, rather than as a generalisable estimate of explanatory power across populations or everyday deployment contexts. The contribution of this study lies not in maximising explained variance, but in demonstrating that a very brief set of acceptance indicators shows stable and interpretable relationships with intention and experience measures in a real deployment setting.

Our cross-sectional design precludes firm causal claims regarding how repeated experience reshapes attitudes over time (Gold et al., 2015). Longitudinal panels or staged field experiments could clarify whether usage intentions will predict behaviour as SAVs become more widespread in society. Finally, while single-item measures proved informative in this study, future work should verify their reliability across different studies, cultures, and service types. While this approach is useful in applied field evaluations for its brevity, it limits construct validity and prevents differentiation among the subdimensions of trust, usefulness, and comfort. The results should therefore not be interpreted as validating these measures as complete representations of the underlying constructs. Multi-item instruments remain necessary for theory testing and population-level inference.

5 Conclusions

This study demonstrates that a lean acceptance framework, focusing on utility, trust, and social comfort, can effectively explain intentions to use shared automated vehicles. Utility emerged as the strongest predictor of intention, with trust contributing modestly and social comfort showing no significant effect. These results support the value of parsimonious models, such as SAVA, especially in applied field settings. Characteristics of the shuttle rides at Terhills play a considerable role in shaping perceptions of the service, as measured by the SAVA. Experiencing negative events deteriorates usage intentions. For future work, it is essential to consider the maturity of the service in question. Longitudinal designs or repeated measures may better capture how SAV experiences shape future uptake. For practitioners, enhancing the perceived utility of SAVs remains a key lever for increasing user acceptance beyond initial exposure.

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Data Access Statement

Data used in this study is not publicly available due to sensitive personal information in the data material and the competitive nature of the pilot being investigated.

Contributor Statement

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Use of AI

During the preparation of this work, the authors used ChatGPT (OpenAI) to support language editing and readability improvements and to help organise and refine phrasing in response to reviewer feedback. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

Conflict of Interest (COI)

There is no conflict of interest.

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Appendix

Table 4 presents the items used to measure key metrics in the current paper. The table outlines the formulation of the items in English (other languages were also available) and response options for the different questions.

Table 4. Formulation and answer options of key metrics

Items	English Formulation of Items	Answer options
Events		
Brake valid reason	Which event(s) occurred during your ride(s) with the Terhills shuttles? Please take into account ALL rides you have taken with the Terhills shuttles. Multiple answers possible.	Multiple binary responses.
Brake without reason		
Obstacle on the road		
Stopping more than 5 min		
Long waiting time		
No events		
Experience		
Pleasant	How was your experience with Terhills' self-driving shuttles? Please take into account ALL rides you have taken with the Terhills shuttles.	Semantic differential using five levels (i.e. 1-unpleasant through 5-pleasant)
Comfort		
Safe		
Efficient		
Background information		
Age	What is your age?	Numeric
Gender	What is your gender?	Three options
Education	What is the highest degree you have obtained?	Four categories
Public Transport use	How often do you use the following transport modes in your daily life?	Five-point ranging from 1-Less than once per year through 5-(Almost) daily
Trip Frequency	How many trips have you already made with Terhills' self-driving shuttles? (including your current ride)?	Numeric
SAVA		
Intro text	The shuttle at Terhills is an example of an innovative service that operates without a driver – it drives and stops automatically to pick up passengers. This type of transport can improve mobility and reduce costs. In the future, this form of transportation could be used more frequently. To what extent do you agree with the following statements?	
Intention to use	I want to use such vehicles in my everyday life when available.	Scale from 1 (completely disagree) to 7 (completely agree).
Trust	Overall, I trust such vehicles.	
Utility	Beyond the Terhills context, such vehicles could help me with my everyday travel needs.	
Social Comfort	I feel uncomfortable sharing such vehicles with people that I don't know.	