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How Testing Impacts Willingness to Use and Share Autonomous Shuttles with Strangers: The Mediating Effects of Trust and Optimism

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ABSTRACT

This study investigates acceptance of shared autonomous shuttles (SASs) in a suburban area. A model where contextual variables were mediated through trust in SASs and technology optimism was tested. We examined intentions to use SASs without a steward and the significance of social distancing. Data were collected at the start and end of a 2020–2021 pilot involving 922 and 608 participants respectively, operating at SAE level 3. Findings indicate that trust and technological optimism significantly influence the willingness to use SASs, though contextual variables show minimal impact. Older adults and women displayed lower trust and optimism, reducing their usage intentions. These two groups also feel that it is more important to be able to keep social distance while riding SASs. The study suggests that future pilots should avoid negative impacts from using immature technology and address the social needs of specific groups.

KEYWORDS

Shared autonomous shuttles; public acceptance; social psychology

1. Introduction

Widespread acceptance of autonomous vehicles (AVs) is one of the great barriers to implementing this new transportation technology on public roads. AVs are heralded as potential bringers of safer, greener, more efficient, and cheaper transport that could help solve some of the infrastructure problems of growing cities in the near future. The achievement of the sustainability goals set by the COP 21 Paris agreement (UNFCCC, 2018) and the UN (United Nations, 2018) is highly dependent on the general public's acceptance and adoption of technological innovations. The acceptance of AVs in the public transportation system may be of particular importance, as scenarios predict that widespread privately owned autonomous cars will increase overall traffic volumes in cities and thus be detrimental to the fulfillment of the sustainability goals (COWI, 2019). In this context, shared autonomous shuttles (SASs) that offer mobility as a service (MaaS) may be an important addition to the transportation systems of the future; they might solve the first mile/last mile problems of large-quantity transportation such as trains or subways. Such shuttles could be particularly attractive if provided as "mobility as a service" (MaaS) – i.e., as a transport service ordered digitally to pick you up where you want and bring you directly to your location, picking up other riders along the way (Butler et al., 2021).

While there has been much research on the technical aspects of AV development, there is also a growing interest in the psychological aspects of introducing AVs and SASs into traffic (Azad et al., 2019; Cohen et al., 2020). For example, previous social science research has explored theoretical frameworks such as the unified theory of acceptance and use of technology (UTAUT; Venkatesh et al., 2016), which later was molded into the multi-level model on automated vehicle acceptance (MAVA; Nordhoff et al., 2019). This model was built by adapting the UTAUT based on an investigation of existing literature on the acceptance of AVs. This framework is vast and points to many different factors that may be important in predicting the adoption of SASs. Recent research further suggests that the acceptance and use of AVs may be governed by a single factor – a general acceptance factor (GAF; de Winter & Nordhoff, 2022; Nordhoff et al., 2018). Other research have found grounds for several factors explaining AV acceptance, particularly using measures of affective evaluations (Etminani-Ghasrodashti et al., 2023; Kacperski et al., 2021; Rahimi et al., 2020). Further, new reviews of research using UTAUT have suggested lower predictive power and revision to the framework (Blut et al., 2022). Other effectual models have also been proposed (Bellet & Banet, 2023; Ghazizadeh et al., 2012). The proposed predictors of intentions to use AVs need further research to create simple and effective models, especially with regards to the novel social situation arising in small, shared AVs used in public transport.

Different factors may be particularly important when it comes to SASs in comparison to privately owned cars. People use cars as private spheres, and car use has been shown to hinder intentions to share shuttles with strangers (Sovacool & Axsen, 2018). Perceptions of safety and trust in

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automation (Choi & Ji, 2015), exposure, and tech-interest (Nordhoff et al., 2019; Tennant et al., 2016), as well as social questions regarding sharing a smaller shuttle (typically six to eight passengers) with strangers are questions that need further exploration (Sanguinetti et al., 2019). While cars are used as a private sphere, public transportation requires people to interact with strangers and may result in discrimination or unpleasant social situations (Arai et al., 2008; Chowdhury & Van Wee, 2020; Smith, 2008). Those who already use public transportation may be more accustomed to this (Backer-Grøndahl et al., 2007; Sovacool & Axsen, 2018). Ridesharing discrimination has recently been documented in smaller public transportation vehicles (Middleton & Zhao, 2019; Moody et al., 2019), and gender issues in transportation have also been found in egalitarian countries like Norway (Backer-Grøndahl et al., 2007). Because previous events trigger feelings of insecurity and women are more at risk for unpleasant social events, women can be expected to want more social distance and have greater needs for safety procurement. The preferences of ridesharing passengers have been investigated with the goal of enhancing the acceptability of sharing rides with strangers (Cui et al., 2021). More research is needed to better understand how these issues will affect the future adoption of SASs and how best to alleviate these issues.

Trust has recently been found to be a good predictor of intentions to use automation in both private and public transportation (Korkmaz et al., 2021; Nordhoff, Stapel, et al., 2021). This may be particularly true for public transportation, where riders to a large degree hand over control of the technical and social situation to the transport service provider (Hegner et al., 2019). Trust can be defined by the way in which it helps reduce vulnerability (Lee & See, 2004). Fears related to the social situation, data hacking, traffic safety, system performance, and equipment failure, and other factors may also be part of the vulnerable situation riders will enter in this novel transport mode. Research could start by testing whether some aspects of trust in SASs, such as safety and the social situation, are of increased importance when evaluating SASs. Looking to extend the concept of trust in this way may increase its' utility in predicting intentions to use SASs.

Trust along with other factors, have been suggested as key determinants of people's willingness to use AVs (Choi & Ji, 2015). Because this particular field is quite a novel niche, there are few validated scales of trust. Consequently, diverging results and confusion about the constructs in question may arise, effectively creating several sibling constructs (Lawson & Robins, 2021). Trust is a complex construct with differing construal in different fields of study (Harrison McKnight & Chervany, 2001; Lee & See, 2004). Trust has been suggested as a direct determinant of behavioral intention (Choi & Ji, 2015; Ghazizadeh et al., 2012), but also as a mediator in fields such as information system acceptance (Kassim et al., 2012), mobile tech use (Akbari et al., 2020), and indeed in acceptance of AV technology (Hegner et al., 2019; Kaur & Rampersad, 2018; Zhang et al., 2019). Researchers seem to agree that trust is essential for AV acceptance, but disagree about its' conceptualization (Sheridan, 2019). Some focus on safety-related trust (Hegner et al., 2019; Kaur & Rampersad, 2018) while others argue for shorter and more general scales (Choi & Ji, 2015; Körber, 2019). Social trust, while understudied in this context, have also been found to correlate with ridesharing intentions (Cha & Lee, 2022; Sakib et al., 2023). Future studies should seek a coherent framework for AV acceptance that incorporate key concepts without being too expansive.

Technological optimism could be an important factor for consideration in the current research on SAS acceptance. Similar constructs, such as technological savviness, have received support (Bansal et al., 2016; Haboucha et al., 2017; Lavieri et al., 2017; Wien, 2019). Research has found that drivers currently using advanced driver assistance systems (ADASs) are willing to pay more for AVs (Kyriakidis et al., 2015). At the same time, those who are more excited about these technical innovations may be more inclined to seek them out and use them. While research often cites generally high expectations for the future of transportation (Nordhoff, 2020), Norwegians report having mixed attitudes (Roche-Cerasi, 2019). In fact, riding with a SAS has been reported to diminish the safety concerns of riders (Eden et al., 2017). Reflecting on the future of AVs may also give people elevated expectations about their capabilities (Tennant et al., 2016). Recent research tries to categorize people based on their AV optimism and finds that young males are the most knowledgeable and optimistic about AVs (Nordhoff, Louw, et al., 2022). Men and young participants are least concerned about the novel technology (Charness et al., 2018). Other research suggests no effect of the contextual variables age and gender on intentions to use AVs (Kacperski et al., 2021). These findings could suggest that technological optimism and interest may play an important role in the formation of people's attitudes and beliefs about SASs and AVs – not only as an antecedent to exposure and thus to attitudes in general but also as a self-enhancing positive belief. Hence, technological optimism may work as a mediator between contextual variables and intention to use (Nordhoff et al., 2019).

By testing some of the factors suggested by previous research, we may gain a better understanding of the individual effects and their interactions. The suggested models, like the MAVA, also suggests several mediator or moderator effects that are largely untested in this domain, particularly using a field test of AVs (Nordhoff et al., 2019). While young and male respondents typically are more positive about the technology, some research has failed to find direct effects of sociodemographic factors on intention to use, perhaps suggesting an indirect path (Bala et al., 2023; Kacperski et al., 2021; Nordhoff, Louw, et al., 2022). A recent review concluded that effects of age and gender on intention to use AVs are inconsistent (Greifenstein, 2024). More research is needed to clarify the extent of effect from sociodemographic variables.

Current travel behavior may largely be habitual and impact the degree to which travelers are used to the proximity of others in this context. Research has found that car use was a negative predictor of the intention to use automated shuttles in public transportation (Nordhoff et al., 2020; Şimşekoğlu et al., 2015). Knowledge about pilots may be a separate predictor that could also have a mediated effect through technological optimism or a belief that the pilots are conducted safely. Context-dependent findings have been noted throughout the literature, and longitudinal surveys exploring evolutions in people's perceptions may be a useful new avenue of research (Bala et al., 2023).

There have been numerous pilots with SASs throughout Europe (Hagenzieker et al., 2021). Most of these use small vehicles with low speeds and a steward on board. They also use a fixed route that is often separate from the general public transportation system. This approach helps assure a safe step-by-step introduction of this technology, but it also hinders realistic testing of SAS implementation. Several pilots have been conducted in the Norwegian context, and the public transportation authority in the Oslo region, Ruter, has recently been attempting to implement SASs as part of their transport system. Some recent pilots of SASs in Europe have found that the vehicles are too cautious while driving, creating concerns about SASs not being effective enough as a public transportation service and even detrimental to safety (Ceunynck et al., 2022; Pokorny et al., 2021). Thus, at present, some variants of SASs may not be technologically mature enough to claim a place in people's everyday transport (Mouratidis & Serrano, 2021). This may further deteriorate the public perception of SASs. Others suggest that there is optimism about the use of AVs in public transportation but that the system performance must be improved (Dreßler & Höfer, 2022). Similar reports find that they cause dangerous situations by increasing the rate of being overtaken due to their slow speed (Mirnig et al., 2022; Pokorny et al., 2021). In 2020, Ruter launched a bus service in Ski, a small city outside Oslo, to serve a neighborhood that was previously unserved by public transportation. The test route included mostly neighborhood roads with 30 km/t speed limits and no sidewalks. This article will report findings from this pilot. Tracking the public perception over time in an area that is subject to such a pilot can provide important insights into how the public perception changes by being subject to such a test.

1.1. Research questions and hypotheses

Because the framework suggested by the MAVA model is developed for AVs in general, and because of its' exhaustive nature, we will focus on some of its' proposed variables. Trust in SASs has long been highlighted as being key for their widespread adoption. Instead of measuring all subcomponents of trust, we used an operationalization focusing on safety and the social situation. MAVA suggests that both trust and technological optimism fall under the category of micro-level individual difference variables, and are mediators of factors such as sociodemographic variables, exposure to SASs, and travel habits. In this article, we want to examine whether an individual's trust and technological optimism may be impacted by living in an area where a pilot is taking place. Using trust and technological optimism as mediators may then in turn predict behavioral intentions. These two constructs could also reveal whether encountering SAS in everyday situations improve or deteriorate the perception of this novel technology, and how this impacts the mediated effect of contextual variables. Experiencing a pilot may impact trust and optimism which may in turn impact behavioral intention. These core constructs, like many other MAVA or UTAUT constructs, may share large correlations and overlap, but still have nuances that make them each important for the current research purpose.

Our research question is to examine the effects of the test implementation of SASs in Ski, outside of Oslo, with a particular focus on contextual (sociodemographic) variables, trust, and technological optimism. These factors are investigated with dependent variables that relate to the specifically social nature of SASs, which distinguish them from private cars and traditional bus services. Figure 1 shows the conceptual model for the variables in this project.

Based on the MAVA model (Nordhoff et al., 2019), we hypothesize that the effects of the contextual variables on intentions to use SASs and attitudes toward the social situation are fully or partly mediated by trust and technological optimism.

We thus propose the following hypotheses based on the literature review above:

1. Younger respondents and men score higher on mediators, trust and technological optimism, compared to others. We also expect these two groups to have positive, direct effects on intentions to use.
2. Women have a higher need for keeping social distance on SASs than men do.
3. Exposure to and familiarity with the pilots positively predict trust, optimism, and intentions to use.
4. Already using public transportation positively predicts having less concern about social proximity
5. The mediators, trust and tech-optimism, positively predict intention to use.

Furthermore, we explore the effects of living in an area where a pilot using SAS is conducted using sample year as a binary variable. This could help discerning whether experiencing a test pilot enhances or deteriorates the trust and optimism towards such services, and whether it impacts intentions to use.

2. Methods

2.1. The current test pilot

Whether the vehicles in question are presented as robot taxis, buses, vans, or shuttles probably affect how they are

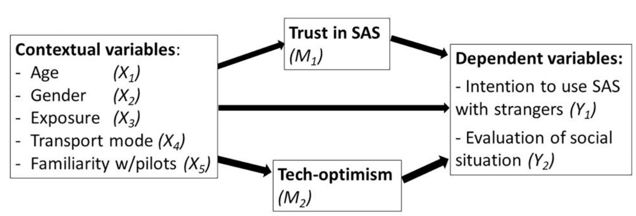

Figure 1. Conceptual model for this study.

perceived. This may in turn impact the assessment of the services, as they are associated with different characteristics. While Ruter referred to their pilot vehicles as buses, they are more accurately described as vans. However, to make a clear distinction between privately owned cars and vehicles used in public transportation, we will refer to the vehicles as shuttles and (mini-)buses interchangeably in this article.

Ruter's test implementation in Ski started on January 25 2021, and lasted until February 2 2022. This period involved a lot of trial and error as they encountered issues with overly passive driving at intersections and adverse weather such as snow. There was also a development in terms of how much time the shuttle spent in autonomous mode. The shuttle was a remodeled Toyota ProAce that was operating at SAE level 3 (SAE International, 2021). The SAE automation levels describe different degrees of vehicle automation and range from 0 meaning no automation, to 5 meaning full automation. Level 3 suggests that the ProAce drove autonomously until it needed urgent manual takeover to handle an immediate problem. Figure 2 shows a picture of the van in Ski.

The shuttle had room for four to six passengers and was approved for autonomous speeds up to 30 km/h, though it averaged 12 km/t during the period (Green et al., 2022). The test period took place under some of the stricter social regulations during the COVID-19 pandemic. This served as a barrier to getting passengers involved with the pilot. Figure 3 shows the largest extent of the buses' route in the Hebekk area in Ski. This route includes some medium capacity roads with 50 km/t, but mostly quiet neighborhood roads without sidewalks and 30 km/t speed limit. These roads mostly lacked road surface marking. The bus largely acted as a regular bus service.

During the pilot, Ruter had a total of 573 passengers, 20,248 km driven, and, on average, five switches to manual control per round. This suggests low speeds even for a residential area, few passengers, and many manual takeovers during the pilot. The shuttle had a passive driving style, often doing abrupt hard stops. The technology struggled to circumvent normal occurrences in the neighborhoods, such as people walking their dogs on the side of the road. Encounters like this would often lead to manual takeovers or abrupt hard stops.

Figure 2. The Toyota van at location in ski, near Oslo, Norway.

2.2. Recruitment

The survey was administered using an SMS invitation. We bought geofenced telephone numbers through Bisnode, a company that does credit checks. They used postal codes to geographically limit the numbers we received, meaning that we solely recruited participants who were registered in the general area where the pilot would be operating. The survey stated that the questions were regarding this on-going pilot in their local area.

Two online surveys were administered to investigate the pilot, the first in December 2020 and the other in December 2021. This corresponds to the start and the end of pilot testing in Ski. After test replies and those who did not enter age or gender were screened out, a total of 1530 participants answered the surveys. In 2020, 922 participants answered between December 16 2020, and January 4 2021, with most responses on the first day ($n = 717$). In 2021, 608 participants answered between December 17 2021, and January 5 2022, with most responses on the first day ($n = 281$). In 2021, the answers were more spread out across the first few days.

The SMS invitations had somewhat low response rates. For 2020, 6484 SMS invites were sent; 876 responded to this invitation, resulting in a response rate of 13.5%. For 2021, 5071 SMS invites were sent; 501 responded, yielding a response rate of 9.9%. The rest of our sample was recruited through word-of-mouth and social media. For these other recruitment methods, no response rates could be calculated. The project was approved by NSD - Norwegian center for research data.

2.3. Survey items

Written informed consent was gathered at the very beginning of the survey. The questionnaire that participants answered was designed to track changes in attitudinal constructs and capture many aspects relating to the operation of the pilot. It also collected information about respondents' travel habits to document any changes. The complete survey contained over 160 questions. Some of these included filtering so that no respondent answered all questions. The complete data sets are published on the web page Open Science Framework (Aasvik, 2022). Of these, we selected 18 variables that were the most relevant for the purposes of this study: testing a model using key contextual variables (five items), and trust (six items) and tech-optimism (five items) as mediators. These would predict two dependent variables: the intention to use SAS in a novel social situation and the importance of social distance. A more detailed look at all the survey items chosen can be found in the appendix.

The contextual variables in this study were age, gender, a single item on travel behavior, and familiarity with the

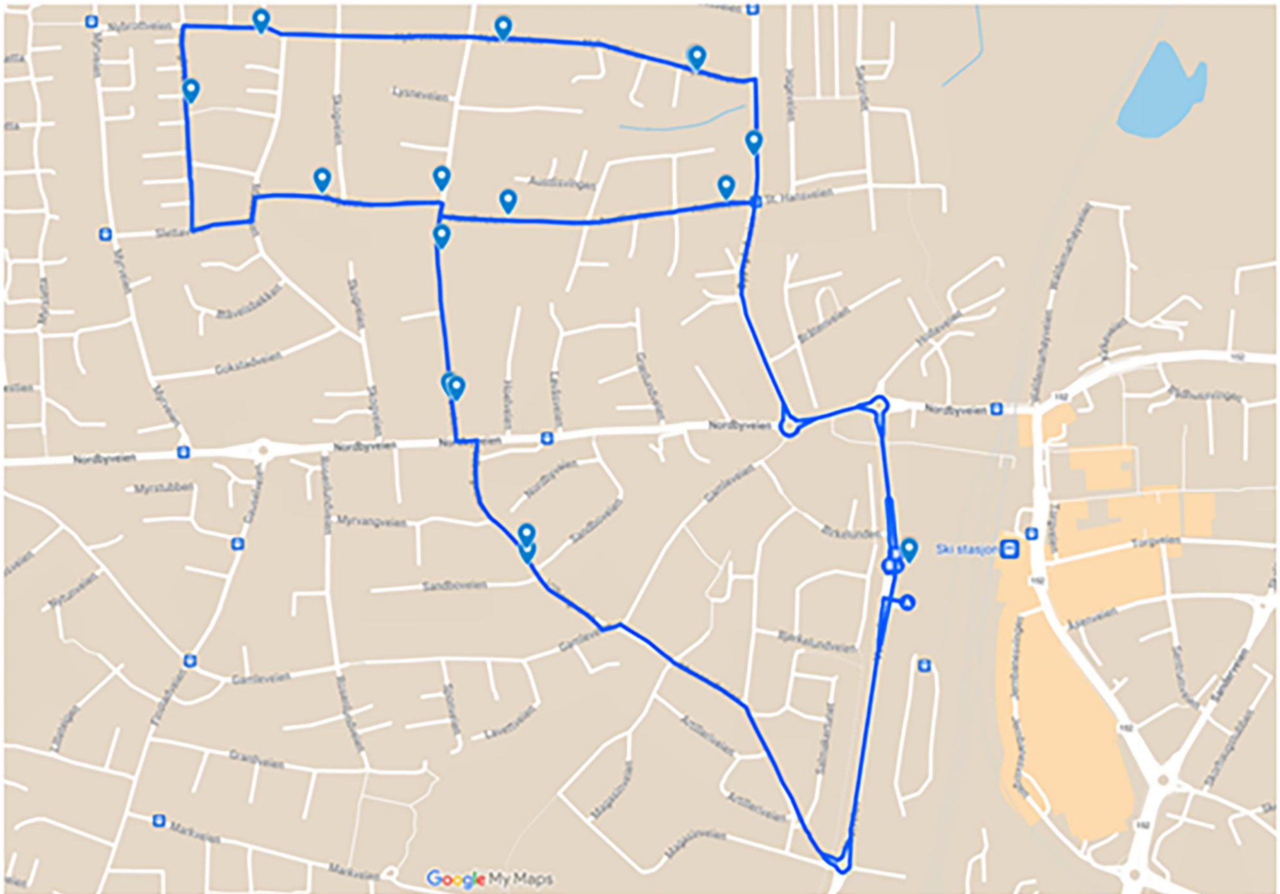

Figure 3. A Map of the final route of the pilot (from Green et al., 2022).

pilots. Travel behavior was framed as participants' main mode of travel to the Ski city center. Familiarity with the pilots was specified before participants answered the survey. The fifth contextual variable was that denoting which year the survey data were collected.

Trust in automation can be a complex construct to define accurately. It often involves an element of risk acceptance, given the evaluation of an automations' performance, purpose, and process (Harrison McKnight & Chervany, 2001; Lee & See, 2004). Trust in SASs was measured on a composite six-item scale. These were fitted to the context of the current pilot and inspired by previous research. These were not developed to be a full measure of the sub-components of trust domain, but to be an adequate representation of trust for our test case (Choi & Ji, 2015; Körber, 2019; Nordhoff et al., 2019; Venkatesh et al., 2016). The scale incorporated some aspects of safety, organizational trust, and efficacy. The items showed acceptable reliability for one sample year (α in 2020 = 0.643, α in 2021 = 0.894). This was improved after we removed one item, as suggested by a negative item-rest correlation. The items used a seven-point Likert scale ranging from "1 – Totally disagree" to "7 – Totally agree." See appendix for further detail.

Technological optimism entails having a positive outlook on the capabilities of technology to improve our future. Our conceptualization is similar to tech-savviness used in previous research, but more focused on respondents' outlook (Nordhoff et al., 2019). We made a scale of five items to measure this, informed by similar research (Bansal et al., 2016; Roche-Cerasi, 2019). The items asked about beliefs regarding the evolution of the technology and its' future capabilities. We used a seven-point Likert scale ranging from "1 – Totally disagree" to "7 – Totally agree." The scale had great reliability (α in 2020 = 0.915, α in 2021 = 0.905). See the appendix for further detail.

The two dependent variables focused on the social situation in SASs. One asked how much they agreed with the statement "I would use such a means of transport with strangers without a steward on board" on a seven-point Likert scale ("1 – Totally disagree" to "7 – Totally agree"). While this statement includes two points of information (wanting to use SASs and wanting to share one), we believe that the item is well suited for the study's purpose. The other asked how important it is "That I don't have to sit close to strangers" on a five-point Likert scale ("1 – Very important" to "5 – Very unimportant"), where lower scores suggested greater rated importance. The latter was positively skewed and thus log-transformed to help meet normality criteria for the analyses. Much research in this domain leaves significant room for conjecture when asking participants about a mode of transport that largely does not yet exist. We approached this issue with an accompanying text explaining that the case they were to assess was a minibus with six to eight seats that could have bus stops close to your home. It further stated that the service could become reality soon and that the buses would be self-driving with a

Table 1. Descriptive results for continuous variables.

	Sample year	*N*	Mean	SD	Range
Age	2020	922	58	15.0	73
	2021	608	59	14.9	62
Trust in SAS	2020	921	4.2	1.4	6.0
	2021	519	4.1	1.5	6.0
Tech-optimism	2020	921	4.4	1.6	6.0
	2021	519	4.2	1.7	6.0
Use with strangers	2020	922	4.8	1.9	6.0
	2021	507	4.6	2.0	6.0
Keeping social distance (non-log-transformed scores)	2020	922	1.7	0.91	4.0
	2021	556	2.5	1.1	4.0

safety steward on-board initially. In both samples, it was made clear that the survey was about the pilots Ruter were conducting in Ski. Naturally, more participants would know about this in 2021 than 2020, so we made sure to include the same information at both time points. See the appendix for further detail.

2.4. Demographics and descriptive statistics

The combined sample in this study has a high mean age ($M = 58.7$, $SD = 15$). The age range was 73, indicating that we also had younger respondents. There were slightly more men (53.3%, $N = 816$) than women in the total sample. Tables 1 and 2 present the descriptive statistics for the study variables.

The scales receive similar responses in the two sample years, with mostly similar central tendencies, variations, and proportions. The respondents thought it was quite important to be able to keep distance from strangers on SASs in 2020, but less so in 2021. Familiarity with the Ski pilots increased from 2020 to 2021, although the proportion having tried an autonomous bus slightly declined with the latter sample. Use with strangers, trust, and technological optimism all had similar small decreases over time. Willingness to use SASs was still quite high in 2021. This high score may be impacted by our low response rate; those more positive to the development of AV technology may have been more inclined to respond to our survey regarding these vehicles.

2.5. Analysis and design

This study was originally designed as a natural experiment that would measure the effects of the introduction of AVs in a residential area. Few people ($N = 36$) reported having trialed the SASs in the 2021 sample. Although these low numbers preclude any analyses of the effect of using SASs, there still may be some effects of living in an area where the service operated; they may see it driving around their neighborhood or hear other people's experience with it. We chose to incorporate the sample year as a predictor to investigate its effect.

A significant benefit of this design is that we could reproduce some of our analyses using two data sets, which improves the reliability of the results. While the two data collections were separate, they were both targeted towards the same limited population. This means that some of the same people may have responded at both times, giving some autocorrelation in the two data sets. This issue is largely sidestepped by including sample year as a variable in our multivariate analyses. This also reveals any effect of the passage of time in our dependent variables.

Table 2. Descriptive results for nominal and ordinal variables in the two samples.

		N		Proportion	
		2020	2021	2020 (%)	2021 (%)
Gender	Male	477	339	52	56
	Female	445	269	48	44
Familiarity Ski Pilots	No, had not heard about it	319	45	35	9
	Yes, a bit familiar	467	307	51	61
	Yes, very familiar	136	153	15	30
Main transport mode	Motorized	491	272	53	47
	Walk/cycle	346	267	38	47
	Public transport	82	35	9	6
Tried autonomous buses	No	844	469	92	93
	Yes	78	36	9	7

The analyses were performed using Jamovi (The Jamovi Project, 2021). The mediation was conducted using the module "jAMM: Jamovi Advanced Mediation Models." The 95% confidence intervals were bootstrapped for each indirect effect. In looking at statistical significance, we corrected the 5% alpha level using a Bonferroni correction. The model consisted of 38 tests, yielding a p value of 0.0012. This was used along with a 0.01 threshold. These were determined to strike a balance between types 1 and 2 errors. We focus on effect sizes rather than p-values when interpreting the results, as much valuable information is lost when solely looking at p values (Amrhein et al., 2019; Wasserstein & Lazar, 2016; Ziliak & McCloskey, 2008). All analyses of interaction terms were done with z-transformed variables to deal with multicollinearity.

3. Results

3.1. Correlation

A first investigation of the relationships between the study variables is presented in Table 3.

We included sample year as a variable to investigate changes over time. We find that familiarity has a positive linear relationship with year, suggesting an increase over time. Tech-optimism is negatively correlated with year. Perhaps an effect of the milder COVID-19 pandemic

Table 3. Correlation matrix for the study variables.

	Year	Age	Gender	Familiarity	Trust in SAS	Tech-optimism	Important w/social distance
Age	0.028						
Gender	−0.039	0.037					
Familiarity	0.292***	0.015	−0.076**				
Trust in SAS	−0.026	−0.117***	−0.144***	0.020			
Tech-optimism	−0.061*	−0.152***	−0.091***	−0.028	0.861***		
Important w/Social Distance	0.347***	−0.042	−0.096***	0.130***	−0.022	−0.055*	
Use w/Strangers no Steward	−0.049	−0.123***	−0.123***	−0.025	0.703***	0.734***	0.020

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

restrictions in 2021, we find that people in 2021 thought it was less important to be able to keep distance.

Older participants seem less likely to be willing to use SASs with strangers without a steward. They also scored lower on both trust and tech-optimism compared to younger participants. There are also many statistically significant gender effects. One of the largest is women having lower scores on trust. They are also less willing to use SASs and find social distance more important. Women reported being less familiar with the pilot. Trust shares a large correlation with technological optimism. Both trust and technological optimism are highly correlated with intentions to use SASs but less so with the importance of social distance.

3.2. Multivariate analyses

We ran two mediation analyses, one for each dependent variable. The mediated indirect effects and total effects of the independent variables on intention to use are presented in Table 4. Indirect effects were also tested using bootstrapped 95% confidence intervals.

Although they are rather weak in strength, there are several significant mediated indirect effects. While not significant, there is a trend that people became less tech-optimistic and less trusting of the SASs over time. This in turn decreased their intentions to use SASs with strangers. Older participants and women reported lower levels of technological optimism and trust, which resulted in lower intentions to use SASs with strangers. We tested an interaction between age and gender but did not find any such effects on the dependent variables. The interaction was then omitted from analyses for ease of interpretation. Using active forms of mobility, but not public transport, seems to increase intentions to use through both mediators.

The total effects show that age and gender are significant predictors of intentions to use SASs with strangers. These suggest that older participants and women are less willing to use. The interaction was tested and found to be ineffectual; it is thus omitted from the analysis. Active mobility habits, as compared to motorized mobility habits, seem to trend towards higher willingness to use.

For the mediation model predicting the rated importance of social distance, we did not find any significant indirect effects. No standardized coefficients were higher than 0.02. For the total effects, we found effects of year ($\beta = 0.32$, $p < 0.001$), gender ($\beta = -0.10$, $p < 0.001$), and active mobility ($\beta = 0.11$, $p < 0.001$).

Table 5 presents estimated direct effects of contextual variables including sample year (X_x), on dependent variables

Table 4. Total and indirect effects from the mediation model predicting intention to use SASs with strangers. $N = 1493$.

Total effects	β
Year ⇒ Intention, SAS strangers	−0.05
Age ⇒ Intention, SAS strangers	−0.12**
Gender ⇒ Intention, SAS strangers	−0.13**
Active mobility[a] ⇒ Intention, SAS strangers	0.08*
Public transport[b] ⇒ Intention, SAS strangers	0.01
Familiarity ⇒ Intention, SAS strangers	−0.03
Indirect effects	
Year ⇒ Tech-optimism ⇒ Intention, SAS strangers	−0.03
Year ⇒ Trust in SAS ⇒ Intention, SAS strangers	−0.01
Age ⇒ Tech-optimism ⇒ Intention, SAS strangers	−0.08**
Age ⇒ Trust in SAS ⇒ Intention, SAS strangers	−0.03**
Gender ⇒ Tech-optimism ⇒ Intention, SAS strangers	−0.05**
Gender ⇒ Trust in SAS ⇒ Intention, SAS strangers	−0.04**
Active mobilitya ⇒ Tech-optimism ⇒ Intention, SAS strangers	0.04*
Active mobilitya ⇒ Trust in SAS ⇒ Intention, SAS strangers	0.03**
Public transport[b] ⇒ Tech-optimism ⇒ Intention, SAS strangers	0.02
Public transport[b] ⇒ Trust in SAS ⇒ Intention, SAS strangers	0.01
Familiarity ⇒ Tech-optimism ⇒ Intention, SAS strangers	−0.01
Familiarity ⇒ Trust in SAS ⇒ Intention, SAS strangers	0.00

[a]0 = Motorized transport. 1 = Active mobility. [b]0 = Motorized transport. 1 = Public transport. *$p < 0.01$, ***pBonferroni* < 0.0013.

(Y_x) and mediators (M_x), and the mediators' (M_x) effect on dependent variables (Y_x).

There are several significant effects from the independent variables on the proposed mediators. Familiarity has a positive effect on technological optimism. We do not find any effect of using public transportation regularly on the mediators. Increased age predicts both lower trust and lower technological optimism. Women score significantly lower than men on both mediators. Both trust and technological optimism are lower in 2021 than in 2020. Yet, the explained variance is low in both mediators. This indicates that other factors are important in determining the variance of these constructs.

The only direct effect of independent variables on intention to use is familiarity with pilots. For the importance of social distance, we find multiple effects. Age and gender both negatively predict it, meaning that older participants and women find it more important to keep social distance. Those who walk or cycle reported lower importance of social distance. Participants rated distance as less important in 2021. We see relatively strong effects of both technological optimism and trust on intentions to use SASs with strangers. Meanwhile, these two mediators do not effectively predict variance in the importance of keeping social distance.

The explained variance in the mediators suggests that other variables may be more important in predicting these key constructs. Without the proposed mediators, the R^2 in

Table 5. Direct standardized effects estimated in the mediation analyses. $N = 1493$.

	Trust in SAS (M_1)	Tech-optimism (M_2)	Intention, SAS strangers (Y_1)	Importance, Social distance (Y_2)
	β	β	β	β
X_1 Age	−0.11**	−0.15**	−0.01	−0.06
X_2 Gender (*0 = male*)	−0.15**	−0.10*	−0.05	−0.09**
X_3 Active mobility[a]	0.10**	0.07*	0.03	0.11**
X_4 Public transport[b]	0.03	0.03	−0.01	0.03
X_5 Familiarity	0.010	−0.02	−0.02	0.00
X_6 Sample year (0 = 2020)	−0.04	−0.06	−0.01	0.32
M_1 Trust in SAS	–	–	0.30**	0.07
M_2 Tech-optimism	–	–	0.56**	−0.10
R^2	0.043	0.038	0.561	0.140

[a]0 = Motorized transport. 1 = Active mobility. [b]0 = Motorized transport. 1 = Public transport. *$p < 0.01$, **pBonferroni < 0.0013.

the intention to use falls to 0.039 and to 0.134 for the importance of social distance. This corroborates the importance of these constructs for intention to use and the insignificance of the proposed mediators for desired social distance. The explained variance in intention to use SAS was, by far, the largest.

In addition, we ran a multivariate linear regression with interaction terms to test whether age and gender are effectual as moderators in this context. This test was only run for intention to use SASs. The results are presented in the appendix. Here, we only find main effects of trust and tech-optimism on intention to use. No other contextual variable reaches our threshold of $p < 0.01$. The interaction between gender and trust exceeded the 5% significance level ($b = 0.07$, $p = 0.045$), suggesting the link between trust and the intention to utilize shared autonomous services (SAS) was stronger in females than in males. However, there was only a minimal increase in explained variance after incorporating these interaction effects into the model ($\Delta R^2 = 0.002$). This implies that the moderating roles of age and gender contributed limited additional explanatory value to the model.

3.3. Analyses of those who tried the pilot shuttles

We also ran analyses using the same predictor variables on the 36 participants who reported in 2021 having tried autonomous buses. None of the factors emerge as statistically significant in predicting use of SASs, and the effect sizes are small. The R^2 of the model was also low, at 0.032. This is probably due to the small effects of limited exposure.

4. Discussion

In this study, we investigated what people in a pilot area think of SASs using two periods of data collection to test a hypothesized mediation model. The model did predict intention to use SASs with strangers and no steward to a large extent, but it did not predict the reported importance of being able to keep social distance on SASs. The mediators had large impacts on intention to use but not on the importance of social distance, confirming our fifth hypothesis. The base model suggests that the chosen independent variables do not sufficiently explain variance in our mediators of trust and technological optimism. Although there were some significant predictors, the overall explained variance in the mediators was low.

4.1. Predicting intentions to use SASs through mediators

The model predicting intention to use SASs with strangers without a steward had several significant effects and good overall explained variance. The indirect effects suggest some effects of all the independent contextual variables through the proposed mediators. While only marginally significant, the passage of time seems to affect both trust and technological optimism, which in turns lowers intentions to use. A similar small effect is found for familiarity through technological optimism. These are important findings that go against the predictions in our third hypothesis. Certain aspects of the pilots conducted thus far in the Oslo region may suggest an explanation: poor handling of vulnerable road users, violation of yielding rules, slow speeds, and passive driving behavior (Mirnig et al., 2022; Pokorny et al., 2021). Running pilots with a technological prowess that fails to meet public expectations may hurt behavioral intentions to use in the future.

The results indicate that age and gender have both direct and indirect effects on intention to use SASs, proving partial support for our first hypothesis. Future research should continue this investigation of what causes women and older people to be less willing to use SASs with strangers without a steward onboard. While recent reviews conclude that age and gender show inconsistent results in predicting intention to use AVs, we find that they may play a role as an indirect determinant in some contexts (Greifenstein, 2024). The results for these two groups suggest that this effect may be due to the social situation involving strangers, as they report this as being more important than younger people and males reported. The mediated effect shows that some of this effect can be explained by older people and females reporting less technological optimism and lower trust than others. In presenting a novel transport mode, public transportation providers should take care to emphasize for this population segment the safety aspects and possible technical improvements that this technology brings. A positive attitude involving trust, usefulness, and enjoyment has been found to be important in predicting intentions to use SASs for current users of both private cars and public transportation (Öztürker et al., 2022). Other research has suggested that such effects of gender and age often disappear when other sociopsychological factors are accounted for, which may explain why they are significant here with few covariates included (Nordhoff et al., 2019). Further research should investigate the interplay of these factors interplay and how to impact them.

We find that young people and men score higher on both mediators. This further translates to a higher intention to use. This partially supports our first hypothesis. There seems to be no direct effect, but a significant mediated effect. We do not find any interaction effect between gender and age. Recent research has identified this population segment as being an enthusiastic group when it comes to AVs (Nordhoff, Louw, et al., 2022). This correlates with a host of positive evaluations of the technology; our results also suggest that young and men trust the SAS to a larger extent. They expect a larger positive impact from it and keep up to date with the latest developments. This group may therefore also be more prone to being disappointed if the current offer does not meet their heightened expectations. This may be an important driver of the finding that technological optimism decreased over time as the pilot experienced a host of technological issues (Green et al., 2022). This also corroborates the conceptualization of trust and tech-optimism as mediators of contextual variables to behavioral intention. While some have positioned trust differently within their models, this study leans on a stream of research using trust as a mediator (see e.g., Ghazizadeh et al., 2012; Hegner et al., 2019). This interpretation is also bolstered by the lack of effect from interaction terms in our exploration of moderator effects in our models. This suggests that there is little added explanatory power from the interaction between trust/tech-optimism and age/gender. Gender and trust show the largest effect size in our sample, suggesting that this may be a fruitful avenue of further investigation. Further research could investigate how a more general measure of trust would impact these relationships.

A large body of literature has measured intentions to perform a certain behavior, as suggested by models such as the theory of planned behavior (Ajzen, 1985). This intention–behavior relationship is not straightforward, however. Some suggest large gaps between intentions and certain behaviors (Ogden, 2012). It remains to be tested whether intentions to use SASs will transform into actual usage. Meanwhile, it is important to note that AVs are still in their infancy, and people have mixed perceptions about their capabilities and limitations (Nordhoff, 2020; Othman, 2021; Roche-Cerasi, 2019). What and how much information participants are given about the future of autonomous public transportation could greatly affect how they respond and develop their perceptions. Previous research has found that experience with AVs tends to improve attitudes towards them (Azad et al., 2019; Othman, 2021). Either way, these effects are important to be aware of in future research and development.

4.2. Predicting social distance appraisals through mediators

There were some effects on the reported importance of social distance but no indirect mediation effects. The inefficacy of our proposed mediators to explain variance in this dependent variable highlights the poor fit of this model. Gender, age, and transport mode play a role, but their relatively weak effects suggest that other factors are more important in this context. Anxiety in sharing small vehicles could be fueled by previous uncomfortable experiences. Research from Norwegian public transportation has documented that people infer a greater fear of unpleasant social events with public transportation (Backer-Grøndahl et al., 2007). Discrimination in ridesharing services has also seen some focus, having been found as a discouraging factor (Moody et al., 2019). Better accounting for social habits, social preferences, socioeconomic factors, and ethnicity may improve such models (Cui et al., 2021). Future research should further investigate the drivers and explanations for differences in the need for social distance while using SASs.

We confirm the second hypothesis that women appear to think it is more important to be able to keep social distance when riding autonomous buses. This is in line with previous findings that women suffer more from uncomfortable social situations when using public transportation (Arai et al., 2008; Backer-Grøndahl et al., 2007; Chowdhury & Van Wee, 2020). The novel social situation will require more knowledge about who will be willing to share rides, with whom, and under what circumstances (Sanguinetti et al., 2019). Other individual differences may matter as well, such as one's orientation towards other people or personality traits. Women have been found to score higher on gregariousness and warmth – traits that stem from extraversion and agreeableness in the Big Five model of personality (Weisberg et al., 2011). These effects are typically small, however, and may be counteracted by the possibility of uncomfortable social situations. This effect should be further investigated in future research. Public transportation providers should take measures to ensure that their shuttles feel safe and inclusive for all demographics.

The passage of time and the use of active mobility predict a rating of social distance being more important. The COVID-19 pandemic may have severely impacted the results in this article, as Norway had strict regulations on social contact in the periods when this survey data was collected – and they were even stricter in 2020 than in 2021. Peoples' preferences changed quickly when restrictions were applied, and this preference for enlarged interpersonal distance partly persisted after restrictions were removed (Welsch et al., 2021). People were also encouraged to use transportation modes that did not involve social contact, which may partly explain why active mobility users preferred more social distance; they may have made a conscious choice toward being alone in transport. How the long-term effects of this situation play out for public transportation use should be monitored.

We did not find any effects of respondents reporting to be regular users of public transportation, thus disproving our fourth hypothesis. This may be because the SAS service seems to be a novel mode of transportation. The size of the vans employed in the current pilot was larger than that of taxis and smaller than that of buses, falling in between typical categories of public transport. The general lack of information about the future of autonomous public transportation may also lead to more speculation on the part of respondents as to what this service will look like in the future. Most participants had not tried this or any other pilot, resulting in little experience to draw on when asked about the social situation in futuristic transportation modes. Some car users think of their cars as a mobile living room, and this has been identified as a hinderance to sharing shuttles with strangers (Sovacool & Axsen, 2018). The participants who use active transport modes think it is less important to have social distance. This is a novel finding that may be explained by the expectation of public transportation to be crowded compared to the solitude of biking or walking. Habitual car use has been found to be a negative predictor of intentions to use public transportation in general, and this finding is somewhat corroborated here (Şimşekoğlu et al., 2015).

4.3. Model fit and explained variance

Our model predicting intentions to use SASs had a R^2 of 0.56. This is lower than recent reports using similar models (Korkmaz et al., 2021; Nordhoff et al., 2020), but those models were more exhaustive, using many factors from the UTAUT and MAVA frameworks. Our explained variance is therefore evidence of adequate fit. However, the low explained variance in our mediators may suggest that the independent variables are less important than our proposed mediators in predicting this independent variable. The large drop in explained variance when mediators are excluded from analysis strengthens this interpretation. Overall, the results corroborate the importance of trust and technological optimism for predicting willingness to use SASs that we also hypothesized in hypothesis five (Choi & Ji, 2015; Hegner et al., 2019; Nordhoff et al., 2019; Nordhoff, Louw, et al., 2022). Their high correlation may also support the idea that there is one GAF governing intentions to use SASs (de Winter & Nordhoff, 2022). Other contextual variables should be considered in future research to explain how to impact the proposed mediators in the current model. As suggested, a GAF approach using a wider range of predictors may be the most appropriate for predicting intentions to use (de Winter & Nordhoff, 2022).

For the reported importance of social distance, we had less success, with an explained variance of $R^2 = 0.14$. This suggests that variables other than the ones included are important for this issue. When we removed mediators from the model, the explained variance almost stayed the same. Trust and technological optimism do not play a role in determining the need for social distance on board a SAS. Surprisingly, the results do not suggest that users and non-users of public transportation differed in their preferences either. The mean score on intention to use was above the midpoint of the scale in both samples, which means that respondents are still curious and willing to try the service. Respondents also reported that it is generally important for them to be able to keep social distance on board, even more so during a pandemic.

4.4. Limitations

Our plan was to investigate the effect of introducing a test pilot of SASs in a small suburban area. However, due to the COVID-19 pandemic, technical issues, and other factors, very few people tried the pilot buses during 2020. This is a risk of using survey data to reach a specific population of potential riders. While this did not affect our ability to investigate baseline results, it would be interesting to investigate the effect of being more directly exposed to SASs on people's attitudes. We had to use indirect measures of exposure, and future research should continue to seek avenues for investigating real-world interaction with this novel technology and how it impacts potential users.

Our measure of trust only covers some of the sub-components associated with the construct (Körber, 2019; Mayer et al., 1995). This limits the validity of the results in some regards. For example, our study is poorly positioned to say something about dependability or propensity to trust and its' effect on intention to use SASs. However, we designed the included items to be directed toward some of the more salient aspects of encountering a SAS in a residential neighborhood. While these choices are mentioned in the manuscript, using the term trust in this way may be somewhat confusing to some. Future research should build on these findings to see whether they hold true for more elaborate measures of trust as well.

Additionally, the pilot test being investigated was only operating at SAE level 3 in an area with mostly 30 km/t speeds. While it is a strength of this study that it follows a field test of SASs, the limitations of the technology being investigated may be playing a part in the slightly negative development of people's perceptions. It is a main finding of this article that respondents' optimism about this novel transport mode is crucial, but not unending. Future research could further investigate the effects of less-than-ideal tech in pilot tests and how this impacts people's acceptance of SASs, but our study suggests that it would be a marked negative impact.

As with all survey data, we are dependent on people answering seriously and truthfully. As it pertains to their perceptions of a largely futuristic technology, there is room for random variation in the answers given as participants are left with their imaginations. Two respondents who have not encountered the pilot buses may have two completely different shuttles in mind when responding to these surveys. This could be alleviated by further feeding participants realistic information about the planned shuttle service and perhaps using images or videos to further control their perceptions. However, doing too much in terms of providing participants with information could also skew their responses by pushing them in a certain direction. Furthermore, our dependent variable of willingness to use SAS with strangers, may have measured willingness to use other kinds of public transport or ridesharing. While an important distinction that should be further addressed in future research, we still believe in our interpretations of willingness to use SAS as described in the survey and in this article as something novel and different.

Our independent variables were measured using only single-item questions. Single-item measures are often found to be less reliable than multi-item scales when measuring psychological constructs (see e.g., Gosling et al., 2003). However, our items were tailored to the specific social situation arising from the pilots in Ski, allowing for more straightforward measurement of intentions. In such specific evaluations, single-item scales can be well-suited and sometimes even preferable to multi-item scales (see e.g., Rossiter, 2002), though this specificity may come at the cost of some generalizability. As such, intention to use SASs could benefit from using several items. The item asking about willingness to use included two clauses, wanting to use and wanting to share. This approach makes this study unsuited to say anything about willingness to use SASs, because respondents may conflate these two aspects. This approach does, however, fit with the aims of this study. Future research should look to create reliable scales for intention to use SASs in public transportation that cover more of the aspects associated with it.

The population we studied may also differ from the general population in important ways. We know that the people who answer voluntary surveys may differ from those who do not. In particular, we may have easier access to respondents with strong opinions on the matter. Therefore, caution should be exercised when extrapolating the results from this survey to other contexts.

Author's contributions

Ole Aasvik: Conceptualization, Methodology, Data collection, Formal analysis, Writing – original draft, Writing – review and editing.
Marjan Hagenzieker: Formal analysis, Supervision, Writing – review and editing
Pål Ulleberg: Formal analysis, Supervision, Writing – review and editing
Torkel Bjørnskau: Conceptualization, Methodology, Writing – review and editing, Project administration, Funding acquisition.

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The authors report that there are no competing interests to declare.

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Appendix

Survey items

Age, gender, travel behavior, and familiarity

Age and gender (1 = male, 2 = female) were queried at the start of the survey. Additionally, they were asked about their knowledge about the self-driving pilots in this particular area before they answered the survey. This question had three possible answers: 1) "Yes, very familiar", 2) "Yes, a little familiar", and 3) "No familiarity" which were reversed for ease of interpretation. Participants reported their main mode of transport to/from Ski center. These were recategorized into 0) Motorized (cars, motorcycles, etc.), 1) walking and cycling, and 2) public transport. For multivariate analyses, active mobility and public transport were separately dummy coded against motorized transport.

We grouped together every respondent who at some point reported having been on board a self-driving bus to be able to include them for some analyses. These may not have been full rides with the bus and may not have been with the pilot in Ski, but they still represent people who report having first-hand experience with a self-driving bus. These were subjected to exploratory analyses. For these analyses, we only used the data collected in 2021.

Trust in SAS

Trust is an elusive concept that has seen many different definitions across applications. Trust in automation has been researched for decades and is often conceptualized by the three factors: performance, process, and purpose (McKnight & Chervany, 2001; Lee & See, 2004). These three factors capture the ability, integrity, and intended goals of any automation. The current measurement of trust in SAS relied on several previously used items that were adapted to better fit the context of the pilots in Ski. Items were inspired by the UTAUT and the MAVA in particular (Nordhoff et al., 2019; Venkatesh et al., 2016), but also research that has investigated trust more specifically (i.e., Choi & Ji, 2015). We developed six items that focused particularly on the safety performance and ability aspects of trust, as these were thought to be the most salient in this context. This is in line with other definitions that trust entails placing yourself in a vulnerable position regarding novel technology (Mayer et al., 1995). We developed the following items (original Norwegian in parentheses):

1. I am certain self-driving vehicles are safe and secure (Jeg mener selvkjørende kjøretøy er trygge og sikre).
2. As a pedestrian/cyclist I would feel safer in traffic when cars become self-driving instead of human-controlled (Som gående/syklende vil jeg føle meg tryggere i trafikken når bilene blir selvkjørende i stedet for menneskestyrte).
3. I trust that the introduction of self-driving vehicles in Ski are done in a safe fashion (Jeg har tillit til at innføringen av selvkjørende kjøretøy i Ski gjennomføres på en trygg og sikker måte).
4. (Reversed) I think self-driving buses will create problems for other traffic (Jeg tror selvkjørende busser kommer til å skape problemer for annen trafikk).
5. I think self-driving minibuses will stop if necessary to avoid collisions (Jeg er sikker på at de selvkjørende minibussene vil stoppe hvis det er nødvendig for å unngå en kollisjon).
6. I think self-driving minibuses are safe to drive in residential areas in Ski (Jeg tror det er trygt at en selvkjørende minibuss kjører i boliggatene i Ski).

Table 6. Means, standard deviations (SD), and Cronbach's α for the two samples.

	2020	2021
Cronbach's α	0.643	0.894
Mean	4.26	4.20
SD	1.09	1.46
N	922	608

These questions were presented with a 7-point Likert scale ranging from "1 - Totally disagree" to "7 – Totally agree". An eighth point was given for "Don't know/Not relevant". There is some debate on how best to deal with such information, but for our analyses we recoded them into the mid-point of the scale "4" (Rogelberg & Stanton, 2007). Table 6 presents key statistics for this scale after compiling them into a single average.

The two data collections both show acceptable measures of reliability. However, the data collection from 2020 has a lower alpha. The means rank above the mid-point of the scale, suggesting that most people score above center of the scale. There is also a slight trend towards less trust over time. Table 7 shows item-specific metrics for the two samples.

It seems that the question about certainty that the AV will stop to avoid collisions causes the alpha for 2020 to drop. If this item was omitted, the two Cronbach-scores would be more equal. Deleting this item would get both alphas above an acceptable level (i.e., preferably above 0.7 or 0.8 for applied research; Lance et al., 2006; Nunnally, 1994), therefore we chose to delete this item from the calculation of the mean score for all further analyses. The other five items were used in all other analyses.

Because trust is a complex construct with many different conceptualizations, it is somewhat difficult to estimate our measure's validity. However, we have tried to cover aspects of performance, process, and purpose. We included several items measuring safety and security. Trust and safety are often heavily interlinked, and definitions of trust often hinge upon a certain element of risk (McKnight & Chervany, 2001; Lee & See, 2004). Therefore, we conclude that our items are sufficiently valid in measuring key features of trust in automation as represented by SASs in our context.

Technology optimism

Being excited about the possibility of autonomous public transport has been found to have important impact on key variables. The current items are informed by previous research and adapted to the specific context (Bansal et al., 2016; Roche-Cerasi, 2019). The measure is similar to tech-savviness measured in previous studies (Nordhoff et al., 2019). These questions were presented with a 7-point Likert scale ranging from "1 - Totally disagree" to "7 – Totally agree". An eighth point was given for "Don't know/Not relevant", which was recoded into the midpoint of the scale. The five items we developed are presented below (original Norwegian in parentheses):

1. I believe that autonomous vehicles can help meet future transport needs (Jeg mener selvkjørende kjøretøy kan løse mange av fremtidens transportbehov).
2. I believe that autonomous buses can become an important part of our public transport system (Jeg tror selvkjørende busser kommer til å bli en viktig del av kollektivtransporttilbudet).
3. I believe that in 2-3 years, we will have self-driving minibuses driving on their own in Ski (Jeg tror at vi i løpet av 2-3 år vil få selvkjørende minibusser som kjører helt på egen hånd i Ski).
4. I think that self-driving buses would be more efficient and faster than todays' public transport (Jeg tror selvkjørende busser vil bli et mer effektivt og raskere transportmiddel enn dagens kollektivtransport).
5. Using self-driving buses for everyday travel would be better and more practical than the means of transport I use today (Å bruke selvkjørende busser på mine daglige reiser vil være bedre og mer praktisk enn de transportmidlene jeg bruker i dag).

Table 7. Item-specific metrics for the scale for the two samples.

	2020		2021	
	Item-rest correlation	Cronbach's α if item dropped	Item-rest correlation	Cronbach's α if item dropped
1) Safe & Secure	0.749	0.457	0.813	0.860
2) Safe as cyc/ped	0.594	0.514	0.640	0.887
3) Trust Ruter	0.715	0.451	0.713	0.876
4) Problem for others[a]	0.430	0.580	0.589	0.895
5) AVs will stop	−0.454	0.866	0.712	0.876
6) AVs safe in Ski	0.660	0.487	0.835	0.856

[a]reverse scaled item.

Table 8 presents key statistics for this scale.

The two data collections both show similar and high levels of reliability. The mean scores also suggest that most people lean towards being optimistic about this technology and its' capabilities, although the means decreased over time. Table 9 shows item-specific metrics for the two samples.

Believing that AVs are just 2 years away correlates the lowest with the other four items for both samples. However, as all Cronbach's α are above a 0.8-threshold, we keep all five items for further analyses (Lance et al., 2006; Nunnally, 1994).

This construct's validity seems appropriate, as the items are directly related to the intended composite variable. Optimism is thus defined through the positive attitude and evaluation that SAS will have a positive impact on future transport.

Table 8. Means, standard deviations (SD), and Cronbach's α for the two samples.

	2020	2021
Cronbach's α	0.915	0.905
Mean	4.38	4.18
SD	1.62	1.66
N	922	608

Table 9. Item-specific metrics for the scale for the two samples.

	2020		2021	
	Item-rest correlation	Cronbach's α if item dropped	Item-rest correlation	Cronbach's α if item dropped
1) AVs will solve	0.788	0.894	0.759	0.886
2) AV important in future	0.846	0.882	0.849	0.866
3) 2 years to AVs	0.761	0.900	0.696	0.898
4) AV efficient and faster	0.831	0.886	0.846	0.867
5) AV better and practical	0.688	0.915	0.670	0.904

Dependent variables and pilot information

In much research hailing from the UTAUT and MAVA a lot of emphasis is put on the intention to perform a certain behavior. However, for most of our sample, using such SAS is still not a realistic alternative. Because there is a lack of a real frame of reference when answering questions about this, respondents can be left to engage in varying degrees of conjecture. The introductory text and items throughout the survey therefore made it very clear that the questions were regarding the current pilot in Ski.

We designed two items to capture different aspects of the social situation surrounding intentions to use such vehicles. The social situation could be more tangible for respondents and still give important information about how this affects willingness to use. These two items were phrased (original Norwegian in parentheses):

1. I would use such a means of transport even though it involves traveling with strangers without a steward on-board (Jeg vil bruke slik transport selv om det innebærer å reise med fremmede uten sjåfør/operatør om bord)
   Intro text: Imagine that there is a new public transport with smaller vehicles (minibuses with 6-8 seats) with regular departures and bus stops within 200 meters of your home. If you were to consider using this transport, how important is the following to you?
2. That I donot have to sit close to strangers (At jeg slipper å sitte tett sammen med fremmede)
   The first question reads more as a standard intention-to-use-item, but with emphasis on the social situation. The second question may seem a bit convoluted but seeks a good balance between offering information and leaving some gaps to be filled by the respondent. The first question was presented with a 7-point Likert scale ranging from "1 - Totally disagree" to "7 – Totally agree". The second question was presented with a scale from "1 – Very important" to "5 – Very unimportant". A sixth and eighth option was given for "Don't know/Not relevant". These were coded into the midpoint of the scale. Because of positive skew in the first

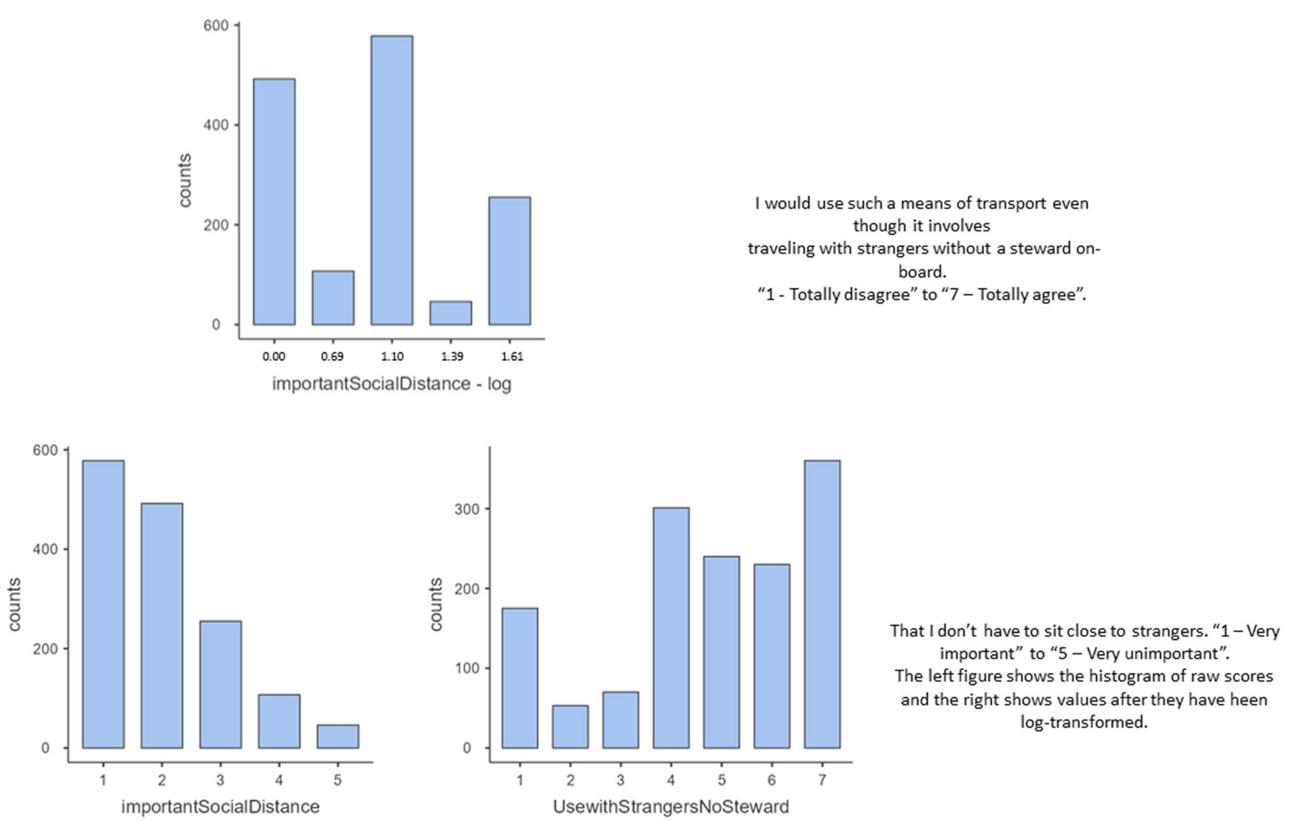

Figure 4. Histograms showing the distributions of the two dependent variables in the study. The first row shows intention to use and the second shows importance of social distance. The second row has two columns. The first showing raw data and the second row showing log-transformed data to meet normality criteria.

dependent variable, we log-transformed it using a natural logarithm (Feng et al., 2014). Figure 4 shows histograms for the two variables' distributions. We see how the log-transform shifts the distribution towards normality. This is an important assumption for the multivariate analyses conducted in this article. Most people seem positive about their willingness to use such a means of transport, and most think it important to be able to keep social distance.

Moderator analysis of gender and age on intention to use SASs

To test the suggested moderating effects of age and gender, we ran a multivariate linear regression analysis. This included z-transformed interaction terms to test the moderator effects. The results are presented in Table 10.

The only significant standardized regression coefficients are the main effects from trust and tech-optimism. No interaction was uncovered.

Table 10. Multiple linear regression with interaction terms testing moderator effects of age and gender on trust and tech-optimism on intentions to use SASs, $N = 1493$.

	B	*p*
Sample year (0 = 2020)	0.03	0.493
Gender (0 = male)	−0.04	0.022
Age	−0.01	0.581
Active mobility[a]	0.04	0.265
Public transport[b]	−0.03	0.691
Familiarity	−0.02	0.358
Trust in SAS	0.27	<0.001
Tech-optimism	0.49	<0.001
R^2	*0.561*	
Age ✻ Tech-optimism	−0.03	0.463
Gender ✻ Tech-optimism	−0.04	0.300
Age ✻ Trust in SAS	0.02	0.495
Gender ✻ Trust in SAS	0.07	0.045
R^2	*0.563*	

Note: Italics are used for a different statistical measure. [a]0 = Motorized transport. 1 = Active mobility. [b]0 = Motorized transport. 1 = Public transport.