Factors that influence the acceptance of future shared automated vehicles – a focus group study with United Kingdom drivers

Patrick Dichabeng, Natasha Merat, Gustav Markkula

Abstract

The development of Shared Automated Vehicles (SAVs) is well underway to provide mobility as a service (MaaS) and bring benefits such as reduced traffic congestion, reduced reliance on privately owned vehicles and increased independence to non-drivers. To realise the benefits of SAVs, adoption by private vehicle users is crucial. Previous research has shown this subset of users as the least likely to adopt SAVs, and it is not well understood what factors are important to achieve such adoption. The purpose of this study is to obtain an in-depth understanding of attitudes, perceptions and preferences that influence the acceptance of future SAVs for drivers. This paper presents the results from an online asynchronous focus group study with 21 British drivers as participants. From the analysis, Service Quality, Trust and Price Value emerged as the three most prominent factors to understand user acceptance of SAVs. These three main factors may be of prime importance for convincing naïve private car owners to accept high-speed SAVs. Productive use of travel time has been frequently mentioned in previous research as a benefit of vehicle automation but was scarcely mentioned by participants in this study. Shared Space Quality in introduced as an indicator for Service Quality, together with Security and Trusting Co-passengers as two indicators of Trust. Based on the findings, this paper concludes with a conceptual SAV technology acceptance model is introduced, with the results added as extended model predictors to the Unified Theory of Acceptance and Use of Technology (UTAUT2).

Keywords: user acceptance, shared automated vehicles, ride-sharing, car-sharing, focus group, shared automated vehicles acceptance model

1. Introduction

Shared Automated Vehicles (SAVs) combine elements of conventional carsharing and ride-sharing with vehicle automation (Fagnant et al., 2014); combining shared vehicles with full self-driving automation (the highest levels of vehicle automation, Levels 4 and 5). At these levels, the system is the fall-back in case of a failure, not the driver, and the vehicle performs all safety-critical driving functions (SAE, 2018). Therefore, a driver is not required to monitor the system. In simpler terms, a SAV is a vehicle that is not owned by the passengers transported in it, much like a taxi but is also an automated vehicle. SAVs are sometimes referred to as RoboTaxis, which are slow-moving vehicles with a top speed of 24km/h due to current early prototype limitations (Maghraoui et al., 2020).

SAVs are a socio-technical solution to meet mobility needs efficiently. It has been suggested that they can contribute to improved sustainable transportation through shared mobility on demand (Bojkovic, 2018); contributing to reductions in individual car ownership by selling mobility instead of cars. Shared Automated Vehicles can bring about other benefits such as reduced traffic congestion (Dia et al., 2017; ITF, 2015), accident reduction (Piao et al., 2016) and improved mobility of non-drivers such as the elderly and physically impaired (Alessandrini et al., 2015).

Currently, car-sharing schemes such as Uber, Lyft, etc. provide Mobility as a Service (MaaS); defining their main value proposition (mobility) as a result, instead of buying a car (Hildebrandt et al., 2015). These car-sharing schemes are use-oriented examples of Product-Service Systems (PSS), in which ownership of the product remains with the manufacturer/service provider, and the user pays for using the services, in this case, mobility. Since users pay only for the actual use of the cars under MaaS (mileage or time), similarly, shared and automated vehicles are expected to be more economical than privately owned cars (Fagnant et al., 2014), with acquisition and maintenance costs shifted from the users to the service providers.

A lot of research has already been done on the acceptance of SAE Level 4 SAVs (Madigan et al., 2016; Nordhoff et al., 2017; Salonen, 2018). In these previous studies, the automated vehicles were confined to a fixed route, have typically been driverless low-speed pods/shuttles, with a supervisor/operator present, with seats for 8 to 12 passengers in what is essentially a small shuttle bus. Salonen (2018) found that the presence of a supervisor/operator is key to the perception of security and for emergency management on-board; features that will not be available in future high-speed SAVs. In the same study involving driverless shuttle buses in Finland with a maximum speed of 13km/h, Salonen (2018) also found that passenger perception of personal in-vehicle security was worse than that of a regular bus (maximum 50km/h in Finland), even though vehicle safety was rated higher. This result is important as it shows the psychological impact that the absence of a human driver has on passengers. To mitigate this, the implementation of emergency buttons has been suggested to give users some sense of control (Hohenberger et al., 2016), thereby reducing anxiety.

Reducing traffic congestion through the adoption of SAVs is a challenge as some users are more readily open to accepting future high-speed SAVs, while others are not. Previous research has found that younger, more educated and more tech-savvy commuters are more likely to be the early adopters of SAVs (Haboucha et al., 2017; Rico Krueger et al., 2016; Lavieri et al., 2017). However, individuals who have a low opinion of current Public Transit (PT) offerings and who do not use PT are less likely to choose SAVs (Haboucha et al., 2017). The findings by Zmud et al. (2017) suggest that likely users focus on personal benefits rather than societal benefits, such that the predicted societal benefits of SAVs, such as reduced traffic congestion and reduced pollution, are not likely to influence user preference unless they are perceived as individual benefits. While traffic congestion can be reduced through numerous ways, drawing travellers away from private cars to public transit can be effective (Abdulkareem et al., 2020), together with the implementation of ride-sharing strategies (Jrew et al., 2019). However, Nordhoff et al. (2017) found that car use is negatively correlated to a positive attitude towards automated vehicles; meaning, the more people make use of their privately owned car, the less likely they are positive towards AVs, let alone SAVs. This lack of acceptance needs to be understood by looking into these users' intention to use SAVs. Researchers often use acceptance models to help investigate users' intention to use a product or a service.

The Technology Acceptance Model (TAM) was developed by Davis (1989) to help predict the adoption and use of information technology (IT). Davis suggested that individuals formed a conscious intention to use IT, through rational cognitive processes. The intention to use is influenced by the extent to which the individual believes the IT would improve their performance (perceived usefulness) and the degree to which the individual believes using the IT would be easy or difficult to use (perceived ease of use).

Venkatesh et al. (2003) expanded on TAM by creating the Unified Theory of Acceptance and Use of Technology (UTAUT). UTAUT integrated the Theory of Reasoned Action (Ajzen & Fishbein, 1980), Technology Acceptance Model (Davis, 1989), the Theory of Planned Behaviour (TPB) (Ajzen, 1991), the Model of PC Utilization (Thompson et al., 1991), Motivational Model (Davis, et al., 1992), a combined model of TAM and TPB (Taylor and Todd, 1995), Social Cognitive Theory (Compeau & Higgins, 1995) and, finally, the Innovation Diffusion Theory (Rogers, 1995). UTAUT 'unified' the eight most significant models of individual acceptance. Just like the Theory of Planned Behaviour, UTAUT assumes that technology acceptance is the result of rational processes, through controlled and deliberate reasoning (Venkatesh et al., 2003). To develop UTAUT further, Venkatesh et al. (2012) added three more constructs to UTAUT to create the Extended Unified Theory of Acceptance and Use of Technology, or UTAUT2 in short (See Figure 1). The three new constructs were hedonic motivation, price value and habit. While these models are often used without modification, researchers can add new constructs to make them more relevant to the specific applied context (Chang, 2012; Tamilmani et al., 2017).

Recently, UTAUT has been used by some researchers (Madigan et al., 2016; Nordhoff et al., 2017; Zmud et al., 2017) to assess drivers' and passengers' acceptance of vehicle automation, and shared vehicle automation. Even more recently, UTAUT2 has been used by Nordhoff et al. (2020) to assess the acceptance of Level 3 automated vehicles. Since UTAUT was developed for understanding user acceptance of information technology, other researchers such as Geldmacher et al. (2017) have created a modified version of UTAUT. Similarly, Osswald et al. (2012) created a modified version of the Technology Acceptance Model (TAM) which they called the Car Technology Acceptance Model (CTAM) as they reasoned important factors such as perceived safety were not in TAM. While these modified versions of TAM and UTAUT brought the acceptance models closer to the transportation research context, they excluded constructs that were later added in the domain-general UTAUT2 by Venkatesh et al. (2012) such as habit, price value and hedonic motivation. In a study comparing seven acceptance of technology models, Rondan-Cataluña et al. (2015) found that, for mobile internet users, UTAUT2 obtains a better explanatory power than the other models; 4.5% better than UTAUT.

To investigate and describe user acceptance of SAVs, it would be helpful to create a modified version of UTAUT2 that integrates factors and constructs that are relevant to future high-speed SAVs, and to the specific users expected to adopt SAVs, i.e. owners and drivers of private cars.

This study identified factors that can influence user acceptance of SAE Level 4 and 5 SAVs by identifying driver attitudes, perceptions and preferences for using private vehicles, current car-share and ride-share modes, as well as future shared automated modes of transport. This was done through an online asynchronous focus group. The focus group was asynchronous as it allowed participants to take part at different times; i.e. without the need for them being online at the same time. The purpose of the focus group was not to infer, generalise, nor make statements about the broader population. It's purpose was to understand, determine a range of issues and provide insights about how people in a group perceive a product or service. As such, meaning units were extracted from participant responses and aggregated to understand values they consider to be important in their choice of transportation, and values they deem important for future SAVs.

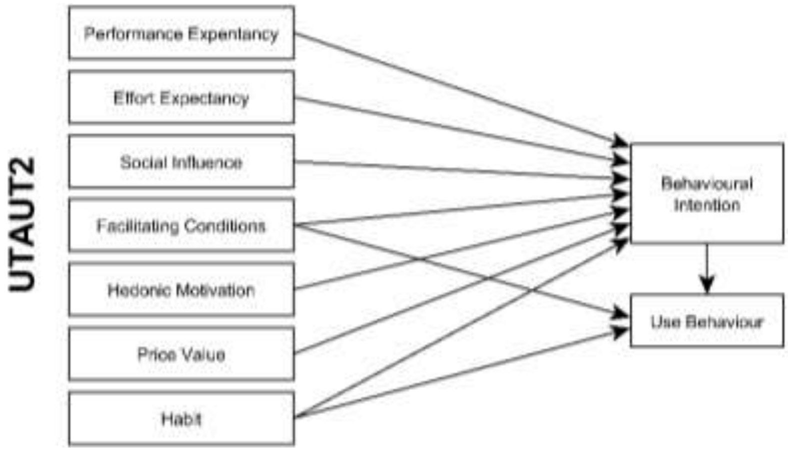

Figure 1: Extended Unified Theory of Acceptance and Use of Technology (Venkatesh et al., 2012)

This study focuses on private car owners and drivers, to understand their attitudes and preferences for SAVs. As discussed above, this subset of users are the least likely to use shared automated vehicles and have previously not been the focus of acceptance studies for SAVs. It is important to get private car owners to leave their cars in favour of SAVs. For this to happen, SAVs need to be tailored to the needs and preferences of these users; meeting not just mobility needs, but also affective needs (Redman et al., 2013). Lastly, this study proposes a conceptual acceptance model that expands on UTAUT2 with a few extended model predictors for future research; for assessing user intentions to use future high-speed SAVs.

1.1. Objectives

This study aims to investigate attitudes and user requirements, from the perspective of car users, for the adoption of shared automated vehicles; in which the user can shift from individual car ownership to taxi services (e.g. Google's Waymo, Uber). More specifically, the objectives for this study are as follows:

i. To determine which factors predict user acceptance of shared automated vehicles.
ii. To establish to what extent UTAUT2 can, in its current form, accommodate these factors.
iii. If UTAUT2 is missing important factors, propose a draft version of a SAV Technology Acceptance Model, as an extension of UTAUT2, to support further research on SAV acceptance.

The next sections of this paper present the research method, results, discussion, limitations and conclusions. The method section details the type of focus group used in this study, sample questions and how the data was analysed. The results section primarily focuses on the three main categories and the subcategories under each. A number of direct quotes from participants are also included in this section to give a sense of the type of responses generated during the focus group. In the discussion, the implications of these categories is discussed, and a conceptual extended acceptance model is proposed for SAVs.

2. Method

An online asynchronous focus group (Sweet, 2001) study was carried out, which ran for five days (May 23 – 30, 2019), using the tool www.focusgroupit.com. An online focus group is the online equivalent of a face-to-face focus group that invites participants to a virtual setting with the ability of the researcher to moderate discussions (Mesari, 2016). Online asynchronous focus groups allow participants to read and respond to each other's responses at their convenience through the use of online discussion forums (Williams et al., 2012). The asynchronous nature of the study allowed participants to consider their responses more carefully than real-time sessions, or even do online searches or similar to guide their responses.

Focus groups have commonly been used as alternatives to in-depth interviews (Bloor et al., 2001) while allowing participants to interact in a discussion. They can be used to understand key user requirements by learning from current and potential users of a product or service (Bader et al., 2002). One advantage of online asynchronous focus groups is that they "need not be time-limited in the same way as face-to-face focus groups, allowing much more extensive discussions to develop" (Bloor et al., 2001, p.81). Since participants give written responses, there was no need for transcription of any audio.

Online asynchronous focus groups typically require more participants than face-to-face focus groups. A face-to-face focus group is a discussion around a given topic by 6-12 participants (Bloor et al., 2001). This small number promotes participation by each member in the discussion (Bader et al., 2002). However, in online focus groups, larger numbers of participants promote greater cross discussion and interaction; a recommendation first made by Murray (1997), who used 6-8 participant. In a review of 21 asynchronous studies, Williams (2009) found a mean number of 12 participants per group; ranging from 3 to 57. As Bloor et al. point out, online focus groups can also be much larger than traditional face-to-face focus groups as the size of the group does not interfere with participants' ability or willingness to contribute. A slightly larger number is usually required to account for inactive participants or drop-out participants.

2.1. Participant recruitment

Twenty-five participants who met the study requirements were recruited primarily through the University of Leeds Institute for Transport Studies Driving Simulator database of study volunteers, through social media (specifically the 'Leedsface' Facebook group, with permission from the group's administrator), and finally through a study participant recruitment website; callforparticipants.com. Study volunteers were directed to an online form to assess their eligibility to take part in the focus group. The target participants had to meet the following criteria (for clarity, also see Table 2):

- non-experts in the research topic
- own and/or use a car every week
- must have used ridesharing or carsharing services such as Uber at least once in the 12 months before the study
- must have daily access to a computer or tablet with internet to participate online

To secure the recruitment process from duplicate participants several security measures were implemented during recruitment. A cookie was set to prevent repeat participation in the recruitment filter, and only one volunteer could be approved per IP address. A unique token ID was assigned to each volunteer who met the criteria, to limit access to the registration page (detailed description, consent form, focusgroupit.com). On focusgroupit.com, new self-registered accounts were manually approved, by comparing the registered user's information against the completed consent forms.

Volunteers who met the criteria were invited to register as participants for the focus group. They were directed to a participant information sheet with a more detailed description of their expected role in the study; followed by a consent form, and finally the focus group's registration page on focusgroupit.com. Their accounts were not active immediately after registration; pending approval and the focus group start date. All initial questions were presented at once on the first day (See the Daily Activity Guide in Appendix A). To limit the extent to which participants would influence each other in their responses to the initial questions, a non-biased approach was used; meaning, participants could not see other participants' responses unless they had already answered the same question. Responses to questions were directly recorded within the group database on focusgroupit.com, which was later exported for restructuring and analysis. A £25.00 Amazon eGift Voucher was given to participants who took part throughout the 5 days. Participants who were active for only 3 days or less were given a £5.00 Amazon eGift Voucher. This was communicated from the outset. Daily participation and activity were monitored through daily session logs. Participants who did not meet the expected daily participation level were encouraged to be more active through private emails. Approval for the study was obtained from the University of Leeds Research Ethics Committee; LTTRAN-102.proc

2.2. Instrument and sample questions

As already mentioned, the instrument used in this study was focusgroupit.com, which allowed the creation of open and closed-ended questions in the form of an online forum. Questions were presented with images and video where necessary to help clarify the question. Participants were presented with three main types of questions based on Richard Krueger (2002). See Table 6 in Appendix A for the full set of questions, and Figure 2 for a flowchart showing the types and order of questions. The three main types of questions were:

1. Engagement questions that introduced participants to the topic, e.g. What is your preferred mode of transport when going to work?
2. Exploration questions prompted participants to go deeper into the topic, e.g. What was your experience like when using a shared vehicle like Uber?
3. Exit questions designed to explore anything missed during the discussion, e.g. Is there anything else you would like to say about making the experience of sharing a driverless vehicle attractive for yourself?

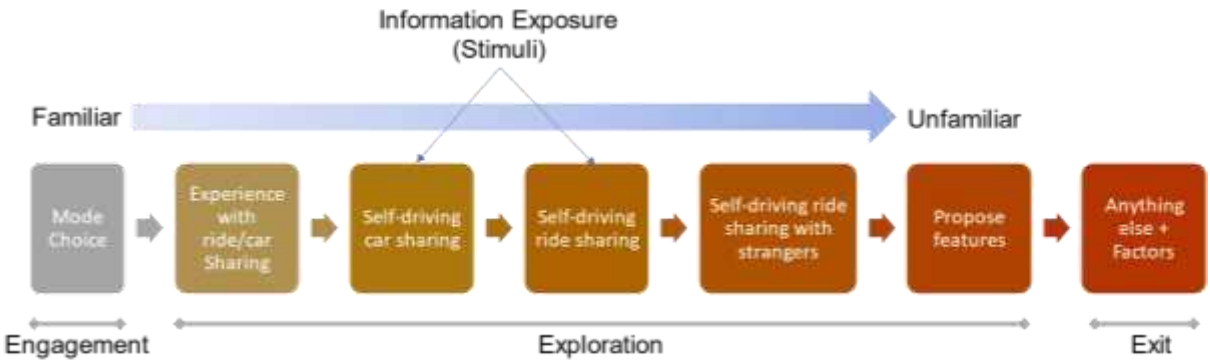

Figure 2: Flowchart on research method

2.3. Procedure

Participants were presented with 17 questions on the first day, with the 18th question (exit question) presented on the last day (see Table 6 in Appendix A). The questions presented transition from what participants are very familiar with (own motivation for their current mode choice) to what participants are slightly familiar with (current car-share and ride-share vehicles such as Uber) on to what they are unfamiliar with (shared automated vehicles); also see Figure 2. The scenario for a SAV that participants were presented with was a short video of a Chevrolet Cruise (autonomous vehicle), with no input controls for the user; i.e. no steering wheel nor pedals.

Participants were given a daily activity guide (See Appendix A for full details) that explained how to participate in the focus group during each day. On the first day, participants were encouraged to descriptively answer all or most of the questions. All questions were optional. On the second day, participants were requested to answer any remaining questions and to begin reading responses from other participants while reflecting on their responses. They were also encouraged to start adding comments to the responses from other participants, which would trigger an email notification to the relevant participant. Participants could also indicate agreement with a response by clicking on the "Agree" button. The moderator requested participants to clarify unclear responses, and also directed participants to opine on specific responses by other participants that disagreed with their responses.

Participants gave written responses to the initial questions, much like they would to an online questionnaire. However, unlike an online questionnaire, their responses were visible to other participants who had already answered the same questions. They could then build on each others' responses by posting a public reply; similar to an online discussion forum. The moderator interacted with participants in the same manner but could post public or private replies as necessary.

2.4. Analysis of responses

Data generated from the focus group were mostly qualitative, from open-ended questions. NVivo was used to analyse the data, which is a software by QSR International that "supports qualitative and mixed methods research by helping researchers to organize, analyse and find insights in unstructured data" (NVivo, 2018). In a study that looked at qualitative research methods used in travel behaviour studies, Mars et al. (2016) noted that out of 18 researchers who used software analysis techniques, 11 used NVivo. Using NVivo, thematic content analysis was performed on the text to derive patterns, recurring themes and highlight important insights. Content analysis is defined by Hsieh et al. (2005, p. 1278) as the "subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns". Coding is a form of qualitative data analysis that involves identifying passages of text and organising them by common themes; allowing the researcher to index the text into categories and subcategories and therefore establish a "framework of thematic ideas about it" (Gibbs, 2007).

In thematic content analysis, the researcher translates qualitative data into quantitative data by converting meaning units or condensed meaning units into codes. This process is known as coding. Erlingsson et al. (2017) define a code as "*a label; a name that most exactly describes what this particular condensed meaning unit is about. Usually one or two words long.*" The generation of codes can be either deductive, in which the researcher starts with a codebook, which is a list of themes or categories from existing theories and previous studies; or it can be inductive, in which new themes or categories are derived from the data during analysis (Bengtsson, 2016).

In this study, deductive coding was used, based on factors previously identified by Nordhoff et al. (2019) from automated shuttle passenger interviews. These were combined with the constructs from UTAUT2 to create the codebook for analysis. Participant responses that did not fit into this coding scheme were added from other sources through inductive coding, as shown in Table 4. For example, perceived safety was added from (Osswald et al., 2012) under perceived risks.

Table 1: Codebook with factors from Nordhoff et al. (2019) and UTAUT2 (Venkatesh et al., 2012)

Category numbering	Main category	Subcategory	Source
1.	Expectations about the capabilities of the automated shuttle	• **Full automation** – capable of handling all traffic situations without the need for human intervention • Comparison of automated shuttles to public transport systems	Nordhoff et al. (2019)

2.	Evaluation of shuttle performance	• Braking behaviour – strong and abrupt • Manual interventions by the steward	Nordhoff et al. (2019)
3.	Service quality	• **Availability** – Instant access to SAVs, service frequency, vehicle fleet, waiting times. • **Convenience** – How well the service adds to one's ease of mobility; door-to-door transport, connective ports, personalisation, Wi-Fi • **Comfort** – Anxiety, motion sickness, entertainment, refreshments, upkeep, abuse or misuse • **Flexibility** – demand-responsive, ability to change route and destination • Creation of advantages • **Reliability** – Access to a vehicle when needed by the user, and where needed, co-passenger punctuality, failure, number of stops per trip, travel time, vehicle fleet, vehicle range, waiting time, wear and tear	Nordhoff et al. (2019)
5.	Travel purpose	• Use of automated shuttles in severe weather conditions • Use of automated shuttles in suburban and rural areas • Use of automated shuttles on closed areas • Use of automated shuttles for transport of goods • Use of automated shuttles in urban areas • Use of automated shuttles in touristic/unfamiliar areas • Use of automated shuttles due to temporary physical impairments (e.g., pregnancy, exhaustiveness) • One-way trips currently covered by car • Suitability of automated shuttles on daily trips	Nordhoff et al. (2019)
6.	Trust	• **Trusting automated vehicles** – feedback, locus of control, interaction with other road users • Preference for supervision of shuttle • **Trialability** – the ability to trial in a safe and secure environment, under supervision • **Perceived Risks –** higher/lower traffic safety, perceived safety, visibility, emotional factors and affective states relating to safety, job losses, ethical programming	Nordhoff et al. (2019)
7.	Performance Expectancy	• Evaluation of Shuttle Performance • Outcome Expectations • Perceived Usefulness • Relative Advantage	Nordhoff et al. (2019) UTAUT2
8.	Effort Expectancy	• Ease of Use • Perceived Ease of Use	UTAUT2
9.	Social Influence	• Social Factors • Subjective Norm	UTAUT2
10.	Facilitating Conditions	Access to resources that allow the use of the technology	UTAUT2
11.	Hedonic Motivation	Perceived enjoyability, pleasure	UTAUT2
	Price Value	• **Cost –** willingness to pay, relative cost, cost per trip, split trip cost • **Perceived Benefits -** Environmental Concerns – electric vehicle, reduced vehicle miles travelled, reduced traffic congestion, not having to drive, productive use of travel time	Nordhoff et al. (2019) UTAUT2
12.	Habit		UTAUT2

3. Results

3.1. Participants

Out of the 25 participants recruited, one withdrew at the start of the focus group, two were completely inactive throughout the five days, and one was removed for misconduct in writing the same short non-informative answer to all questions. This left 21 participants, aged between 20 and 64 years, broken into smaller age groups, as shown in Table 2. All of the participants used a private vehicle at least once a week, were at least aware of self-driving cars and none of them were experts in the field of self-driving cars. It was a recruitment requirement for all participants to have prior car sharing experience. The composition of the focus group thus characterised by homogeneity; i.e. all participants have something in common, which is, frequent use of a private car and past use of a car sharing service. The variation in age and experience allowed for contrasting opinions in discussions.

Participants' daily activity was monitored. A participant was considered to be fully active if they followed the recommended engagement level in the daily activity guide (See Appendix B). This meant answering most of the initial questions on the first day, engaging with other participants on the second day, responding to questions from the moderator and other participants on the third day, reviewing their previous contributions to the discussions, and responding to the exit questions on the last day. Participants who engaged in discussions for not less than three days were considered to be moderately active. Of the 21 participants, 13 were fully active in the discussions and 8 were moderately active with minimal engagement with other participants.

Table 2: Participant information

Cultural	
I am a UK National	20
I have stayed in the UK for more than 5 years.	1
I have stayed in the UK for less than 5 years.	0
Using a car as a driver	
Almost every day	15
At least twice a week	4
At least once a week	2
At least once a month	0
Knowledge of self-driving cars	
I have never heard nor read about self-driving cars.	0
I am aware of self-driving cars but have very little knowledge about them.	16

I know a great deal about self-driving cars.	5
I study/research self-driving cars.	0
I develop self-driving cars.	0
Age Groups	
20 - 34 Years	13
35 - 49 Years	5
50 - 64 Years	3
Gender	
Male	10
Female	11
Preferred Mode	
Private Car	14
Cab/Ride Sourcing	0
Motorcycle	0
Bicycle	1
Bus/Coach	2
National rail/Other rail	1
Walk	3
Other modes	0

Participants from a large geographical spread across England were recruited; see Figure 3. Out of the twenty-one recruited participants, nine were from Leeds.

Figure 3: Geographical spread of recruited participants

3.2. Main categories and subcategories

The data analysis resulted in 953 coded references, which were coded into main categories and subcategories. From the codebook, only main categories that contained more than 100 coded references are reported in this paper (see Table 3).

Table 3: Coded references per main category in descending order

Main Category	Number of Coded References
1. Trust	456
2. Service Quality	307
3. Price Value	123
4. Hedonic Motivation	23
5. Travel Purpose	15
6. Performance Expectancy	12
7. Effort Expectancy	9
8. Social Influence	8
9. Facilitating Conditions	0
10. Habit	0
11. Shuttle capability expectations	0
12. Evaluation of shuttle performance	0

Table 4 shows the subcategories for these three main categories, and for each subcategory, the number of participants with coded references and the number of coded references is provided. Figure 4 provides a visual representation of the number of coded references per main category and subcategory.

Table 4: Number of participants and number of coded references in each category

Category Number	Main Category	Subcategory		*Participants*	*Coded References*
1	Service Quality	**Availability**		**7**	8
		Comfort		**15**	67
		Convenience		**18**	50
		Flexibility		**11**	20
		Reliability		**20**	101
		+ Shared space quality – co-passenger interaction, proxemics, absence of driver	Newly added	**19**	61
2	Trust	**Trusting automated vehicles**		**21**	65
		Preference for supervision		**16**	66
		Trialability		**9**	14
		Perceived risks		**21**	153
		+ Security – cybersecurity, liability, personal security, privacy, secure storage	Newly added	**20**	72
		+ Trusting co-passengers – co-passengers as strangers, co-passenger behaviour, co-passenger interaction, shared space sentiment	Newly added	**21**	86
3	Price Value	**Cost**		**19**	65
		Perceived benefits		**18**	58

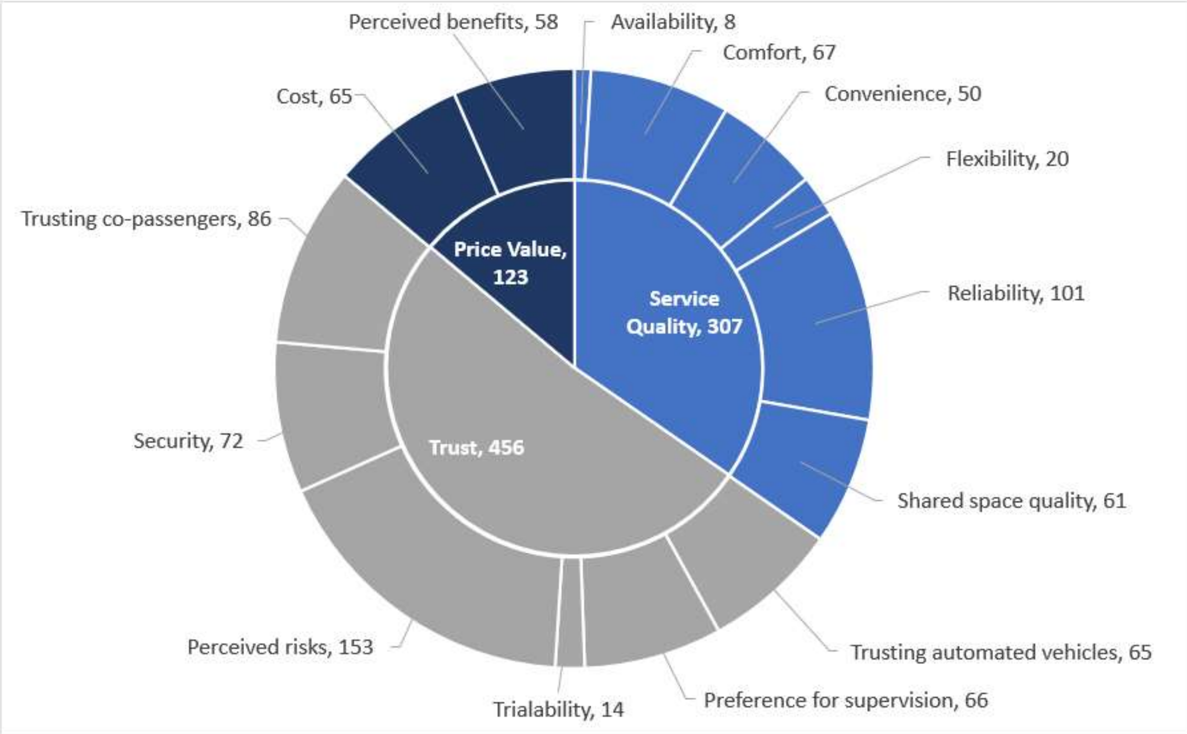

Figure 4: Main categories and subcategories by the number of coded references.

In the next section of this paper, each factor is discussed in more detail and sample quotes from participant responses are provided. For each subcategory presented, the following guide was used to decide on the number of example quotes to include; for consistency and brevity:

(1) Less than ten participants – one quote
(2) Ten to fifteen participants – two quotes
(3) Sixteen or more participants – three quotes

3.3. Main category 1: Service Quality

3.3.1. Availability

Availability pertains to the instant access to SAVs and the frequency of SAV services with short waiting times (Shen et al., 2018). Only seven participants (33%) talked about availability as an important factor. Some participants talked about how they expect improved service quality through automation as the availability of vehicles would not be tied to the availability of drivers. Others expect to have guaranteed pickup times with limited walking to access the car, similar to their privately owned vehicle. One participant said the following:

"I think for certain jobs and certain work routes a car is often necessary as public transport is inconvenient and/or unavailable." [P20]

3.3.2. Comfort

Fifteen participants (71%) mentioned the importance of comfort in their travel experience and expressed this by talking about abuse or misuse of the SAV (5 participants), anxiety (8), entertainment (8), motion sickness (1), refreshments (4) and upkeep of the vehicle interior (5). Some participants talked about how a privately owned vehicle allows them to enjoy a quiet moment after a busy day of work, to listen to music, relax and think. Others expressed the need for comfortable and spacious seating, without being cramped, too hot or too cold, and not smelly. Two of them said the following:

"I like that I can be assured of the comfort and cleanliness of the vehicle and it is (usually) a reliable mode of transport." [P1]

"I like being alone in my car, its stress relief and I enjoy driving with my choice of music…. Driving is a lot quicker for me than public transport, plus a lot more reliable without being cramped, too hot/cold, noisy, smelly etc." [P9]

3.3.3. Convenience

Eighteen participants (86%) referred to convenience as an important factor in influencing their choice of transport. Easy booking and payment, connective ports for charging phones and onboard internet were mentioned as some of the expected features onboard SAVs. Others talked about the convenience of not having to look for and pay for parking, while others expressed concern about whether SAVs will be able to be as convenient as their privately-owned car. Three participants said the following:

"Yes, I would probably use a driverless shared vehicle as much as I use a driven one now – i.e. when it's the most convenient mode of transport for the journey I wish to make." [P17]

"I think for certain jobs and certain work routes a car is often necessary as public transport is inconvenient and/or unavailable." [P20]

> *"can be dropped off at my exact location and don't have to worry about parking etc." [P13]*

3.3.4. Flexibility

Flexibility gives users freedom and independence from rigid service structures, by allowing users to have greater control over their trips. Eleven participants (52%) mentioned flexibility as a factor influencing their decision to use a certain mode of transportation. One participant mentioned the ability to set co-passenger preferences, e.g. female only, while others expressed interest in being able to define custom or optimal routes instead of solely relying on SAV to set route. Participants also explored the ability to set max speed or have different driving modes (relax/gentle/rush), being able to change the destination. A privately owned vehicle allows users to go anywhere at any time, and this flexibility is what some participants hope to see in SAVs. Lastly, the ability to cancel a trip for a refund if not feeling safe with passengers already in the SAV was also mentioned. Two participants said the following:

> *"I also like using my vehicle as I can choose which route to take and/or change the route if required." [P15]*

> *"On the sharing aspect, the ability to not get in the vehicle (if you feel unsafe with the passengers already in) and have an option for money to be refunded easily" [P20}*

3.3.5. Reliability

All twenty-one participants agreed reliability is an important factor to consider. Participants expressed reliability by talking about co-passenger punctuality (8), failure (15) with ten of them concerned about emergency actions during system failure, number of stops per trip (8), travel time (11), waiting time (10) as influenced by availability and co-passenger punctuality, wear and tear (4). Participants expected that SAV solutions should be reliable in general; free from malfunction, with contingencies for eventual malfunction. The service delivery should have short waiting times, short travel times, while taking the quickest route without too much delay from picking up other passengers. Participants expressed that:

> *"My experience with using UBER over several years has been mostly positive, the service has been reliable and I normally get a nice driver." [P4]*

> *"I did not like the experience. The uber goes on longer routes and they do not drop you off at your designated area." … "P9, it's best to pay for a taxi fare than car sharing. Especially if you need to get to your destination quicker. Food for thought..." [P10]*
> *"Travelling by bus is expensive, unreliable, particularly in bad weather (in the past I have had to walk home in the snow) and I can stand at the bus stop for ages as buses go past full or only go to the city centre." [P11]*

3.3.6. Shared Space Quality

Nineteen participants (90%) talked about shared space quality in SAVs; predominantly around the topics of co-passenger interaction (13) and proxemics (13). Some participants talked about the awkwardness of forced conversation with strangers, while others remarked on how they often enjoy chatting with drivers. Participants agreed that shared space can bring about unwanted interaction, which can make the experience of using SAVs unpredictable. The need for preserving personal space was strongly emphasised, with some participants worried that this may not be possible in ride-share SAV solutions. Three of them saying the following:

> *"Especially if you have a stressful job, it's lovely to have your own space and think your own thoughts." [P10]*

> *"Room - to not be too close to others and still have enough personal space" [P13]*

> *"The separation between passengers for security (including private space for a bag) plus personal boundaries." [P9]*

3.4. Main category 2: Trust

3.4.1. Trusting automated vehicles

Scepticism about the capabilities of AVs was fuelled by drawing parallels to past failures of other technologies such as satellite navigation. All Twenty-one participants mentioned the trust of automated vehicles as a factor. The discussion was mostly around trust of automated vehicles (16), feedback (15), locus of control (13) and other road users (3). Participants talked about the unease of putting their lives in the hands of unsupervised automation, being more willing to use SAVs once the technology matures and there is a proven safety record. They also discussed the need for continuous feedback about the status and actions the SAV performs, e.g. trip information, how much time to get into or out of the SAV. Participants also expressed concern about completely surrendering control of the vehicle to an automated system, with no user controls. Others countered this by pointing that the driving style of some people is very unsafe, and perhaps automation may be a welcome alternative. Three participants said the following:

> *"I wouldn't feel as safe as a result of my life being in the hands of a machine." [P1]*

> *"There just isn't enough evidence or proof either way, it will take years to build up any kind of trust with self-driving cars let alone car-sharing and self-driving" [P3]*

> *"I cannot imagine I would ever feel safe using a driverless vehicle, regardless of whether it was shared or not." [P19]*

3.4.2. Preference for supervision

Seventeen participants mentioned some form of preference for supervision of SAVs; whether with a steward onboard or remote supervision. The lack of a driver was seen as a negative feature by some participants due to the newness of SAVs. This was mainly for two reasons; as a fallback in case of automation failure, and as a moderating authority figure to ensure onboard passenger safety in the event of disruptive co-passengers. Participants said the following:

> *"My only issue is if a problem arises i.e. difficult/aggressive passenger/passenger is unwell/issues with the car. I would need to know how I could contact someone for help". [P10]*

> *"Having a driver would make me feel slightly better about sharing with strangers, particularly if it's the same driver each time and I trust them". [P11]*
>
> *"... having a human driver could add a (perceived) element of safety in e.g. risky/lonely situations, but also adds an element of additional risk." [P17]*

3.4.3. Trialability

Nine (9) participants talked about the importance of trialability in shaping their perceptions of SAVs. The discussion was primarily around experiencing SAVs in a controlled and safe environment, and an established safety record. One of the participants said:

> *"I would consider it after reading more about it + experiencing it in a safe, trusted environment - i.e. with people I know - in a car park or workplace." [P9]*

3.4.4. Perceived risks

All 21 participants mentioned perceived risks in one form or another. Participants talked about job losses due to automation (2), perceived safety (20) and traffic safety (19). Perceived safety is the degree to which an individual believes that using a system will affect his or her well-being (Osswald et al., 2012). Most participants (18) were concerned about an increase in risk from sharing a vehicle with strangers at night. A few felt vehicle safety could increase as automation brings superior driving performance at night due to reduced visibility for human drivers. Participants expressed concerns about software failure by drawing parallels to other automated systems that have failed in the past, concerns about greater risk at night, and the absence of a driver was perceived as safer by some participants and less safe by others. Participants also expressed the need for SAVs to have the same safety features and go through the same rigorous safety tests as normal cars. Only one participant [P8] talked about the risk of catching a cold from co-passengers. Three participants said the following:

> *"The lack of ability to 'take the wheel' (both metaphorically and literally) in one such moment of crisis is a concern for me. No brake, no wheel - it seems there is not much left to do in a breakdown than to jump out the*

door/window but then you are relying on the car retaining enough function to allow you to do that!" [P1]

"Unsure at the moment. In one sense it would initially seem safer, they would be limited to the speed limits of roads etc. However having to rely on computer software for your travel and safety initially is quite daunting, especially after the issues had with the Boeing 737 planes." [P15]

"I think that driverless cars could potentially be safer than some drivers. I have felt unsafe when being a passenger in some cars" [P20]

3.4.5. Security

Twenty participants (95%) expressed security as a factor, by talking about cybersecurity (8), liability (9), personal security (18), privacy (5) and secure storage (8). Contributions from participants included concerns about intrusion from hackers that can corrupt or affect the software operation of the vehicle and access data about trip history. Others talked about liability in the event of an accident or an incident with a co-passenger. Participants noted that since SAVs are unlikely to refuse entry to abusive or disruptive persons and the expected lack of background checks, personal security may have to be enforced through a camera continuously recording inside the vehicle due to the lack of a witness such as a driver. Some suggested a direct line to police can be helpful for emergencies. Lastly, others mentioned the need for storage of luggage in a secure compartment with lockable doors to avoid co-passengers taking the wrong bag. Three participants said the following:

"If I was in one of these cars and it had an accident, would I be covered as a passenger?" .... "I'd have to ask to be picked up and dropped off a few streets away from my actual home." [P11]

"I think I would be apprehensive about sharing a vehicle with a stranger if I was been picked up/dropped off at my home or place of work. It would become a concern if you were in the vehicle with the same people routinely. It just sits a little uneasy with me that strangers would know my routine." [P15]

"Thinking about this again - I wouldn't like a driverless bus for the personal safety aspect either. Having a driver means someone can be refused to come on board or the vehicle can be stopped, and they can be told to leave if they are abusive. Police can be called. What happens with driverless vehicles?" [P20]

3.4.6. Trusting co-passengers

All of the twenty-one participants expressed trust in other passengers as a major factor in the acceptance of SAVs. Unlike AVs, SAVs have the additional component of user interaction with other passengers in a confined space, which requires trust in other passengers. For this study, some participants said the following:

"I wouldn't feel comfortable driving alone with strangers at night it's a safety concern." [P3]

"You do not know who else may be picked up and you are in a small confined space." [P14]

"I think I would feel uncomfortable initially. Even though on public transport you are often sat next to people you do not know, there are often many other people as well. I think I wouldn't like to be in such a confined space with people I didn't know." [P15]

Shared space sentiment was investigated to understand participant attitudes towards shared space in SAVs. Responses that fell under the nodes shown in **Error! Reference source not found.Error! Reference source not found.** were coded for sentiment. A node is a name given to a group of related coded references. In the *Co-passenger strangers* node, the following are examples of how sentiment was coded:

Very positive:

"I'm friendly and these things would attract people who are comfortable around others so I don't think it would be too bad." [P13]

Moderately positive:

"About the same, apart from the added extras of alcohol maybe on a night time." [P21]

Moderately negative:

"I wouldn't feel comfortable driving alone with strangers at night it's a safety concern." [P3]

Very Negative:

"I would not feel safe. I personally do not like to share a taxi with someone I don't know. People are people - but the risk element that something may happen worries me." [P16]

Error! Reference source not found. summarises the frequency of these sentiments.

Table 5: Coded Sentiment for Shared Space in SAVs, number of participants.

Nodes	A: Very positive	B: Moderately positive	C: Moderately negative	D: Very negative
1: Co-passenger strangers	3	6	48	24
2: Co-passenger interaction	5	11	13	4
3: Conversation	3	9	8	2
4: Safety at night	3	8	24	13
5: Shared Space Quality	5	17	24	6
6: With no driver	3	9	15	10

3.5. Main category 3: Price Value

3.5.1. Cost

Nineteen participants expressed cost per trip as a factor in their transportation mode choice, especially from frequent use when compared with a privately owned vehicle. In their discussion, participants generally agreed the fuel cost of using a private car is lower than using current shared modes of transport. Others pointed out that these costs are offset by not having to pay for car insurance, tax, MOT, maintenance, repairs, parking, etc., which can make owning a private car expensive. Only nine participants mentioned split trip cost with fellow passengers as a factor that could influence the acceptance of SAVs. Three of them expressing the following:

"I would like all of these, but worried that it would make the journey more expensive." ... "I agree but also the only way it can be economically and financially viable is through car-sharing." [P3]

"Good for the environment but I worry about expense and sharing." [P8]

"...easy to use via apps and can see your history. Also, I don't need cash which I never carry! Sometimes I can feel like it gets expensive though when used often." [P13]

3.5.2. Perceived benefits

Perceived benefits were in three forms; environmental concerns (17 participants), productive use of travel time (3), and not having to drive (2). Participants who expressed concern for the environment talked about reduced traffic congestion and the eco-friendly nature of ride-sharing and electric vehicles.

"I like the positive impact that the act of car sharing has on the environment. I am environmentally conscious, and this is a big plus for me, knowing that I am doing something better for the environment as compared to riding solo." [P1]

"Positive would be that car-sharing has less impact on the environment." [P15]

"If I'm sitting in a vehicle (and not driving) I like to spend the time doing something else, whether that's talking, reading, working." [P17]

4. Discussion

Unlike previous studies in this context that interviewed users after a short ride on a specific self-driving shuttle (Eden et al., 2017; Madigan et al., 2016; Nordhoff et al., 2017; Nordhoff et al., 2019), this study looked at the user attitudes and perceptions in the context of competing mobility solutions to understand user requirements for high-speed SAVs, without fixating on one specific mode of transportation. Participants expressed broader attitudes that are not only relevant to SAVs, but the general mobility needs of users. The next section summarises the main outcomes from the focus group, divided into three main categories; service quality, trust and price value. Lastly, a conceptual acceptance model for SAVs is introduced that integrates these three main categories into UTAUT2.

4.1. Service Quality

Service quality attributes such as comfort, convenience and reliability were discussed prominently. Participants saw sharing of vehicles, particularly with strangers, as having a detrimental effect on the quality of their travel experience. This same conclusion was reached by Nordhoff et al. (2019) who recommended further research on the perception of privacy and pleasure in shared vehicles, across different cultures and income groups.

Service quality attributes such as comfort, convenience, availability (accessibility) and reliability have been described by Redman et al. (2013) as important for creating a mode shift from privately owned car to using public transport, for which buses often fill the first and last-mile portion of the trip. In a simulation study that replaced buses with SAVs for the first and last mile section of a trip, Shen et al. (2018) found that increasing the availability of SAVs can reduce out-of-vehicle travel times (OVT) in ride-share scenarios. However, increased demand during peak hours can reduce the availability of shared vehicles, and also increase the cost per trip to lower the demand (Uber, 2018); both of which may be undesirable for users as they reduce the quality of the service. Comfort is important in user travel experience, which Madigan et al. (2016) recommended should be considered when researching acceptance of SAVs, and later found onboard comfort to be very important in determining user preferences towards SAVs (Madigan et al., 2017). These factors (comfort, convenience, availability, reliability) were highly discussed by participants in this study, reaffirming their importance to private vehicle users. The same can be said for flexibility, but in a slightly different sense.

Participants noted that sharing a ride may harm the flexibility of their travel experience, which is contrary to Rico Krueger et al. (2016) who expect that SAVs may provide flexibility levels similar to private cars. This conclusion is only drawn by assuming the inflexibility of ride-sharing will be offset by the convenience of not having to drive. However, Geldmacher et al. (2017) note that full private car flexibility in SAVs is achievable under a car-sharing model. Just like Nordhoff et al. (2019), reliability was found to be an important attribute influencing mode choice, and most likely to influence the choice to use shared automated vehicles. This service quality attribute is most likely to be affected by waiting times at the start of a trip and travel time; which in ride-share scenarios will be influenced by the number of stops per trip and co-passenger punctuality. We know from previous research that travel time is a significant factor in determining the choice between using a private car or public transit solutions (Abdulkareem et al., 2020), and this is likely to impact the service quality of SAVs as well.

The nature of ride-sharing is that the interior space of the vehicle is communal; allowing passengers to freely interact with each other. Early SAV prototypes took this same configuration, but instead of having up to four passengers, they increased the number to 8 – 10 passengers. As Merat et al. (2017) point out, this approach fails to take into account user requirements for enhanced personal space; potentially creating tension and stress for users, especially on longer journeys. Participants in this study echoed similar sentiments about the importance of preserving personal space boundaries. Results in this study emphasise the importance of shared space that can be positively perceived by encouraging or discouraging co-passenger interaction in line with user preferences and preserving personal space. This was further explored by Ong et al. (2019), who introduced the concept of segmented shared spaces in ride-share SAVs to enhance in-vehicle privacy and prevent passenger interaction. This paper introduces Shared Space Quality, which goes beyond mere segmentation to encapsulate enhanced personal space, proxemics, privacy and moderate passenger interaction.

4.2. Trust

Participants reflected on the lack of evidence to support any form of trust in automated vehicles, regardless of whether they are shared or not. This result is consistent with Zmud et al. (2017) who found a lack of trust in the technology used in AVs to be the most frequently cited reason for being unlikely to use. Trialability can mitigate this lack of trust in automation by giving users the ability to experience SAVs in a safe and trusted environment. Merat et al. (2017) found that interaction and experience with automated vehicles greatly influence user trust, similar to Lavieri et al. (2017) who also found that individuals who already experienced ride-sharing services are more inclined to adopt SAVs.

Trust is also influenced by how safe users perceived the SAV to be. For non-shared AVs, perceived safety is affected by the vehicle's ability to safely follow the road and planned trajectories (Elbanhawi et al., 2015). For SAVs, perceived safety also includes any risk from internal agents such as co-passengers, particularly given the absence of a driver.

Concerns were raised about software vulnerability to hacking, background screening of co-passengers, liability in the event of an accident, privacy, and reduced onboard security due to the absence of a driver. This is in line with Salonen (2018) who, in a study involving driverless shuttle buses, found that passenger perception of personal in-vehicle security for SAVs was worse than that of a regular bus, even though vehicle safety was rated higher. The issue of liability is very contentious. Any SAV solutions are likely to be controlled by some form of artificial intelligence (AI), which would be responsible for its own actions. Perc et al. (2019) proposed that such issues need to be resolved through legislation before the introduction of AVs and SAVs; to help put the minds of users at ease. To further ease users' minds, they also proposed users need to be aware of the actions AI will take during critical situations. Any effective AI solution implemented in SAVs will have to improve safety; i.e. drive safer than humans. While manufacturers strive for perfect safety records, this is not possible in practice, and as Perc et al. (2019) point out, users of AI driven systems such as SAVs need to understand this limitation.

Participants expressed concern for sharing such a small space with strangers, especially at night, or who may be intoxicated. Previous studies have found the lack of familiarity with other passengers increased this discomfort (Bansal et al., 2016). In a survey on ride-sharing, Merat et al. (2017) found similar results in which passengers were more willing to share with friends and family (90.8%) and less with strangers (51%). Building on this, participant sentiment towards shared space with strangers, within a SAV with no driver was mostly negative in this study, similar to Salonen (2018) who highlighted the psychological impact that the absence of a human driver has on passengers. While only one participant talked about the risk of catching a cold from co-passengers, in a post-Covid-19 world, this is likely to be a greater concern for more people.

4.3. Price Value

Haboucha et al. (2017) found that cost is an important variable in the choice to use SAVs, which was found by Zmud et al. (2017) to be the third most cited reason (after trust and safety) for being unlikely to use AVs. However, in this study, some participants were optimistic about ride-sharing being more affordable through split trip cost. Yakovlev et al. (2018) noted some of the benefits of car-sharing and/or ride-sharing to users is no acquisition costs and no car ownership costs (maintenance/repair, insurance, tax, etc.). Participants in this study mostly overlooked these tangible financial benefits and focused on SAV trip costs, indicating a lack of awareness of these benefits, which will require greater emphasis when communicating SAV benefits to future users. It could also indicate participants were not concerned about these cost benefits as they have already incurred the costs in acquiring their own private vehicle.

Lavieri et al. (2017) found that individuals with a green-lifestyle inclination, or concern for the environment, are more inclined to adopt SAVs as a preferred mode of transport. Most participants in this study expressed similar sentiments of environmental concern. Only three participants (e.g. P17 above) talked about productive use of their travel time, which was described by Wadud et al. (2016) and Diels (2017) as one of the benefits of using automated vehicles and shared automated vehicles. This less optimistic result is consistent with Cyganski et al. (2015), Singleton (2018) and Nordhoff et al. (2019), who found that passengers in AVs and SAVs may not utilise their travel time productively due to being more like car passengers instead of train passengers, thereby reducing the value of travel time. These researchers attributed the reduced value of travel time primarily to short trip lengths, and Saeed et al. (2020) suggested that trips longer than 2.5 miles may offer better benefits.

4.4. .Conceptual technology acceptance model for shared automated vehicles

From the results of this study, service quality and trust are important constructs not found in UTAUT2 for understanding user acceptance of SAVs. By combining the constructs from UTAUT2 and the findings from this study, as extended model predictors (indicated by blue boxes in Figure 5), an acceptance model for SAVs is proposed. This is only an initial draft intended for further development, further research and later validation. In this initial draft, the main categories from this study are added to UTAUT2 as constructs (latent variables) and the sub-categories as indicators (measurable variables).

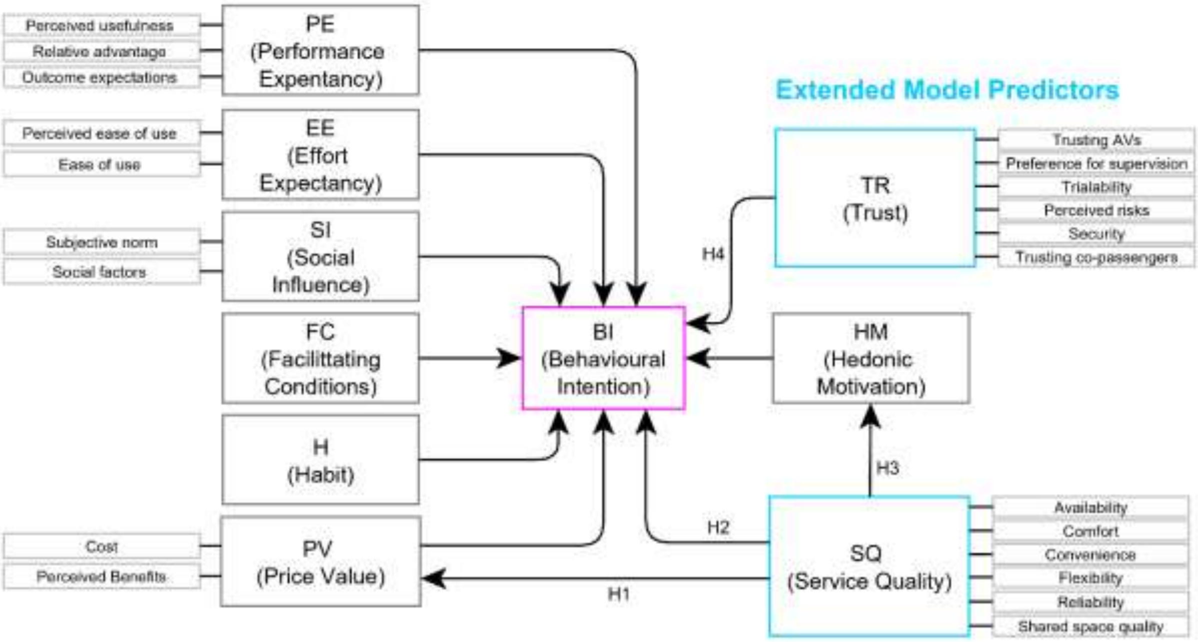

Figure 5: A conceptual acceptance model for SAVs developed by combining UTAUT2 with findings from this study as extended model predictors

The following are tentative hypotheses from this initial model, for the extended model predictors:

H1. Service quality is expected to influence price value.

H2. Service quality is expected to directly influence users' behavioural intention (BI) for SAVs

H3. Service quality is expected to influence hedonic motivation (pleasure) and

H4. Trust is expected to have a direct influence on BI.

5. Limitations of this study

This study has several limitations. First, the target participants in this study were only private car owners, who make up 60% of trips in England (DfT, 2018). As such, the results may not apply to users who do not own and use private cars, as they may express slightly different attitudes. Second, participants in this study did not directly experience SAVs, which may be a problem (Zmud et al., 2017). Nonetheless, it yielded results similar to Nordhoff et al. (2019), whose framework was one of the starting points for the coding scheme used here. Many of the newly created categories by Nordhoff et al. (2019) were not coded in from the results; such as braking behaviour, ethical programming, use of automated shuttles in severe weather. This may be due to the lack of direct experience of SAVs by participants. However, this study explored the interests and concerns of naïve potential users of future SAVs, who need to be convinced to adopt a mode switch from private car use to SAVs in the future. Therefore, a key takeaway from this study is that the three main factors (service quality, trust and price value) prominently discussed by participants, need to be prioritised in developing and researching future high-speed SAVs.

Lastly, since this research was conducted online without access to SAVs on the market, it was necessary to sensitise participants on current developments of SAVs through short descriptions with pictures and videos. Participant responses are guided by this information, along with other sources they may have come across beforehand (Rahman et al., 2017). This approach may give unrealistic results due to hypothetical bias, as each participant fills knowledge gaps with their imagination. In attitude research, this is known as 'information exposure approach', and participants can develop different, and at times even inaccurate mental models of SAVs (Körber et al., 2018). Future studies could build on the present results by applying them to acceptance studies with actual high-speed SAVs, in the few locations where these now start to become available, such as Waymo and Cruise (Mcgee, 2019).

6. Conclusions

This focus group study brought together 21 private car owners in the United Kingdom to discuss attitudes, perceptions and preferences for using private vehicles, current car-share and ride-share modes, and future high-speed (passenger car type) shared automated vehicles (SAVs). Previous acceptance research had found this subset of users to be the least likely to use shared automated vehicles. The adoption of future high-speed SAVs by this subset of users is important for the realisation of the potential benefits of SAVs, such as reduced congestion, accident reduction, etc. Discussions began with current familiar modes of travel that participants use in their daily lives, through to the unfamiliar future of high-speed SAVs; exploring both car-share and ride-share SAV scenarios. This is the first study on the acceptance of high-speed SAVs, as opposed to low-speed (pod/shuttle type) SAVs, that focuses on private car owners. From a long list of factors based on previous research, three main factors (service quality, trust, price value) came out as overwhelmingly discussed; more than all the other factors. These three main factors may be of prime importance for convincing naïve private car owners to consider giving up their cars for high-speed SAVs. From its findings, this paper introduces Shared Space Quality as one more important indicator for service quality, and further introduces Security and Trusting Co-passengers as two important indicators of Trust. For SAVs, Trusting Co-passengers was found to be as important as Trusting Automated Vehicles, which was reaffirmed by the overall negative sentiments towards shared space in SAVs.

The findings of this study offer useful preliminary insights that can be used in later high-speed SAVs acceptance studies, as part of an extended UTAUT2. Currently, there is no existing technology acceptance model that seems directly suitable for studying/modelling acceptance of high-speed SAVs. A tentative first draft of such a model is proposed in this paper, by adding the findings from this paper (Trust and Service Quality) to UTAUT2 as extended model predictors; for testing and validation in future research. Other important findings of this study such as Shared Space Quality, Security and Trusting Co-Passengers can be used as indicators in the proposed measurement model for future research on acceptance of high-speed SAVs.

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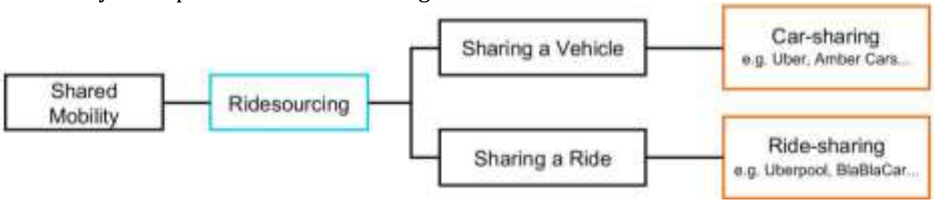
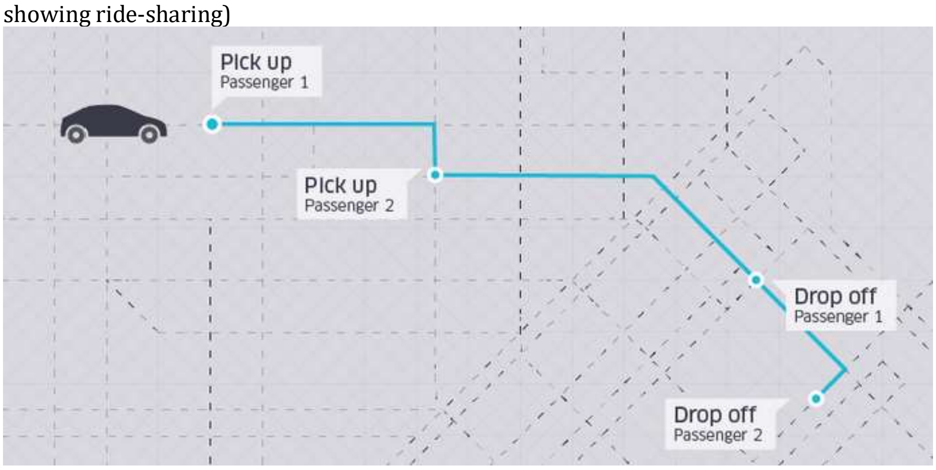
8. Appendix A – Sample Questions

Table 6: Sample questions

<table>
<tr><td>Engagement questions</td><td>Preferred Mode of Transport
• What is your preferred mode of transport when going to work?
o Private Car
o Cab/Ride Sourcing
o Motorcycle
o Bicycle
o Bus/Coach
o National rail/Other Rail
o Walk
o Other Modes____ Please specify.
• What is it about this mode of transport that makes you like it?</td></tr>
<tr><td>Exploration questions</td><td>Experience with Shared Modes of Transport
• What was your experience like when using a shared vehicle like Uber?


• What did you like about using a shared vehicle?
• What did you <u>not</u> like about using a shared vehicle?

Perceptions of Shared Driverless Modes of Transport
• In what ways do you think your experience would change when using a car sharing service like an Uber, if the car is self-driving (without a human driver, without a steering wheel)? Watch this short example video: https://www.youtube.com/embed/Ys-W51tNweQ (a 45 second USA Today news clip showing a General Motors prototype for Cruise, which is designed to operate with no driver, steering wheel, pedals or other manual controls.)

• Which of these changes would you perceive as positive, and which would be negative?
• Would your experience with the self-driving shared car change depending on the time (night vs day)? If yes, explain.
• In what ways do you think your experience would change when using a ride sharing service like an Uberpool/BlablaCar, if the car is self-driving (without a human driver)? (With figure showing ride-sharing)


• Which of these changes would you perceive as positive, and which would be negative?
• Does your experience with the self-driving shared ride change depending on the time (night vs day)? If yes, explain.

Perceptions of Shared Space In Driverless Modes of Transport
• How do you feel about sharing the space inside a driverless vehicle with people you do not know?</td></tr>
</table>

	• How does this change depending on the time of day? i.e., Night vs Day. **Features of Driverless Shared Vehicles** • If you were to design your own shared automated vehicle (driverless shared vehicle), what features/aspects/functionality would you consider to be important? List as many as you can think of. • Choose the two (2) most important features from your list. Explain why they are important for your self-driving shared vehicle. • Do you feel with these changes you would personally use a driverless shared vehicle? Explain why or why not.
Exit questions	**Anything Else…** • Is there anything else you would like to say about making the experience of sharing a driverless vehicle attractive for yourself? • Which of the following would you personally consider to be important for your self-driving ride-share experience (sharing with other passengers)? Select all that apply. (Presented on day 5, as a private question) ☐ Personal security ☐ Cost per trip ☐ Space between passengers ☐ Travel time ☐ Waiting time for vehicle ☐ Co-passenger punctuality ☐ Traffic congestion ☐ Cyber security ☐ Splitting trip cost ☐ Number of stops per trip ☐ Liability ☐ Connective ports ☐ Wifi ☐ Vehicle being electric ☐ Abuse/Misuse of car ☐ Upkeep ☐ Reduced vehicle miles travelled ☐ Configurable seating ☐ Vehicle options ☐ Vehicle fleet (number in operation) ☐ Secure storage ☐ Configurable lighting ☐ Entertainment ☐ Refreshments ☐ Vehicle range

9. Appendix B – Daily Activity Guide

UNIVERSITY OF LEEDS

UK Drivers Online Focus Group
DAILY GUIDE

Thank you for volunteering and for completing your registration. This is a daily activity guide on how to participate in the on focus group.

DAY 1 – May 23, 2019

- You will be presented with 18 questions. Answer as many of the questions as you can in this first day.
- All questions are unbiased. Responses from other participants will <u>not</u> be visible to you, until you have answered the same question.
- When answering a question, <u>be descriptive</u>. Do not just state your answer.

DAY 2 – May 24, 2019

- If there are any questions that you have not answered, then try to answer all the remaining questions.
- This is a good time to read the responses from other participants. This part can feel a bit overwhelming, but try to approach this in steps; question by question.
- When reading other participants' responses, think back to both the question and your own answer.
- This is also a good time to start adding comments/replies to other participants' responses.

DAY 3 – May 28, 2019

- If you have not already done so, start adding comments/replies to other participants' responses. Challenge their position if you disagree with them.
- You can agree, disagree, or even ask a question. Feel free.
- When you reply to a participant, they will receive an email notifying that someone has replied to their comment. Keep an eye on your own inbox for these.
- Also keep and eye out for questions/replies from the moderator.

DAY 4 – May 29, 2019

- Revisit your own answers. You cannot edit an answer you have given before, but you can reply to your own comment if you want to make something clearer.
- Make sure you have responded to all replies directed at you, if necessary, especially questions from the moderator.

DAY 5 – May 30, 2019

- Check what other participants have been up to. Read their new replies.
- There is an agree button. Click this to quickly agree with a point being made.
- Avoid asking questions on this day. Simply reply by giving a comment if you have something to share.

Remember, you can login at any time you are free, as many times as you want.