Customer perceptions of shared autonomous vehicle usage: an empirical study

Amy Wong*

School of Business,
Singapore University of Social Sciences,
463 Clementi Road, 599494, Singapore
Email: amywongom@suss.edu.sg
*Corresponding author

Peter Rinderer

MCI Management Center Innsbruck,
Universitaetsstrasse 15, 6020 Innsbruck, Austria
Email: p.rinderer@berlin.de

Abstract: Changes in demographics and mobility behaviour such as the increasing participation in shared economies and the evolving trend of autonomous driving has accelerated the move towards autonomous mobility services. Coupled with the changing needs, perceptions and behaviours of customers, it is crucial that automobile manufacturers and mobility service providers deliver excellent customer service and build long-term customer relationships. This study examined customer perceptions of technology availability, internet connectivity, safety, reliability, service provider attributes and their relationships with customer perceived value and customer purchase intentions in mobility services. Data was collected from 206 respondents via an online survey. The findings showed that the best predictor of customer perceived value is technology availability, while the best predictor of purchase intentions is service provider attributes. The findings provide important insights for automobile manufacturers and mobility service providers. Further discussion and implications are provided.

Keywords: customer perceived value; purchase intentions; shared autonomous vehicles.

Reference to this paper should be made as follows: Wong, A. and Rinderer, P. (2020) 'Customer perceptions of shared autonomous vehicle usage: an empirical study', *Int. J. Automotive Technology and Management*, Vol. 20, No. 1, pp.108–129.

Biographical notes: Amy Wong is a Senior Lecturer at the Singapore University of Social Sciences. She received her PhD in Management from Monash University, Australia, and has publications in journals such as the *Journal of Services Marketing*, *Journal of Consumer Behavior*, and *Journal of International Consumer Marketing*.

Peter Rinderer received his Masters in Engineering from the University of Applied Sciences HTW Berlin, Germany, and his Masters in Business Administration (International Business) from the Management Centre Innsbruck, Austria. He has been involved with the automotive industry with a focus on autonomous vehicles for many years.

1 Introduction

The current global economy is constantly changing, triggered by expansion in new emerging markets, growth in disruptive technologies, increase in voluntary sustainability standards and changing consumer preferences around automobile ownership. In the recent years, autonomous vehicles have been at the forefront of sustainable business practices, and automobile manufacturers (e.g., General Motors, Ford, Daimler) and technology companies (e.g., Google, Uber, Waymo) are increasingly paying more attention to the development, testing and deployment of this innovative technology (Muoio, 2017). The advent of fully autonomous vehicles has enabled end-to-end mobility services to reach everyone. Autonomous vehicles are likely going to change consumers' preferences and habits on car usage as they move towards shared mobility services rather than private car ownership. This has led to a shift in car usage adoption from automobile manufacturers to mobility service providers (Hawthorne-Castro, 2018). Instead of focusing on the tangible product, consumers will place more emphasis on various aspects of the service offering, such as comfort, relaxation, socialisation and personalised in-vehicle entertainment (Meyer, 2016).

Technology innovations have made fully autonomous driving a reality in the foreseeable future. In line with this, automobile manufacturers will become the supplier of autonomous vehicles to mobility service providers (i.e., in B2B markets), which will offer shared mobility services to the final customer (i.e., in B2C and/or B2B markets). A recent Forbes report highlighted Toyota's announcement to transform its vision from a car company into a mobility service company (Hawthorne-Castro, 2018). With its focus on mobility services and transportation solutions, Toyota is expanding into the car-sharing, self-driving and electric vehicle business, which will help the company create a competitive advantage.

Previous research on autonomous vehicles, public transport and collaborative consumption in shared mobility services have examined customer characteristics, preferences for shared and pooled-use and reasons for using autonomous vehicles (Haboucha et al., 2017; Stoiber et al., 2019; Yap et al., 2016; Zmud and Sener, 2017). A McKinsey study conducted by Gao et al. (2016) reported a significant change in car ownership, with the number of car-sharing members in Europe and North America growing by more than 30% per annum over the last five years. Over 40% of the millennials, one of the largest population groups, believe that half of the vehicles in 2030 will be in the form of shared ownership where people will use shared vehicles depending on their specific needs.

A KPMG Global Automotive Executive Survey (2017) reported that the differentiation in mobility services is driven by the services offered rather than the physical car. According to the report, more than 70% of consumers stated that they would make their purchase decisions based on service experience attributes. The motivation for customers will be on what they can do best with their time while being driven around. Customers no longer view their journeys from a product-specific perspective. Instead, they will shift their overall evaluation of customer value to dimensions of the service experience rather than relying solely on product features. Despite previous research, to date, there is a lack of studies that investigate the factors that affect customer value and purchase intentions in shared mobility services. This study addressed this gap by examining customer perceived value and purchase intentions regarding shared autonomous vehicles in the mobility services segment.

1.1 The rise in autonomous vehicles

Demographic changes such as the growing population, increasing urbanisation and densification are driving new business models aimed at addressing the challenges of urban mobility. Further, with the increased population of people living and working in urban areas, problems such as traffic congestions, car accidents, parking problems and pollution are exacerbated. These problems, coupled with the increasing cost of fuel, have led to a consumption shift from private car usage and ownership to ride-sharing services and autonomous driving.

Autonomous vehicles, which refer primarily to future vehicles that may have the ability to operate without human intervention for extended periods of time and to perform a broad range of actions, can take active control of at least one driving function without a driver input (Lin, 2016). Currently, autonomous vehicles can perform longitudinal control functions (e.g., adaptive cruise control, autonomous emergency braking, etc.) or lateral control functions (e.g., steering assist, lane keeping functions, etc.), allowing the driver to keep both hands on the steering wheel for surveillance of the driving environment. The global industry and traffic associations such as the National Highway Traffic Safety Association (NHTSA), the Society of Automotive Engineers (SAE), the Association of the German Automotive Industry, and the European Road Transport Research Advisory Council (ERTRAC) have developed a scale which defines the various levels of vehicle automation, starting from Level 0, with no automation at all, to Level 1, which utilises the latest available technology, known as the Advanced Driver Assistance Systems (ADAS).

At Level 1, the driver, assisted by ADAS, has main control of the vehicle. Starting from Level 2, partial automation is handled by the vehicle using longitudinal and lateral control; while at Level 3, the automated driving system controls all aspects of the dynamic driving task, increasing the driving complexity. With the driving automation rising to Level 4, the driver is no longer expected to react to the driving task. At Level 5, the fully automated vehicle drives by itself without human supervision, and the vehicle can handle any situation from highway driving to urban scenarios, allowing fully autonomous transportation door-to-door. In December 2018, SAE released a new visual chart to clarify and simplify its J3016 ‘Levels of Driving Automation’ standard for consumers (SAE, 2018). Some of the highlights include the unconditional operation of Level 5 and the optional steering wheel requirement for Level 4. Previously, a Level 5 vehicle needed to be able to drive autonomously in a restricted region to be called a fully autonomous vehicle. The new change states that for a vehicle to be Level 5, it needs to operate autonomously, irrespective of geography or technology.

Forecasting long-term adoption of autonomous vehicle technologies is challenging in itself, given the variation of demand-side factors (e.g., willingness to pay) and supply-side factors (e.g., technology prices) (Bansal and Kockelman, 2017). Predictions about the future uptake of autonomous vehicles vary significantly due to the unpredictable and complicated implementation factors such as technology, ethics and liability, social, economic, legal policies, transport planning, business models, consumer behaviour and public acceptability (Cavazza et al., 2019; Nikitas et al., 2019; Thomopoulos and Nikitas, 2019). For example, a survey of transportation experts in London reported that Level 4 and Level 5 vehicles will hit the public roads by 2025 and 2040 respectively (Begg, 2014), while Underwood et al. (2014) reported 2030 as a median forecast year for the deployment of full automation.

By 2035, the contribution of autonomous vehicle to mobility services will reach a potential value of more than US$100 billion (Reiner et al., 2015). Autonomous vehicles are expected to account for 15% of vehicles sold in 2030 as they will be able to address several of the mobility issues (Gao et al., 2016). Autonomous vehicles, connected via vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications, have a much quicker reaction time than a human driver. The probability of autonomous vehicles getting involved in an accident is estimated to be one tenth compared to a human driver (Reiner et al., 2015). Moreover, it is predicted that autonomous vehicles will drive the development of enhanced mobility, as the vehicle can pick up a customer autonomously and park or drive on to the next customer once the service is completed, thereby reducing the need for parking and optimising traffic flow.

Recent studies have shown that people are willing to pay extra for the benefits of autonomous vehicles, as they can provide travellers with the freedom to use the available time during their ride for other tasks and activities (Howard and Dai, 2014; Reiner et al., 2015; Schoettle and Sivak, 2014, 2015). In addition, self-driving vehicles can serve an untapped customer base which includes those who are unable to operate a vehicle, such as the young, the elderly, the handicapped, or disabled, or those who experience impaired driving ability due to alcohol, medication or drug use (Payre et al., 2014). Along with the rise in autonomous vehicles, automobile manufacturers need to tailor their offerings of vehicles to support mobility service providers. A KPMG Global Automotive Executive Survey reported that 86% of automotive professionals and 75% of consumers trust established automobile manufacturers and car brands when making consumption decisions related to autonomous vehicles and mobility services (Meyer, 2016).

Trust is a key element that shapes consumer behaviours during their interactions with autonomous vehicles (Zhang et al., 2019), as it affects human monitoring or operating behaviours when riding an autonomous vehicle. Although the mobility service offering is important, the choice of the car manufacturer still matters, as they ultimately supply autonomous vehicles to mobility service providers, and trust in a car manufacturer determines whether people would ride the autonomous vehicle or not (Zhang et al., 2019). Several studies have reported that trust is a positive and significant predictor of consumers' positive attitudes towards autonomous vehicles and mobility services, which leads to further purchase intentions (Buckley et al., 2018; Kaur and Rampersad, 2018; Liu et al., 2019a). In order to create, communicate and deliver customer value, automobile manufacturers need to understand their customers' perceptions regarding autonomous vehicle usage, which is integral to the successful attraction and retention of customers in a new market that will undergo massive transformation in the near future.

1.2 Customer perceptions of autonomous vehicle usage

Existing research has investigated service quality in public transport settings (Pareigis et al., 2011; van Hagen and Bron, 2014), identifying the need to consider the holistic customer journey even though it might include aspects which the firm cannot control, such as factors external to the service experience (i.e., competitors) or service elements before or after the actual customer journey (i.e., word-of-mouth, customer complaints). Customer perceptions, acceptance and possible barriers regarding autonomous vehicle usage have been studied by several researchers in a quest to understand the product and service attributes that lead to customer adoption and/or resistance (Bansal and Kockelman, 2017; König and Neumayr, 2017; Kyriakidis et al., 2015). Some of the attributes leading to adoption include the availability of amenities (e.g., ability to send text messages, take notes or multitask), convenience (e.g., not having to worry about finding parking), environmental friendliness, increased mobility, speed, safety and reliability, while concerns leading to resistance include lack of control, costs, liability and privacy issues.

Several authors have examined user preferences for autonomous vehicles in public transport networks, focusing on dimensions such as travel time and travel cost (Haboucha et al., 2017; Hudson et al., 2019; Krueger et al., 2016; Yap et al., 2016), while others have investigated the influence of amount of time, mode choice, automobile ownership and other travel behaviours on intentions to use autonomous vehicles (Stoiber et al., 2019; Zmud and Sener, 2017). Building on the Car Technology Acceptance Model (CTAM), Osswald et al. (2012) found that the reasons for autonomous vehicle usage include the belief that these vehicles would drive safer than humans, the expectation of stress relieve from driving and the productive use of time while travelling. In another study, Haboucha et al. (2017) examined commuter preferences regarding using a regular vehicle, an owned autonomous vehicle or a shared autonomous vehicle, and found five important variables, namely technology interest, environmental concern, enjoyment while driving, public transport attitude, and autonomous vehicle sentiments. Hudson et al. (2019) analysed people's attitudes towards autonomous vehicles and reported that the young are more in favour that the elderly. The authors also found that professionals and senior management are more in favour than the retired and unemployed, while the more educated and men are more in favour compared to the less educated and women.

Previous research in public transport (Pareigis et al., 2011; van Hagen and Bron, 2014), shared economies (Hamari et al., 2016; Hwang and Griffiths, 2017; Möhlmann, 2015) and autonomous vehicles (Howard and Dai, 2014; König and Neumayr, 2017; Schoettle and Sivak, 2014, 2015) have examined a variety of factors that impact autonomous vehicle usage. This study extends the literature in this field by holistically addressing customers' expectations regarding shared autonomous vehicles in mobility services. Specifically, the following factors are examined: technology availability, internet connectivity, safety, reliability, service provider attributes, and their relationships with customer perceived value and customer purchase intentions. The rest of the paper is structured as follows: Section 2 examines the literature, Section 3 discusses the method, Sections 4 and 5 present the results and discussion, while Section 6 concludes with suggestions for future research.

2 Literature review

2.1 Customer perceived value

The perceived value construct is used in a wide range of research to study and understand consumer behaviour. Perceived value is subjectively evaluated by individuals and thus varies between customers at different times. In general, perceived value is explained as a result or benefit in relation to the cost expanded, or as the difference between what customers receive (e.g., benefits, quality, worth and utility) and what they pay (e.g., price, costs and sacrifices) (Bettencourt et al., 2014). Within the context of transportation and mobility, perceived value often includes the dimensions of time (e.g., travel, waiting) and cost (per trip) (Howard and Dai, 2014; König and Neumayr, 2017; Schoettle and Sivak, 2014, 2015).

Focusing on a trade-off approach and considering a utilitarian perspective to understanding value, Zeithaml (1988) identifies value dimensions as low price, quality obtained for the price paid, and what is obtained for what is handed over. Several authors adopted this definition of value, for example, Sweeney et al. (1999) propose sub-dimensions of value as value for money, product quality, functional service quality, technical service quality, performance and relative price. The increasing popularity of shared mobility services such as ride-sharing implies a trend towards a more utilitarian perspective on automobiles (Schaefers, 2013). Utilitarian value or functional value has been traditionally assumed to be the main driver in consumer choices and includes items such as convenience, good economic value, prompt service, and frugality when it comes to money matters (Prebensen and Rosengren, 2016). Utilitarian behaviour is further identified as functional or task-oriented, while utilitarian value is value "resulting from some type of conscious pursuit of an intended consequence" [Babin et al., (1994), p.645].

2.2 Technology availability

Within the context of mobility service, the availability of technology plays an important role in creating customer value (Möhlmann, 2015). Technology can provide customers with a solution, where they can connect with the autonomous vehicles using mobile smartphone applications, rather than walking long distances to search for an available vehicle (Fagnant and Kockelman, 2014). These applications can provide mobility service providers or car-sharing companies with a way of seamlessly repositioning vehicles in order to maximise fleet demand and utilisation. For example, the availability of a smartphone application can facilitate the pre-purchase stage, which includes journey planning and booking with its real-time information for consumption efficiency. The use of an application also allows for product and service personalisation during the consumption process, as well as ongoing customer engagement and relationship management at the post-purchase stage, which relieves stress and enhances customer perceived value. The availability of technology can increase the richness and usefulness of information and facilitate the customer learning and discovery process, which in turn brings about positive customer attitudes and customer perceived value towards the mobility service (Rudran and Kumar, 2017). In a study conducted on public transport, sharing and ownership of self-driving vehicles in Ireland, a positive relationship was found between favourable attitudes towards technology in general and perceived benefits of autonomous vehicles (Acheampong and Cugurullo, 2019). As such, the following hypothesis is advanced:

Hypothesis 1a Technology availability is positively related to customer perceived value.

2.3 Internet connectivity

Several studies on autonomous vehicles have investigated the reasons why customers use mobility services (Howard and Dai, 2014; König and Neumayr, 2017; Kyriakidis et al., 2015; Schoettle and Sivak, 2014, 2015). Innovations in the V2V and V2I internet connectivity technologies installed in autonomous vehicles are transforming customer journey experiences (Brown et al., 2014). Internet connectivity allows the customer to communicate via text-messages, engage in work related e-mail correspondences and use internet services to enhance the entertainment experience while travelling in an autonomous vehicle. Focusing on the management and business of autonomous vehicles, Cavazza et al. (2019) highlighted the need for future studies to consider the creation of an 'infotainment' environment (information + entertainment) for in-car customers. With internet connectivity, customers' lifestyle needs are met and the journey experience can be transformed into an entertainment realm where users can immerse fully in a multimedia, cross-channel and engaging customer experience. The provision of internet connectivity can add value for the customer, as notions of utilitarian and hedonic value can be formed during the consumption process (Möhlmann, 2015). To this end, the following hypothesis is posited:

Hypothesis 2a Internet connectivity is positively related to customer perceived value.

2.4 Safety and reliability

The strongest selling point of autonomous vehicles is safety in terms of accident prevention, and many industry experts believe that the transition to autonomous vehicles will significantly improve road safety (Fagnant and Kockelman, 2018; Howard and Dai, 2014; Liu et al., 2019c). Autonomous vehicles have the potential to reduce at least 40% fatal crashes, as sources of driver error such as alcohol, distraction, drug use and fatigue diminish (Fagnant and Kockelman, 2015). Self-driven vehicles are devoid of human failings, hence these vehicles can easily handle many driving situations (Liu et al., 2019b). However, autonomous vehicles cannot eliminate all crashes as it can be challenging to design a system that can perform in every situation. The complex technology of autonomous vehicles can give rise to technical errors that might jeopardise vehicle safety (Taeihagh and Lim, 2019). For example, recognition of humans and objects on the road can be more difficult for autonomous vehicles, especially in bad weather conditions that may further impede the sensor recognition of the vehicles (*Economist Technology Quarterly*, 2012).

Previous studies have reported safety and reliability as key concerns in the adoption of autonomous vehicles. Results of studies conducted in Australia, UK, and USA have highlighted safety and reliability concerns such as the following: vehicles driving unoccupied, interaction with other manually driven vehicles, the capabilities of smart mobility solutions and the reliability of the autonomous vehicle driving technology (Howard and Dai, 2014; Merfeld et al., 2019; Schoettle and Sivak, 2014, 2015). Among early adopters of autonomous vehicles, Bansal et al. (2016) reported fewer crash as the most important perceived benefit, whereas equipment failure emerged as the strongest concern. In a study on electric vehicles in a shared autonomous vehicle setting, Schmalfuß et al. (2017) found the importance of riders' perceptions of safety and reliability in autonomous vehicle operations. Similarly, safety was found to be the most important factor in studies on autonomous vehicle functions (Souka et al., 2019) and autonomous vehicle sharing (Merfeld et al., 2019), while Panagiotopoulos and Dimitrakopoulos (2018) found that safety concerns towards autonomous vehicles can have a negative influence on the intention to use and adopt the vehicles.

Alongside safety and reliability issues, there exists the question of who should be responsible for liability while riding in a driverless vehicle. While countries such as

Belgium, France, Italy, UK and USA plan to operate autonomous vehicles transport systems, some hurdles faced include public acceptability in terms of safety and reliability of autonomous vehicles and issues relating to liability in the case of an accident (Mounce and Nelson, 2019). From a rider's perspective, the safety of autonomous vehicles, which relates to a 'crash-less' vehicle that can accurately respond to complex environments and prevent traffic accidents as well as the reliability of the vehicle in bringing travellers from one point to another dependably will lead to increased customer perceived value. These aspects of safety and reliability are the focal point in this study. As people will generally accept and use autonomous vehicles if their perceptions of safety and reliability are sufficiently high (Mounce and Nelson, 2019), the following hypotheses are advanced:

Hypothesis 3a Safety is positively related to customer perceived value.

Hypothesis 4a Reliability is positively related to customer perceived value.

2.5 Service provider attributes

Service quality is understood as the global judgement on the superiority of the service provided by an organisation (Parasuraman et al., 1991). One of the most commonly used service quality models is the Gap Model which suggests that service quality is a function of the difference between expectation and performance across the several dimensions of quality (Parasuraman et al., 1985). The authors later refined their research and offered the SERVQUAL scale for measuring customer perceptions of service quality (Parasuraman et al., 1991, 1994). Another frequently used model is the technical and functional quality model, whereas technical quality refers to what the customer receives or obtains from her/his interaction with the firm, while functional quality is about how she/he receives the service (Grönroos, 1982).

In later studies, Klaus and Maklan (2012) argued in favour of the experience quality scale (EXQ) over SERVQUAL as the measurement tool was based on the customer's perspective. Further, the tool measured service and customer experience and met the psychometric robustness of a good measurement scale. The provision of superior service by the service provider such as delivering flexible services, looking out for the customer's needs, taking good care of the customer, listening to the customer and making the customer feel comfortable contribute to the value creating process (Klaus and Maklan, 2012). In fact, Grönroos (2008) proposes a 'service as a business logic', where the service provider puts a major focus on the customer's every day activities and how value supporting assistance can be provided in the various interactions during the consumption process. This suggests that service provider attributes and capabilities can deliver customer value through the value creation process. As a result, the following hypothesis is advanced:

Hypothesis 5a Service provider attribute is positively related to customer perceived value.

2.6 Purchase intentions

The construct of purchase intentions, which measures the likelihood of a consumer to purchase a product or service, has been examined in several studies on repeat purchase behaviour and customer loyalty (Gummesson, 2008; Ha et al., 2014). A person's behaviour is driven primarily by behavioural intentions, which is the person's readiness or desire to perform a given behaviour. The theory of reasoned action suggests that behavioural intentions consist of two parts: behavioural beliefs (attitude) and normative beliefs (subjective norms) (Fishbein and Ajzen, 1975). Attitude can be described as the overall evaluation of a behaviour as either positive or negative, whereas subjective norms represent the social pressure to perform or not perform a certain action.

Dodds and Monroe (1985) found that perceived value and perceived quality influence purchase intentions, and the stronger the perceived value and perceived quality, the higher the purchase intentions. In other studies, Zeithaml (1988) reported that higher perceived benefits lead to higher purchase intentions, while Munnukka (2008) suggests a positive relationship between customers' price perceptions and their purchase intentions. Further, Osswald et al. (2012) analysed customers' acceptance of advance driving assistance technology and found a positive relationship with purchase intentions. As such, the following hypothesis is proposed:

Hypothesis 6 Customer perceived value is positively related to purchase intentions.

Within a car sharing context, Hwang and Griffiths (2017) investigated perceived hedonic, utilitarian and symbolic value and reported that utilitarian value influences purchase intentions via attitude, whereas hedonic and symbolic value have a positive relationship with purchase intentions via empathy. Further literature on public transport (Pareigis et al., 2011; van Hagen and Bron, 2014) and autonomous vehicles (Chen and Yan, 2019; Howard and Dai, 2014; König and Neumayr, 2017; Schoettle and Sivak, 2014, 2015) examined the importance of elements of customer experience and purchase intentions. The purpose of this study is to examine the factors leading to customer perceived value of shared autonomous vehicles in mobility services and their subsequent purchase intentions. Based on the relationship between customer perceived value and purchase intentions, anecdotal evidence suggests that the factors leading to customer value will have the same relationship with purchase intentions. Hence, the following hypotheses are posited:

Hypothesis 1b Technology availability is positively related to purchase intentions.

Hypothesis 2b Internet connectivity is positively related to purchase intentions.

Hypothesis 3b Safety is positively related to purchase intentions.

Hypothesis 4b Reliability is positively related to purchase intentions.

Hypothesis 5b Service provider attribute is positively related to purchase intentions.

3 Method

3.1 Sample

Data was collected over a two-week period via an online survey. A survey link was randomly distributed to 500 respondents by means of direct e-mail to the authors' professional networks as well as sharing of the survey link via the social networking platform, LinkedIn. The respondents were provided with information regarding the purpose of the survey, the estimated time required for completion, as well as assurance of confidentiality and anonymity of data. As not all the respondents were aware of the autonomous vehicle technology, a link to a five-minute animated video (https://www.youtube.com/watch?v=4B7mZFU2sB4) about autonomous vehicles and the projected vision of urban mobility in 2030 was included in the introduction section of the survey to provide the participants with a realistic and vivid overview of autonomous vehicle usage and mobility services in the future.

A total of 206 respondents completed the survey, which translated to a response rate of 41.2%. This response rate is considered acceptable, given the response rate for web surveys are normally about 10% (Fricker, 2008). Majority of the sample (78%) were male. The age breakdown of the sample is as follows: 20% between 45 to 54 years old, 33% between 35 to 44 years old, 32% between 25 to 34 years old, and 10% between 18 to 24 years old. In terms of country of residence, a quarter of the respondents reside in Italy, 22% from USA, 13% each from Germany and Singapore, 9% from Austria, and 5% or less from countries including India, China, Brazil and others. When asked about the size of the territory they are residing in, one third of the respondents reported that they came from a metropole area with more than one million residents, 12% came from major cities with more than 500,000 residents, and 21% came from smaller cities with less than 250 residents. Most of the respondents use private cars (77%) as their primary mode of transport, 18% uses public transport, 2% ride a motorcycle, with the rest (3%) using other means such as walking and cycling. Most of the respondents are daily commuters (84%), while 82% of them own a vehicle. When asked about their usage of shared mobility services, a quarter of the respondents stated that they have used car-sharing services, and 92% reported that they are familiar with self-driving cars. Reasons cited for using shared autonomous vehicles include using it when tired (25%), for commuting (24%), driving is stressful (19%), part of everyday journey (19%), driving is boring (7%), and for vacation purposes (6%).

3.2 Measures

A self-administered questionnaire was developed based on several multi-item scales derived and adapted from the literature. Respondents were asked to indicate their perceptions of the following constructs on five-point Likert type scale (1 = 'strongly disagree' and 5 = 'strongly agree'). Technology availability was measured with six items: three items from Möhlmann (2015), one item from Rudran and Kumar (2017), while the remaining two were developed for the study. Internet connectivity was assessed by two items from Möhlmann (2015). Safety and reliability were measured with three items each, adapted from Schmalfuß et al. (2017). To examine service provider attributes, four items from the EXQ were used: product experience, outcome focus, moments-of-truth and peace of mind (Klaus and Maklan, 2012). Customer perceived value was measured using four items: one item from Hwang and Griffiths (2017) and three items from Möhlmann (2015). Finally, purchase intentions were measured using the three-item purchase intentions scale adopted from Osswald et al. (2012).

4 Results

The data was analysed using SPSS version 25.0. Reliability analysis was used to verify the reliability of the constructs via Cronbach's alpha coefficient. The means, standard deviations, reliability and validity of the constructs are presented in Table 1. The internal consistency (Cronbach's alpha) of the composite scores was between the ranges of 0.718 to 0.945. According to Nunnally (1978), a coefficient of above 0.70 is considered acceptable; hence reliability of the scales was established. The composite reliabilities (CR) for the constructs ranged from 0.807 to 0.965 with the factor loadings from 0.61 to 0.95, and the average variance extracted (AVE) ranged from 0.55 to 0.90, providing satisfactory support for convergent validity of the constructs (Fornell and Larcker, 1981).

Table 1 Scale statistics: mean, standard deviation, reliability and validity

Construct (no. of items)	*Mean*	*Standard deviation*	*Alpha α (CR)*	*AVE*
Technology (6)	2.10	0.554	0.825 (0.877)	0.55
Connectivity (2)	1.53	0.550	0.786 (0.904)	0.82
Safety (3)	2.53	0.662	0.723 (0.854)	0.66
Reliability (3)	2.66	0.711	0.817 (0.899)	0.75
Service provider attributes (4)	1.95	0.544	0.724 (0.836)	0.56
Customer perceived value (4)	2.27	0.632	0.718 (0.807)	0.58
Purchase intentions (3)	2.02	0.677	0.945 (0.965)	0.90

A Pearson correlation analysis was conducted to examine the relationships between the constructs in this study. As seen in Table 2, positive relationships exist between all the constructs. The highest positive relationship is exhibited between safety and reliability, with an R value of 0.644. This is not surprising, given that safety and reliability are important aspects that emerged as key concerns in previous studies which investigated the adoption of autonomous vehicles (Howard and Dai, 2014; Mounce and Nelson, 2019; Schoettle and Sivak, 2014, 2015). On the other hand, there is a lack of relationship between internet connectivity and service provider attributes ($r = 0.143$), given that access to internet for entertainment and work productivity is often seen as a separate element from the service experience delivered by the service provider. The relationship between internet connectivity and reliability of the autonomous vehicle is also insignificant ($r = 0.150$), as the reliability construct relates to the dependability of the vehicle to transport customers from one place to another on all occasions, which is expected to be carried out irrespective of access to internet connectivity.

In terms of customer perceived value, positive relationships are exhibited with factors important to autonomous vehicles, namely technology ($r = 0.386$, $p < 0.01$), reliability ($r = 0.363$, $p < 0.01$) and safety ($r = 0.362$, $p < 0.01$). Similarly, research on autonomous vehicles (Fagnant and Kockelman, 2015; Howard and Dai, 2014; König and Neumayr, 2017; Liu et al., 2019b; Schoettle and Sivak, 2014, 2015) found safety to be one of the major concerns for customers, thus confirming its positive relationship with customer perceived value. For purchase intentions, positive relationships can be seen between reliability ($r = 0.431$, $p < 0.01$), safety ($r = 0.400$, $p < 0.01$) and service provider attributes (r = 0.396, p < 0.01). The findings reinforced the importance of reliability and safety attributes of autonomous vehicles and their relationships with customer purchase intentions (Merfeld, 2019; Schmalfuß et al., 2017; Souka et al., 2019). The strongest correlation is seen between customer perceived value and purchase intentions (r = 0.499, p < 0.01), which provided support for H6. This finding is consistent with previous research on autonomous vehicles (Howard and Dai, 2014; König and Neumayr, 2017; Schoettle and Sivak, 2014, 2015), public transport (Pareigis et al., 2011; van Hagen and Bron, 2014), collaborative consumption and shared economy service settings (Hwang and Griffiths, 2017; Möhlmann, 2015) which found significant relationships between customer perceived value and purchase intentions.

Table 2 Pearson correlation coefficient

	1	*2*	*3*	*4*	*5*	*6*	*7*
Technology	1.00						
Connect	0.408**	1.00					
Safety	0.238**	0.227**	1.00				
Reliability	0.209**	0.150	0.644**	1.00			
Service	0.169*	0.143	0.177*	0.151*	1.00		
Value	0.386**	0.265**	0.362**	0.363**	0.219**	1.00	
Purchase	0.261**	0.199**	0.400**	0.431**	0.396**	0.499**	1.00

Notes: **correlation is significant at the 0.01 level (2-tailed);
*correlation is significant at the 0.05 level (2-tailed)

Given that the aim of the study is to investigate the factors that contribute to customer value and purchase intentions, regression analyses were used to determine the relationships between the independent variables (i.e., technology availability, internet connectivity, safety, reliability, and service provider attributes) and the dependent variables (i.e., customer perceived value, purchase intentions). To access the issue of multicollinearity in regression analyses, the variance inflation factor (VIF) for each independent variable was computed via SPSS. A VIF value from 1 to 4 indicates that there is no correlation between the independent variables and the dependent variable, and all VIF for the independent variables were from 1.057 to 1.782, which is acceptable (Hair et al., 1995).

To test the hypotheses proposed in this study, multiple regression analyses were conducted to find out which of the independent factor is the best predictor of customer perceived value (Table 3) and purchase intentions (Table 4), while linear regression analysis was conducted to examine the effect of customer perceived value on purchase intentions (Table 5).

Using customer perceived value as a dependent variable, a multiple regression analysis was conducted. As shown in Table 3, the five independent factors (technology availability, internet connectivity, safety, reliability and service provider attributes) explained 26.6% of the variance in customer perceived value, which is statistically significant (F = 11.91, p < 0.001). An examination of the regression coefficients in Table 3 indicates that the best predictor of customer perceived value is technology availability (β = 0.261, p < 0.001) followed by safety (β = 0.189, p < 0.05).

Table 3 Multiple regression analysis (customer perceived value)

Model	*Unstandardised coefficients*	*Standard error*	*Standardised coefficients beta*	*t-values*	*Significance*
(Constant)	0.445	0.247		1.799	0.74
Technology	0.305	0.088	0.261	3.488	0.000***
Connect	0.097	0.087	0.083	1.120	0.264
Safety	0.182	0.085	0.189	2.158	0.032*
Reliability	0.127	0.081	0.140	1.570	0.118
Service	0.127	0.080	0.109	1.589	0.114
$F(5,206) = 11.905$, $p < 0.001$					
Adj. $R^2 = 0.244$					

Notes: *p < 0.05, **p < 0.01, ***p < 0.001;
dependent variable: customer perceived value;
independent variables: technology availability, internet connectivity, safety, reliability, and service provider attributes

Table 4 Multiple regression analysis (purchase intentions)

Model	*Unstandardised coefficients*	*Standard error*	*Standardised coefficients beta*	*t-values*	*Significance*
(Constant)	0.098	0.252		0.388	0.698
Technology	0.128	0.089	0.103	1.441	0.151
Connect	0.051	0.089	0.041	0.576	0.566
Safety	0.275	0.086	0.268	3.192	0.002**
Reliability	0.134	0.082	0.139	1.623	0.107
Service	0.380	0.081	0.308	4.678	0.000***
$F(5,206) = 16.011$, $p < 0.001$					
Adj. $R^2 = 0.308$					

Notes: *p < 0.05, **p < 0.01, ***p < 0.001;
dependent variable: purchase intentions;
independent variables: technology availability, internet connectivity, safety, reliability, and service provider attributes

To determine the best contributor of purchase intentions, a multiple regression analysis was conducted. As shown in Table 4, the five independent factors (technology availability, internet connectivity, safety, reliability and service provider attributes) explained 32.8% of the variance in purchase intentions, which is statistically significant ($F = 16.01$, $p < 0.001$). The best predictor of purchase intentions is service provider attributes ($\beta = 0.308$, $p < 0.001$) followed by safety ($\beta = 0.268$, $p < 0.01$).

As shown in Table 5, customer perceived value explained 24.9% of the variance in purchase intentions, which is statistically significant ($F = 55.61$, $p < 0.001$). The results in Table 6 show the different hypotheses that are supported. Reiterating, H1a–H5a are concerned with the links between the five independent factors and customer perceived value, while H1b–H5b are concerned with the links between the five independent factors and purchase intentions. Finally, H6 examined the effect of customer perceived value on purchase intentions.

Table 5 Linear regression analysis (purchase intentions)

Model	*Unstandardised coefficients*	*Standard error*	*Standardised coefficients beta*	*t-values*	*Significance*
(Constant)	0.831	0.168		4.949	0.000
Value	0.531	0.071	0.499	7.457	0.000***
$F(1,206) = 55.607$, $p < 0.001$					
Adj. $R^2 = 0.244$					

Notes: ***p < 0.001;
dependent variable: purchase intentions;
independent variables: customer perceived value

Table 6 Hypothesis testing

Hypothesis		*Standardised coefficients beta*	*t-values*	*Support*
H1a	Technology availability is positively related to customer perceived value	0.261	3.488	Yes***
H2a	Internet connectivity is positively related to customer perceived value	0.083	1.12	No
H3a	Safety is positively related to customer perceived value	0.189	2.158	Yes*
H4a	Reliability is positively related to customer perceived value	0.14	1.57	No
H5a	Service provider attribute is positively related to customer perceived value	0.109	1.589	No
H1b	Technology availability is positively related to purchase intentions	0.103	1.441	No
H2b	Internet connectivity is positively related to purchase intentions	0.041	0.576	No
H3b	Safety is positively related to purchase intentions	0.268	3.192	Yes**
H4b	Reliability is positively related to purchase intentions	0.139	1.623	No
H5b	Service provider attribute is positively related to purchase intentions	0.308	4.678	Yes***
H6	Customer perceived value is positively related to purchase intentions	0.499	7.457	Yes***

Note: *p < 0.05, **p < 0.01, ***p < 0.001

5 Discussion

Over the next few decades, patterns and modes of mobility will change significantly due to a demographic shift and a densification of the population in urban areas. Mobility services will provide customers a comfortable way of getting from point to point, by combining multi-modal journeys based on available capacity and relevant customer requirements. One of the modes of mobility services will be travelling in shared autonomous vehicles, with driverless cars picking up different customers in different locations who share the same vehicle and moving on to the next customer once it has dropped off the current customer, minimising idle capacity and the number of circulating cars. Given this trend, mobility service providers need to understand customer needs, deliver excellent customer service to meet their needs and build customer relationships in a bid to create competitive advantage.

5.1 Theoretical implications

Existing research has investigated service quality in public transport settings (Pareigis et al., 2011; van Hagen and Bron, 2014), identifying the need to consider the holistic customer journey even though it might include aspects which the firm cannot control. Building on previous literature, this study filled a gap by holistically addressing customers' perceptions regarding shared autonomous vehicles in mobility services. The results showed significant positive relationships between the five factors (technology availability, internet connectivity, safety, reliability, and service provider attributes) and customer perceived value as well as purchase intentions. Although these attributes have been examined in previous research, the constructs have been studied separately rather than simultaneously.

5.2 Managerial applications

The findings of this study have practical applications for managers of automobile manufacturers and mobility service providers. The findings showed that the best predictor of customer perceived value is technology availability ($\beta = 0.261$, $p < 0.001$), which reinforces the importance of the role of technology in delivering customer value (Möhlmann, 2015). In a similar vein, Krueger et al. (2016) found that customers who use technology such as smart phone applications in ride-sharing are likely to choose the option of autonomous vehicle in shared mobility services due to its perceived value. Within a mobility service setting, Rudran and Kumar (2017) reported that the availability of technology can increase the richness and usefulness of information and enhance the customer learning and discovery process, which contributes to increased customer perceived value of the mobility service provider. Hence, to better customise the in-vehicle experience, managers can collect and analyse customer insights from various customer touch points (e.g., television, internet, mobile) and devices (e.g., laptops, tablets, smartphones) to deliver innovative customer service strategies that can better engage travellers. With the advent of autonomous vehicles, travellers can have the freedom to engage in other tasks and activities during their commute. As such, autonomous vehicles can be transformed into an entertainment realm where users can immerse fully in a multimedia, cross-channel and engaging customer experience.

The complexity of multi-modal travel and multi-purpose mobility requests creates difficulties in the matching of available capacity with customer service requirements. Mobility service providers and policy makers need to examine travel demands and land use in order to implement preemptive measures to mitigate the effects of fleet deployment on land use and customer travel patterns (Haboucha et al., 2017). Journey maps from the public transport sector can provide valuable insights which can be extended to shared autonomous vehicle and mobility services. Technology such as digital marketing analytics can be harnessed to identify the crucial touchpoints in the customer journey which the firm should concentrate on. By analysing each customer interaction using marketing analytics that incorporate both online and offline data points, firms can make intelligent marketing and innovative product development decisions that can lead to higher customer perceived value, purchase intentions, customer retention and lifetime value. With these customer insights, relevant smart phone applications can be developed and used during test trials to validate the customer journey map with the actual customer experience. These applications can provide mobility service providers or car-sharing companies with a way of seamlessly repositioning vehicles in order to maximise fleet demand and utilisation (Fagnant and Kockelman, 2014). The better a firm is able to capture the real customer experience during the mobility service, the faster it can deliver a seamless service experience, providing it with competitive advantage.

The findings showed that the best predictor of purchase intentions is service provider attributes ($\beta = 0.308$, $p < 0.001$). In view of this, car manufacturers, technology companies, mobility service providers and policy makers should jointly create opportunities for the public to engage in interactive experiences with autonomous vehicles throughout the development, testing and deployment process. Such interactive experiences can positively affect people's perceptions and help in the wider adoption of autonomous vehicle technology (Penmetsa et al., 2019). To encourage adoption and usage of mobility services, mobility service providers need to pay attention to customers' needs by listening to their customers, making them feel comfortable, and taking great care in customising and personalising their service experience while being there for them throughout the entire customer journey. The role of the service provider in building long-term customer relationships is especially important in mobility services, given customers' ongoing concerns with liability issues while riding in autonomous vehicles. Mobility service providers should ensure that their recruitment, selection and training efforts focus on cultivating front-line employees to become excellent listeners who can make their customers feel comfortable and secure, hence building customer trust and confidence in the mobility service provider.

A significant positive correlation has been found between safety and reliability of shared autonomous vehicles ($r = 0.644$, $p < 0.01$). In addition, safety is found to be a significant predictor of customer perceived value ($\beta = 0.189$, $p < 0.05$) and purchase intentions ($\beta = 0.268$, $p < 0.01$). This finding is reinforced by a study of survey respondents who viewed safety as the most attractive features of autonomous vehicles, whereas liability and cost were the least attractive elements (Howard and Dai, 2014). Similarly, safety was found to be the most important factor in studies on autonomous vehicle functions (Souka et al., 2019) and autonomous vehicle sharing (Merfeld et al., 2019). Hence, managers need to pay attention to safety and reliability issues, which can act as potential barriers in the acceptance and adoption of shared mobility services. Aspects such as safety and reliability concern not only the vehicle, but also the entire service, as the vehicle can navigate autonomously in the surrounding infrastructure.

Automobile manufacturers may need to conceal vehicle trial tests from customers, by conducting them in isolated and safe infrastructure areas such as airports, separate lanes (e.g., taxi or bus lanes) reserved for autonomous vehicle, or in large infrastructures around open shopping malls, where customers can familiarise themselves with the technology. Such vehicle trials can facilitate refinement of the autonomous vehicle technology while providing the general public with opportunities to familiarise themselves with the vehicles (Pettigrew and Cronin, 2019), subsequently gaining trust and confidence. To build customer confidence, firms can focus their positioning and marketing strategies on creating perceptions of mobility service usage as being safe and reliable. Further, firms can conduct market research studies such as focus groups or surveys to gain better insights into customers' preferences and expectations regarding safety and reliability issues.

Finally, the study reported a significant positive correlation between customer perceived value and purchase intentions ($r = 0.499$, $p < 0.01$). In view of this, firms should focus on communicating the utilitarian and functional benefits of shared autonomous vehicle usage, such as emphasising the efficiency, cost and time savings of shared mobility services to differentiate themselves from their competitors. In order to retain customers, firms can include rational messages that focus on key functional benefits in their advertising communications. These utilitarian benefits can bring about increased purchase intentions, which will directly impact on the acceptance and usage of shared mobility services (Prebensen and Rosengren, 2016).

6 Conclusions and future research

This study extends the literature in the field of autonomous vehicles by holistically addressing customers' perceptions regarding shared autonomous vehicle usage in mobility services. Specifically, the study found that the best predictor of customer perceived value is technology availability, while the best predictor of purchase intentions is service provider attributes. Although this study provided some valuable findings, some potential limitations must be noted. Given that fully autonomous vehicle services are not widely available yet, the data collected for this study was based on an animated video which simulated a shared autonomous vehicle experience to give respondents an idea of how future mobility may look like hypothetically, and to show them how autonomous vehicles can enable door-to-door mobility. This homogenous approach used to illustrate the complex technology of autonomous vehicles created a possibility of biasness. In addition to the use of online surveys, future research could examine customer perceptions of shared autonomous vehicles by combining different mobility experiential types in an experimental design.

The small sample size of 206 is acknowledged as a limitation of the study, which affects the generalisability of the findings. Moreover, other service elements (e.g., responsiveness, assurance, aspects of safety such as personal security and cybersecurity) and relational attributes (e.g., trust, commitment, brand experience) that might be of importance to customers were not examined in the present study. Future research could investigate the relevance of other service elements and relational attributes in shared autonomous vehicles with different sharing and pooling modes such as privately-owned autonomous cars, pooled-use autonomous taxis, and autonomous public transport shuttles (Stoiber et al., 2019). Once test trials of shared autonomous vehicles are available, further data mining and marketing analytics can identify relevant customer experience elements and touchpoints in a more exhaustive way in order to draw more accurate customer journey maps for the mobility services segment.

References

Acheampong, R.A. and Cugurullo, F. (2019) 'Capturing the behavioural determinants behind the adoption of autonomous vehicles: conceptual frameworks and measurement models to predict public transport, sharing and ownership trends of self-driving cars', *Transportation Research Part F: Traffic Psychology and Behaviour*, April, Vol. 62, pp.1369–8478.

Babin, B., Darden, W. and Griffin, M. (1994) 'Work and/or fun: measuring hedonic and utilitarian shopping value', *Journal of Consumer Research*, Vol. 20, No. 4, pp.644–656.

Bansal, P. and Kockelman, K.M. (2017) 'Forecasting Americans' long-term adoption of connected and autonomous vehicle technologies', *Transportation Research Part A: Policy and Practice*, January, Vol. 95, pp.49–63.

Bansal, P., Kockelman, K.M. and Singh, A. (2016) 'Assessing public opinions of and interest in new vehicle technologies: An Austin perspective', *Transportation Research Part C: Emerging Technology*, June, Vol. 76, pp.1–14.

Begg, D. (2014) 'A 2050 vision for London: What are the implications of driverless transport?', *Transport Times*, London, UK [online] https://www.transporttimes.co.uk/Admin/uploads/64165-transport-times_a-2050-vision-for-london_aw-web-ready.pdf (accessed 18 September 2019).

Bettencourt, L.A., Lusch, R.F. and Vargo, S.L. (2014) 'A service lens on value creation: marketing's role in achieving strategic advantage', *California Management Review*, Vol. 57, No. 1, pp.44–66.

Brown, B., Drew, M., Erenguc C., Hasegawa, M., Hill, R., Schmith, R. and Ganula, B. (2014) *Global Automotive Consumer Study: The Changing Nature of Mobility – Exploring Consumer Preferences in Key Markets Around the World*, Technical Report, Deloitte.

Buckley, L., Kaye, S.A. and Pradhan, A.K. (2018) 'Psychosocial factors associated with intended use of automated vehicles: a simulated driving study', *Accident Analysis and Prevention*, June, Vol. 115, pp.202–208.

Cavazza, B., Gandia, R., Antonialli, F., Zambalde, A., Nicolaï, I., Sugano, J. and Neto, A. (2019) 'Management and business of autonomous vehicles: a systematic integrative bibliographic review', *International Journal of Automotive Technology and Management*, forthcoming.

Chen, H.K. and Yan, D.W. (2019) 'Interrelationships between influential factors and behavioral intention with regard to autonomous vehicles', *International Journal of Sustainable Transportation*, Vol. 13, No. 7, pp.511–527.

Dodds, W.B. and Monroe, K.B. (1985) 'The effect of brand and price information on subjective product evaluation', *Advances in Consumer Research*, Vol. 12, pp.85-90.

Economist Technology Quarterly (2012) 'Inside story: look, no hands', 1 September, pp.17–19 [online] https://www.economist.com/technology-quarterly/2012/08/30/look-no-hands (accessed 18 September 2019).

Fishbein, M. and Ajzen, I. (1975) *Belief, Attitude, Intention and Behaviour: An Introduction to Theory and Research*, Addison Wesley, Reading, MA.

Fagnant, D.J. and Kockelman, K.M. (2014) 'The travel and environmental implications of shared autonomous vehicles, using agent-based model scenarios', *Transportation Research C: Emerging Technologies*, March, Vol. 40, pp.1–13.

Fagnant, D.J. and Kockelman, K.M. (2015) 'Preparing a nation for autonomous vehicles: opportunities, barriers and policy recommendations', *Transportation Research Part A: Policy and Practice*, July, Vol. 77, pp.167–181.

Fagnant, D.J. and Kockelman, K.M. (2018) 'Dynamic ride-sharing and fleet sizing for a system of shared autonomous vehicles in Austin, Texas', *Transportation*, Vol. 45, No. 1, pp.143–158.

Fornell, C.G. and Larcker, D.F. (1981) 'Evaluating structural equation models with unobservable variables and measurement error', *Journal of Marketing Research*, Vol. 18, No. 1, pp.39–50.

Fricker, R.D. (2008) 'Sampling methods for web and e-mail surveys', in N. Fielding, R.M. Lee and G. Blank (Eds.): *The Sage Handbook of Online Research Methods*, pp.195–216, Sage, Los Angeles, CA.

Gao, P., Hans-Werner, K., Detlev, M. and Wee, D. (2016) 'Automotive revolution: perspectives towards 2030', *Auto Tech Review*, McKinsey, Delhi.

Grönroos, C. (1982) 'A service quality model and its marketing implications', *European Journal of Marketing*, Vol. 18, No. 4, pp.36–44.

Grönroos, C. (2008) 'Service logic revisited: who creates value? And who co - creates?', *European Business Review*, Vol. 20, No. 4, pp.298–314.

Gummesson, E. (2008) 'Customer centricity: reality or a wild goose chase?', *European Business Review*, Vol. 20, No. 4, pp.315–330.

Ha, H.Y., Akamavi, R.J., Kitchen, P. and Janda, S. (2014) 'Exploring key antecedents of purchase intentions within different services', *Journal of Services Marketing*, Vol. 28, No. 7, pp.595–606.

Haboucha, C.J., Ishaq, R. and Shiftan, Y. (2017) 'User preferences regarding autonomous vehicles', *Transportation Research Part C: Emerging Technologies*, May, Vol. 78, pp.37–49.

Hair, J.F. Jr., Anderson, R.E., Tatham, R.L. and Black, W.C. (1995) *Multivariate Data Analysis*, 3rd ed., Macmillan, New York.

Hamari, J., Sjöklint, M. and Ukkonen, A. (2016) 'The sharing economy: why people participate in collaborative consumption', *Journal of the Association for Information Science and Technology*, Vol. 67, No. 9, pp.2047–2059.

Hawthorne-Castro, J. (2018) 'Autonomous vehicles will be a new opportunity for marketers', *Forbes*, Forbes Agency Council, 4 June [online] https://www.hawthornedirect.com/insights/autonomous-vehicles-will-be-a-new-opportunity-for-marketers/ (accessed 18 September 2019).

Howard, D. and Dai, D. (2014) 'Public perceptions of self-driving cars: the case of Berkeley, California', in *Proceedings of the 93rd Annual Meeting of the Transportation Research Board*, Washington, DC, pp.1–21.

Hudson, J., Orviska, M. and Hunady, J. (2019) 'People's attitudes to autonomous vehicles', *Transportation Research Part A: Policy and Practice*, March, Vol. 121, pp.164–176.

Hwang, J. and Griffiths, M. (2017) 'Share more, drive less: millennials value perception and behavioral intent in using collaborative consumption services', *Journal of Consumer Marketing*, Vol. 34, No. 2, pp.132–146.

Kaur, K. and Rampersad, G. (2018) 'Trust in driverless cars: investigating key factors influencing the adoption of driverless cars', *Journal of Engineering and Technology Management,* April–June, Vol. 48, pp.87–96.

Klaus, P. and Maklan, S. (2012) 'EXQ: a multiple - item scale for assessing service experience', *Journal of Service Management*, Vol. 23, No. 1, pp.5–33.

König, M. and Neumayr, L. (2017) 'Users' resistance towards radical innovations: the case of the self-driving car', *Transportation Research Part F: Traffic Psychology and Behaviour*, January, Vol. 44, pp.42–52.

KPMG (2017) *Global Executive Automotive Survey*, KPMG International, pp.1–56.

Krueger, R., Rashidi, T.H. and Rose, J.M. (2016) 'Preferences for shared autonomous vehicles', *Transportation Research Part C: Emerging Technologies*, August, Vol. 69, pp.343–355.

Kyriakidis, M., Happee, R. and De Winter, J.C. (2015) 'Public opinion on automated driving: results of an international questionnaire among 5000 respondents', *Transportation Research Part F: Traffic Psychology and Behaviour*, October, Vol. 32, pp.127–140.

Lin, P. (2016) 'Why ethics matters for autonomous cars', in M. Maurer et al. (Ed.): *Autonomous Driving: Technical, Legal and Social Aspects*, Springer Open, pp.69–85.

Liu, H., Yang, R., Wang, L. and Liu, P. (2019a) 'Evaluating initial public acceptance of highly and fully autonomous vehicles', *International Journal of Human-Computer Interaction*, Vol. 35, No. 11, pp.919–931.

Liu, P., Yang, R. and Xu, Z. (2019b) 'How safe is safe enough for self - driving vehicles?', *Risk Analysis: An International Journal*, Vol. 39, No. 2, pp.315–325.

Liu, P., Zhang, Y. and He, Z. (2019c) 'The effect of population age on the acceptable safety of self-driving vehicles', *Reliability Engineering and System Safety*, May, Vol. 185, pp.341–347.

Merfeld, K., Wilhelms, M.P., Henkel, S. and Kreutzer, K. (2019) 'Carsharing with shared autonomous vehicles: uncovering drivers, barriers and future developments – a four-stage Delphi study', *Technological Forecasting and Social Change*, July, Vol. 144, pp.66-81.

Meyer, M. (2016) *Global Automotive Executive Survey*, KPMG International, pp.1–52.

Möhlmann, M. (2015) 'Collaborative consumption: determinants of satisfaction and the likelihood of using a sharing economy option again', *Journal of Consumer Behaviour*, Vol. 14, No. 3, pp.193–207.

Mounce, R. and Nelson, J. (2019) 'On the potential for one-way electric vehicle car-sharing in future mobility systems', *Transportation Research Part A: Policy and Practice*, February, Vol. 120, pp.17–30.

Munnukka, J. (2008) 'Customers' purchase intentions as a reflection of price perception', *Journal of Product and Brand Management*, Vol. 17, No. 3, pp.188–196.

Muoio, D. (2017) 'Ranked: the 18 companies most likely to get self-driving cars on the road first', *Business Insider* [online] https://www.businessinsider.sg/the-companies-most-likely-to-get-driverless-cars-on-the-road-first-2017-4/ (accessed 18 September 2019).

Nikitas, A., Njoya, E.T. and Dani, S. (2019) 'Examining the myths of connected and autonomous vehicles: analysing the pathway to a driverless mobility paradigm', *International Journal of Automotive Technology and Management*, Vol. 19, Nos. 1–2, pp.10–30.

Nunnally, J.C. (1978) *Psychometric Theory*, 2nd ed., McGraw-Hill, NY.

Osswald, S., Wurhofer, D., Trösterer, S., Beck, E. and Tscheligi, M. (2012) 'Predicting information technology usage in the car : towards a car technology acceptance model', in *Proceedings of the 4th International Conference on Automotive User Interfaces and Interactive Vehicular Applications*, Portsmouth, pp.51–58.

Panagiotopoulos, I. and Dimitrakopoulos, G. (2018) 'An empirical investigation on consumers' intentions towards autonomous driving', *Transportation Research Part C: Emerging Technologies*, October, Vol. 95, pp.773–784.

Parasuraman, A., Berry, L.L. and Zeithaml, V.A. (1991) 'Refinement and reassessment of the SERVQUAL scale', *Journal of Retailing*, Vol. 67, No. 4, pp.420–450.

Parasuraman, A., Zeithaml, V.A. and Berry, L.L. (1985) 'Conceptual model of service quality and its implications for future research', *Journal of Marketing*, Vol. 49, No. 4, pp.41–50.

Parasuraman, A., Zeithaml, V.A. and Berry, L.L. (1994) 'Reassessment of expectations as a comparison standard in measuring service quality: implications for further research', *Journal of Marketing*, Vol. 58, No. 1, pp.111–124.

Pareigis, J., Edvardsson, B. and Enquist, B. (2011) 'Exploring the role of the service environment in forming customer's service experience', *International Journal of Quality and Service Sciences*, Vol. 3, No. 1, pp.110–124.

Payre, W., Cestac, J. and Delhomme, P. (2014) 'Intention to use a fully automated car: attitudes and a priori acceptability', *Transportation Research Part F: Traffic Psychology and Behaviour*, Vol. 27, No. B, pp.252–263.

Penmetsa, P., Adanu, E.K., Wood, D., Wang, T. and Jones, S. L. (2019) 'Perceptions and expectations of autonomous vehicles: a snapshot of vulnerable road user opinion', *Technological Forecasting and Social Change*, June, Vol. 143, pp.9–13.

Pettigrew, S. and Cronin, S.L. (2019) 'Stakeholder views on the social issues relating to the introduction of autonomous vehicles', *Transport Policy*, ISSN 0967-070X, DOI: https://doi.org/10.1016/j.tranpol.2019.06.004.

Prebensen, N.K. and Rosengren, S. (2016) 'Experience value as a function of hedonic and utilitarian dominant services', *International Journal of Contemporary Hospitality Management*, Vol. 28, No. 1, pp.113–135.

Reiner, J., Pletziger, R. and Buss, J. (2015) 'The true value of autonomous driving', *Automotive Manager*, July, pp.6–11.

Rudran, R. and Kumar, A. (2017) 'Measurement scales for technology-generated customer contact', *International Journal of Operations and Production Management*, Vol. 37, No. 5, pp.534–556.

SAE (2018) 'Levels of driving automation', *Standard for Self-Driving Vehicles* [online] https://www.sae.org/news/press-room/2018/12/sae-international-releases-updated-visual-chart-for-its-levels-of-driving-automation-standard-for-self-driving-vehicles.

Schaefers, T. (2013) 'Exploring carsharing usage motives: a hierarchical means-end chain analysis', *Transportation Research Part A: Policy and Practice*, Vol. 47, No. 1, pp.69–77.

Schmalfuß, F., Mühl, K. and Krems, J.F. (2017) 'Direct experience with battery electric vehicles (BEVs) matters when evaluating vehicle attributes, attitude and purchase intention', *Transportation Research Part F: Traffic Psychology and Behaviour*, April, Vol. 46, Part A, pp.47–69.

Schoettle, B. and Sivak, M. (2014) 'Public opinion about self-driving vehicles in China, India, Japan, the U.S., the U.K., and Australia', The University of Michigan Transportation Research Institute, Ann Arbor, Michigan, 48109-2150, pp.1–85.

Schoettle B. and Sivak, M. (2015) 'A survey of public opinion about connected vehicles in the U.S., the U.K., and Australia', in *ICCVE 2014: Proceedings of the International Conference on Connected Vehicles and Expo*, Vienna, Austria, pp.687–692.

Souka, M., Böger, D., Decker, R., Stummer, C. and Wiemann, A. (2019) 'Is more automation always better? An empirical study of customers willingness to use autonomous vehicle functions', *International Journal of Automotive Technology and Management*, forthcoming.

Stoiber, T., Schubert, I., Hoerler, R. and Burger, P. (2019) 'Will consumers prefer shared and pooled-use autonomous vehicles? A stated choice experiment with Swiss households', *Transportation Research Part D: Transport and Environment*, in press.

Sweeney, J., Soutar, G. and Johnson, L.W. (1999) 'The role of perceived risk in the quality-value relationship: a study in a retail environment', *Journal of Retailing*, Vol. 75, No. 1, pp.77–105.

Taeihagh, A. and Lim, H.S.M. (2019) 'Governing autonomous vehicles: emerging responses for safety, liability, privacy, cybersecurity, and industry risks', *Transport Reviews*, Vol. 39, No. 1, pp.103–128.

Thomopoulos, N. and Nikitas A. (2019) 'Editorial: smart urban mobility futures', *International Journal of Automotive Technology and Management*, Vol. 19, Nos. 1–2, pp.1–9.

Underwood, S.E., Marshall, S. and Niles, J. (2014) *Automated, Connected and Electric Vehicles: An Assessment of Emerging Transportation Technologies and a Policy Roadmap for More Sustainable Transportation*, Report for Graham Environmental Sustainability Institute [online] http://graham.umich.edu/media/files/LC-IA-Final-Underwood.pdf.

van Hagen, M. and Bron, P. (2014) 'Enhancing the experience of the train journey: changing the focus from satisfaction to emotional experience of customers', *Transportation Research Procedia*, Vol. 1, No. 1, pp.253–263.

Yap, M.D., Correia, G. and van Arem, B. (2016) 'Preferences of travellers for using automated vehicles as last mile public transport of multimodal train trips', *Transportation Research Part A: Policy and Practice*, December, Vol. 94, pp.1–16.

Zeithaml, V.A. (1988) 'Consumer perceptions of price, quality and value: a means-end model and synthesis of evidence', *Journal of Marketing*, Vol. 52, No. 3, pp.2–22.

Zhang, T., Tao, D., Qu, X., Zhang, X., Lin, R. and Zhang, W. (2019) 'The roles of initial trust and perceived risk in public's acceptance of automated vehicles', *Transportation Research Part C: Emerging Technologies*, January, Vol. 98, pp.207–220.

Zmud J.P. and Sener I.N. (2017) 'Towards an understanding of the travel behavior impact of autonomous vehicles', *Transportation Research Procedia*, Vol. 25, pp.2504–2523.

Appendix I

Table 1 Survey items

Technology availability (6)
I am comfortable with using e-travel agent to plan my travel for mobility services.
I am comfortable with using e-travel agent to make reservations for mobility services.
Using a smartphone, e-travel agent increases the productive use of the mobility service.
I believe that my successful interactions with the e-travel agent will determine the efficiency of the mobility service.
The use of e-travel agent to personalise the service will be stress relieving for me.
The use of e-travel agent to personalise the service will make the travel more valuable for me.
Internet connectivity (2)
Internet connectivity increases the productive use of the mobility service.
Internet connectivity will enhance the entertainment level of my travel.
Safety (3)
Compared to a conventional car, I feel safe in a shared autonomous vehicle.
The safety in shared autonomous vehicle is given.
A shared autonomous vehicle will take me to my destination safely.
Reliability (3)
The new technology of shared autonomous vehicles is reliable.
Shared autonomous vehicles are reliable.
I can depend on the shared autonomous vehicle to take me from one place to another on all occasions.
Service provider attributes (4)
It is important that the service provider is flexible in dealing with me and looking out for my needs.
The service provider should they know me, take good care of me and look after me for a long time.
It would be great if I could deal with a designated contact through the entire process of getting from one place to another, wherever I am.
It is important that the service provider I am dealing with is listening and makes me feel comfortable.
Customer perceived value (4)
I believe using shared autonomous vehicle mobility services is a good substitute for owning a car.
I believe using shared autonomous vehicle mobility service instead of my own car saves me money.
I believe using shared autonomous vehicle services is an efficient way to manage my time.
I feel good about the idea of using shared autonomous vehicle services.
Purchase intentions (3)
Assuming I had access to the service, I intend to use it.
Given that I had access to the service, I predict that I would use.
If the service is available, I plan to use it.