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Autonomous vehicles can be shared, but a feeling of ownership is important: Examination of the influential factors for intention to use autonomous vehicles

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ABSTRACT

Autonomous vehicles are expected to be commercialized within a few years, and researchers have investigated various factors that influence their adoption. However, only a few studies have considered comparative and psychological perspectives that can affect user-vehicle relationships. Focusing on this limitation, this study investigates influential factors on the use of autonomous vehicles in terms of a technology acceptance model (which considers perceived ease of use, perceived usefulness, and intention to use) and factors for autonomous vehicle use (e.g., perceived risk, relative advantage, self-efficacy, and psychological ownership (i.e., feeling of ownership)). Our results show that self-efficacy positively affects the perceived ease of use and intention to use, while the relative advantage affects perceived usefulness. Psychological ownership affects the intention to use but not the perceived usefulness. This implies that encouraging a consumer to form a psychological bond (i.e., psychological ownership) with an autonomous vehicle may be an effective strategy for promoting the use of autonomous vehicles.

1. Introduction

Autonomous vehicles have great potential for improving the safety and efficiency of transportation. With minimized human intervention and optimized traffic control systems, autonomous vehicles can lead to a new transportation environment with less traffic and safer driving. Over the last decades, autonomous vehicles have been a conceptual idea. However, advances in artificial intelligence and real-time data processing technologies have enabled the development of practical autonomous vehicles. Early autonomous vehicles were only able to recognize and handle some driving situations, but these limitations have been removed due to continued technological advances. Several vehicle companies, including Ford, Honda, Toyota, Nissan, Volvo, Hyundai, Daimler, Fiat-Chrysler, and BMW, are developing autonomous vehicles and have plans to release full-automation vehicles (i.e., vehicles that can drive without any human intervention) starting in 2021 (Walker, 2018).

With ongoing technological advances in autonomous vehicles, several researchers have investigated influential factors for vehicle adoption. Merat et al. (2012) suggested that the reliability of autonomous vehicles may be a crucial factor affecting adoption. Verberne et al. (2012) suggested that trust is a crucial psychological factor when considering the acceptability of automation technologies in automobiles. Choi and Ji (2015) showed that trust was a major construct determining users' willingness to adopt

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autonomous vehicles. Finally, Ward et al. (2017) found that perceptions of risk and benefit, knowledge, and trust were related to the intention to use automated vehicles.

Although these studies have suggested various factors that influence the potential adoption of autonomous vehicles, influential factors for autonomous vehicle adoption still need to be investigated further from two perspectives. First, factors related to the technology acceptance model need to be reexamined by considering the context of autonomous vehicles in more detail. Many previous studies have addressed factors that influence the technology acceptance model, but these reports are often inconsistent due to the different considerations of underlying structures. Reviewing the existing studies of autonomous vehicles and reorganizing the relationships of the factors can yield meaningful insights related to the use of autonomous vehicles. Second, psychological factors influencing the use of autonomous vehicles also need to be examined accordingly. When reconstructing influential factors in the technology acceptance model, several psychological factors related to the use of autonomous vehicles can be examined together, thereby extending the understanding of users' perceptions of autonomous vehicles.

Based on these issues, this study reviews previous studies related to autonomous vehicles and identifies the relationships between factors that need to be examined. By reviewing the identified factors in detail, we design a structural equation model and examine how users perceive the properties of autonomous vehicles when determining their potential use of autonomous vehicles. Based on the findings from existing studies and this study, we aim to provide more detailed information related to users' perceptions of autonomous vehicles, as well as the influential factors determining an individual's intention to use autonomous vehicles.

2. A brief review of previous studies

Numerous studies have investigated factors that influence the potential use of autonomous vehicles and suggested that safety, environmental concerns, relative advantage, compatibility, subjective norms, and self-efficacy can be considered influential factors for intention to use of autonomous vehicles (Gkartzonikas and Gkritza, 2019). We reviewed previous studies which addressed influential factors for autonomous vehicles based on a theoretical framework of technology acceptance and provided statistical information for the effects of factors. Fig. 1 shows these influential factors and their relationships and Table 1 describes an overview of these studies. As shown in the table, three theoretical frameworks (i.e., the technology acceptance model (TAM, Davis, 1989; Davis et al., 1989), theory of planned behavior (TPB, Ajzen, 1991), and unified theory of acceptance and use of technology (UTAUT, Venkatesh et al., 2003) and two methodological approaches (structural equation modeling and regression modeling) have been used by previous studies. TAM was considered to be the major theoretical frame, but this is sometimes extended with TPB because the original model could not reflect the distinctive properties of autonomous vehicles. Moták et al. (2017) examined the effects of TAM, TPB, and other extended factors on the intention to use autonomous vehicles and reported that the factors in TAM and TPB explained most of the variance in the intention to use.

Although these studies identified factors that influence the intention to use autonomous vehicles, some TAM factors and their relationships remain unclear (i.e., the underlined factors and dotted arrows in Fig. 1). For example, TAM suggested that the perceived ease of use influenced the perceived usefulness and intention to use, but several previous studies reported that these effects were not significant (Buckley et al., 2018; Choi and Ji, 2015; Hein et al., 2018). In addition, because previous studies extended the original TAM to include psychological and sociological factors related to autonomous vehicles, their reports were often inconsistent depending on their assumptions related to the effects of factors. For example, several studies assumed that the perceived behavioral

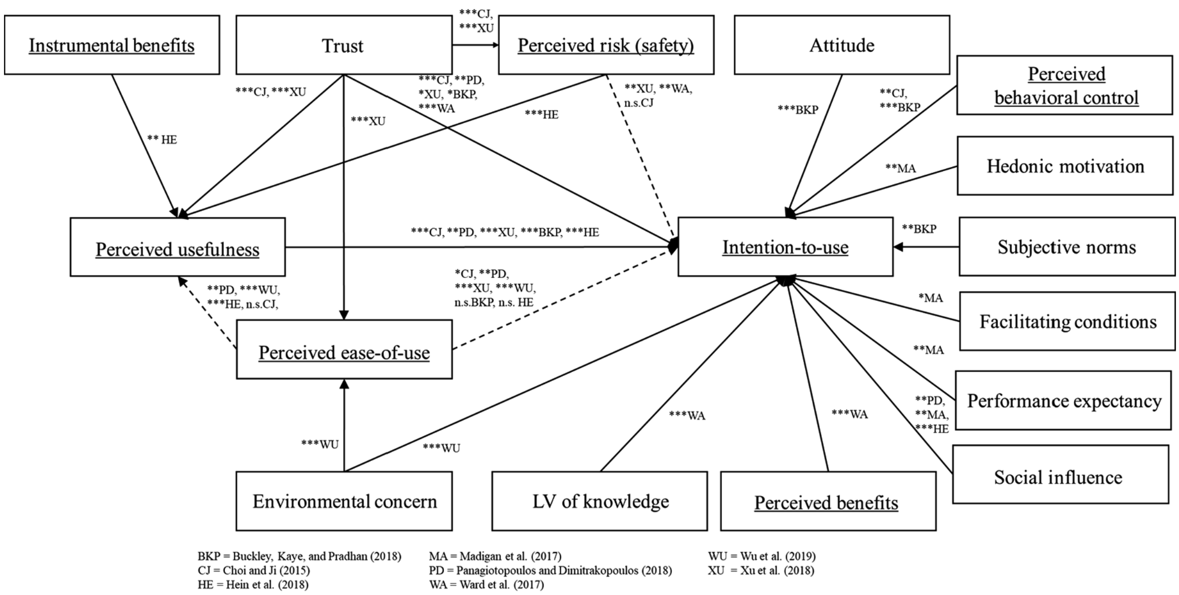

Fig. 1. Previous studies investigating influential factors.

Table 1
Overview of previous studies.

Basic model	Analysis method	Study
Technology acceptance model (TAM)	Structural equation modeling	Choi and Ji (2015)
		Hein et al. (2018)
		Xu et al. (2018)
		Wu et al. (2019)
	Multiple regression	Ward et al. (2017)
		Panagiotopoulos and Dimitrakopoulos (2018)
Technology acceptance model (TAM) + Theory of planned behavior (TPB)	Hierarchical multiple regression	Buckley et al. (2018)
		Moták et al. (2017)
Unified theory of acceptance and use of technology (UTAUT)	Hierarchical multiple regression	Madigan et al. (2017)

control (locus of control) only affected the intention to use (Buckley et al., 2018; Choi and Ji, 2015). However, the concept of perceived behavioral control is similar to self-efficacy; thus, it would be more reasonable to assume that perceived behavioral control not only affects the intention to use but that it also affects the perceived ease of use.

In a similar vein, misspecification of the perceived risk can also explain the inconsistencies in previous reports. Two studies looking into autonomous vehicles reported that perceived risk influenced the intention to use (Ward et al., 2017; Xu et al., 2018), but one study reported that it did not (Choi and Ji, 2015). Conceptually, feelings of anxiety are closely related to self-efficacy (Bandura, 1988); thus, it would be reasonable to assume that perceived risk is affected by perceived ease of use and self-efficacy. Without considering the underlying structure of the perceived risk, only a limited understanding of the potential use of autonomous vehicles can be drawn. Similarly, underlying structure of perceived usefulness also need to be examined to clarify the effects of perceived usefulness. Although some studies considered the underlying constructs of perceived usefulness, such as perceived benefits (Ward et al., 2017) and instrumental benefits (Hein et al., 2018), these did not examine the effects on the perceived usefulness and intention to use at the same time. Also, these factors were insufficient to reflect the relative advantages of autonomous vehicles, compared to existing vehicles. Because potential users of autonomous vehicles are users of existing vehicles, the effects of the relative advantage need to be examined in detail. There have been several discussions on whether relative advantage and perceived usefulness should be regarded as the same construct (Karahanna et al., 2006; Moore and Benbasat, 1991). Kulviwat et al. (2007) reviewed the previous studies and suggested that both concepts were conceptually distinguishable and relative advantage can be an antecedent of perceived usefulness.

Another limitation of previous studies is that they did not consider the concept of ownership from a technology acceptance perspective. Autonomous vehicles can drive without human intervention, and people can go anywhere and convey cargo without their own vehicles (Wachenfeld et al., 2016). This suggests that people may be interested in the use of autonomous vehicles without ownership but with feelings of ownership (psychological ownership). Combined with the other psychological factors considered in previous studies, psychological ownership needs to be examined from a technology acceptance perspective. Redesigning the relationships of factors in a new model may provide different results related to the effects of psychological factors.

Based on the reviews of previous studies, this study focuses on three factors related to TAM (i.e., the perceived usefulness, perceived ease of use, and intention to use) and four factors related to autonomous vehicle usage (i.e., relative advantage, psychological ownership, self-efficiency, and perceived risk) to examine factors influencing the intention to use autonomous vehicles. By reviewing these factors, a new theoretical research model is developed.

3. Model development

3.1. Perceived ease of use and perceived usefulness

Previous studies of TAM have considered three core factors: perceived ease of use, perceived usefulness, and intention to use. However, these reports have been inconsistent. For example, some studies reported that all of the relationships were significant (e.g., Panagiotopoulos and Dimitrakopoulos, 2018; Wu et al., 2019) but other studies reported that only some relationships were significant (e.g., Buckley et al., 2018; Choi and Ji, 2015; Hein et al., 2018). Choi and Ji (2015) found that perceived ease of use did not affect perceived usefulness, while Buckley et al. (2018) and Hein et al. (2018) found that perceived ease of use did not influence intention to use. A major reason for these inconsistent reports is that different assumptions were used for the effects of other factors (e.g., instrumental benefits, environmental concerns, trust, and perceived risk were selectively considered as the precedents of perceived ease of use, perceived usefulness, and intention to use). However, except Xu et al. (2018), most studies related to TAM followed the basic assumptions of the original TAM: perceived ease of use positively affects perceived usefulness, and both factors positively affect the intention to use (Davis, 1989; Davis et al., 1989). This suggests that studies of autonomous vehicles based on TAM should start by examining TAM's basic assumptions. Thus, we hypothesize the following:

H1. Perceived ease of use positively affects perceived usefulness of autonomous vehicles
H2. Perceived ease of use positively affects intention to use autonomous vehicles
H3. Perceived usefulness positively affects intention to use autonomous vehicles

3.2. Perceived risk

Although previous studies have reported that autonomous vehicles can significantly enhance traffic safety levels (Milakis et al., 2017), users still have serious concerns about the risk of autonomous vehicles. For example, Kyriakidis et al. (2015) conducted a survey study with 5000 participants and found that people had major concerns regarding security, legal, and safety issues of autonomous vehicles. Similarly, König and Neumayr (2017) conducted a survey study with 489 respondents and showed that people still had serious concerns regarding trust and risk issues of autonomous vehicles. However, results of previous studies related to the effects of perceived risk have been inconsistent. For example, Choi and Ji (2015), Liu et al. (2019), and Liu et al. (2018) reported that perceived risk has no significant effect on the intention to use autonomous vehicles, whereas Xu et al. (2018), and Ward et al. (2017) reported it has a significant effect. As Payre et al. (2014) suggested, this inconsistency may come from different contexts of autonomous vehicle use (e.g., different road types, driving environments, and/or physical/mental status). Depending on how much a user perceives that an autonomous vehicle has no barriers to its use (i.e., high ease of use), the user may perceive low risk and then determine whether or not they want to use autonomous vehicles. Based on existing studies, we can consider the following hypotheses:

H4. Perceived ease of use negatively affects the perceived risk of autonomous vehicles
H5. Perceived risk negatively affects the intention to use autonomous vehicles

3.3. Relative advantage

Another important factor that needs to be considered for autonomous vehicle studies is the relative advantage of these vehicles. Several previous studies have reported that relative advantage affected perceived usefulness of new technology (e.g., Lee et al., 2011; Wu et al., 2010) and intention to use (e.g., Lee et al., 2011). Similarly, several previous studies of autonomous vehicles have reported that users considered autonomous vehicles from a comparative perspective, relative to traditional vehicles. Ward et al. (2017) showed that prior knowledge, as well as perceived trust, risk, and benefit, played important roles on the acceptance of autonomous vehicles. Perceived benefit was presented as the primary factor among these four factors. Brell et al. (2018) showed that many people perceived lower risk values and higher comfort and innovation values for autonomous vehicles than for conventional vehicles; nonetheless, they still hesitated to adopt autonomous vehicles. In the study by Pakusch et al. (2018), people perceived more utility value for conventional vehicles than autonomous vehicles, and people predicted that conventional vehicles will remain the preferred choice in the future. These studies suggest that the relative advantage may be positively related to perceived usefulness and intention to use autonomous vehicles. Based on the findings of these studies, we can suggest the following hypotheses:

H6. Relative advantage positively affects perceived usefulness of autonomous vehicles
H7. Relative advantage positively affects intention to use autonomous vehicles

3.4. Self-efficacy

Self-efficacy is another important factor that should be considered to evaluate autonomous vehicle use. Self-efficacy can be defined as "how well one can execute courses of action required to deal with prospective situations" (Bandura, 1982, p. 122). Thus, self-efficacy is conceptually related to perceived ease of use (Venkatesh and Davis, 1996). In the context of autonomous vehicles, self-efficacy is also closely related to the level of automation. As level of automation increases, a driver's range of possible actions becomes smaller and self-efficacy decreases accordingly. Several studies have reported that the level of automation and self-efficacy were significantly related to the use of autonomous vehicles and the perceived risk. For example, Rödel et al. (2014) found that perceived behavioral control, intention to use, attitude, trust, and fun decreased as the level of automation increased compared to the level of automation in modern vehicles. Choi and Ji (2015) considered the concept of locus of control as a form of self-efficacy and reported that the locus of control was related to the intention to use. Bandura (1988) argued that intensified self-efficacy can reduce feelings of anxiety, and Hohenberger et al. (2017) showed that it can be applied to the context of autonomous vehicles. These studies suggest that one's self-efficacy has positive relationships with perceived risk and intention to use. Based on these studies, we build the following hypotheses:

H8. Self-efficacy positively affects perceived ease of use of autonomous vehicles
H9. Self-efficacy negatively affects perceived risk of autonomous vehicles
H10. Self-efficacy positively affects perceived intention to use autonomous vehicles

3.5. Psychological ownership

Because autonomous vehicles can drive without humans, several researchers have predicted that various forms of autonomous vehicle services will appear in the future (Wachenfeld et al., 2016). Milakis et al. (2017) reviewed previous studies of autonomous vehicles and suggested that autonomous vehicles can replace conventional vehicles with various forms of sharing services. Like existing transportation (e.g., taxis) and car-sharing services (e.g., Uber), we can use these services without actually owning a vehicle. This implies that the perceptions of these vehicles would be significantly changed as the feeling of possession (i.e., psychological ownership (Pierce et al., 2001; Pierce et al., 1991)) for vehicles is changed. Previous studies on vehicle-sharing services have reported

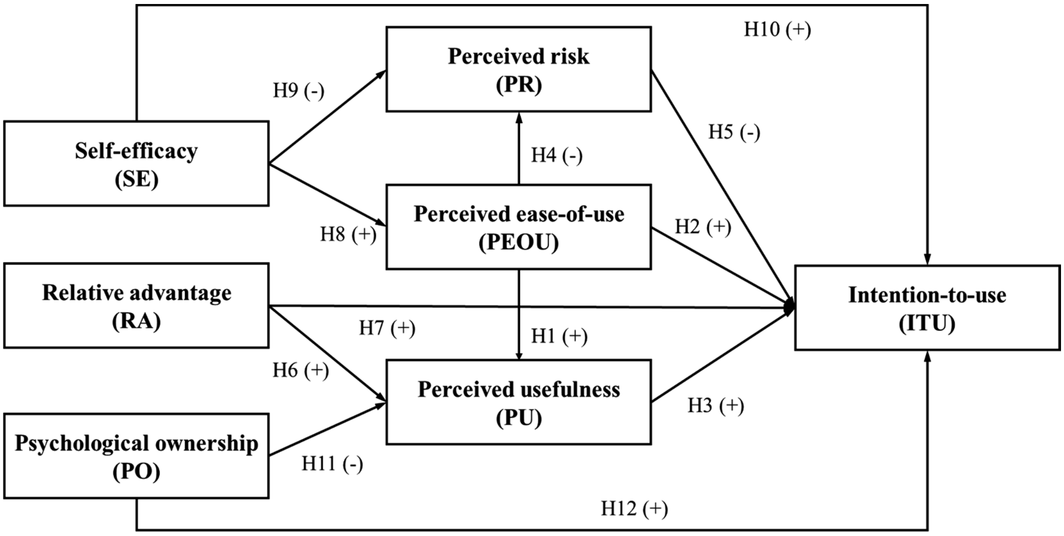

Fig. 2. Research model.

that vehicle ownership was significantly related to the use of vehicles. Efthymiou et al. (2013) conducted a survey with 233 participants and found that vehicle ownership has both positive (e.g., travel convenience and comfort) and negative (e.g., parking problems and pollution) relationships with the use of vehicles. In Schlüter and Weyer (2019), users reported that vehicle ownership negatively affected the perceived usefulness of car-sharing services but did not affect service ease of use. However, in the study by Zmud et al. (2016), many users reported that they would prefer to own autonomous vehicles rather than just use existing car sharing services. These contradictory reports suggest that psychological ownership, rather than vehicle ownership, is likely to affect perceived usefulness and intention to use autonomous vehicles. Based on these findings, we can build the following hypotheses:

H11. Psychological ownership negatively affects perceived usefulness of autonomous vehicles
H12. Psychological ownership positively affects intention to use autonomous vehicles

Fig. 2 shows all the factors and hypothetical relationships considered in this study. We examined the significances of these hypotheses through structural equation modeling.

4. Data collection

To examine the hypotheses of the developed research model, we designed a questionnaire consisting of 28 items to measure seven constructs. The items were adapted from previous studies and modified according to the context of autonomous vehicles. Table 2 shows the constructs and questionnaire items considered in this study.

The questionnaire was provided to 313 Korean respondents who were recruited from the research panel of Macromill Embrain, an online survey company with the largest panel in Korea. Before answering the questionnaire items, the respondents were asked to read concepts related to autonomous vehicles, as suggested by the society of automotive engineers international, as well as descriptions of the changes that autonomous vehicles might bring (SAE, 2018). Vehicle ownership questions were also asked to learn more about the respondents. Responses for all the questionnaire items were gathered using a five-point Likert scale. Tables 3 and 4 show the demographic properties of the respondents overall. The ages of participants ranged from 14 to 67. The majority of respondents (190, 60.9%) answered that they had their own cars.

5. Structural equation modeling

To identify the underlying structure of the items, we conducted a factor analysis based on respondent data. Because the examined items were designed to measure seven constructs in previous studies (i.e., PEOU, PU, ITU, PR, RA, SE, and PO), we considered that the number of constructs in factor analysis should be seven (Matsunaga, 2010). Also, through iterative checking of communalities and factor scores for seven constructs, we excluded 5 items from the analysis (PEOU4, PU3, ITU2, PR4, PO2) and consequently only 23 items were used for structural equation modeling. The Kaiser-Mayer-Olkin (KMO) test and Bartlett's test showed that the examined data was acceptable for factor analysis in terms of sampling adequacy (0.908) and sphericity ($\chi^2(253) = 4388.615$, p-value < 0.001). Also, component rotation with principle component analysis and varimax with the Kaiser normalization method showed that the examined constructs of the research model were discriminable without communality problems (all communality values were higher than 0.5). Tables 5 and 6 show the variance explained by the constructs and the results of communality and component rotation analyses. Decision criteria for the statistics were based on the guidelines of factor analysis (Child, 1990; Hair et al., 2014; Tabachnick

Table 2
Constructs and questionnaire items.

Questionnaire items	Adapted from
PEOU1. Interacting with an autonomous vehicle would be clear and understandable.	Davis (1989); Davis and Venkatesh (1996)
PEOU2. I would find an autonomous vehicle is easy to use.	
PEOU3. Interacting with an autonomous vehicle would not require much mental effort.	
PEOU4. Learning to operate an autonomous vehicle would be easy for me.	
PU1. Using an autonomous vehicle would enhance my driving effectiveness.	
PU2. Using an autonomous vehicle would increase my productivity.	
PU3. Using an autonomous vehicle would enhance my driving effectiveness.	
PU4. I would find an autonomous vehicle is useful.	
ITU1. Assuming I have access to an autonomous vehicle, I would intend to use it.	
ITU2. Given I have access to an autonomous vehicle, I predict I would use it.	
ITU3. In the future, I would not hesitate to use an autonomous vehicle	
PR1. A system in the autonomous vehicle may not enough to drive.	Featherman and Pavlou (2003) (Performance risk)
PR2. Using an autonomous vehicle may not perform well and create problems.	
PR3. An autonomous vehicle may not work properly.	
PR4. An autonomous vehicle may perform unstably and incorrectly.	
RA1. An autonomous vehicle would make it easier to drive compared to existing vehicles.	Moore and Benbasat (1991)
RA2. An autonomous vehicle would be advantageous in driving compared to existing vehicles.	
RA3. An autonomous vehicle would enable me to accomplish tasks more quickly compared to existing vehicles.	
RA4. An autonomous vehicle would give effective functions for driving compared to existing vehicles.	
RA5. An autonomous vehicle would give greater control of driving compared to existing vehicles.	
SE1. I can use the autonomous vehicle if there is a manual for it.	Compeau and Higgins (1995)
SE2. I can use the autonomous vehicle if someone shows me how to do it first.	
SE3. I think I can use the autonomous vehicle without help.	
SE4. I can use the autonomous vehicle although I had not used it before.	
SE5. I would not spend much time to learn how to use an autonomous vehicle.	
PO1. I would sense an autonomous vehicle is my place.	Van Dyne and Pierce (2004)
PO2. I would think an autonomous vehicle is mine.	
PO3. I would feel very high degree of personal ownership for the autonomous vehicle	

*Note: PEOU = perceived ease of use; PU = perceived usefulness; ITU = intention to use; PR = perceived risk; RA = relative advantage; SE = self-efficacy; PO = psychological ownership.

Table 3
Gender and age distributions of the respondents.

Measure	Value	Frequency (Percentage)	Korean population (Percentage)
Gender	Male	157 (50.16)	21,523,075 (51.16)
	Female	156 (49.84)	20,546,424 (48.84)
Age (years)	10–19	67 (21.40)	5,621,871 (13.36)
	20–29	68 (21.73)	6,796,396 (16.16)
	30–39	60 (19.17)	7,738,472 (18.39)
	40–49	60 (19.17)	8,726,984 (20.74)
	50–59	48 (15.34)	8,220,296 (19.54)
	60–69	10 (3.19)	4,965,480 (11.80)

*Note: Demographic information of Korea was identified by the Korean statistical information service.

et al., 2006).

We then constructed a structural equation model and examined it through partial least squares structural equation modeling (PLS-SEM) with ADANCO 2.1. Following the steps of PLS-SEM, we examined the measurement model first. Cronbach's alpha values for the measures were higher than 0.7, and the composite reliability (CR) and average variance extracted (AVE) values were higher than 0.7 and 0.5, respectively. The square roots of AVE for each construct were higher than the intercorrelations. All standardized indicator loading values for all constructs were higher than 0.7. To check the multicollinearity, the values of the variance inflation factor (VIF) were measured, and all values were lower than 5.0. Based on these values, we confirmed that the measures and constructs were acceptable in terms of the internal reliability, convergent validity, and discriminant validity (Chin, 1998; Fornell and Larcker, 1981; Gefen et al., 2000; Hair et al., 2017). Tables 7 and 8 show the reliability and validity test values.

Next, we examined the structural model through bootstrapping with 4999 subsamples following the recommendation of a previous study (Henseler et al., 2016). Fig. 3 shows the standardized coefficients of the structural model. As presented in the figure and table, H1, H3, H5, H6, H8, H10, and H12 were supported, while the other hypotheses were rejected at the 0.05 level of significance.

Table 4
Other properties of the respondents.

Measure	Value	Frequency (Percentage)
Education	Middle school graduate and below	4 (1.28)
	In high school	52 (16.61)
	High school	46 (14.70)
	In undergraduate school	33 (10.54)
	Undergraduate school	165 (52.72)
	In graduate school	3 (0.96)
	Graduate school and above	10 (3.19)
Marriage	Married	170 (54.31)
	Not married	143 (45.69)
Monthly income	Under 2 million won	30 (9.58)
	About 2 million won	36 (11.50)
	About 3 million won	72 (23.00)
	About 4 million won	41 (13.10)
	About 5 million won	56 (17.89)
	About 6 million won	24 (7.67)
	Between 7 and 10 million won	25 (7.99)
	Over 10 million won	29 (9.27)
Vehicle ownership	Car owner	190 (60.90)
	Car non-owner	123 (39.10)

Table 5
Variance explained by constructs.

# Constructs	Eigenvalues	Variance explained	Cumulative variance explained
1	9.200	40.002	40.002
2	2.228	9.686	49.688
3	2.141	9.310	58.997
4	1.383	6.011	65.009
5	1.013	4.406	69.415
6	0.785	3.414	72.828
7	0.647	2.812	75.640

*Note: Variances are expressed as percentages.

Table 6
Communalities and rotated components.

	Communality	Component						
		1	2	3	4	5	6	7
PEOU1	0.681	**0.604**	0.238	0.184	−0.104	0.287	0.352	0.086
PEOU2	0.800	**0.793**	0.171	0.128	−0.047	0.213	0.244	0.049
PEOU3	0.783	**0.715**	0.237	0.173	−0.033	0.176	0.387	0.144
PU1	0.709	0.193	**0.618**	0.235	−0.046	0.402	0.259	0.059
PU2	0.817	0.208	**0.730**	0.225	−0.037	0.394	0.183	0.018
PU3	0.775	0.276	**0.657**	0.201	0.008	0.437	0.187	−0.027
ITU1	0.867	0.176	0.260	**0.811**	−0.103	0.167	0.232	0.133
ITU2	0.840	0.280	0.246	**0.716**	−0.096	0.295	0.267	0.145
PR1	0.728	−0.130	−0.177	0.045	**0.813**	0.010	0.113	−0.054
PR2	0.792	0.010	0.073	−0.085	**0.865**	−0.119	−0.110	0.070
PR3	0.790	−0.015	0.042	−0.095	**0.879**	0.011	−0.068	0.040
RA1	0.695	0.184	0.198	0.101	0.014	**0.760**	0.170	−0.073
RA2	0.722	0.134	0.008	0.307	−0.061	**0.764**	0.142	0.043
RA3	0.699	0.241	0.115	0.124	−0.004	**0.746**	0.205	0.118
RA4	0.694	0.036	0.279	−0.090	−0.096	**0.766**	0.085	0.055
RA5	0.648	0.085	0.226	0.095	0.002	**0.736**	0.147	0.132
SE1	0.791	0.130	0.140	0.167	0.008	0.157	**0.838**	0.020
SE2	0.764	0.099	0.306	0.091	0.061	0.231	**0.771**	−0.003
SE3	0.716	0.450	−0.051	0.241	−0.048	0.094	**0.633**	0.203
SE4	0.751	0.406	0.099	0.130	−0.111	0.211	**0.672**	0.225
SE5	0.768	0.452	0.071	0.060	−0.100	0.225	**0.686**	0.155
PO1	0.760	0.174	0.034	0.144	0.041	0.105	0.172	**0.816**
PO2	0.807	0.026	−0.001	0.038	0.023	0.046	0.057	**0.894**

Table 7
Reliability and validity assessments.

Construct	Measure	Loading	VIF	Cronbach's alpha	CR	AVE
PEOU	PEOU1	0.862	1.886	0.849	0.909	0.769
	PEOU2	0.907	2.481			
	PEOU3	0.860	2.097			
PU	PU1	0.865	1.958	0.863	0.917	0.786
	PU2	0.902	2.542			
	PU3	0.891	2.360			
ITU	ITU1	0.921	2.213	0.851	0.930	0.870
	ITU2	0.943	2.213			
PR	PR1	0.786	1.569	0.820	0.892	0.735
	PR2	0.898	2.099			
	PR3	0.884	2.159			
RA	RA1	0.824	2.012	0.868	0.905	0.655
	RA2	0.806	1.910			
	RA3	0.831	2.053			
	RA4	0.779	1.826			
	RA5	0.806	1.891			
SE	SE1	0.822	2.274	0.893	0.921	0.700
	SE2	0.787	2.058			
	SE3	0.822	2.090			
	SE4	0.877	2.813			
	SE5	0.873	2.782			
PO	PO1	0.953	1.474	0.724	0.867	0.766
	PO2	0.791	1.474			

*Note: VIF = variance inflation factor; CR = composite reliability; AVE = average variance extracted.

Table 8
Intercorrelation matrix of the constructs.

Construct	PEOU	PU	ITU	PR	RA	SE	PO
PEOU	**0.877**						
PU	0.634***	**0.886**					
ITU	0.603***	0.636***	**0.932**				
PR	−0.144**	−0.095	−0.180*	**0.857**			
RA	0.533***	0.703***	0.510***	−0.098	**0.809**		
SE	0.747***	0.543***	0.580***	−0.114*	0.491***	**0.837**	
PO	0.323***	0.185*	0.329***	0.035	0.223***	0.354***	**0.875**

*Note: Scores in bold indicate the square root of the average variance that was extracted; ***, **, * = Significance at the 0.001, 0.01, and 0.05 levels

6. Discussion

It is an autonomous vehicle. The matter is how useful it is rather than how easy it is to use.

The original technology acceptance model assumed that the perceived ease of use affected the perceived usefulness, and both factors affect the intention to use (Davis, 1989; Davis et al., 1989). However, among previous studies looking into autonomous vehicles, which examined all of these relationships, only Panagiotopoulos and Dimitrakopoulos (2018) reported that all of the relationships were significant. Choi and Ji (2015) showed that the perceived ease of use did not influence the perceived usefulness, and Hein et al. (2018) presented that the perceived ease of use had no significant effect on the intention to use. In this study, we found that the perceived ease of use and perceived usefulness affected the perceived usefulness and intention to use, respectively. However, the perceived ease of use did not influence the intention to use. This result was similar to the one reported by Hein et al. (2018) but partly different from Choi and Ji (2015) and Panagiotopoulos and Dimitrakopoulos (2018).

Although some studies have reported different results, a common finding in previous studies was that the intention to use autonomous vehicles was mainly affected by the perceived usefulness rather than by the perceived ease of use (Choi and Ji, 2015; Hein et al., 2018; Panagiotopoulos and Dimitrakopoulos, 2018). This was also supported by several meta-analysis studies of the technology acceptance model (King and He, 2006; Ma and Liu, 2004). In the context of autonomous vehicles, the dominant effect of the perceived usefulness on the intention to use can be regarded as a distinctive characteristic of autonomous vehicles. Autonomous vehicles can drive without human intervention, and people can go anywhere and convey cargo without proficient driving skills. This property predicts that the effect of the perceived ease of use on the intention to use autonomous vehicles may be weakened compared to conventional vehicles; our results supported this prediction.

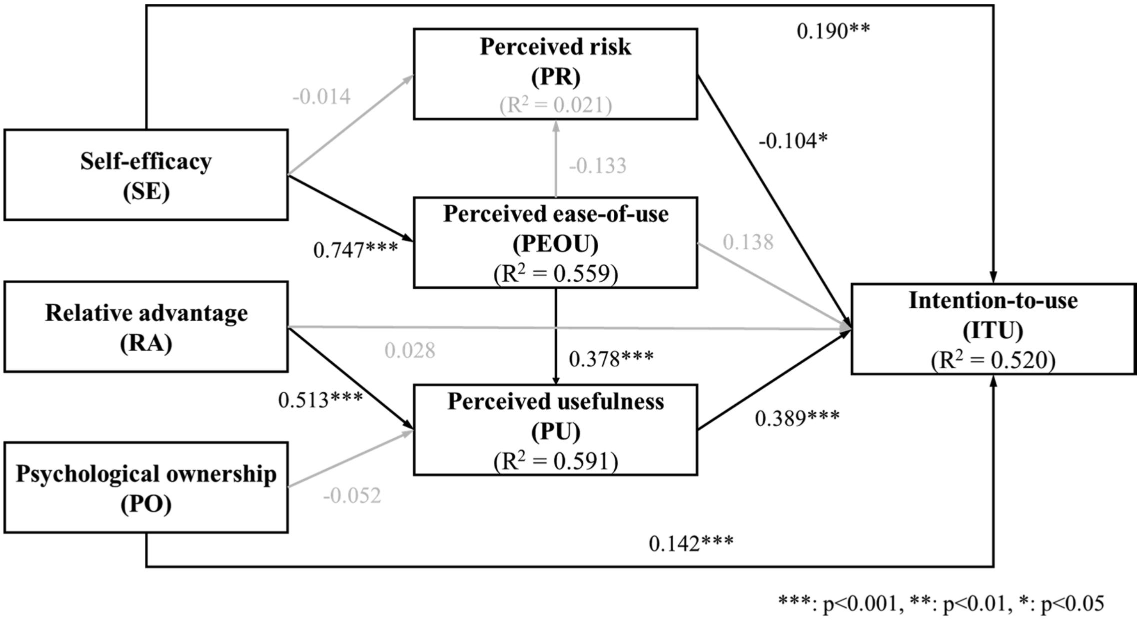

Fig. 3. Estimated structural equation model.

Driving is autonomous, but I believe my ability is still important in driving.

Previous studies investigating autonomous vehicles reported that self-efficacy can affect the intention to use (Buckley et al., 2018; Choi and Ji, 2015). However, they did not consider self-efficacy as antecedent to the perceived ease of use (Venkatesh and Davis, 1996). Similarly, although Ward et al. (2017) examined the effect of the perceived benefits on the intention to use, they did not consider the perceived usefulness as a consequence of the perceived benefits but as an antecedent of the intention to use (Kulviwat et al., 2007). Based on these limitations, this study presented how such underlying constructs can affect the intention to use through the perceived ease of use and perceived usefulness.

Self-efficacy was determined to be influential on the perceived ease of use and intention to use; however, the perceived ease of use did not influence the intention to use. This shows how users determine whether they want to use autonomous vehicles in detail. At the system level, users may believe that their ability to operate autonomous vehicles is not critical for actually using autonomous vehicles because most parts of driving are autonomous. However, at the psychology level, their beliefs about their ability are critical because they may still consider that some parts of autonomous driving are related to their ability (even though they are not). This implies that providing feedback indicating that one's ability is significantly involved in autonomous driving, and is helpful to enable comfortable driving, may be an effective strategy to enhance the intention to use autonomous vehicles. Although actual driving performance may not be related to one's ability, this strategy can enhance self-efficacy and induce the use of autonomous vehicles (directly or indirectly) through the perceived ease of use and perceived usefulness.

Contrary to self-efficacy, the relative advantage affected the perceived usefulness but not the intention to use autonomous vehicles. In other words, the perception of usefulness at the psychological level was not influential on the intention to use but became influential at the system level. This shows how users decide to use autonomous vehicles. Emphasizing the relative advantages may be a good way to help users more seriously consider using autonomous vehicles. However, without clear and unique advantages that only autonomous vehicles can provide, users may decide against using autonomous vehicles. This is supported by several previous studies, which reported that users who already own vehicles would not adopt an autonomous vehicle because they do not perceive clear and unique advantages of autonomous vehicles (Pakusch et al., 2018). To increase the intention to use autonomous vehicles, marketers should emphasize not only their relative advantages, as compared to conventional vehicles, but also their unique usefulness.

Autonomous vehicles are risky because accidents can occur, regardless of my ability.

As reported by several previous studies (Ward et al., 2017; Xu et al., 2018), we found that the perceived risk influenced the intention to use autonomous vehicles. An interesting finding was that no antecedents (self-efficacy and perceived ease of use) were influential on the perceived risk. This means that users believed the risks of autonomous vehicles were only related to external factors, such as system errors or accidental events. With autonomous vehicles, users are only involved in a few parts of driving; thus, they are hardly responsible for any accidental situations that occur during driving. The isolated effect of perceived risk in our research model clearly presents this idea.

Several studies have suggested strategic approaches to address the perceived risk of autonomous vehicles. For example, improving anthropomorphic features of autonomous vehicles and providing information about autonomous driving can enhance the perceived trust and reduce the perceived risk of autonomous vehicles. Waytz et al. (2014) showed that using anthropomorphic features was effective to increase trust for autonomous vehicles. Additionally, Haeuslschmid et al. (2017) designed a human-like avatar, which presented driving information to a user, and examined its effect on trust in autonomous driving. Although they failed to find that the avatar created any significant effect, they did find that information feedback was effective to enhance trust for autonomous vehicles. Dikmen and Burns (2016) reported that autopilot drivers' perception of risk was significantly correlated with knowing how the vehicle made decisions. They suggested that information feedback can be effective to reduce the perceived risk of autonomous vehicles. Designers can utilize these strategies to reduce the perceived risk of autonomous vehicles and minimize negative effects on the intention to use.

Autonomous vehicles can be shared, but a feeling of ownership is important to me.

In an interview conducted by Zmud et al. (2016), people reported that they were interested in owning autonomous vehicles because they seemed useful. Also, people who preferred a sharing service rather than owning an autonomous vehicle reported that they preferred the service because they wanted to experience an autonomous vehicle before owning one. We also found that the perceived usefulness and psychological ownership positively affected the intention to use. An interesting point was that psychological ownership did not influence the perceived usefulness of autonomous vehicles. In other words, whether or not people feel like an autonomous vehicle is their own, they perceive the usefulness of the autonomous vehicle and may consider using it because they want to own it.

This finding suggests that focusing on psychological ownership can be a strategic marketing approach. As we discussed above, it is important to emphasize the relative advantages of an autonomous vehicle compared to existing vehicles. For persons who already have their own vehicles, however, this may not be easy because they would have to own more than one vehicle if they decide to adopt an autonomous vehicle. Usually, this is an unnecessary situation; thus, an individual would likely keep their own vehicle rather than adopting a new autonomous vehicle (Zmud et al., 2016). These people would likely perceive lower usefulness of autonomous vehicles because they have a small relative advantage. However, these persons can still have psychological ownership of multiple vehicles. Even though they do not actually own the vehicles, they can still feel like the vehicles are their own. Several marketing strategies can be suggested based on psychological ownership. For example, if an autonomous vehicle plays some music or movies based on a user's preference information or recommends some driving routes based on a user's driving history, a user may be more likely to feel that the vehicle is customized to him/her, and which consequently lead the user to feel that the vehicle is my personal place. Also, several functions of indoor environment control such as air conditioning and indoor lighting can be provided based on the user information. The more autonomous vehicles reflect user information and provide personalized mobility services, the more users can feel that the vehicles are focused on them and construct psychological ownership for the vehicles. This psychological ownership may not affect perceived usefulness but it can still promote the use of autonomous vehicles.

7. Limitations of this study

To help grasp the results and findings of this study in more detail, three limitations need to be stated. First, although statistical tests showed that the examined constructs were acceptable in terms of reliability and validity, some of the constructs were measured by items less than three (i.e., intention to use) and presented high correlations. Thus, future studies can consider different sets of items for the constructs and further improve the reliability and validity of the findings in this study. Second, although we tried to control the demographic properties of the collected data, distributions of the ages of respondents and the Korean population were not statistically identical (chi-square = 44.114, p-value < 0.001). Also, due to the unbalanced distribution of the ages (e.g., only few respondents were 60–69 year old), results of this study may have skewed to specific age groups. Thus, readers of this study should note that the findings of this study limitedly reflect properties of the Korean population, and future studies can consider sample weighting methods to remedy the demographic property issue. Third, other factors that may affect the perception of autonomous vehicles were not strictly controlled and examined in this study. For example, respondents of this study may have had different concepts of automation levels in mind when they respond to the questionnaire items and this may have affected the reliability and validity of the findings in this study. Similarly, driving experiences of respondents can affect the perception of autonomous vehicles (Becker and Axhausen, 2017). Thus, future studies can control these factors and examine users' perceptions in detail.

8. Conclusion

In this study, we examined influential factors for intention to use autonomous vehicles. Relationships between seven factors (i.e., perceived usefulness, perceived ease of use, intention to use, perceived risk, relative advantage, self-efficacy, and psychological ownership) were examined using structural equation modeling. Our results showed that perceived usefulness, self-efficacy, perceived risk, and psychological ownership can be significant factors that affect intention to use autonomous vehicles. Especially, psychological ownership was presented as not related to perceived usefulness but related to the intention to use. We discussed the implications of this finding on other factors.

Future studies should consider two issues in greater detail. First, trust toward autonomous vehicles and the perceived risk for autonomous driving situations can be evaluated together. Examining the relationships between trust, perceived risk, and intention to use autonomous vehicles may provide a detailed strategic approach that can be used to enhance customers' intention to use. Second, more details on the effects of perceived risk should be examined. Although we only considered the performance risk in our analysis, there are several different types of risk, including psychological, social, and privacy risks (Featherman and Pavlou, 2003). A segmented approach with different types of perceived risks could better illustrate the relationships among trust, perceived risk, and intention to use.

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References

Ajzen, I., 1991. The theory of planned behavior. Organ. Behav. Hum. Decis. Process. 50 (2), 179–211.
Bandura, A., 1982. Self-efficacy mechanism in human agency. Am. Psychol. 37 (2), 122–147.
Bandura, A., 1988. Self-efficacy conception of anxiety. Anxiety Res. 1 (2), 77–98.
Becker, F., Axhausen, K.W., 2017. Literature review on surveys investigating the acceptance of automated vehicles. Transportation 44 (6), 1293–1306.
Brell, T., Philipsen, R., Ziefle, M., 2018. sCARy! Risk perceptions in autonomous driving: the influence of experience on perceived benefits and barriers. Risk Anal. 39 (2), 342–357.
Buckley, L., Kaye, S.-A., Pradhan, A.K., 2018. Psychosocial factors associated with intended use of automated vehicles: a simulated driving study. Accid. Anal. Prev. 115, 202–208.
Child, D., 1990. The Essentials of Factor Analysis, second ed. Cassell Educational, New York, NY.
Chin, W.W., 1998. Commentary: issues and opinion on structural equation modeling. MIS Quarterly 22 (1), 7–16.
Choi, J.K., Ji, Y.G., 2015. Investigating the importance of trust on adopting an autonomous vehicle. Int. J. Human-Comput. Interact. 31 (10), 692–702.
Compeau, D.R., Higgins, C.A., 1995. Computer self-efficacy: development of a measure and initial test. MIS Quarterly 19 (2), 189–211.
Davis, F.D., 1989. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly 13 (3), 319–340.
Davis, F.D., Bagozzi, R.P., Warshaw, P.R., 1989. User acceptance of computer technology: a comparison of two theoretical models. Manage. Sci. 35 (8), 982–1003.
Davis, F.D., Venkatesh, V., 1996. A critical assessment of potential measurement biases in the technology acceptance model: three experiments. Int. J. Hum Comput. Stud. 45 (1), 19–45.
Dikmen, M., Burns, C.M., 2016. Autonomous driving in the real world: experiences with tesla autopilot and summon. In: Paper Presented at the Proceedings of the 8th International Conference on Automotive User Interfaces and Interactive Vehicular Applications (AutomotiveUI), Ann Arbor, MI.
Efthymiou, D., Antoniou, C., Waddell, P., 2013. Factors affecting the adoption of vehicle sharing systems by young drivers. Transp. Pol. 29, 64–73.
Featherman, M.S., Pavlou, P.A., 2003. Predicting e-services adoption: a perceived risk facets perspective. Int. J. Hum. Comput. Stud. 59 (4), 451–474.
Fornell, C., Larcker, D.F., 1981. Evaluating structural equation models with unobservable variables and measurement error. J. Mark. Res. 18 (1), 39–50.
Gefen, D., Straub, D., Boudreau, M.-C., 2000. Structural equation modeling and regression: guidelines for research practice. Commun. Assoc. Inform. Syst. 4 (1) Article 7.
Gkartzonikas, C., Gkritza, K., 2019. What have we learned? A review of stated preference and choice studies on autonomous vehicles. Transport. Res. Part C: Emerg. Technol. 98, 323–337.
Haeuslschmid, R., von Buelow, M., Pfleging, B., Butz, A., 2017. Supporting trust in autonomous driving. In: Paper Presented at the 22nd International Conference on Intelligent User Interfaces (IUI), Limassol, Cyprus.
Hair, J.F., Black, W.C., Babin, B.J., Anderson, R.E., 2014. Multivariate Data Analysis, seventh ed. Pearson Education, Essex, UK.
Hair, J., Hollingsworth, C.L., Randolph, A.B., Chong, A.Y.L., 2017. An updated and expanded assessment of PLS-SEM in information systems research. Ind. Manage. Data Syst. 117 (3), 442–458.
Hein, D., Rauschnabel, P., He, J., Richter, L., Ivens, B., 2018. What drives the adoption of autonomous cars? In: Paper Presented at the 39th International Conference on Information Systems (ICIS), San Fransisco, CA.
Henseler, J., Hubona, G., Ray, P.A., 2016. Using PLS path modeling in new technology research: updated guidelines. Ind. Manage. Data Syst. 116 (1), 2–20.
Hohenberger, C., Spörrle, M., Welpe, I.M., 2017. Not fearless, but self-enhanced: the effects of anxiety on the willingness to use autonomous cars depend on individual levels of self-enhancement. Technol. Forecast. Soc. Chang. 116, 40–52.
Karahanna, E., Agarwal, R., Angst, C.M., 2006. Reconceptualizing compatibility beliefs in technology acceptance research. Manage. Inform. Syst. Quart. 30 (4), 781–804.
King, W.R., He, J., 2006. A meta-analysis of the technology acceptance model. Inform. Manage. 43, 740–755.
König, M., Neumayr, L., 2017. Users' resistance towards radical innovations: the case of the self-driving car. Transport. Res. Part F: Traffic Psychol. Behav. 44, 42–52.
Kulviwat, S., Bruner II, G.C., Kumar, A., Nasco, S.A., Clark, T., 2007. Toward a unified theory of consumer acceptance technology. Psychol. Market. 24 (12), 1059–1084.
Kyriakidis, M., Happee, R., de Winter, J.C., 2015. Public opinion on automated driving: results of an international questionnaire among 5000 respondents. Transport. Res. Part F: Traffic Psychol. Behav. 32, 127–140.
Lee, Y.H., Hsieh, Y.C., Hsu, C.N., 2011. Adding innovation diffusion theory to the technology acceptance model: supporting employees' intentions to use e-learning systems. J. Ed. Technol. Soc. 14 (4), 124–137.
Liu, P., Xu, Z., Zhao, X., 2019. Road tests of self-driving vehicles: affective and cognitive pathways in acceptance formation. Transport. Res. Part A: Pol. Pract. 124, 354–369.
Liu, P., Yang, R., Xu, Z., 2018. Public acceptance of fully automated driving: effects of social trust and risk/benefit perceptions. Risk Anal. 39 (2), 326–341.
Ma, Q., Liu, L., 2004. The technology acceptance model: a meta-analysis of empirical findings. J. Org. End User Comput. 16, 59–72.
Matsunaga, M., 2010. How to factor-analyze your data right: Do's, Don'ts, and HOW-to's. Int. J. Psychol. Res. 3 (1), 97–110.
Madigan, R., Louw, T., Wilbrink, M., Schieben, A., Merat, N., 2017. What influences the decision to use automated public transport? Using UTAUT to understand public acceptance of automated road transport systems. Transport. Res. Part F: Traffic Psychol. Behav. 50, 55–64.
Merat, N., Jamson, A.H., Lai, F.C., Carsten, O., 2012. Highly automated driving, secondary task performance, and driver state. Hum. Factors 54 (5), 762–771.
Milakis, D., Van Arem, B., Van Wee, B., 2017. Policy and society related implications of automated driving: a review of literature and directions for future research. J. Intell. Transport. Syst. 21 (4), 324–348.
Moore, G.C., Benbasat, I., 1991. Development of an instrument to measure the perceptions of adopting an information technology innovation. Inform. Syst. Res. 2 (3), 192–222.
Moták, L., Neuville, E., Chambres, P., Marmoiton, F., Monéger, F., Coutarel, F., Izaute, M., 2017. Antecedent variables of intentions to use an autonomous shuttle: moving beyond TAM and TPB? Revue Européenne de Psychologie Appliquée/Europ Rev Appl Psychol 67 (5), 269–278.
Pakusch, C., Stevens, G., Boden, A., Bossauer, P., 2018. Unintended effects of autonomous driving: a study on mobility preferences in the future. Sustainability 10 (7), 2404.

Panagiotopoulos, I., Dimitrakopoulos, G., 2018. An empirical investigation on consumers' intentions towards autonomous driving. Transport. Res. Part C: Emerg. Technol. 95, 773–784.
Payre, W., Cestac, J., Delhomme, P., 2014. Intention to use a fully automated car: attitudes and a priori acceptability. Transport. Res. Part F: Traffic Psychol. Behav. 27, 252–263.
Pierce, J.L., Kostova, T., Dirks, K.T., 2001. Toward a theory of psychological ownership in organizations. Acad. Manag. Rev. 26 (2), 298–310.
Pierce, J.L., Rubenfeld, S.A., Morgan, S., 1991. Employee ownership: a conceptual model of process and effects. Acad. Manag. Rev. 16 (1), 121–144.
Rödel, C., Stadler, S., Meschtscherjakov, A., Tscheligi, M., 2014. Towards autonomous cars: the effect of autonomy levels on acceptance and user experience. In: Paper Presented at the Proceedings of the 6th International Conference on Automotive User Interfaces and Interactive Vehicular Applications (AutomotiveUI), Seattle, WA.
SAE, 2018. Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles (J3016_201806).
Schlüter, J., Weyer, J., 2019. Car sharing as a means to raise acceptance of electric vehicles: an empirical study on regime change in automobility. Transport. Res. Part F: Traffic Psychol. Behav. 60, 185–201.
Tabachnick, B.G., Fidell, L.S., Ullman, J.B., 2006. Using Multivariate Statistics, fifth ed. Pearson, Boston, MA.
Van Dyne, L., Pierce, J.L., 2004. Psychological ownership and feelings of possession: three field studies predicting employee attitudes and organizational citizenship behavior. J. Org. Behav.: Int. J. Ind., Occup. Org. Psychol. Behav. 25 (4), 439–459.
Venkatesh, V., Davis, F.D., 1996. A model of the antecedents of perceived ease of use: development and test. Dec. Sci. 27 (3), 451–481.
Venkatesh, V., Morris, M.G., Davis, F.D., Davis, G.B., 2003. User acceptance of information technology: toward a unified view. MIS Quart. 27 (3), 425–478.
Verberne, F.M., Ham, J., Midden, C.J., 2012. Trust in smart systems: sharing driving goals and giving information to increase trustworthiness and acceptability of smart systems in cars. Hum. Factors 54 (5), 799–810.
Wachenfeld, W., Winner, H., Gerdes, J.C., Lenz, B., Maurer, M., Beiker, S., et al., 2016. Use cases for autonomous driving. In: Maurer, M., Gerdes, J.C., Lenz, B., Winner, H. (Eds.), Autonomous Driving. Springer, Berlin, Heidelberg.
Walker, J., 2018. The self-driving car timeline – Predictions from the top 11 global automakers. Retrieved from. https://www.techemergence.com/self-driving-car-timeline-themselves-top-11-automakers/.
Ward, C., Raue, M., Lee, C., D'Ambrosio, L., Coughlin, J.F., 2017. Acceptance of automated driving across generations: the role of risk and benefit perception, knowledge, and trust. In: Paper Presented at the 19th International Conference on Human-Computer Interaction, Vancouver, Canada.
Waytz, A., Heafner, J., Epley, N., 2014. The mind in the machine: anthropomorphism increases trust in an autonomous vehicle. J. Exp. Soc. Psychol. 52, 113–117.
Wu, H.Y., Lin, C.C., Li, O., Lin, H.H., 2010. A study of bank customers' perceived usefulness of adopting online banking. Global J. Bus. Res. 4 (3), 101–108.
Wu, J., Liao, H., Wang, J.-W., Chen, T., 2019. The role of environmental concern in the public acceptance of autonomous electric vehicles: a survey from China. Transport. Res. Part F: Traffic Psychol. Behav. 60, 37–46.
Xu, Z., Zhang, K., Min, H., Wang, Z., Zhao, X., Liu, P., 2018. What drives people to accept automated vehicles? Findings from a field experiment. Transport. Res. Part C: Emerg. Technol. 95, 320–334.
Zmud, J., Sener, I.N., Wagner, J., 2016. Self-driving vehicles: determinants of adoption and conditions of usage. Transport. Res. Record: J. Transport. Res. Board 2565, 57–64.