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Teenage dreams of self-driving cars: Findings of a UTAUT-based conjoint analysis among the 14–19 age group

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ABSTRACT

The impending ubiquity of self-driving cars promises profound societal change, making public acceptance crucial. However, most studies focus on the general population, particularly those familiar with driving and technology, neglecting teenagers' views. Given their significant exposure to this upcoming auto-revolution and uninfluenced driving habits, understanding their perspective is vital. Our research, targeting teenagers aged 14–19, employs a visualized conjoint method built upon the UTAUT (unified theory of acceptance and use of technology) framework. With this method we were able to measure not just agreement with attitudinal statements, but rather grasp real preferences, as respondents were asked to rank concrete level 5 autonomous vehicles with specific attributes. Although this age group may be considered reckless and self-assertive, our results suggest the opposite as safety proved to be paramount for them, while social influence and recommendation proved to be less significant This offers valuable insights for future autonomous vehicle strategies catering to the next generation.

1. Introduction[1]

Today, the question is no longer whether autonomous vehicle-driven urban mobility becomes a reality but rather when it will be realized (Grindsted et al., 2022). The technological conditions of the dissemination of autonomous vehicles are becoming increasingly stable, vehicle companies report more and more convincing test results. Not only the number of involved cities in street tests and companies with road test permit is increasing dynamically, but also the number of test kilometers on the roads, while documented human intervention is decreasing[2] (DMV, 2023).

The rapid and widespread deployment of autonomous vehicles does not only require technological maturity but also the technology acceptance of society's critical mass (Kovács and Lukovics, 2022, Zhang et al., 2023). However, in terms of the public, positive anticipation is accompanied by considerable anxiety, concern, and uncertainty (EC, 2018), which can be shown for different demographic groups in different ways (Janatabadi and Ermagun, 2022; Miller et al., 2022).

The youth is considered as one of the earliest acceptors of new technologies in general (Grewal et al., 2017) and autonomous vehicles in particular (Huang et al., 2022; Silberg and Wallace, 2012). However we have to note that this can vary culturally and among industries. The young generally have different characteristics in terms of their mobility attitudes compared to previous generations (Maltese and Zamparini, 2023). The proportion of young adults who have or intend to have a driving license is decreasing (Delbosc 2017; Bayart et al., 2020). Similarly, younger generations have lower willingness regarding car ownership and/or usage worldwide (Hjorthol 2016; Verma et al., 2016). Furthermore, they show higher willingness to use more sustainable mobility options and alternative modes of transport in general (Groth and Kuhnimhof, 2021; Hunecke et al., 2020). Since today's young generation is the maker of tomorrow's mobility (Herrekind et al., 2019b), it is particularly justified to understand young people's technology acceptance.

The technology acceptance models (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) models considered as the main frameworks of numerous research studies addressing autonomous technology acceptance in the literature. These questionnaire-based

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[2] In California in 2022, the vehicles travelled 5.7 million miles, which was 1 million miles more compared to the base period, in autonomous mode with 28% more test vehicles with a decreasing need for human intervention (DMV 2023).

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research papers identified the factors that have influence on technology acceptance (Nordhoff et al., 2019). They showed that attitude (Hudson et al., 2019), perceived usefulness (Koul and Eydgahi, 2018), performance expectancy (Kaye et al., 2020), perceived ease of use (Páthy, 2021), social influence (Korkmaz et al., 2022), hedonic motivation (Madigan et al., 2017), perceived enjoyment (Müller, 2019), price sensitivity (Kapser and Abdelrahman, 2020), safety (Manfreda et al., 2019), trust (Cai et al., 2023), compatibility (Foroughi et al., 2023), self-efficacy (Du et al., 2021), novelty seeking (Baccarella et al., 2020), anxiety (Cho et al., 2017), and experience (Moták et al., 2017) are all significant predictors of behavioral intention. Keszey (2020) also concluded through a systematic literature review that these studies obtain heterogenous, often controversial results, which indicates the complexity, uncertainty, and unclarified nature of this topic.

Yuen et al. (2020) found that attitude, subject norm, perceived behavioural control, along with its perceived facilitating conditions, are all effective predictors of intention to use AVs. Benleulmi and Blecker (2017) found that percieved risks has an important role in the acceptance of fully autonomous cars. While Xing et al. (2020) added that trust ss an important mediator between perceived risk, usefulness, and ease of use on both affect and intention to ride self-driving vehicles. Trust was also found to be important as Du et al. (2021) found that trust – as well as self-efficacy and subjective norms – had significant affect on the intention to use self-driving cars. Liu et al. (2019) identified trust from a slightly different angle, claiming that the intention to use AV was predicted by social trust.

Rahman and Thill (2023) acknowledged in their state-of-the-art literature review that psychological factors are the most significant internal influences on people's willingness to adopt AVs. Other internal factors, such as an individual's and their household's socioeconomic profile, along with their knowledge and familiarity with AV technologies, also impact adoption tendencies.

We have identified two gaps in the literature that our study aims to fill. On the one hand it is increasingly clear that the above presented numerous factors have significant influence on the attitudes toward autonomous vehicles. However, as Acheampong and Cugurullo (2019) highlights, little is known about the relative importance of these factors, while comparing and ranking them would be essential in defining an ideal autonomous vehicle. The other gap in the literature derives from the scarce information about the attitudes of teenagers at the age of 14–19, as the majority of research makes findings and suggestions at a general social level (Howard and Dai 2014). In most of the studies, the respondents were typically older individuals with experience in driving and more thorough technological knowledge, while it is the young people who hold the potential to make future travel behavior more sustainable (Herrekind et al., 2019b; Si et al., 2024). Thus, we know little about the technology acceptance of the segment whose exposure to future mobility driven by autonomous cars is significant, while their attitudes are not yet influenced by long-standing habits in terms of car driving.

Our research aims to find out which autonomous vehicle attributes are the most important for consumers at the age of 14–19. As our study focuses on a still scarcely spread Level 5 autonomous vehicles, where vehicles are driven without human intervention (SAE, 2016), we needed to address this question with a method that is suited for brand new technologies. Conjoint analysis is a methodology of a decade-long tradition in the area of innovation and new product development (Green et al., 2001), where respondents had to evaluate and rank fictional images (presented in paper cards) of self-driving cars with different attributes. This method allows us to compare the importance of each vehicle attributes according to the respondents. Based on this we were able to provide the attribute combination of their most desirable autonomous vehicle, or in other words portray an "ideal" autonomous vehicle according to our respondents.

2. Literature review

In order to understand consumers' attitude toward autonomous vehicles, we need to take technology acceptance models as our basis. The common root of these models is the Theory of Reasoned Action (Fishbein and Ajzen, 1975), and the related Theory of Planned Behavior (Ajzen, 1991). These two models were mainly used in corporate environment, while the Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT1 and UTAUT2) are the common methodological frameworks in case of measuring the technology adaptation of consumers (Keszey, 2020). The basic logic of the TAM and UTAUT models is common: the use of new technology is derived from behavioral intention, and these methods aim to grasp the main factors which influence this behavioral intention (Zefreh et al., 2023). These factors are summarized in Table 1.

The majority of research addressing autonomous technology acceptance relies on the independent variables of TAM and UTAUT systems (Keszey 2020) and typically analyzes with Partial Least Squares Structural Equation Modeling (PLS-SEM) or regression method after data collection via questionnaire (Table 2). However, these studies do not necessarily identify the specific preferences and needs of consumers, and thereby the future buyer behavior (Nickaar et al., 2023). Furthermore UTAUT model has well documented limitations that arise mostly from the development of the scales that were used to measure the core constructs (Marikyan and Papagiannidis, 2023).

In response to the limitations of the traditional survey methods conjoint analysis is already applied by several papers in the literature for unfolding consumers' preferences related to autonomous vehicles. In these research respondents had to rate and rank various autonomous vehicle solutions (Zhou et al., 2023) that differ in attributes such as travel time (Kashani et al., 2023), responsibility (Maeng and Cho, 2022), safety (Shabanpour et al., 2018), comfort (Cunningham et al., 2019), price (Bansal and Daziano, 2018), or ownership (Jabbari et al., 2022). Most of them are discrete choice experiment (DCE), in which the researchers themselves create the combinations of these attributes, primarily to analyze Willingness To Pay (WTP). Daziano et al. (2017) discovered that the average household is willing to pay a significant amount for automation: about $3500 for partial automation and $4900 for full automation. Furthermore Cunningham et al. (2019) found that attitudes and opinions relating to perceived benefits, level of comfort with an AV undertaking certain driving functions, and engagement in secondary activities were among the strongest predictors of WTP. Bansal and Daziano (2018), and Daziano et al. (2017) point out that consumers would not purchase an autonomous vehicle because of the presumably high price of autonomous technology, on the other hand, they are willing to pay a significantly higher price to travel by them. Jabbari et al. (2022), as well as Shabanpour et al. (2018)) found that safety is of the highest relative importance in the case of autonomous vehicles, but little is known about what other attributes are important for users. The majority of the presented, mainly online, questionnaire surveys do not study the autonomous vehicle preferences of the age group under 18. At the same time, Shabanpour et al. (2018) and Shin et al. (2015) highlight that the younger generation shows different patterns compared to older ones and tend to be more open to use new modes of transport, thus, examining their autonomous vehicle preferences is of particular importance.

The following table summarizes the main characteristics of conjoint-based studies applied in AV research (Table 3). There is an interesting contradiction in the literature: while the mainstream AV technology acceptance studies almost exclusively analyze the variables in the TAM and UTAUT frameworks (Keszey, 2020), the research studies conducted with conjoint methodology rely more on Utility Theory and omit the analysis of TAM/UTAUT variables. The essence of Utility Theory is that when choosing from different products, the decision maker evaluates each attribute of the product in a different way (Luce and Tukey, 1964), and their aim is to purchase the product which represents the highest

Table 1
Independent variables of the models measuring technology acceptance.

TAM 1 (Davis 1989)	TAM 2 Venkatesh and Davis (2000)	TAM 3 (Venkatesh and Bala, 2008)	UTAUT (Venkatesh et al., 2003)	UTAUT2 (Venkatesh et al., 2012)
- External factors	- Subjective Norm - Image - Job Relevance - Output Quality - Result Demonstrability	- Subjective Norm - Image - Job Relevance - Output Quality - Result Demonstrability - Computer Self-efficacy - Perceptions of External Control - Computer Anxiety - Computer Playfulness - Perceived Enjoyment - Objective Usability	- Performance Expectancy - Effort Expectancy - Social Influence - Facilitating Conditions	- Performance Expectancy - Effort Expectancy - Social Influence - Facilitating Conditions - Hedonic Motivation - Utilitarian Motivation - Price Value

Source: authors' own.

Table 2
Data collection and age group focus data of TAM/UTAUT-based empirical studies on AV acceptance.

Study	Theoretical framework	Sample size	Data collection	Method of analysis	Age focus
Buckley et al. (2018)	TAM	74	simulator and questionnaire	Hierarchical regression analysis	25–64 years
Chen (2019)	TAM, UTAUT	700	test ride and questionnaire	Multi-group SEM	18 – 65
Chen and Yan (2019)	TAM, UTAUT	574	questionnaire	PLS-SEM, PLS-MGA, PLS-POS	16 – 65
Choi and Ji (2015)	TAM	552	online questionnaire	PLS	30 – 59
Hegner et al. (2019)	TAM	369	online questionnaire	SEM	average age 31 (SD = 12.9) years
Herrekind et al. (2019a)	TAM	268	online questionnaire	SEM	20 – 60
Herrekind et al. (2019b)	TAM	268	online questionnaire	PLS	35
Kapser and Abdelrahman (2020)	UTAUT	501	online questionnaire	SEM	18 – 65
Koul and Eydgahi (2018)	TAM	377	online questionnaire	Pearson correlation, Multiple Linear Regression	18 – 60
Lee et al. (2019)	TAM, UTAUT	313	online questionnaire	SEM	14 – 67
Liu et al. (2019)	TAM	742	questionnaire	PLS-SEM	20 – 60
Madigan et al. (2017)	UTAUT	315	questionnaire	Hierarchical multiple regression	9.18 – 65.83 years
Moták et al. (2017)	TAM	532	questionnaire	regression	17–25
Panagiotopoulos and Dimitrakopoulos (2018)	TAM, UTAUT	483	online questionnaire	Multiple regression	18 – 60
Payre et al. (2014)	TAM	358	online questionnaire	Hierarchical linear regression	19–82
Robertson et al. (2019)	TAM	2662	online questionnaire	SEM	16 – 70
Sener et al. (2019)	TAM, UTAUT	3097	online questionnaire	Regression	18<
Wu et al. (2019)	TAM, UTAUT	470	online questionnaire	SEM	18–50
Zmud et al. (2016)	TAM, UTAUT	556	online questionnaire	Regression	30–65

Source: authors' own.

Table 3
Data collection and age group focus data of conjoint-based empirical studies on AV acceptance.

Study	Theoretical framework	Sample size	Data collection	Method of analysis	Age focus
Bansal and Daziano (2018)	Utility theory	298	Discrete choice experiment	Multinominal logit regression modeling	18 – 60
Cunningham et al. (2019)	Utility theory	6133	Discrete choice experiment	Logistical hierarchical regression modeling	18<
Czakon et al. (2020)	Utility theory	160	Choice-based conjoint analysis	Multinominal logit regression modeling	20 – 64
Daziano et al. (2017)	Utility theory	1260	Discrete choice experiment	Mixed logit regression modeling	18–62
Eggers and Eggers (2022)	Utility theory	551	Discrete choice experiment	Multinominal logit regression modeling	18 – 55
Jabbari, Auld and MacKenzie (2022)	Utility theory	757	Discrete choice experiment	Linear structural regression equation modeling	18 – 75
Kashani et al. (2023)	Utility theory	607	Discrete choice experiment	Binary logit regression modeling	18 – 65
Kowalska-Pyzalska et al. (2022)	Utility theory	1002	Full profile conjoint analysis	Multinominal logit regression modeling	19 – 50
Maeng and Cho (2022)	Utility theory	1000	Discrete choice experiment	Multiple discrete–continuous extreme value modeling	20 – 69
Nickaar et al. (2023)	Utility theory	216	Adaptive choice-based conjoint analysis	Multinominal logit regression modeling	20 – 70
Papadima et al. (2020)	Utility theory	43	Choice-based conjoint analysis	Multinominal logit regression modeling	18 – 68
Shabanpour et al. (2018)	Utility theory	1253	Discrete choice experiment	Mixed logit regression modeling	25 – 40
Shin et al. (2015)	Utility theory	675	Discrete choice experiment	Multinominal logit regression modeling	20 – 60

Source: authors' own.

utility based on their own values, which has the most appropriate combination of product attribute level for them (Krantz and Tversky, 1971).

It is also an interesting result that the research studies often conclude that young people's autonomous technology acceptance is higher (or more positive) than that of older people (Bansal et al., 2016; Shabanpour et al., 2018; Hardman et al., 2019). Despite this, as it is illustrated in the table, what is meant by "young" is not consistent in the studies, and the minimum and maximum age of the sample are different.

At the same time, even though 98 % of the most important autonomous technology acceptance studies included data collection related to age (Janatabadi and Ermagun, 2022), the authors attempt to carry out a deeper analysis within a certain age group only a few times. In examining youngsters' acceptance of autonomous buses, Herrekind et al., (2019b) found that for young users perceived usefulness does not show a significant relationship with behavioral intention, and attitude is the most important influencing factor. Also, young people especially appreciate the simplicity and comfort of autonomous buses, and they are less worried about the price. Wang et al. (2022) concluded that the mechanism behind young people's stronger autonomous technology acceptance can be explained by people's affordability level, the built environment, and exposure level to AV.[3] Huang et al. (2022) suggest that young peoples' openness to autonomous vehicles may also be related to the fact that they have less driving experience and thus rate AV's capabilities more positively compared to their own driving ability.

Based on the above, we identified the following research gaps: on the one hand, while TAM/UTAUT frameworks are the most commonly used in AV acceptance measurement, they are rarely applied in research with conjoint methodology of this field. On the other hand, young people are studied to a lesser extent, whose exposure to future mobility driven by autonomous cars is significant, while their attitudes are not yet influenced by long-standing habits in terms of car driving.

3. Method

In response to the above-described research gap, in our article we examine the autonomous vehicle preferences of the age group of 14–19 with full-profile conjoint analysis based on the UTAUT model. Conjoint method is typically used for unfolding consumer attitudes towards products which are considered completely new, mostly not even publicly available on the market; thus, the respondents do not have any experience – Level 5 AV qualifies as such. The products and services available to consumers have become extremely complex, and it is therefore crucial to understand the characteristics of the goods that meet the expectations of consumers. During this decision-making process consumers do not evaluate each good offered to them as a single entity in a vacuum but consider its characteristics separately and then decide on the basis of the combination of their utilities. Moreover, in their choices, they are forced to forego others to obtain particular goods, and therefore they seek to select the one that is most useful for them (Herrmann et al., 2003; Luce and Tukey, 1964).

The practical implementation of the conjoint method is to present the respondent with concrete printed cards, each of which contains an L5 autonomous vehicle type. The types differ along pre-specified attributes. We had to define which attributes of the vehicles (e.g., price) we intended to involve in the analysis, as well as what levels (e.g., cheap-medium-expensive) these attributes can take. To define the attributes, we relied on the independent variables of the UTAUT (Venkatesh et al., 2012) model. The characteristics of a cards are defined by their attributes and the levels of each attribute. Our objective was to estimate the partial utilities associated with these attributes, by applying the multiple regression analysis model presented below. This approach allowed us to derive the partial utilities by calculating the contribution of each attribute level to the overall preference. We consider the responses as dependent variables and estimate the value of the constant and the level of the attribute of the card under consideration.

$$r_i = \beta_0 + \sum_{j=1}^{p} u_{j,k_i}$$

r_i: respondents rating of the i-th card (on a scale from 1 [not preferred at all] to 10 [very much preferred])

β_0: constant.

uj.kj partial utility for the j-th attribute level on the i-th card.

The partial utilities of each attribute are measured on the same scale, so the importance of the attributes can be described by the range of (dispersion of) the partial utilities. The relative importance of attributes can be calculated using the following formula:

$$IMP_j = \frac{R_j}{\sum_{i=1}^{p} \mathrm{R}_j}$$

IMPj: importance of the j-th attribute

Rj: difference between the highest and lowest partial utilities for the j-th attribute.

Thus, we defined the fictional self-driving cars along seven attributes in total and we determined three levels for each attribute (Table 4):

- worse than the currently used means of transport (low)
- identical to the currently used means of transport (average)
- better than the currently used means of transport (high).

Theoretically, for seven dimensions, where each dimension can take three levels, a total of 2187 variations (possible printed cards) are possible. However, no single respondent can line up that many variations and that many cards. Therefore using orthogonal dimension reduction of the combination of attribute levels (Herman, 1988) we created 18 cards depicting fictional self-driving cars. Table 5 illustrates these 18 printed cards. The respondents were given all the printed cards at the same time, and they had to evaluate them accordingly. On each card was a description of an imaginary car, in each case illustrated in colour according to the same 7 attribute-dimension (see Table 4), whether it was low-average-high on that attribute.

4. Data

The research was carried out in Hungarian ethnics secondary schools in Northern Serbia, where in total N = 202 participating students were involved in the study. Our exploratory research aimed at validating our proposed UTAUT based conjoint method for understand the youngsters' preferences towards L5 autonomous vehicles. The data collection took place in 3 different secondary schools where 3 classes took part in it with ca. 18 student each. This sample does not meet the representative methods defined by Ayaz et al. (2021), but the sample size is suitable to carry out the method we use. We accept the sample size of 202 for further analysis considering the exploratory aim our research. The descriptive statistics of our respondents are presented in Table 6. All the respondents belonged to the age group of 14–19. Two thirds of them were female, typically lived in cities, and the majority of them had already heard about autonomous vehicles before taking part in the research. 11 of them had a driving license, while the majority participated in traffic mostly as passengers by car or bus. Our respondents first listened to a brief presentation about autonomous technologies in general, the potential advantages of their widespread introduction, and the simultaneously occurring social challenges. After that, they received the above-described cards for evaluation. In the data collection process, we asked our respondents to evaluate all the autonomous vehicles illustrated in the cards on a 10-point scale (1 – not preferred at all, 10 – very much preferred).

[3] Experience in riding an AV, the most influential factor, improves acceptance by 44.8% (Wang et al., 2022).

Table 4
Attributes characterizing fictional self-driving cars and their levels.

UTAUT independent variable	Attribute	Explanation	Attribute levels		
			Low	Average	High
Performance Expectancy	Performance	How much does it facilitate transport and everyday life?	Hinders	Does not influence	Facilitates
Effort Expectancy	Ease	How much effort does it take to use it?	Complicated	Not demanding	Easy
Social Influence	Recommendation	How much do the people living around me recommend its use?	Rejecting	Neutral	Popular
Facilitating Conditions	Support	What assistance can I expect in the case of an occasional error?	No help	Call center	Instant solution
Hedonic Motivation	Hedonism	How comfortable is it to use?	Uncomfortable	Average	Outstanding
Price-Value Perception	Price	How much does its usage cost?	Expensive	Average	Cheap
Safety	Safety	How safe is it to use?	Dangerous	Average	Very safe

Source: authors' own.

Table 5
Attribute level combinations of the cards depicting fictive self-driving cars according to their number (L – Low, A – Average, H – High).

Card number		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Attributes and their levels	Performance	A	L	H	L	H	L	A	H	L	A	L	H	H	L	A	A	H	A
	Ease	A	L	L	H	H	H	A	A	A	H	L	H	L	A	L	H	A	L
	Recommendation	H	L	H	A	H	L	L	L	H	A	H	L	A	A	A	H	A	L
	Support	L	L	L	H	A	A	A	H	H	L	A	L	H	L	A	H	A	H
	Hedonism	A	L	H	A	L	H	L	H	L	L	A	A	L	H	H	H	A	A
	Price	L	L	H	H	H	L	H	A	A	A	A	A	L	H	A	L	L	H
	Safety	L	L	A	L	L	A	H	L	A	A	H	H	H	H	L	H	A	H

Source: authors' own.

Table 6
Descriptive statistics of our respondents.

Heard of AV's (%)

no	*yes*
20.7	79.3

Weekly travel time (hrs) (%)

0	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*12*	*14*	*15*
4.1	8.8	16.6	12.4	11.9	11.9	11.9	5.7	5.7	2.6	4.7	2.6	0.5	0.5

Driver's licence (%)

no	*yes*
76.7	23.3

Transportation form (%)

bike	*bus*	*car*	*moto*	*train*
4.7	38.3	49.2	1.0	6.7

Sex (%)

female	*male*	*other*
70.5	29.0	0.5

Age (%)

15 years old	*16 years old*	*17 years old*	*18 years old*	*19 years old*
23.8	3.6	24.9	36.3	11.4

Residence (%)

city	*town*	*village*
2.6	68.4	29.0

Table 7
Results of the significance test.

Significance		Pearson's R		Kendall's tau	
result	criteria	result	criteria	result	criteria
0.00	<0.05	0.941	>0.75	0.673	>0.60

Source: authors' own.

5. Results

The analysis of the collected data was carried out with IBM SPSS 26 statistical analysis software. The explanatory power of our model fulfils the criteria for further analyses, it describes our respondents' autonomous vehicle preferences along significant and strong correlations (Table 7).

The relative importance of the attributes is a value given in percentage, which refers to the overall extent of each attribute's contribution to the total utility. Based on the value of the relative importance we can rank the attributes from the most important till the least important. For our respondents, the most important attribute was safety (29.25 %), which was followed by performance expectancy (13.70 %), hedonic motivation (13.33 %), price-value perception (13.14 %), and facilitating conditions (12.37 %) with lower but close values. The least important attributes were social influence (9.33 %) and effort expectancy (8.85 %).

We also examined what performance do our respondents expect from a self-driving vehicle compared to a conventional one. For this purpose, the sub-utilities of the attribute levels were obtained with utility value estimation (Table 8). The results show the same for all attributes: respondents expect better performance from L5 self-driving vehicles than from current vehicles in all areas. It should be noted that this sub-utility estimate calculation is only meaningful within one attribute – the above mentioned relative importance calculation is the proper method for comparing attributes to each other. Based on all this the most preferred AV is safer (4.12), a better solution to mobility (1.95), cheaper (1.91), more comfortable (1.89), has more efficient troubleshooting (1.72), easier to use (1.12), and socially more accepted (1.11) than traditional vehicles.

6. Discussion

In our research, we studied the autonomous vehicle preferences of consumers at the age of 14–19 with a full-profile conjoint analysis which was built on the framework of the UTAUT model.

Although in many respects we have obtained results that have already been reported in the literature on this topic, it is important to highlight four distinctive features of our research. First, unlike most research, we did not ask about attitudes, but measured stated preferences. In other words, we did not ask about their preference for a vehicle, but rather explored the criteria behind their choices between specific vehicles. Related to this is the second specificity of our research, as preferences related to L5, fully autonomous vehicles are relatively rarely measured, as they are difficult to grasp in the absence of experience. However, the method used in our study only required comparisons between fictional vehicles with specific characteristics (portrayed in cards) and was therefore more suitable for exploring opinions related to the still barely available L5 vehicles. Thirdly, we adapted the UTAUT model, the most widely used theoretical framework in this field, to conjoint methodology where it was rarely used in previous AV acceptance studies. Fourthly, we did this by targeting teenagers, an important yet seldom researched target group for future transport.

Table 8
Value estimation of partial utilities of attribute levels.

Attribute	Attribute level		Utility estimate	Std. error
Performance	Low	It hinders traffic	0.65	0.219
	Average	It does not influence traffic	1.3	0.437
	High	It is a better solution to transport	1.949	0.656
Ease	Low	It is difficult to use	0.372	0.219
	Average	It is not more difficult than traditional vehicles	0.744	0.437
	High	It is easy to use	1.115	0.656
Recommendation	Low	People living around me reject it	0.37	0.219
	Average	It is neutral for my environment	0.741	0.437
	High	People living around me accept it	1.111	0.656
Support	Low	There is no assistance when used	0.574	0.219
	Average	Call center	1.148	0.437
	High	Comprehensive problem solving	1.722	0.656
Hedonism	Low	It is less enjoyable than the traditional one	0.629	0.219
	Average	Its enjoyment is identical to the traditional one	1.257	0.437
	High	It is more enjoyable than the traditional one	1.886	0.656
Price	Low	It is more expensive than the traditional one	0.636	0.219
	Average	It has the same price as the traditional one	1.273	0.437
	High	It is cheaper than the traditional one	1.909	0.656
Safety	Low	It is more dangerous than the traditional one	1.372	0.219
	Average	Its safety is identical to the traditional one	2.744	0.437
	High	It is safer than the traditional one	4.117	0.656
(Constant)			−3.62	1.17

Source: authors' own.

Therefore in presenting our results we would like to draw attention to which previous research results have been confirmed – or complemented – by this novel methodological approach and unique sample.

Our results are in line with the findings of Jabbari et al. (2022), and Shabanpour et al. (2018) claiming that safety is of the highest relative importance among the attributes of autonomous vehicles.

Kaye et al., (2020)considered Performance Expectancy, i.e. the capability of the autonomous vehicle that it performs better than conventional cars in everyday transport as the most important factor – in our research this came in as the second most important behind safety. We have supported Cunningham et al. (2019) findings that safety and performance expectancy is followed by hedonism as key indicators of consumer acceptance. It can be interpreted that comfort and joy of travelling by an autonomous vehicle is also a factor of significant importance. Similarly to Herrekind et al., (2019b), we managed to point out that price is not included in the most important attributes, in this case youngsters are not concerned about the costs of travelling by a self-driving car. Furthermore, they are not anxious about what support they can expect in case of an occasional failure (Du et al., 2021). Bansal and Daziano (2018) highlighted that consumers would be willing to pay a higher price for a well-functioning autonomous vehicle compared to a traditional one. It is confirmed by our results since safety, performance, and hedonism all come before price.

Finally recommendation (social influence) and ease of operate appear as the least important attributes, suggesting that young people are more confident in both their own abilities and in the acceptance of their peers. All this is compatible with the findings of Wang et al. (2022) claiming that young people are much more open to technological innovations. Also, Huang et al., (2022) highlight that the younger someone is, the more accepting they are regarding autonomous vehicles.

7. Conclusions

Our research aimed at responding a challenge that is fundamental to consumer acceptance of autonomous vehicles (especially L5 fully autonomous vehicles). Namely, how to capture potential consumers' views on a technology that they cannot try – and most likely have never seen. As the penetration of fully autonomous vehicles is still very limited, it is difficult to measure consumers' stated preferences, as they do not even know what attributes such a car might have.

We consider the main result of our research is that we were able to operationalize this complex issue by adapting the full-profile conjoint method. This adaptation meant that the autonomous vehicle attributes used in the conjoint method were identified based on certain dimensions of the UTAUT framework. Thus, respondents had to rate specific imaginary cars based on cards representing them. Using the conjoint method, we were able to determine the underlying preferences by identifying the importance of AV attributes based on the card ratings. The traditional UTAUT questionnaire surveys have not been suitable for this feature ranking. Since they are only capable of identifying factors that have a significant impact on technology adoption, but are unable to compare and rank them these – whereas the conjoint method is capable of this. Therefore, we consider the main result of our research to be the introduction and presentation of an adapted version of the full-profile conjoint method specified for autonomous vehicles.

Our findings demonstrate that safety emerged as the most critical attribute for potential consumers, overshadowing other factors such as social influence and recommendations from peers. This suggests that the perception of safety and trust will be pivotal in determining the widespread adoption of autonomous vehicles. If consumers do not perceive these vehicles as safe, their acceptance and use will be significantly hindered, regardless of other technological advancements or endorsements.

Moreover, while social influence and recommendations were less significant in our study, they should not be entirely disregarded. As autonomous vehicle technology continues to develop and becomes more prevalent, the role of social influence might grow, especially as trusted figures and early adopters begin to share their experiences. Therefore, manufacturers and policymakers should focus on building trust through transparent communication about safety features and robust regulatory frameworks that ensure the protection of users.

It's crucial to acknowledge the limitations of our study. The sample size was modest, which limits the generalizability of the findings. Additionally, the demographic characteristics of our sample—comprising young individuals from a region with specific ethnic backgrounds and lower economic development—mean that the respondents may not represent the broader population or the primary market segment for Level 5 autonomous vehicles. However, studying this demographic provides valuable insights into the perceptions and aspirations of future consumers. Understanding these 'teenage dreams' helps anticipate future market trends and tailor autonomous vehicle designs and marketing strategies to meet the expectations of the next generation of drivers, who may be more open to innovation and technological advancements. In conclusion, our research not only highlights the importance of safety in consumer acceptance of autonomous vehicles but also introduces an innovative approach to measuring and understanding these preferences through the adapted full-profile conjoint method. Future research should explore larger and more diverse samples to validate these findings and further explore the evolving role of social influence as autonomous vehicles become more integrated into everyday life.

CRediT authorship contribution statement

Szabolcs Prónay: Writing – review & editing, Writing – original draft, Conceptualization. **Miklós Lukovics:** Writing – review & editing, Supervision, Project administration, Funding acquisition, Conceptualization. **Tamás Ujházi:** Writing – review & editing, Writing – original draft, Software, Methodology, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Miklos Lukovics reports financial support was provided by National Research Development and Innovation Office of Hungary. If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

References

Acheampong, R.A., 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. *Transport. Res. F: Traffic Psychol. Behav.* 62, 349375. https://doi.org/10.1016/j.trf.2019.01.009.

Ajzen, I., 1991. The theory of planned behaviour. Organiz. Behav. Hum. Decis. Processes 50 (2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T.

Ayaz, A., Waheed, A., Saleem, H., et al., 2021. Travelers' attitude towards carpooling in Islamabad. J. Eng. Appl. Sci. 68, 23. https://doi.org/10.1186/s44147-021-00023-x.

Baccarella, C.V., Wagner, T.F., Scheiner, C.W., Maier, L., Voigt, K.-I., 2020. Investigating consumer acceptance of autonomous technologies: the case of self-driving automobiles. *Eur. J. Innov. Manage.* 24 (4), 1210–1323. https://doi.org/10.1108/EJIM-09-2019-0245.

Bansal, P., Daziano, R.A., 2018. Influence of choice experiment designs on eliciting preferences for autonomous vehicles. *Transp. Res. Procedia* 32, 474–481. https://doi.org/10.1016/j.trpro.2018.10.044.

Bansal, P., Kockelman, K.M., Singh, A., 2016. Assessing public opinions of and interest in new vehicle technologies: an Austin perspective. *Transp. Res. Part C Emerging Technol.* 67, 1–14. https://doi.org/10.1016/j.trc.2016.01.019.

Bayart, C., Havet, N., Bonnel, P., Bouzouina, L., 2020. Young people and the private car: a love-hate relationship. Transp. Res. Part D: Transp. Environ. 80, 102235. https://doi.org/10.1016/j.trd.2020.102235.

Benleulmi, A.Z., Blecker, T. (2017): Investigating the factors influencing the acceptance of fully autonomous cars. In: Kersten, W. B., and Thorsten Ringle, C. M. (eds.): *Digitalization in Supply Chain Management and Logistics: Smart and Digital Solutions for an Industry 4.0 Environment Proceedings of the Hamburg International Conference of Logistics (HICL)* Vol. 23, pp. 99–115., epubli GmbH, Berlin. https://doi.org/10.15480/882.1449.

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. https://doi.org/10.1016/j.aap.2018.03.021.

Cai, L., Yuen, K.F., Wang, X., 2023. Explore public acceptance of autonomous buses: an integrated model of UTAUT, TTF and trust. *Travel Behav. Soc.* 31, 120–130. https://doi.org/10.1016/j.tbs.2022.11.010.

Chen, C.-F., 2019. Factors affecting the decision to use autonomous shuttle services: evidence from a scooter-dominant urban context. *Transp. Res. F* 67, 195–204. https://doi.org/10.1016/j.trf.2019.10.016.

Chen, H.-K., Yan, D.-W., 2019. Interrelationships between influential factors and behavioral intention with regard to autonomous vehicles. *Int. J. Sustain. Transp.* 13 (7), 511–527. https://doi.org/10.1080/15568318.2018.1488021.

Cho, Y., Park, J., Park, S., Jung, E.S., 2017. Technology acceptance modeling based on user experience for autonomous vehicles. *J. Ergon. Soc. Korea* 36 (2), 87–108.

Choi, J.K., Ji, Y.G., 2015. Investigating the importance of trust on adopting an autonomous vehicle. *Int. J. Hum.–Comput. Interact.* 31, 692–702. https://doi.org/10.1080/10447318.2015.1070549.

Cunningham, M.L., Regan, M.A., Ledger, S.A., Bennett, J.M., 2019. To buy or not to buy? Predicting willingness to pay for automated vehicles based on public opinion. *Transp. Res. F* 65, 418–438. https://doi.org/10.1016/j.trf.2019.08.012.

Czakon, W., Niemand, T., Gast, J., Kraus, S., Frühstück, L., 2020. Designing coopetition for radical innovation: an experimental study of managers' preferences for developing self-driving electric cars. *Technol. Forecast. Soc. Chang.* 155, 119992. https://doi.org/10.1016/j.techfore.2020.119992.

Davis, F.D., 1989. Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Q. 13 (3), 137–340.

Daziano, R.A., Sarrias, M., Leard, B., 2017. Are consumers willing to pay to let cars drive for them? Analyzing response to autonomous vehicles. *Transp. Res. C* 78, 150–164. https://doi.org/10.1016/j.trc.2017.03.003.

Delbosc, A., 2017. Delay or forgo? A closer look at youth driver licensing trends in the United States and Australia. Transportation 44 (5), 919–926. https://doi.org/10.1007/s11116-016-9685-7.

DMV (2023): California Department of Motor Vehicles. https://www.dmv.ca.gov/.

Du, H., Ge, Z., Zheng, J., 2021. Why travelers trust and accept self-driving cars: an empirical study. Travel Behav. Soc. 22, 2214–2367. https://doi.org/10.1016/j.tbs.2020.06.012.

EC (2018). Autonomous driving in European transport. Official Journal of the European Union, C(411), 2-12.

Eggers, F., Eggers, F., 2022. Drivers of autonomous vehicles – analyzing consumer preferences for self-driving car brand extensions. Mark. Lett. 33, 89–112.

Fishbein, M., Ajzen, I., 1975. Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research. Addison Wesley, Boston, USA.

Foroughi, B., Nhan, P.V., Iranmanesh, M., Ghobakhloo, M., Nilashi, M., Yadegaridehkordi, E., 2023. Determinants of intention to use autonomous vehicles: findings from PLS-SEM and ANFIS. *J. Retail. Consum. Serv.* 70, 103158. https://doi.org/10.1016/j.jretconser.2022.103158.

Green, P.E., Krieger, A.M., Wind, Y. (2001): „Thirty years of conjoint analysis: reflections and prospects", in.: Wind, Y. – Green, P. E. (2004): Marketing research and modeling: Progress and prospects. New York, USA: Springer Science and Business Media.

Grewal, D., Roggeveen, A.L., Nordfält, J., 2017. The future of retailing. *J. Retail.* 93 (1), 1–6. https://doi.org/10.1016/j.jretai.2016.12.008.

Grindsted, T.S., Christensen, T.H., Freudendal-Pedersen, M., Friis, F., Hartmann-Petersen, K., 2022. The urban governance of autonomous vehicles – In love with AVs or critical sustainability risks to future mobility transitions. *Cities* 120, 106504. https://doi.org/10.1016/j.cities.2021.103504.

Groth, S., Kuhnimhof, T., 2021. Multimodality in transportation. In: Vickerman, R. (Ed.), International Encyclopedia of Transportation, Vol. 5. Elsevier Ltd, UK, pp. 118–126. https://doi.org/10.1016/j.rtbm.2022.100906.
Hardman, S., Berliner, R., Tal, G., 2019. Who will be the early adopters of automated vehicles? Insights from a survey of electric vehicle owners in the United States. Transp. Res. Part D: Transp. Environ. 71 (June 2018), 248–264. https://doi.org/10.1016/j.trd.2018.12.001.
Hegner, S.M., Beldad, A.D., Brunswick, G.J., 2019. In Automatic we trust: investigating the impact of trust, control, personality characteristics, and extrinsic and intrinsic motivations on the acceptance of autonomous vehicles. *Int. J. Hum.–Comput. Interact.* 35, 1769–1780. https://doi.org/10.1080/10447318.2019.1572353.
Herman, S. (1988). Software for full-profile conjoint analysis. in *Proceedings of the Sawtooth conference on perceptual mapping, conjoint analysis and computer interviewing.* ed. M. Metegrano, Sawtooth Software, Ketchum, Idaho, 117-130..
Herrekind, B., Brendel, A.B., Nastjuk, I., Greve, M., Kolbe, L.M., 2019a. Investigating end-user acceptance of autonomous electric buses to accelerate diffusion. *Transp. Res. D* 74, 255–276. https://doi.org/10.1016/j.trd.2019.08.003.
Herrekind, B., Nastjuk, I., Brendel, A.B., Trand, S., Kolbe, L.M., 2019b. Young people's travel behavior – Using the life-oriented approach to understand the acceptance of autonomous driving. *Transp. Res. D* 74, 214–233. https://doi.org/10.1016/j.trd.2019.07.023.
Herrmann, A., Gustafsson, A., Huber, F., 2003. Conjoint Measurement: Methods and Applications. University of St.Gallen. https://doi.org/10.1007/978-3-540-24713-5_13.
Hjorthol, R., 2016. Decreasing popularity of the car? Changes in driving licence and access to a car among young adults over a 25-year period in Norway. J. Transp. Geogr. 51, 140–146. https://doi.org/10.1016/j.jtrangeo.2015.12.006.
Howard, D., Dai, D. (2014). "Public Perceptions of Self-Driving Cars: The Case of Berkeley, California". *Transportation Research Board 93rd Annual Meeting*, USA, Washington DC.
Huang, G., Hung, Y.-H., Proctor, R.W., Pitts, B.J., 2022. Age is more than just a number: the relationship among age, non-chronological age factors, self-perceived driving abilities, and autonomous vehicle acceptance. Accid. Anal. Prevent. 178, 106850. https://doi.org/10.1016/j.aap.2022.106850.
Hudson, J., Orviska, A., Hunady, J., 2019. People's attitudes to autonomous vehicles. *Transp. Res. A*. 121, 164–176. https://doi.org/10.1016/j.tra.2018.08.018.
Hunecke, M., Groth, S., Wittowsky, D., 2020. Young social milieus and multimodality: Interrelations of travel behaviours and psychographic characteristics. Mobilities 15 (3), 397–415. https://doi.org/10.1080/17450101.2020.1732099.
Jabbari, P., Auld, J., MacKenzie, D., 2022. How do perceptions of safety and car ownership importance affect autonomous vehicle adoption? *Travel Behav. Soc.* 28, 128–140. https://doi.org/10.1016/j.tbs.2022.02.002.
Janatabadi, F., Ermagun, A., 2022. Empirical evidence of bias in public acceptance of autonomous vehicles. Transport. Res. F: Traffic Psychol. Behav. 84, 330–347. https://doi.org/10.1016/j.trf.2021.12.005.
Kapser, S., Abdelrahman, M., 2020. Acceptance of autonomous delivery vehicles for last-mile delivery in Germany – Extending UTAUT2 with risk perceptions. *Transp. Res. C* 111, 210–225. https://doi.org/10.1016/j.trc.2019.12.016.
Kashani, M.A., Abbasi, M., Mamdoohi, A.R., Sierpinski, G., 2023. The role of attitude, travel-related, and socioeconomic characteristics in modal shift to shared autonomous vehicles with ride sharing. *World Electric Veh. J.* 14, 23. https://doi.org/10.3390/wevj14010023.
Kaye, S.-A., Lewis, I., Forward, S., Delhomme, P., 2020. A priori acceptance of highly automated cars in Australia, France, and Sweden: a theoretically-informed investigation guided by the TPB and UTAUT. *Accid. Anal. Prev.* 137, 105441. https://doi.org/10.1016/j.aap.2020.105441.
Keszey, T., 2020. Behavioural intention to use autonomous vehicles: systematic review and empirical extension. *Transp. Res. C* 119, 1–16. https://doi.org/10.1016/j.trc.2020.102732.
Korkmaz, H., Fidanoglu, A., Ozcelik, S., Okumus, A., 2022. User acceptance of autonomous public transport systems: Extended UTAUT2 model. *J. Public Transp.* 24, 100013. https://doi.org/10.5038/2375-0901.23.1.5.
Koul, S., Eydgahi, A., 2018. Utilizing technology acceptance model (TAM) for driverless car technology adoption. *J. Technol. Manag. Innov.* 13 (4), 37–46. https://doi.org/10.4067/S0718-27242018000400037.
Kovács, P., Lukovics, M., 2022. Factors influencing public acceptance of self-driving vehicles in a post-socialist environment: statistical modelling in Hungary. Regional Statistics 12 (2), 149–176.
Kowalska-Pyzalska, A., Michalski, R., Kott, M., Skowrońska-Szmer, A., Kott, J., 2022. Consumer preferences towards alternative fuel vehicles. Results from the conjoint analysis. Renew. Sustain. Energy Rev. 155, 111776. https://doi.org/10.1016/j.rser.2021.111776.
Krantz, D.H., Tversky, A., 1971. Conjoint-measurement analysis of composition rules in psychology. *Psychol. Rev.* 78 (2), 151–169. https://doi.org/10.1037/h0030637.
Lee, J., Lee, D., Park, Y., Lee, S., Ha, T., 2019. Autonomous vehicles can be shared, but a feeling of ownership is important: examination of the influential factors for intention to use autonomous vehicles. Transp. Res. Part C 107, 411–422. https://doi.org/10.1016/j.trc.2019.08.020.
Liu, P., Xu, Z., Zhao, X., 2019. Road test od self-driving vehicles: affective and cognitive pathways in acceptance formation. Transp. Res. A 124, 354–369. https://doi.org/10.1016/j.tra.2019.04.004.
Luce, R.D., Tukey, J.W., 1964. Simultaneous conjoint measurement: a new type of fundamental measurement. *J. Math. Psychol.* 1, 1–27.
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. Transp. Res. Part f: Traffic Psychol. Behav. 50, 55–64. https://doi.org/10.1016/j.trf.2017.07.007.
Maeng, K., Cho, Y., 2022. Who will want to use shared autonomous vehicle service and how much? A consumer experiment in South Korea. *Travel Behav. Soc.* 26, 9–17. https://doi.org/10.1016/j.tbs.2021.08.001.
Maltese, I., Zamparini, L., 2023. Sustainable mobility choices at home and within destinations: a survey of young Italian tourists. Res. Transp. Bus. Manag., 100906 https://doi.org/10.1016/j.rtbm.2022.100906.
Manfreda, A., Ljubi, K., Groznik, A., 2019. Autonomous vehicles in the smart city era: an empirical study of adoption factors important for millennials. Int. J. Inf. Manag. 58. https://doi.org/10.1016/j.ijinfomgt.2019.102050.
Marikyan, D., Papagiannidis, S. (2023): Unified Theory of Acceptance and Use Technology: A review. In S. Papagiannidis (Ed), TheoryHub Book. Available at https://open.ncl.ac.uk/ ISBN: 9781739604400.
Miller, K., Chng, S., Cheah, L., 2022. Understanding acceptance of shared autonomous vehicles among people with different mobility and communication needs. *Travel Behav. Soc*. 29, 200–210. https://doi.org/10.1016/j.tbs.2022.06.007.
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? *Eur. Rev. Appl. Psychol.* 67 (5), 269–278. https://doi.org/10.1016/j.erap.2017.06.001.
Müller, J.M., 2019. Comparing technology acceptance for autonomous vehicles, battery electric vehicles, and car sharing—A study across Europe, China, and North America. Sustainability 11 (16), 4333. https://doi.org/10.3390/su11164333.
Nickaar, A., Lee, Y.-J., Shin, H.-S., 2023. Willingness-to-pay for shared automated mobility using an adaptive choice-based conjoint analysis during the COVID-19 period. *Travel Behav. Soc.* 30, 11–20. https://doi.org/10.1016/j.tbs.2022.08.004.
Nordhoff, S., Kyriakidis, M., Arem, B., Happee, R., 2019. A multi-level model on automated vehicle acceptance (MAVA): a review-based study. Theor. Issues Ergon. Sci. 20 (6), 682–710. https://doi.org/10.1080/1463922X.2019.1621406.
Panagiotopoulos, I., Dimitrakopoulos, G., 2018. An empirical investigation on consumers' intentions towards autonomous driving. Transp. Res. Part C Emerging Technol. 95, 773–784. https://doi.org/10.1016/j.trc.2018.08.013.
Papadima, G., Genitsaris, E., Karaigotas, I., Naniopoulos, A., Nalmpantis, D., 2020. Investigation of acceptance of driverless buses in the city of Trikala and optimization of the service using conjoint analysis. *Util. Policy* 62, 100994. https://doi.org/10.1016/j.jup.2019.100994.
Páthy, Á. (2021). Kényelem és félelem – az önvezető járművek várható előnyeinek és hátrányainak megítélése. In Csizmadia, Z. & Rechnitzer, J. (szerk.): *Az önvezető járművek világa*. Akadémiai Kiadó, Budapest. https://doi.org/10.1556/9789634546290.
Payre, W., Cestac, J., Delhomme, P., 2014. Intention to use a fully automated car: attitudes and a priori acceptability. *Transp. Res. F* 27, 252–263. https://doi.org/10.1016/j.trf.2014.04.009.
Rahman, M., Thill, J.-C., 2023. What drives people's willingness to adopt autonomous vehicles? A review of internal and external factors. *Sustainability* 15 (15). https://doi.org/10.3390/su151511541.
Robertson, R.D., Woods-Fry, H., Vanlaar, W.G.M., Hing, M.M., 2019. Automated vehicles and older drivers in Canada. *J. Saf. Res.* 70, 193–199. https://doi.org/10.1016/j.jsr.2019.07.003.
SAE (2016). Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles, J3016_202104.
Sener, I.N., Zmud, J., Williams, T., 2019. Measures of baseline intent to use automated vehicles: a case study of Texas cities. *Transp. Res. F* 62, 66–77. https://doi.org/10.1016/j.trf.2018.12.014.
Shabanpour, R., Golshani, N., Shamshiripour, A., Mohammadian, A.(Kouros)., 2018. Eliciting preferences for adoption of fully automated vehicles using best-worst analysis. *Transp. Res. Part C Emerging Technol.* 93 (June), 463–478. https://doi.org/10.1016/j.trc.2018.06.014.
Shin, J., Bhat, C.R., You, D., Garikapati, V.M., Pendyala, R.M., 2015. Consumer preferences and willingness to pay for advanced vehicle technology options and fuel types. *Transp. Res. C* 60, 511–524. https://doi.org/10.1016/j.trc.2015.10.003.
Si, H., Duan, X., Cheng, L., De Vos, J., 2024. Adoption of shared autonomous vehicles: combined effects of the external environment and personal attributes. *Travel Behav. Soc*. 34, 100688. https://doi.org/10.1016/j.tbs.2023.100688.
Silberg, G., Wallace, R. (2012). "Self-driving cars: The next revolution." KPMG LLP.
Venkatesh, V., Bala, H., 2008. Technology acceptance model 3 and a research agenda on interventions. Decis. Sci. 39 (2), 273–315. https://doi.org/10.1111/j.1540-5915.2008.00192.x.
Venkatesh, V., Davis, F.D., 2000. A theoretical extension of the technology acceptance model: four longitudinal field studies. Manag. Sci. 46 (2), 186–204. https://doi.org/10.1287/mnsc.46.2.186.11926.
Venkatesh, V., Morris, M.G., Davis, G.B., Davis, F.D., 2003. User acceptance of information technology: toward a unified view. MIS Q. 27 (3), 425–478. https://doi.org/10.2307/30036540.
Venkatesh, V., Thong, J.Y.L., Xu, X., 2012. Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. MIS Q. 36 (1), 157–178. https://doi.org/10.2307/41410412.
Verma, M., Manoj, M., Verma, A., 2016. Analysis of the influences of attitudinal factors on car ownership decisions among urban young adults in a developing country like India. Transp. Res. Part F: Traffic Psychol. Behav. 42, 90–103. https://doi.org/10.1016/j.trf.2016.06.024.
Wang, S., Li, Z., Wang, Y., Wyatt, D.A., 2022. How do age and gender influence the acceptance of automated vehicles? – Revealing the hidden mediating effects from the built environment and personal factors. Transp. Res. A Policy Pract. 165, 376–394. https://doi.org/10.1016/j.tra.2022.09.015.

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. F: Traffic Psychol. Behav. 60, 37–46. https://doi.org/10.1016/j.trf.2018.09.029.

Xing, Y., Handy, S., Circella, G., Wang, Y., Alemi, F. (2020): *Exploring the role of attitude in the acceptance of self-driving shuttles.* University of California, Davis. https://doi.org/10.7922/G2Q52MVZ.

Yuen, K.F., Huyen, D.T.K., Wang, X., Qi, G., 2020. Factors influencing the adoption of shared autonomous vehicles. *Int. J. Environ. Res. Public Health*. 17 (13), 4868. https://doi.org/10.3390/ijerph17134868.

Zefreh, M.M., Edries, B., Esztergár-Kiss, D., Török, Á., 2023. Intention to use private autonomous vehicles in developed and developing countries: What are the differences among the influential factors, mediators, and moderators? *Travel Behav. Soc.* 32, 100592. https://doi.org/10.1016/j.tbs.2023.100592.

Zhang, Q., Zhang, T., Ma, L., 2023. Human acceptance of autonomous vehicles: research status and prospects. *Int. J. Ind. Ergonomics*. https://doi.org/10.1016/j.ergon.2023.103458.7.

Zhou, C., Zhao, X., Xie, D., Bi, J., 2023. Understanding individuals' choice-making mechanism in trip chains of shared autonomous vehicles. *Travel Behav. Soc*. 33, 100619. https://doi.org/10.1016/j.tbs.2023.100619.

Zmud, J., Sener, I.N., Wagner, J., 2016. Self-Driving Vehicles: Determinants of Adoption and Conditions of Usage. Trans. Res. Record 2565 (1), 57–64. https://doi.org/10.3141/2565-07.