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Factors Influencing the Purchase Intention of Autonomous Cars

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Abstract: Even though autonomous cars have not yet crossed into the mainstream car market, their adoption seems inevitable, but not much is known about the purchasing intention of ACs and potential influences on it. To better understand the influences of various factors on purchasing intentions of autonomous cars, research using bibliometrics, an online survey and SEM modelling was performed. Based on an analysis of previous research work and the unified theory of acceptance of technology, an empirical model was produced and tested using data obtained from an online survey involving 266 individuals. The goal was to analyse which characteristics of autonomous cars, socio-demographic variables of potential buyers, and buyers' personal and social characteristics could potentially influence the adoption of autonomous cars. The results show that factors of car safety, buyer age and level of education, perceived social influence, anxiety and performance expectancy are significantly correlated to purchasing intention of ACs, while correlations with other factors to purchasing intentions have not been proven.

Keywords: autonomous car; purchase intention; autonomous car adoption; SEM modelling

1. Introduction

Technology in motor vehicle manufacturing and performance is developing rapidly, focusing many of the latest innovations on automatic self-driving or autonomous cars. Many manufacturers of cars have been focusing their attention on developing different Advanced Driver Assistance Systems (ADAS) such as Adaptive Cruise Control (ACC), Intelligent Speed Adaptation (ISA), Collision Warning Systems, Assisted Parking Systems, Traffic Sign Recognition, Lane Keeping Assistance, etc. [1]. Moreover, several car brands have already come up with test specimens or are researching vehicles matching the criterion of fully autonomous cars (ACs or self-driving cars) that can drive themselves on existing roads and can navigate many types of roadways and environmental contexts with almost no direct human input [2,3]. The advantages of such systems are vast, namely in the potential increase of road safety due to the elimination of humans as an influencing factor. The ACs are also predicted to improve productivity [4] because they will enable people to focus their attention on things other than driving. Additionally, they will reduce fuel consumption, pollution effects and cost of living [5]. More on the advantages, disadvantages and challenges of autonomous vehicles as a concept and barriers to implementation can be found in existing literature [6–9].

However, a fraction of individuals will always oppose any new technology. Technology acceptance is related to social influence processes and cognitive instrumental processes [10]. Regarding ACs, individuals are troubled for several reasons. Although the potential of ACs in increasing road safety has been recognised [11,12], individuals have several concerns regarding their safety (system failures and breaches as well as safety concerns associated with unoccupied moving vehicles) or the technology

behind it, and still prefer to have control of the vehicle [12–15]. Furthermore, there are concerns regarding the potential costs of such high-tech since ACs needs very high precision navigation maps, radars, sensors and vehicle-to-vehicle communication structures [13,16,17]. Besides, many countries across the world still have legislation in place which relies on the historical framework [18,19]; thus, legal liability and security represent a significant concern to individuals [12,20].

Regarding the partial resistance of innovations of these types of cars, there have been proposals of various models to predict the behaviour of consumers towards autonomous cars [4,21]. This study aims to analyse the factors that influence the decision for AC adoption and the purchase intentions for these types of cars. By considering findings from existing literature and the unified theory of acceptance of technology, an empirical model was produced and tested using data obtained from an online survey involving 266 individuals.

Factors Influencing the Purchase Intention

Contemporary literature offers some insight into factors that are most relevant when researching attitudes towards ACs. To establish the most relevant areas of research and to identify the main factors influencing individuals' purchasing intentions, a basic literature review focusing on keywords and research areas was conducted. For this research, VOSviewer and Bibliometric Analysis were used [22]. A search for publications related to the ACs and consumer purchase intention was performed in two phases in the Web of Science Core Collection (WOSCC) scientific database. This search was conducted in September 2020, and it showed several articles on autonomous cars. The string ("autonomous car" OR "autonomous vehicle" OR "self-driving car" OR "self-driving vehicle") without any restrictions was used for the first part of the search, and it gave 2086 results which were included into the database for further analysis. The expressions that were included in the search string were set in a way that would result in a maximum number of relevant results. Since a preliminary literature review showed that both "vehicle" and "car" are used to describe a vehicle used for personal mobility, we included combinations of both terms in our search string. Additionally, both the terms "autonomous" and "self-driving" were used in the search string since many authors use these terms almost interchangeably, and we also wanted to include all literature that deals with automation on a higher level regardless of it being fully automated or not.

Several analyses were performed using VOSviewer: (1) co-occurrence analysis of keywords for the first search string to explore research areas for autonomous cars, (2) citation analysis and (3) co-occurrence analysis of keywords focusing on ACs as well as purchasing factors. Keywords were looked through, and synonyms were joined together before the visualisation process was run (e.g., autonomous car, self-driving car(s), autonomous cars were joined together into the keyword autonomous car). All keywords used at least ten times (99 keywords altogether) are shown in Figure 1, where each circle presents a detected keyword, the node's size points to the number of occurrences of the keyword, and the links show which keywords appear together in publications.

The keywords with most occurrences were "autonomous car" (which included keywords such as autonomous automobiles, automated vehicles, autonomous vehicle(s), autonomous car(s), self-driving car(s),) with 508 occurrences, "autonomous driving" with 56, "design" with 309 and "acceptance" with 10. We can identify a couple of clusters of keywords, meaning that these keywords have common themes. The most prominent clusters that occur are (1) the yellow one that focuses on navigation, localisation and sensing, (2) the green one that focuses on computer learning, object detection and processing, (3) the violet one that focuses on artificial intelligence, classification and data models, and the (4) red one that focuses on safety, acceptance and ethics. Based on this analysis, we can identify which areas related to autonomous cars are the most frequently researched, in addition to "deep learning" (94), "model" (50), etc.

Figure 1. Co-occurrence of all keywords for papers with string ("autonomous car" OR "autonomous vehicle" OR "self-driving car" OR "self-driving vehicle").

The second part of the bibliography analysis added the dimension of purchasing intentions to the analysis subset. The second search string was set as: (("autonomous car" OR "autonomous vehicle" OR "self-driving car" OR "self-driving vehicle") AND (purcha OR buy OR adoption)). The goal of this search string is to identify studies that address the area related to car purchases and to reveal keywords that are used in researching the purchasing intentions of ACs which will then be used as input into the user survey.

Even though autonomous cars or at least their beginnings have existed for quite some time, research on their purchasing trends began rising from 2016 (Figure 2). Before that, only ten publications were published that correspond to the above search string in WOSCC. Out of the 190 included publications, 128 were published in scientific journals, and 54 were published in conference proceedings.

Citations in the WOSCC database were also examined to identify papers with the largest impact in the field. The most cited authors are Hulse, Xie, and Galea [23] with 82 citations, followed by Millard-Ball [24] with 44 citations.

The keywords with the most occurrences were "autonomous cars" with 26 occurrences, "adoption" with seven, and "user acceptance" with four. All keywords that appeared at least three times in the literature pool of 190 publications are shown in Figure 3 (see Figure 2 description for explanation of Figure elements).
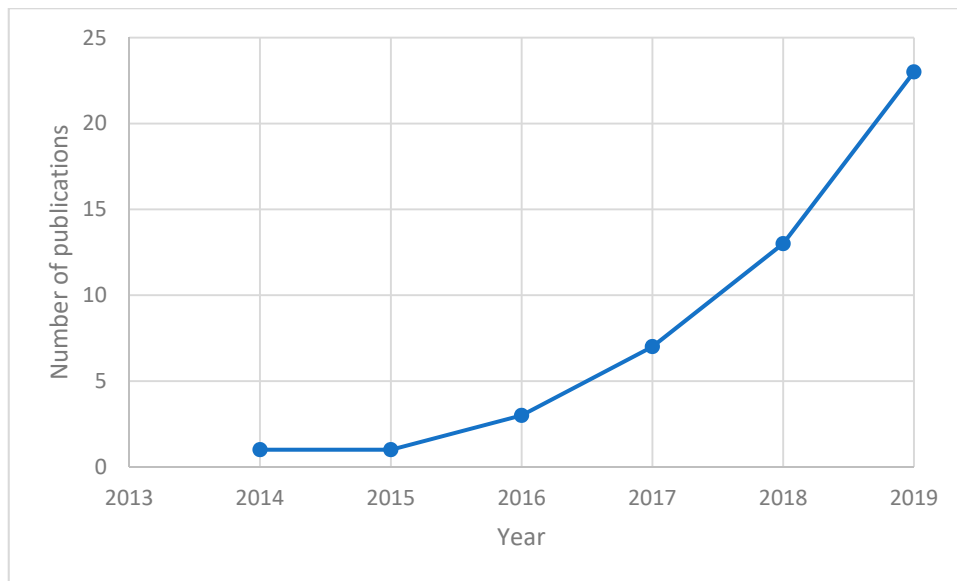
Figure 2. Number of publications per year for search string ((“autonomous car” OR “autonomous vehicle” OR “self-driving car” OR “self-driving vehicle”) AND (purcha OR buy OR adoption)).
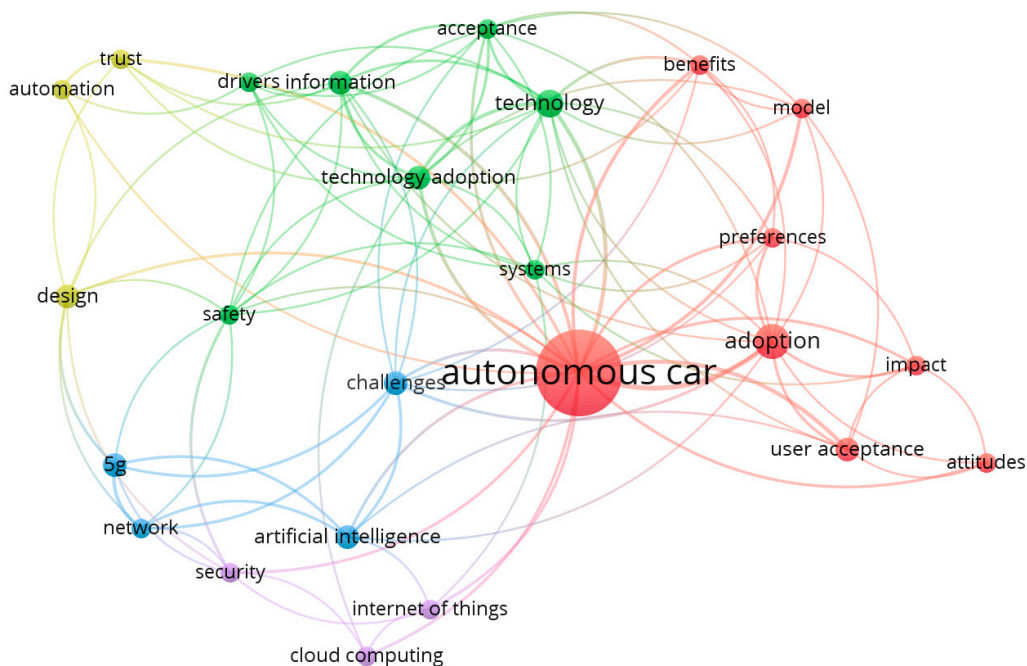

Figure 3. Co-occurrence of all keywords for papers with string ((“autonomous car” OR “autonomous vehicle” OR “self-driving car” OR “self-driving vehicle”) AND (purcha OR buy OR adoption)).

The clusters that the analysis showed are somewhat similar to those that emerged while analysing all publications on autonomous cars. The two main clusters are (1) the red one, which focuses on adoption or user acceptance of ACs and the factors concerning that area, and (2) the green one that focuses on the technology behind ACs. Based on the described analysis, we have identified several studies that investigated the individual’s purchasing intention of ACs and which serves as input into our further research.

Different models related to consumer purchase intention are focused on intention as an independent variable. A higher level of purchase intention is connected to more complex innovations, which better match the current needs and involve lower uncertainty [25]. The latest published research developed

measurement models regarding the adoption of ACs, in which socio-demographic variables such as perceived benefits, perceived ease of use, public fears and anxieties, subjective norms, perceived behavioural control, the environment, technology, collaborative consumption, public transit and car ownership were used [21].

Furthermore, the perceived cost of the vehicle was also identified as a factor. Namely, the direct cost of the vehicle as well as indirect costs such as service cost, insurance costs or fuel consumption may prevent consumers from actual purchase [25].

Besides the previously mentioned, safety is a crucial parameter. As mentioned earlier, ACs use a number of cameras, sensors, radars, communication devices, protocols and algorithms to safely manoeuvre in traffic. Due to the several media covered accidents which involved test ACs, as well as to the human's general distrust of new technologies, concerns regarding the safety of ACs are high [7–9] and most drivers think that the level of automation which is thought to be safer than a human driver will not represent an acceptably safe performance for most drivers [26].

Also, one major factor is related to the personal preferences of individuals. Namely, people have different tastes when it comes to car features [27]. Some individuals would go for cars with particular features which other people fail to prefer [28]. Therefore, it can be concluded that a person may purchase a given car due to the features it possesses [29]. On the other hand, some individuals may buy a specific car just due to the implications it has for their social status and influence. The connection between social influence and purchasing intention is significant only if the product is used publicly [30]. As a result, innovations must be compatible with people's way of life [1].

Furthermore, the demographic characteristics of the region in which an individual lives determine the kind of products which can sell in that region [23]. For instance, there are particular types of cars which are mainly liked by young people and those which older people prefer [31]. Moreover, the ability to purchase and maintain a car depends on the annual income of a person [1]. In many instances, individuals with higher income and education have more purchasing power and buy vehicles with better equipment [32].

Another factor is performance expectancy. According to Leicht, Chtourou, and Youssef [4], performance expectancy is the degree to which a person believes that by using a new product, he or she can improve his or her performance [33]. Therefore, someone may consider buying a new product in the market to improve on a particular performance. Finally, the value of a car by the year in which it was made and the mileage that it has covered also affects purchase intention [34]. Namely, people get attracted to cars that are trusted to have a long-lasting body and that can cover long mileage without damage [33,35].

2. Materials and Methods

The data used for the applicative part of the research was collected using an online-based questionnaire that is described in the following section. The questionnaire was implemented on the QuestionPro platform and was disseminated through social media accounts and mailing lists of two faculties from Slovenia and Croatia between November 2019 and January 2020. The selection of dissemination procedures was intentional in order to ensure the sample would include a larger amount of younger respondents who are the largest group of potential buyers of ACs. Only responses that responded to all questions and gave their full demographic information were included, meaning 266 fully completed questionnaires were received in the given time frame and were included in further research.

The questionnaire used in the survey was divided into three sections, with each section focusing on a specific topic. The topics and questions themselves were derived from an extensive literature review on autonomous cars and specifically on the existing literature, connected to purchasing intentions of ACs, as was presented in the bibliometrics in the introduction. The first part provided information about car ownership, whether the car drivers possessed a driving license and the current value of the car under their ownership. In this part, the respondents were also required to provide information on

criteria that they considered important while buying cars and to what extent such criteria are important to them. The purpose of this section, therefore, was to help in identifying important elements which guide them while deciding which car to buy. The elements which they were required to select included safety while using the car, type of fuel and fuel consumption rate. On the other hand, choices were provided to determine the extents of criteria used while buying a car. The choices were given in a range from 1 to 5 on a Likert scale, as shown below:

- 1—Not important
- 2—Slightly important
- 3—Moderately important
- 4—Important
- 5—Very important

The second section of the questionnaire dealt with issues concerning ACs, and it is in this section where the respondents were given the definition of ACs for their understanding. After this, the respondents were asked to give their views concerning the purchase of the car by selecting whether they agree or disagree with the purchase of the ACs. The choices were also in the range of 1 to 5, where 1 stood for strongly agree and 5 for strongly disagree.

The third section was aimed at identifying the socio-demographic features of the participants. The demographic features which were essential to this survey included gender, age, education level, employment status, year of acquisition of driving license and their driving experience. The total number of respondents who participated in this survey and were included in the analysis was 266.

The next step involved conduction of maximum likelihood analysis using Promax rotation. This was conducted to investigate the behaviour of variables that are measured using multiple items. Cronbach's alpha was applied in assessing their internal consistency.

For the statistical analysis, a two-stage design of the structural equation was used. The first stage of this analysis was a confirmatory factor analysis in which a theoretical factor model based on EFA was injected into the measurement theory evaluation. This was followed by the formulation of a structural equation model (SEM) that was constructed to investigate the relationships in car-related issues, purchase intention and social factors.

Several indices were then employed in the evaluation of the fit of the tested model such as the goodness-of-fit index (GFI), comparative fit index (CFI), as well as the root mean square error of approximation (RMSEA). Generally, GFI; CFI > 0.9 indicates that the model is suitable to observed data. Also, a fit model is considered acceptable if its PMSEA is below 0.06 [36].

The SEM model developed represented an advanced tool for statistical analysis to combine the factor analysis and multiple regression analysis into a single modelling technique [36]. Moreover, it can also be used in the characterisation of a generalised casual path modelling since it deals with covariance structures analysis [36].

After deriving the overall SEM model, it was necessary to examine the goodness of fit (GOF) measures since it enabled validity and adequacy testing of the model. The SEM model developed was then used in exposing the relationship between all the factors involved in this study. All the calculations in this study were conducted in the program package IBM SPSS V26 and its extension AMOS V26.

Based on the literature review and bibliographic analysis, three major groups of factors that could potentially influence the purchasing intentions of autonomous cars were identified. Based on this, we set out three research questions that our research aims to answer, and which are also shown in Figure 4:

RQ1: What autonomous car-related factors influence customers' purchase intentions towards buying autonomous cars?

RQ2: What personal and social factors influence customers' purchase intentions toward buying autonomous cars?

RQ3: What socio-demographic factors influence customers' purchase intentions toward buying autonomous cars?
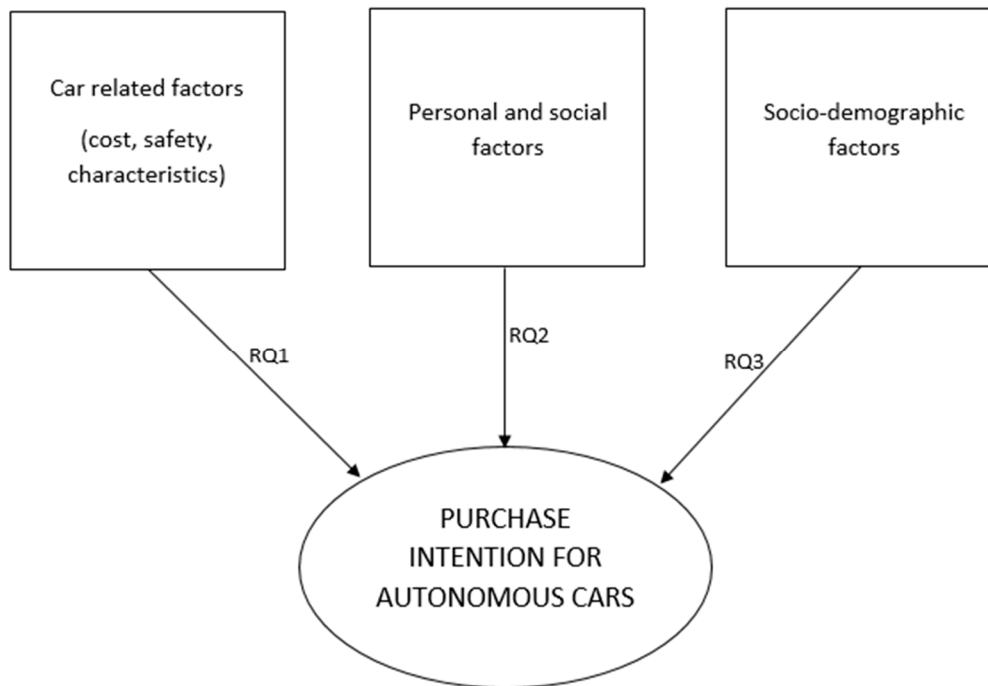

Figure 4. Conceptual framework with the hypothesised model.

3. Results

The demographic features from the survey were recorded and are shown in Table 1. The total number of participants is given by N = 266.

Table 1. Characteristics of the respondents (N = 266).

Characteristics	Percent (%)
Gender	
Male	64.5
Female	35.5
Age	
19–29	50.0
30–39	25.0
40–49	10.5
50–59	6.6
+60	7.9
Education Level	
vocational or four-year high school	14.4
higher education or 1st Bologna degree	30.3
university or 2nd Bologna degree	30.9
specialisation or Master of Science	13.2
PhD	11.2
Employment	
Employee	62.5
Self-employed	3.3
Student	28.2
Unemployed	0.7
Retired	5.3

Table 1. *Cont.*

Characteristics	Percent (%)
Driving licence	
less than 2 years	5.3
2 to 5 years	13.2
5 to 10 years	27.0
over 10 year	54.5
If you own a car, what is (in your estimation) its CURRENT value	
Up to €2000	8.6
From €2001 to €5000	28.9
From €5001 to €7500	20.4
From €7501 to 10,000	16.4
From 10,001 to 15,000 €	10.5
From €15,001 to €25,000	10.5
From €25,001 to €35,000	2.0
From 35,001 to 45,000 €	2.0
Above 45,001 €	0.7
Annual net income	
up to €10,000	36.8
from 10,000 to 20,000 €	40.8
from 20,000 to 30,000 €	19.1
from €30,000 to €40,000	2.0
over €40,000	1.3

As can be observed from the table, the majority of the respondents were male (64.5%), while females who participated in the survey were at 35.5%. The focus was on interviewing predominantly young people, and this was achieved since the majority of the participants were between the age of 19 and 29. Concerning education level, it was observed that majority of the respondents either had higher education or their first Bologna degree. On employment status, the sample was heterogeneous. The majority of the respondents were employees in both the private and public sector (62.5%). On the other hand, only 0.7% were unemployed, while another 5.3% were retired. Also, a significant number of participants were students (28.2%). Majority of them (54.5%) had more than ten years of driving experience, while only 5.3% had less than two years of driving experience. The current value of the cars owned by the respondents varied significantly. 8.6% of the participants had the value of their car ranging from €2001 to €5000 while only 0.7% had cars valued at more than €45,001. Furthermore, the result of the annual net income of the respondents showed that 36.8% were earning between €10,000 to €20,000, and only 1.3% of them were earning over €40,000 as net yearly income.

Maximum likelihood analysis was conducted to analyse the factorial structure of various constructs, and the possibility of using the factor analysis without any concerns was also tested through two tests; Kaiser-Meyer-Olkin (KMO) test, and the Barlett's Test of Sphericity (BTS). From the results, it was observed that the BTS value was significant (Approx.Chi-Square was 2038.037 with df = 351 and $p < 0.001$), and the KMO value was 0.752. Usually, the convergent validity is reflected by factor loading size in which variables having a single factor must be highly correlated. For the sample size comprised of 266 participants, the threshold required for factor loadings to be regarded as significant should be greater than 0.4. The results shown in Table 2 show that all the items had a factor loading >0.40 on a threshold ranging from 0.480 to 0.991, hence confirming the unidirectional structure of the constructs. Moreover, reliability, which investigates the level of consistency between multiple measurements of a certain variable, was assessed using the most widely used reliability measure, Cronbach's alpha reliability coefficient. The generally agreed minimum lower level for Cronbach's alpha coefficient is the value 0.70. The measurement instruments reliability and internal consistency evaluated by Cronbach alphas revealed that all the factors had their coefficients above the cut-off criterion of 0.7 and hence indicating high reliability. Besides, the results also show that Cronbach alpha $\alpha = 0.881$ for

performance expectancy, α = 0.785 for indirect car costs, α = 0.836 for anxiety, α = 0.845 for purchase intention, α = 0.815 for social influence, α = 0.723 for car safety and α = 0.725 for car characteristics.

Table 2. Results of the rotated factor pattern matrix (exploratory factor analysis).

Performance expectancy		
As you will not have to drive/operate an autonomous car, driving them will be different from today's experience		
Q10R7	I'll be able to talk to passengers and look at them.	0.864
Q10R3	While driving, I will be able to do other things (work, reading etc.).	0.794
Q10R6	I will be able to use my mobile phone while driving.	0.780
Q10R2	I will enjoy the drive and watch the surroundings.	0.707
Q10R4	As I will not operate the car, I will not cause a car accident.	0.694
Q10R5	I will not receive penalties for traffic violations (e.g., speeding, running a red light, etc.).	0.666
Q10R8	I will go on short trips more often (since I will not need to drive on unfamiliar roads, because driving will not make me tired, etc.).	0.489
Anxiety		
The following are claims related to the use of autonomous cars.		
Q11R2	I will be afraid to use such a car due to possible malfunctions.	0.991
Q11R1	I will be afraid to use an autonomous car, as the car may make a non-repairable error.	0.820
Q11R5	I will be afraid to use such a car because I do not know who is responsible in the event of an accident (car or me).	0.562
Q11R8	I have a prejudice related to distrust in automation and technology.	0.534
Purchase intention		
The following are claims related to the purchase of an autonomous car		
Q8R5	I will buy an autonomous car because it will be electrically powered.	0.890
Q8R6	I will buy an autonomous car because it is the progress of humanity.	0.792
Q8R4	I will buy an autonomous car because ownership will be cheaper (purchase, maintenance, repairs, insurance).	0.787
Q8R2	I can imagine myself buying and using an autonomous car someday.	0.496
Indirect car costs		
What criteria were important to you when you bought the car you now own		
Q5R9	Insurance price	0.906
Q5R8	Maintenance costs	0.751
Q5R10	Annual road use tax	0.744
Q5R2	Low fuel consumption	0.504
Q5R5	The price of the car	0.480
Social influence		
The following are claims about the characteristics of autonomous cars		
Q9R5	Allows the disabled (e.g., on a wheelchair) to reach their desired destination.	0.894
Q9R4	Allows the blind and visually impaired to reach their desired destination.	0.886
Q9R9	Because of autonomous cars, older people will no longer depend on others.	0.527
Car safety		
What criteria were important to you when you bought the car you now own		
Q5R4	Accessories in terms of safety systems	0.755
Q5R1	General car safety	0.713
Car characteristics		
What criteria were important to you when you bought the car you now own		
Q5R11	Engine power	0.864
Q5R12	The shape/type of car	0.533

The confirmatory factor analysis was also conducted to check the reliability and validity of the constructs. The results indicate that the data model used in the confirmatory analysis was valid and hence acceptable. The results for the confirmatory analysis (CFA) were as follows; Chi-square = 512.568; df = 303; $p < 0.05$, NFI = 0.904, GFI = 0.946, RMSEA = 0.057 and TLI = 0.962. On the other hand, the score

composite reliability score was greater than 0.7 for all the considered constructs. Another important factor in this test was the convergent validity which was determined as the average variance extracted (AVE). For all the constructs, the AVE was greater than 0.5, as shown in Table 3; moreover, all the factor loadings were equal to or greater than 0.7. This suggests that the items under consideration were a true representation of the constructs. For every construct, the AVE value was greater than the correlation squared; this confirms the discriminant validity of the constructs used in the study.

Testing the Research Model

The results obtained from the research model are as shown in Figure 5 below. The focus of the study was mainly to determine the primary motivation of people to buy an autonomous car, which is referred to here as the purchase intention. In Figure 5, estimates that are considered at the 0.10 level are marked with a full line and the ones drawn with a dashed line were not found to be significant. This, therefore, means that the factors of car safety (0.832, $p = 0.032$), buyer age (0.186, $p = 0.014$) and level of education (−0.290, $p = 0.019$), perceived social influence (0.199, $p = 0.022$), anxiety (−0.188, $p = 0.090$) and performance expectancy (0.313, $p = 0.001$) are considered significantly correlated at the 0.10 level to purchasing intention of ACs, while the other factors' correlations to purchasing intentions haven't been proven. The final results of the model are shown in Figure 5, and the calculated fit indices of the SEM model are shown in Table 3.
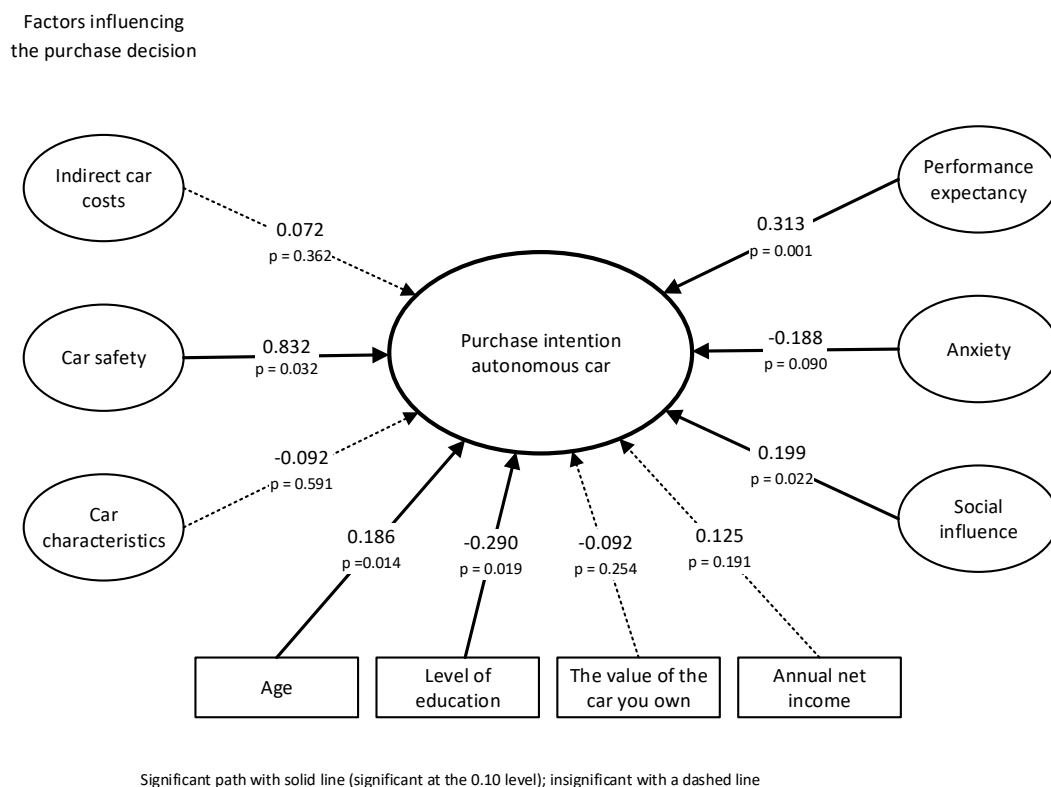
Factors influencing
the purchase decision

Significant path with solid line (significant at the 0.10 level); insignificant with a dashed line

Figure 5. SEM Analysis Results.

The results therefore closely point to relations between given factors and purchasing intentions for ACs. For example, the path from the factor "car safety" to the factor "purchasing intention of ACs" is positively weighted, which means that when car safety goes up by 1 standard deviation, purchasing intention of ACs goes up by 0.832 standard deviations. Consequently, we can conclude that people that value car safety will be more inclined to buy an AC. On the contrary, the path from the factor "level of education" to the factor "purchasing intention of ACs" is negatively weighted, which means that people with higher education are less inclined to buy ACs.

Table 3. Calculated fit indices of the constructed SEM model.

Fit Index	Acceptable Threshold Levels	Achieved Values
χ^2	Low value relative to degrees of freedom *df*	555.945
(χ^2/df)	<3 good <5 permissible	1.404
RMSEA	<0.07 good 0.07 < 0.10 moderate >0.10 bad	0.052
NNFI (TLI)	>0.90 acceptable >0.95 good	0.956
CFI	>0.90 acceptable >0.95 good	0.970
IFI	>0.90 acceptable >0.95 good	0.973
SRMR	<0.08 good	0.0702

The first research question of the present research was connected to car-related factors and their potential influence on purchasing intentions. This influence was measured through three groups of car characteristics, namely indirect car costs, car safety and car characteristics (in the technical sense). Results of the constructed model confirm that car safety is a significant factor when looking at purchasing intentions for autonomous cars, while indirect car costs and car characteristics are not. The second research question focused on personal and social factors of the customers, and our model showed that performance expectancy and social influence are positively and significantly correlated to purchasing intentions, while anxiety is negatively and significantly correlated. The third research question looked at various socio-demographic variables of potential buyers of ACs and found that age and level of education significantly impact customers' purchasing intentions. In contrast, their income levels and the current car they own do not seem to have significant effects.

4. Discussion

This study aimed to determine the factors which influence purchase intentions of autonomous cars among various people. In the field of factors related to the autonomous car itself, we found that car safety is the most important factor that potential buyers will consider, more important than other car characteristics and indirect car costs. This result clearly shows that with the increase of general safety aspects of autonomous driving, the purchase intention will also increase. This is also confirmed by other studies [4,37–39]. However, although autonomous driving will eliminate human errors (which are known to be the major cause of traffic accidents [40]), people still have safety concerns regarding the proper functioning of such technologies.

When looking at personal and social factors of the customers, which encompassed questions about their expectations of social acceptance of their purchase of an autonomous car, their potential anxiety about using such advanced technology and alike, our results showed that this area has a large impact on purchasing intentions since all three factors that were included in SEM from this field were found to be significantly correlated. It is known that when a certain kind of innovation is widely implemented, the impact of the social norms on purchase intention can be stronger than that of the innovation that is being privately used [41]. Several other studies have also highlighted social factors and norms as an important factor [42–44]. Furthermore, the fact that anxiety about AC use is negatively correlated to purchase intentions should not be overlooked since this points to a potentially significant obstacle in AC adoption. Namely, anxiety is related to people's trust in such technologies, and it is found that the more people perceive the risk of ACs, the less they trust them, and the more they trust the ACs, the lower the perceived risk [45].

Furthermore, performance-to-price values are usually considered when purchasing a car, and if an innovation has a low performance-to-price value compared with product substitutes, the majority of consumers may not be willing to purchase it [46]. However, our research found that financial aspects seem to have no connection to purchasing intentions of ACs, which is to some extent contrary to existing literature. Namely, the literature indicates that the price is the main factor in purchasing ACs [47] and that the customers' willingness to buy such vehicles changes depending on their potential price [48,49]. On the other hand, some studies suggest that the relative price between ACs and conventional vehicles is more important than the price of ACs [50]. Discrepancies between results of the present study and other studies may be due to the different characteristics of the correspondents (cultural background, age, education etc.) as well as the fact that ACs are not yet available on the market, so customers do not have concrete opportunities to compare the price points of ACs to vehicles currently on the market. Two found influences on AC purchasing intentions that were confirmed in our study are customer age, where purchasing intentions are increasing with buyer age, and level of educations, where interestingly a negative correlation was identified. Regarding age, a similar result was obtained in [51] which authors suggested that older people are more likely than younger ones to use assistive devices in order to compensate for their old age. However, it must be noted that 75% of the respondents in this study were younger (between 19–39 years of age), so the aforementioned results may not represent the real picture.

In a study of a comparable sector, green luxury cars, results similarly showed that social influence, showing as status motivation, is an important factor of purchasing intention [52]. Similar findings were also produced by Higueras-Castillo, Molinillo, Coca-Stefaniak & Liebana-Cabanillas [53] whose research pointed out that car performance greatly impacts purchasing intention for electric vehicles, but they did not confirm our findings about the impact of social influence. However, these comparisons with similar research cannot be directly compared to our research since the main aspect of autonomous cars lies in its self-driving ability and not in its luxury or propulsion.

The outcome of this study should be evaluated under consideration of the state of the market of autonomous cars at the moment [54] since no fully autonomous cars are available to the general public, which means that most people do not yet have direct experience with ACs and only rely on circumstantial and secondary information from the media. Additionally, the survey failed to particularly consider the potentially unequal knowledge of ACs among the survey participants. For many categories of products, an increase in knowledge about the product and its use affects the preferences which were considered in the survey [3]. For the case of autonomous cars, research shows that individuals who initially wanted to keep driving may ultimately change their attitudes and adopt autonomous cars after getting information and experience about the product. A similar case was found with the adoption of electric vehicles, where customers with previous direct experience with electric vehicles had different attitudes and purchase intentions than customers with no previous direct contact [55]. Another weakness of this study entails the lack of actual use of autonomous cars in a situation where the consumer adopted or bought the car. As it can be observed, the diffusion processes involved may not be understood without understanding the concepts of use [56]. Precise details on the ACs, such as price or regulations, were not considered, yet they can be expected to have a major impact on AC adoption [5]. This infers that the assumptions made in the study may not include all the influential aspects as that is impossible to do until ACs penetrate the personal car market to a larger extent. Another thing to be aware of is the so-called attitude-action gap, which means that not all customers who estimate they would buy an AC would actually buy it when they had the opportunity to do so [57].

In summary, further research should be conducted to analyse the relevance of various product characteristics concerning the life cycle of autonomous cars. Other factors facilitating adoption as well as their effects on the consumer's intentions to purchase the products should also be explored. As the launch of the autonomous cars draws near, the manufacturers should conduct a comprehensive study to capture several aspects, including the culture of the intended users [58]. Therefore, it is

recommended for the developers to extensively explore the attitude of the consumers alongside other social groups [4]. There is also a potential in bringing the experience of automated car driving to potential users through virtual test driving, which would, in turn, ensure at least a small level of experience with ACs of any test subject before answering similar surveys than the one utilised in this paper [59]. Besides, further studies on clusters or groups can assist the developers in producing products that are readily accepted by the public. Finally, the long-term impact of the current health crisis on overall technology development, social practices and habits, as well as mobility (both on the global and local level) is still unknown. Over the short to mid-term, the COVID-19 crisis could delay the development of autonomous driving, due to the lack of investments and safety measures during the pandemic. However, it is possible that over the long term, ACs will see higher-than-expected demand, since they enable physical distancing while ensuring some of the most important advantages of public transport such as a relatively hands-off driving experience. The short, mid and long-term effects of the pandemic on the overall technological and mobility trends should be analysed in future studies in order to modify the model obtained in this study.

5. Conclusions

This study analysed three groups of factors (car-related, personal and social, socio-demographic) on purchasing intention of ACs. Out of the ten factors, six are significantly correlated to the purchasing intention: "car safety", "buyer age", "level of education", "perceived social influence", "anxiety" and "performance expectancy"; while four are not: "indirect cost", "car characteristics", "the value of the car you own" and "annual net income". Furthermore, the factor "safety" is identified as the major one, followed by "performance expectancy", "level of education", "social influences", "anxiety" and lastly "age". Four of the significant factors are positively weighted (safety, performance expectancy, social influences and age), meaning that with their increase the purchasing intention also increases, while two are negatively weighted (level of education and anxiety).

Overall findings indicate that further activities of manufacturers, policymakers and other stakeholders interested in increasing adoption and acceptance of autonomous vehicles should focus on using the potential social influence and performance capabilities of ACs to leverage purchasing intentions. Besides mentioned, activities should also be focused on the reduction of overall anxiety about the technological and usage aspects of ACs. Based on the findings, we recommend that relevant authorities on both the national and global level start to develop educational campaigns in which benefits of ACs, such as general safety and reduction of crashes, cost-efficiency, reduction of traffic jams, fuel consumption and emission of greenhouse gases, as well as enhancement of convenience and enjoyment, would be clearly explained and presented to the general public.

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