

Exploring Demographic Influences on Public Perception and Adoption of Autonomous Vehicles: An Empirical Perspective

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Abstract. *Autonomous vehicles constitute a major innovation in the field of transportation, redefining mobility and providing solutions to many of the existing traffic problems, which is why literature seeks to identify the factors influencing their perception and acceptance by the general public.*

The present research analyzes the impact of demographic factors such as age, education level, professional status on the perception and trust in autonomous vehicles. Existing research studies largely explore technical challenges, empirical studies on the influence of these factors remain limited.

The methodology underlying the study is a quantitative one, based on a structured survey applied to a representative sample. Hypotheses were formulated and tested on the basis of a questionnaire answered by 530 respondents. The questionnaire included questions on demographics, familiarity with autonomous vehicles, sources of information used, confidence in safety and cybersecurity as well as concerns about automation and its impact on the labor market. The research results identified a significant negative correlation between age and familiarity with autonomous vehicles, demonstrating that younger people are more informed and more open to this technology. Educational level also influences information sources, as respondents with higher education prefer academic and professional sources. In terms of professional status, the results show that certain professional categories are more concerned about the impact of autonomous vehicles on jobs. Last but not least, the research shows that cybersecurity concerns are not determined by age.

This article emphasizes the importance of demographic factors in the public's perception of AVs and offers guidelines for strategies to inform and adopt this technology.

Keywords: autonomous vehicles, public acceptance, artificial intelligence, demographic factors, traffic safety.

Introduction

The current economic dynamics contribute to the emergence of new technologies and determine new consumption and usage behaviors. Sustainable development has contributed to learning new aspects, unlearning others or remembering others (Pislaru *et al.*, 2010; Sarfraz and Ivascu, 2023). Market requirements are given by consumers. Consumers design their needs and marketing mix according to their needs and desires. Sometimes the concept of marketing is antithesis to

sustainability. If marketing creates new products and campaigns to attract and increase sales, sustainability implies a balance in the use of resources (Hakak *et al.*, 2023). The vehicle industry knows various forms and innovative products. Many customers are attracted to new technologies without using them to their full capacity (Giannaros *et al.*, 2023). However, decisions are influenced by several factors, including environmental and marketing ones. In practice, new technologies contribute to the development of new behaviors, needs and desires. In such a perspective, the consumer becomes an initiator of an always innovative and competitive marketing mix. Here, organizational capacity and the production system must be considered. Investments must be in line with market forecasts and the expectations of marketing people. Automation of facilities and system flows are aspects of competitive systems that contribute to easing the activity of the human factor. In the field of automation, the steps taken so far are important (Zaarane *et al.*, 2020).

Autonomous vehicles are technological solutions that can fully or partially replace humans. These AVs lead to the avoidance of hazards and rapid adaptation to traffic conditions (Giannaros *et al.*, 2023). Many studies show a considerable attraction for these AVs, but they also involve a series of human barriers. Research shows that 5th generation mobile technologies can be leveraged to meet AV requirements. Such advances can be proven to be considerable, and emerging technologies are important in the context of sustainability. AV represents a transition to mobility, satisfying consumer desires for comfort, quality education, and speed (Qian *et al.*, 2023).

The paper is structured into two parts. The first part presents the results of the qualitative evaluation of the specialized literature regarding a series of aspects outlined in the research hypotheses and the results and discussions of the quantitative analysis. This research is innovative through the sample accessed and the comprehensive way of developing the questionnaire.

Literature review and hypothesis development

The aspects of AV are complex and develop a series of research topics. In the continuation of this section, the outlined aspects of the established hypotheses are presented.

1. How age impacts perceptions of autonomous vehicles

Scientific literature shows that the successful adoption of autonomous vehicle technology is strongly influenced by demographic factors, in particular the age of the user, which is in line with the level of familiarity, perception and willingness of the individual to adopt specific technology. Studies have concluded that younger people are significantly more open to the use of autonomous vehicles, having a higher level of familiarity and confidence in the benefits of such technology.

A study conducted by (Rahman *et al.*, 2019) investigates the general public's perception of autonomous vehicle adoption and finds that people under 35 years of age have a higher level of acceptance compared to age groups over 35 years.

In similar research, (Bansal, Kockelman and Singh, 2016) analyze the factors influencing the adoption of autonomous vehicles and conclude that younger people are more likely to know details about AV technology, which leads to a greater openness in its use, while older people show a higher level of reluctance and skepticism. The same study shows that familiarity with AV technology is strongly correlated with the degree of exposure to information about autonomous mobility, i.e. the use of technological devices in current activities.

Another study that attests to the correlation between age and acceptance of autonomous vehicles is the one conducted by (Howard and Dai, 2014) in which they investigate attitudes towards autonomous vehicles, concluding that people under 40 are more likely to interact with emerging technologies, having a more positive attitude towards their use. The study also highlights that age is a key factor in familiarization with AVs, with younger people more interested in testing and adopting the technology compared to older generations.

Considering the relevant literature, we formulated the following hypothesis:

Hypothesis 1: There is a significant relationship between age and familiarity with autonomous vehicle technology

2. How the level of education influences people's approach to autonomous vehicles

Level of education plays a key role in determining which sources of information individuals consider credible and relevant. People with a higher level of education tend to have more developed critical faculties, which enable them to evaluate information more rigorously and to distinguish between reliable and potentially unreliable sources. In general, these individuals prefer academic publications, scientific studies, scholarly journals and government sources as more accurate and objective. On the other hand, less educated people frequently rely on traditional media, social networks and informal sources, which are more accessible and easier to understand, but often less rigorous in terms of verifiability.

Haboucha et al. (Haboucha, Ishaq and Shiftan, 2017) have examined the public's perception of autonomous vehicles and found that the level of education significantly influences the level of trust in information sources. Those with tertiary education were more likely to access information from scientific journals, conferences and technical articles, while respondents with lower educational levels relied mainly on television, online forums and recommendations from social circles.

Starting from the idea of a 1970 study known as the "Knowledge Gap Hypothesis" (TICHENOR, DONOHUE and OLIEN, 1970), which states that people with a higher level of education have greater access to quality information and a better ability to interpret it, which contributes to a disparity in knowledge between different social groups, and reinforcing that this theory explains how education not only facilitates access to information but also influences the selection of sources considered credible, highlighting the differences between individuals according to their academic background, the following hypothesis was formulated:

Hypothesis 2: Level of education influences preferred sources of information regarding autonomous vehicles

3. How employment status influences concerns about job loss due to automation

Broad research (Filippi, Bannò and Trento, 2023) explores how automation affects employment at multiple levels (global, national, regional, industry and occupational), highlighting that the technological impact on the labor market is not uniform and depends on multiple variables, including the skill level of employees and job characteristics.

One of the main results of the study is that the literature converges in identifying the occupations most exposed to automation, confirming that certain occupational characteristics determine the risk of substitution. In particular, jobs involving repetitive, manual and easily automatable tasks are the most vulnerable, while occupations requiring advanced cognitive skills, creativity and complex human interaction are less affected by automation processes. The article concludes that cross-country variations in the impact of automation can be explained by differences

in the structure of occupations, the distribution of non-routine tasks and national education and training policies. Thus, the authors emphasize the need for future studies to explore these differences in depth and explain why the likelihood of automation varies across countries (Filippi, Bannò and Trento, 2023).

Analyzing the prospects of increasing concerns in relation to employment status, the following hypothesis was formulated:

Hypothesis 3: Employment status influences concerns about the impact of autonomous vehicles on the labor market

4. How age influences the level of concern about cyber security risks

Age significantly influences how individuals perceive and express concern about cybersecurity risks, reflecting differences in awareness, digital experience and exposure to online threats. Previous research has highlighted that younger individual, being more familiar with technology and frequently using internet-connected devices, may have a more nuanced perception of cyber risks, but not necessarily a higher level of concern, as they feel more competent in managing these threats (Pham and Xiong, 2021). In contrast, older people, although they may be less exposed to cyberattacks on a daily basis, tend to exaggerate the potential impact of these risks, having lower confidence in the ability of autonomous systems to prevent such threats (Lim and Rajivan, 2023). Research also shows that differences in levels of technological literacy and access to cybersecurity information influence the level of concern, with more informed users having a more realistic perception of the threats and available safeguards (Gorine and Khan, 2024). In the context of autonomous vehicles, these differences in perception may affect the acceptance of technology, particularly among groups that associate automation with increased vulnerability to cyberattacks.

Hypothesis 4: Age influences cybersecurity concerns regarding autonomous vehicles

Methodology

This research uses a questionnaire as an investigative tool. The questionnaire was administered online, and the validated sample consisted of 530 individuals. Participants were recruited by stratified convenience sampling, aiming to achieve diversity in terms of age, educational level and professional status. The questionnaire was distributed through online platforms, academic institutions and professional networks, targeting individuals from different occupational fields to achieve a balanced representation. Although the convenience sampling method may introduce selection bias, efforts were made to ensure a balanced distribution of respondents. In order to improve external validity, future research should use random or quota-based sampling techniques so that the sample distribution is more representative of the entire population. The survey instrument was developed based on an extensive literature review and adapted from previously validated studies on public trust and perceptions of autonomous vehicles. Items measuring familiarity with AVs, sources of information, cybersecurity concerns, and labor market impacts were retrieved and adapted to maintain consistency and comparability with previous research. The newly formulated questions were also pre-tested through a pilot study with 30 participants to assess their clarity, reliability and relevance. Based on the feedback received from the pilot study, minor adjustments were made to the wording of the questions to make them easy to understand and to remove any ambiguities. The responses obtained were quantitatively modeled using statistical analysis. The results contribute to the advancement of the specialized literature by outlining the avatar of the AV user.

Results and discussions

In order to test the first hypothesis, we performed a Spearman correlation test, measuring the strength and direction of the relationship between the variables.

Age was used as the independent, ordinal variable classifying respondents into age categories and familiarity with autonomous vehicles was used as the dependent, ordinal variable, measured on a scale from 1 representing not at all familiar to 5 representing very familiar.

Table 1. Spearman's Rank Correlation Between Age and Familiarity with Autonomous Vehicles
Correlations

		Age		Familiarity with Autonomous Vehicles
Spearman's rho	Age	Correlation Coefficient	1.000	-.704**
		Sig. (2-tailed)	.	.000
		N	530	530
	Familiarity with Autonomous Vehicles	Correlation Coefficient	-.704**	1.000
		Sig. (2-tailed)	.000	.
		N	530	530

** . Correlation is significant at the 0.01 level (2-tailed).

The result of the statistical analysis using the Spearman correlation coefficient revealed a strong and statistically significant negative relationship between the age of the respondents and the level of familiarity with autonomous vehicles. This result indicates that as age increases, the level of familiarity with autonomous vehicle technology tends to decrease. The p value < 0.001 confirms that this correlation is highly significant, reducing the likelihood that this association is the result of random variation in the data. Thus, the hypothesis that younger individuals are significantly more familiar with autonomous vehicles than older individuals is supported by strong statistical evidence.

The second hypothesis was also subjected to a Spearman correlation test as shown in Table 2, the result validating the correlation between the two variables.

Table 2. Spearman's Rank Correlation between Educational Level and preferred information source
Correlations

		Education Level		Preferred Information Source
Spearman's rho	Education Level	Correlation Coefficient	1.000	.669**
		Sig. (2-tailed)	.	.000
		N	530	530
	Preferred Information Source	Correlation Coefficient	.669**	1.000
		Sig. (2-tailed)	.000	.
		N	530	530

** . Correlation is significant at the 0.01 level (2-tailed).

Spearman test results indicate a strong positive and statistically significant positive correlation between the level of education and the main source of information about autonomous vehicles. The result confirms that people with a higher level of education are more likely to get

their information from academic and professional sources, such as scientific articles, specialized conferences or technical publications. In contrast, those with a lower level of education tend to mainly use traditional media and social networks as sources of information about autonomous vehicle technology.

The high significance of $p\text{-value} < 0.001$ indicates that this relationship is not the result of random variation but reflects a clear pattern of information behavior as a function of education level.

For the third hypothesis, according to which professional status influences concern about job loss, we tested the variables "Professional Status" and "Concern_Job Loss" using the Chi-square test. This statistical test is suitable for analyzing the relationship between two categorical variables and allows us to assess the existence of a significant association between them.

Table 3. Chi-square test results for the association between occupational status and concern about job loss

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	439.483 ^a	5	.000
Likelihood Ratio	592.888	5	.000
Linear-by-Linear Association	3.746	1	.053
N of Valid Cases	530		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 31.20.

Table 3 shows the results of the Chi-square test, revealing a significant association between employment status and concern about job loss, with a Pearson Chi-Square value of 439.483, $df=5$ and a significance level of $p<0.001$, indicating that the observed differences between occupational groups are not random, but reflect a clear relationship between respondents' occupation and their level of concern about the impact of automation, highlighting the need for retraining and adaptation measures for affected sectors.

In order to test the relationship between age and cybersecurity concerns, we subjected hypothesis 4 to a Spearman correlation test.

Table 4. Spearman's Rank Correlation between Age and Concerns regarding cyber attacks and data protection
Correlations

		Age	Concern_Cyber Attacks and Data Protection
Spearman's rho	Age	Correlation Coefficient	1.000
		Sig. (2-tailed)	.058
		N	530
	Concern_Cyber Attacks and Data Protection	Correlation Coefficient	-.082
		Sig. (2-tailed)	.058
		N	530

The results indicate a very weak negative correlation between age and concern about cyber-attacks and data protection. Although the negative suggests that younger individuals may have fewer cybersecurity concerns than older individuals, the value is extremely small, indicating an almost non-existent relationship between the two variables.

Also, the p-value = 0.058 is slightly above the conventional significance threshold of 0.05, which means that the observed relationship is not statistically significant, indicating that we do not have sufficient evidence to conclude that age influences the perception of cybersecurity of autonomous vehicles.

Statistical analysis of the four hypotheses revealed significant relationships between certain demographic variables and perceptions of autonomous vehicles, confirming three hypotheses and rejecting one. The first hypothesis, that age influences the level of familiarity with autonomous vehicles, was supported by a strong and statistically significant negative correlation, indicating that younger people are significantly more familiar with AV technology than older people. The second hypothesis, regarding the influence of educational level on preferred sources of information, was also confirmed, showing that individuals with higher education tend to get more information from academic and professional sources, while individuals with lower educational level rely more frequently on traditional media and social media.

Regarding the third hypothesis, the results of the Chi-square test indicated a significant association between occupational status and concern about job loss, thus confirming that people with an active occupational status are more concerned about the impact of automation compared to people who are not professionally active.

The last hypothesis that age influences confidence in the cybersecurity of autonomous vehicles was not supported by the analyzed data. The results indicated a weak and insignificant relationship, suggesting that concerns about cyber-attacks are not directly influenced by age, but may depend more on other factors such as digital experience, exposure to cybersecurity information or general technological literacy.

The survey results highlight significant demographic differences in the perception and adoption of autonomous vehicles, demonstrating that young people are more likely to embrace this technology due to their increased familiarity with digital innovations and frequent use of artificial

intelligence in everyday activities. In contrast to older generations, who perceive autonomous technology as less predictable and difficult to control, young people interact more easily with automated systems and are more receptive to integrating them into everyday transportation. However, the acceptance of AVs by older people remains a significant challenge, suggesting the need for tailored educational strategies and testing experiences, such as assisted test-drive sessions and interactive technology demonstrations, aimed at reducing uncertainty and increasing confidence in the safety and effectiveness of these systems.

On the other hand, educational level influences how individuals' access and process information about autonomous vehicles. The results indicate a strong correlation between educational attainment and the type of information sources used, with highly educated individuals relying predominantly on academic and professional sources such as scientific articles, conferences or technical reports, while those with lower educational attainment rely more on traditional media and social networks. This difference leads to variations in understanding of the risks and benefits of AVs, which may influence the level of acceptance of technology.

In order to ensure accurate and balanced information, mixed communication strategies tailored to different audiences need to be implemented. For highly educated people, communication should include detailed reports, case studies and scientific analysis, providing well-founded arguments on the safety and effectiveness of AVs. For the general public, messages need to be more accessible, using visual media campaigns, explanatory content on social networks and simplified educational materials so that the information is easy to understand and assimilate.

These findings suggest important implications for policy makers and the automotive industry, which can help increase the acceptance of autonomous vehicles through effective public policies and information campaigns. Governments could support technology testing programs for those less familiar with the technology, as well as educational initiatives integrated into the school system to familiarize future generations with these innovations. At the same time, automakers could customize marketing strategies to address the needs and concerns of each demographic. In this way, the adoption of autonomous vehicles could be accelerated, contributing to the development of a safer and more efficient transportation ecosystem.

Conclusion and limitations

This research is important for the field of transportation, marketing and sustainability. The accepted hypotheses and the rejected hypothesis outline a complex profile of the user. If the education and training of the customer are important in the decision-making process, the stability of the job and its level are criteria in choosing autonomous solutions. Studies carried out in the field anticipate an evolution of the typology of the customer and the facilities of autonomous vehicles.

The automotive industry can optimize marketing and product development strategies by demographically tailoring communication and user experience, given the differences identified in this study. The personalization of advertising messages is key, as younger people are more receptive to digital content, interactive experiences and virtual reality-based demonstrations, while older people prefer detailed presentations and hands-on demonstrations to understand the benefits of autonomous technology. The introduction of progressive user experiences, through vehicles that allow a gradual transition from manual to autonomous driving, could also facilitate the acceptance of new technologies and increase confidence in their safety. In addition, partnerships with educational institutions and testing centers can help to familiarize future users with autonomous vehicles at an early stage, which could shape favorable attitudes and a faster integration of this

technology into society. The implementation of these strategies would not only support the uptake of AVs but could also contribute to a sustainable transformation of the automotive industry, aligning with global trends of digitization and automation of mobility.

Although the study provides a detailed insight into the influence of demographic factors on the perception of autonomous vehicles, there are certain limitations that need to be considered for a more nuanced interpretation of the results. The first limitation is related to sample bias, as the use of an online questionnaire may lead to the overrepresentation of younger and technologically familiar individuals. This distribution may influence the general perception of autonomous vehicles, creating a more optimistic picture than the general population. In the future, the use of more diversified sampling methods, including face-to-face or telephone surveys, could improve the representativeness of the sample.

A second limitation is the lack of a cross-cultural comparison, as the study was carried out exclusively in Romania, without analyzing differences in perceptions with other countries. Cultural and regional factors may play a significant role in the adoption of emerging technologies, and attitudes towards autonomous vehicles may vary depending on the level of digitization, transport infrastructure and national regulations. Future research could address this dimension through multi-country comparative studies to identify global trends and regional particularities in the acceptance of AVs.

The study also used a cross-sectional methodology, which means that respondents' perceptions were measured at a single point in time, without analyzing the evolution of trust in technology over the long term. A longitudinal approach, tracking changes in perceptions over a longer period of time, could provide a deeper understanding of the factors influencing acceptance of autonomous vehicles.

In addition, self-reported responses may introduce social desirability bias, in which participants may provide responses perceived as favorable, rather than their genuine opinions. To reduce this effect, future research could combine quantitative and qualitative methods, such as in-depth interviews or technology testing experiments, to gain a clearer picture of how users actually interact with AVs. By addressing these limitations and expanding research methodologies, future studies can contribute to a more complete and applicable understanding of the perception and acceptance of autonomous vehicles globally.

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