Changing social attitudes towards self-driving vehicles: the beginning of a new era

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Abstract: The proliferation of self-driving cars has given rise to mixed feelings among many. Many are excited about the developing technology, while others are concerned about the potential dangers and impacts. People are gradually switching to new technologies, for example, fewer people are watching TV, while online streaming is growing in popularity. The same applies to digital money. The advent of autonomous vehicles could bring changes in transport patterns and infrastructure. Studying adoption and analysing attitudes is key to understanding the technology. Ethical and legal issues are the main barriers to technology adoption. Issues of liability, privacy and ethical decisions need to be clarified. The research methodology involves the use of combined data. A questionnaire survey collecting the views of past respondents will allow changes to be monitored. The Covid-19 epidemic has had an impact on the adoption of self-driving cars because people are looking for distancing options. Technological development must take into account people's needs and expectations and ensure that ethical and legal frameworks are respected.

Keywords: self-driving cars, social acceptance)

1 Introduction

The adoption and uptake of autonomous vehicles is a dynamic and multidimensional process that is fundamentally transforming the automotive industry and people's daily lives. As these technological developments become increasingly integrated into society, the challenges ahead become more significant. The emergence of autonomous vehicles will not only change the way people travel, but also the way they behave, feel safe and live their lives.

This paper reviews the challenges and opportunities for autonomous vehicles and the factors that influence their social acceptance. It analyses in detail the ethical, safety and technological challenges of autonomous vehicles and the responses to these challenges [1]. Although autonomous vehicles are increasingly present in transport, their private use is still at an early stage. Despite adequate hardware and software tools, public acceptance remains low, especially among women due to fear [2].

Research shows that those who are not open to autonomous vehicles are more afraid of potential negative consequences such as hacker attacks, system failures or lack of control [3]. In contrast, proponents expect positive effects such as reducing accidents and promoting environmental protection [4]. Overall, the study helps to understand the drivers of trust in autonomous systems and provides lessons for manufacturers and policy makers to address concerns and integrate autonomous vehicles into the transport system of future smart cities [5].

2 Self-driving vehicles

Technological advances and innovations have become part of our everyday lives, but not everyone embraces them with equal enthusiasm. The rise of self-driving cars in particular has provoked mixed feelings [6]. Examining technology acceptance and analysing attitudes is key to understanding and embracing technological developments. In addition, it is important to clarify ethical and legal issues for the integration of new technologies into everyday life [1].

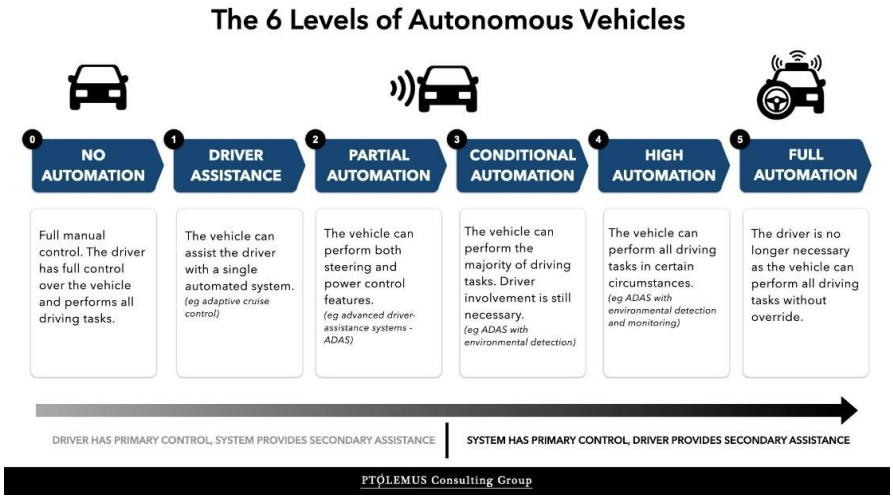

Figure 1.
Levels of automation [7]

Despite the availability of self-driving vehicle technology, questions remain about its reliability and the need for its deployment. Self-driving vehicles offer modes of transport where human supervision is not required. SAE International (2016) defines six levels of autonomy, with level 0 being full human control and level 5 being full self-driving. Although autonomous technology is available, legal and moral issues mean that few people trust these systems completely. The EU legal framework is slowly evolving, while in the US the NHTSA has issued new guidelines for self-driving cars [7] [8].

The challenges of implementing autonomous systems are rooted in legal and ethical uncertainties, in addition to high prices and personal fears [4]. Individuals' perceptions of technology are influenced by demographic characteristics such as age, gender and education [9]. Software companies have an interest in the rapid uptake of self-driving vehicles, but the complexity of the problem means that regulatory and ethical issues need to be considered.

The technological development of self-driving cars has been underway for a long time, but their mass uptake is still a long way off due to concerns about the technology and reliability issues. Legal and ethical issues continue to hinder the adoption of autonomous systems, and many people are not comfortable giving up full control to a machine [10]. The uptake of autonomous vehicles in the EU is hampered by long-standing transport conventions, such as the Vienna Convention, which require a human driver to be in the vehicle. Some countries have already amended these conventions to adapt to new technologies and allow the use of autonomous systems. In the United States, the era of self-driving cars is approaching, and safety is a priority. Car manufacturers need to ensure that self-driving cars are as safe as conventional vehicles.

When autonomous vehicles are introduced, people naturally react to new technologies with fears and concerns. Car developers need to pay particular attention to safety and reliability. People are often afraid to hand over full control to a system that is not yet fully understood and regulated. Although car manufacturers are spending considerable sums on developing self-driving cars, people are more concerned than enthusiastic about the new technology. Studies show that most drivers do not want to use fully autonomous cars, but would welcome some automated features in their vehicles [11] [12].

According to 2014 surveys, the majority of people in the US, UK and Australia expressed concerns about the cost and reliability of autonomous vehicles. However, many would welcome a higher level of autonomy in their cars if it did not increase the price. According to a 2015 survey by Kyriakidis and colleagues, the majority of respondents were optimistic about the future of self-driving cars and believed that by 2050 a significant proportion of cars would be autonomous [13]. In contrast, research by Kettles and Van Belle in 2019 showed that the majority of people would not be interested in self-driving cars in the first six months of their local introduction, although they responded positively to the performance and driving experience of autonomous vehicles [14].

People's attitudes to self-driving cars are much more positive in public transport, where it matters less whether the vehicle is autonomous as long as it is clean and comfortable. It is important to take people's opinions and attitudes into account in order to speed up the uptake of the technology. The human factor and user preparedness are key for new technologies. If preparedness is low, it can lead to a decrease in technology adoption and take-up [15]. Building trust is particularly important for self-driving cars, as people perceive their own vulnerability in

complex systems [16]. The proliferation of self-driving cars also raises ethical and social dilemmas. People express concern about loss of control and decisions made by the vehicle that may affect their well-being and safety, which poses additional challenges to the adoption of autonomous vehicles [17] [18].

Self-driving cars and control software face difficult moral choices in extreme situations, such as when a child runs in front of the car and a collision is inevitable [1]. The car must decide whether to jerk the steering wheel, endangering the occupants, or hit the child. Such ethical issues have a significant impact on the social acceptance of autonomous vehicles. People generally accept that cars should reduce casualties, but this opinion may change if they imagine themselves in the car. Regular software updates and improvements are key to the proper functioning of self-driving cars. The software must be prepared for any situation and be able to make life-changing decisions, as well as recognise and distinguish roadside objects such as traffic signs. The development and adoption of autonomous vehicles poses many challenges, but the discussion of ethical issues and the continuous development of software is essential to shape the future of autonomous transport [19] [20] [21] [22].

Security risks associated with autonomous vehicles include attacks by hackers, as any computer that communicates with or accesses another is potentially at risk [23]. Autonomous cars are no exception, and there have been examples of hackers manipulating these vehicles [24]. For example, in 2015, two hackers took control of a Jeep Cherokee's UConnect system, completely controlling the car and rendering the passenger helpless [25]. These cases highlight the challenges of developing security systems for autonomous vehicles.

3 Research methodology

The research methodology effectively combines primary and secondary data, and the convenience sampling survey is a reasonable approach given the resources available. To validate the self-developed questionnaire, I first conducted a literature review to familiarise myself with relevant theories and existing measurement tools. I then designed the questionnaire, which was evaluated with experts to refine the questions. I modified the questionnaire based on feedback from the pilot test. To ensure validity, I compared the results of the questionnaire with those of an established measurement tool and retested it to check stability. Finally, I finalised the questionnaire as a reliable and valid measurement tool.

Examining age, gender, educational attainment and technological affinity helps to reveal the deeper correlations behind attitudes. The analyses are based on simple descriptive statistics, Spearman correlations and independent samples t-tests, conducted using SPSS 20 software on the basis of the responses collected. It is important to emphasise that due to the size of the study and the non-representative

nature of the participants, the results cannot be considered as general truths. The sample does not reflect the entire population, so the results are more indicative of the relationships between the different variables describing the people in the sample.

When analysing the results of the research, it is important to stress that the conclusions presented here should not be considered as generally valid or categorically conclusive. Although the research has produced significant results, we must be aware of the limitations of the research and the risk of generalisation. Rather, the data help to explore the relationships between variables and to understand possible correlations, but further research is needed to draw more reliable conclusions. For data collection, I used an anonymised quantitative questionnaire, which allowed participants to respond honestly, increasing the statistical reliability and generalisability of the research. Online questionnaires are a cost-effective and quick way to collect data, with flexible time schedules for participants. However, low response rates and convenience sampling can distort results and make it difficult to establish causal relationships. Bias may also occur and it is difficult to check the reliability of responses. Convenience sampling may limit representativeness, so results should be treated with caution and further representative research is needed to draw more reliable conclusions. The Levene's test for equality of variance and the two-sample t-test were used to interpret the statistical table.

4 Results

4.1 Presentation of the samples

To examine demographic variables, I asked respondents about their gender, age, place of residence and highest level of education. In addition, I asked about the respondents' current level of education, employment status, attitudes towards technology in general, level of awareness, and whether they have a driver's license. The sample was gender-balanced, with 1,266 men and 1,206 women participating in the survey. Although the sample cannot be considered fully representative, the large number of respondents provides an opportunity to analyse gender differences.

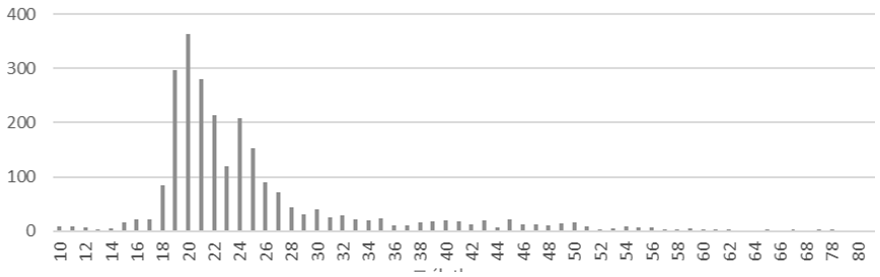

Figure 2

Age distribution of respondents

In terms of age, the average age of respondents was 25.25 years, with people aged between 12 and 70 years old taking part in the survey. 80% of the respondents were under 25 years old, which is probably a consequence of the chosen snowball method and convenience sampling. In terms of educational attainment, there were high school, college and university graduates. By employment status, students, unemployed, part-time and full-time workers also completed the questionnaire. I also looked at technological affinity and awareness, as these may affect the adoption of self-driving cars.

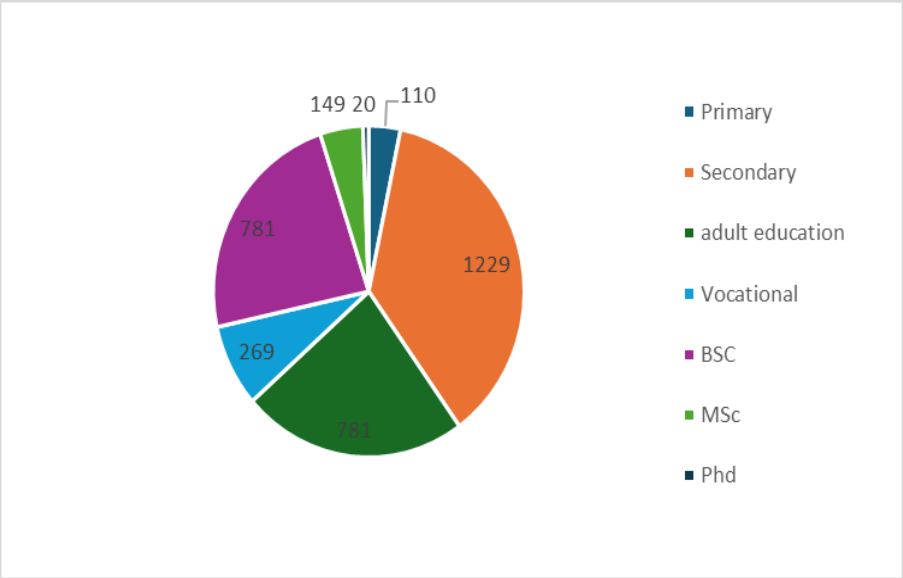

Figure *3*

Distribution of respondents by educational level

In terms of highest educational attainment, the majority of respondents have a secondary school degree, 479 respondents have a BSc and 140 respondents have a MSc. Younger respondents tend to have a lower level of education. Education and employment status are correlated, with 56% of respondents working, many while studying.

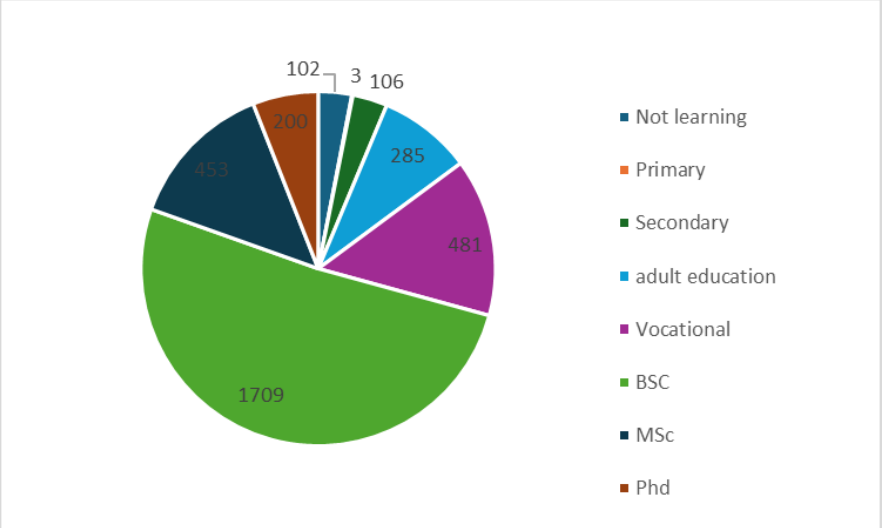

Figure 4

Studies of respondents

This indicates that the majority of respondents are continuously improving their knowledge, which is important to understand the acceptance of self-driving cars. Educational attainment and employment status can have an impact on attitudes towards technology, as learning and working together increases sensitivity to innovation. Although the majority of respondents were from the capital city, the snowball method was successful because responses were received from municipalities of different sizes. This diversity may help to get a more comprehensive picture of opinions on self-driving cars. Interestingly, 69% of respondents have a driving licence, while 31% do not, so the majority have driving experience. The survey did not reveal any significant difference between the attitudes of those with and without a driving licence towards self-driving cars. The 31% is probably due to those who are under 18 or do not wish to drive. The geographical diversity ensures that the results of the survey have a wider relevance, better reflecting the views of the population.

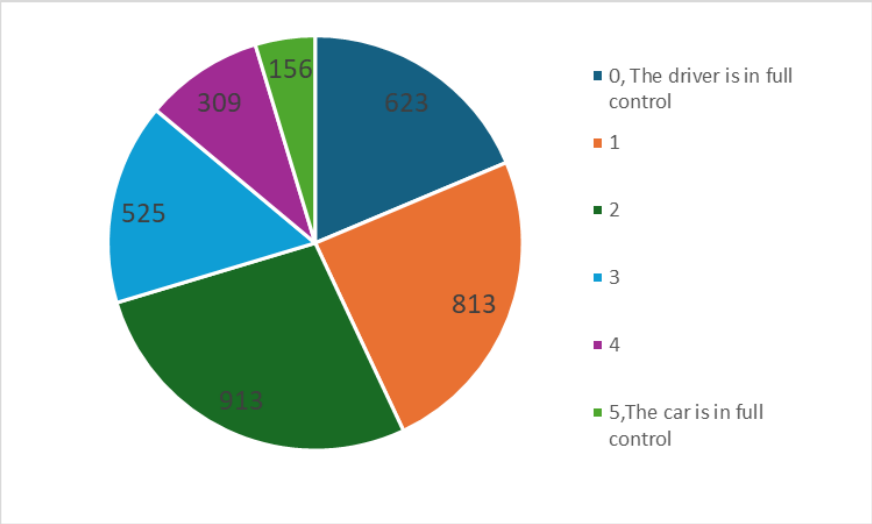

Figure 5

What self-driving mode would be supported

Figure 5 shows that the majority were interested in vehicles with a lower level of autonomy, only 6.1% were interested in fully autonomous vehicles, while 22.3% preferred to be able to regain control if needed. This is consistent with international findings that the majority are not yet ready to use self-driving cars.

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
What is your gender?		43,714	,000	-2,331	3304	,020
How old are You?	*	31,006	,000	,356	3337	,722
In which country do You live in?	*	31,783	,000	-3,869	3337	,000
Where do You currently live?	*	55,765	,000	-3,243	3337	,001
What is your highest education?	*	21,540	,000	-2,355	3337	,019
In what level are You currently studying at?	*	35,801	,000	-9,647	3337	,000
Are You working right now?	*	,241	,624	-,258	3337	,796
		* Equal variances assumed				

Table 1

Levene's test for equality of variance

The results in Table 1 show that there are significant differences in both variances and means for most of the variables examined. The exceptions are age and employment, where no significant differences in means were found. The results of the Levene's test and the two-sample t-test may be important for further analysis and inference, in particular for identifying and interpreting differences between groups.

					difference of means	standard error	differences 95% confidence interval	
	number of	number of supporter	mean of opponents	mean of supporters			Lower	Upper
What is your gender?	457,000	2849,000	1,438	1,496	-,059	,025	-,108	-,009
How old are You?	465,000	2874,000	25,370	25,225	,145	,407	-,653	,944
In which country do You live in?	465,000	2874,000	10,634	12,093	-1,458	,377	-2,197	-,719
Where do You currently live?	465,000	2874,000	2,183	2,371	-,188	,058	-,302	-,075
What is your highest education?	465,000	2874,000	3,131	3,295	-,164	,070	-,300	-,027
In what level are You currently studying at?	465,000	2874,000	4,135	4,779	-,643	,067	-,774	-,512
Are You working right now?	465,000	2874,000	,542	,548	-,006	,025	-,055	,042

Table 2

Differences between demographic variables and support for the introduction of self-driving cars

Table *2* details the difference in means, standard error and confidence intervals of the differences between opponents and supporters. The results show significant differences for a number of variables, providing important insights for understanding differences between groups.

Correlations

			Support of selfdriving cars	What is your gender?	How old are You?	In which country do You live in?	Where do You currently live?	What is your highest education?	In what level are You currently studying at?	Are You working right now?
Spearman's rho	Support of selfdriving cars	Correlation Coefficient	1,000	-,082**	,055**	-,098**	-,035*	,065**	-,113**	,002
		Sig. (2-tailed)		,000	,001	,000	,043	,000	,000	,923
		N	3339	3306	3339	3339	3339	3339	3339	3339
	What is your gender?	Correlation Coefficient	-,082**	1,000	,045**	,038*	,021	,023	,097**	,036*
		Sig. (2-tailed)	,000		,009	,027	,231	,181	,000	,040
		N	3306	3306	3306	3306	3306	3306	3306	3306
	How old are You?	Correlation Coefficient	,055**	,045**	1,000	,102**	,033	,485**	,174**	,280**
		Sig. (2-tailed)	,001	,009		,000	,054	,000	,000	,000
		N	3339	3306	3339	3339	3339	3339	3339	3339
	In which country do You live in?	Correlation Coefficient	-,098**	,038*	,102**	1,000	,026	-,034*	,096**	,081**
		Sig. (2-tailed)	,000	,027	,000		,132	,047	,000	,000
		N	3339	3306	3339	3339	3339	3339	3339	3339
	Where do You currently live?	Correlation Coefficient	-,035*	,021	,033	,026	1,000	,013	,012	-,067**
		Sig. (2-tailed)	,043	,231	,054	,132		,457	,477	,000
		N	3339	3306	3339	3339	3339	3339	3339	3339
	What is your highest education?	Correlation Coefficient	,065**	,023	,485**	-,034*	,013	1,000	,111**	,185**
		Sig. (2-tailed)	,000	,181	,000	,047	,457		,000	,000
		N	3339	3306	3339	3339	3339	3339	3339	3339
	In what level are You currently studying at?	Correlation Coefficient	-,113**	,097**	,174**	,096**	,012	,111**	1,000	,003
		Sig. (2-tailed)	,000	,000	,000	,000	,477	,000		,884
		N	3339	3306	3339	3339	3339	3339	3339	3339
	Are You working right now?	Correlation Coefficient	,002	,036*	,280**	,081**	-,067**	,185**	,003	1,000
		Sig. (2-tailed)	,923	,040	,000	,000	,000	,000	,884	
		N	3339	3306	3339	3339	3339	3339	3339	3339

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

*. Correlation is significant at the 0.05 level (2-tailed).

Table 3

Correlation table

The data in the table confirms that certain demographic and socio-economic variables such as gender, country, place of residence, education and current education can have a significant impact on the question under consideration. Age

and employment did not show significant differences, suggesting that these factors are less relevant. These results may be important for policy, economic and educational decision making as they can help identify groups that need more attention.The results of the analysis show that although certain demographic variables such as gender, age, country, education and current education have a significant effect on the support for the introduction of self-driving cars, the correlations are generally weak. This suggests that although there are small differences between different demographic groups, these differences are not significant. The only demographic variable that does not affect support at all is employment status. These results suggest that support for the introduction of self-driving cars is influenced by a number of factors, but the effect of demographic variables is relatively small.

Summary

In my article, I showed that although self-driving vehicles are becoming more common in transport, their private use remains limited. Despite advanced technology and the growing number of semi-autonomous vehicles, public acceptance is still low, especially among women. In my research, I analysed the impact of demographic variables on support for the adoption of self-driving cars. The results of the research show that although several demographic factors (such as gender, country, current place of residence, educational attainment and current education) significantly influence support for self-driving cars, other factors such as age and employment did not show significant effects. These results may be important for manufacturers and policy makers who want to promote the uptake of self-driving vehicles, as they can help to understand and address the concerns and expectations of different groups.

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