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RESEARCH ARTICLE

Understand the impact of positive and negative information on public opinion about autonomous vehicles among young Ecuadorians

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Abstract: Technological advances have accelerated the development of autonomous vehicles (AVs) in recent years. AVs offer several potential benefits, such as improving road safety, fuel efficiency, traffic flow and reducing greenhouse gases. The problem is that while AVs offer potential benefits, they also present ethical challenges and concerns, and there is a lack of research on public perceptions specifically among young Ecuadorians, who are heavy technology consumers. In this context, this study aimed to analyze the attitudes and perceptions of young Ecuadorians towards AVs by presenting them with positive and negative information about AVs. More than 500 surveys were collected using the snowball technique in the community of the Universidad Técnica Particular de Loja (UTPL), which is located in a city in the south of the country. The survey looked at their perceptions before and after they were presented with positive and negative information about AVs. The study found gender and driving frequency differences in the perception of (AVs, with women exhibiting greater reductions in their opinions and confidence levels about AVs compared to men, and overall, there was a slight decline in opinion towards AVs, accompanied by increased concerns about AVs travel. Driving frequency had an impact on perception and concerns. This type of study allows for a better understanding of the perceived benefits and concerns regarding AVs adoption in Ecuador.

Keywords: Technology adoption, Gender differences, Driving habits, Attitude change, Young adults

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1. Introduction

The interest in studies related to AVs has grown among researchers and the general public due to the advances that this technology can offer in education, employment possibilities or increased productivity by reducing the burden of daily tasks [1,2].

AVs have several potential benefits, for example (1) safety, (2) intersection control, (3) collision-free navigation, (4) obstacle detection and (5) pedestrian protection [3,4].

Likewise, AVs bring several novelties to problems that currently interest the majority of the population, such as fuel efficiency, traffic flow or the reduction of greenhouse gases [5,6].

While AVs offer several advantages, their rapid introduction can also bring certain disadvantages that should be considered at the time of implementation [7,8]. Some of these issues include, first of all, the Law, i.e. determining who is liable in the event of an accident or crime (the vehicle owner, the occupant, the vehicle manufacturer or another entity) [9,10]. Secondly, as AVs are a technology based on computer and technological systems, AVs can be vulnerable to hackers who can access different functions of the vehicle, such as the Global Positioning System (GPS), Inertial Measurement Unit (IMU), Light Detection and Ranging (Lidar) or monoscopic and stereoscopic cameras [11,12]. Finally, other functions may also be affected, such as internal or external communication systems and attacks or risks to the hardware [11,13].

In general, the process of diffusion of innovations is not always easy when it comes to the application of new technologies in people's daily lives [14,15]. Several studies indicate that innovations are positive and should be accepted by the general public [16,17]. However, in most cases, this does not happen because people can resist the acceptance and use of new innovations in technologies (AVs) [18,19]. In other words, innovations in most cases face psychological barriers (reliability, fear, anxiety, distrust or uncertainty), poor dissemination of information or lack of clear statements about benefits [20].

Therefore, in recent years several surveys have been conducted on the acceptance of AVs and its impact on people's daily lives. Table 1 presents a summary of the different surveys that have been carried out to identify and detect the parameters, opinions, doubts and intentions that the general public has regarding the use or acceptance of AVs. Each article includes the author, the country in which the survey was conducted, the date of collection, the number of survey participants, and the significant results obtained from each study.

Table 1. Summary of related studies.

First author (year)	Country	Date of data collection	Participants	Significant results	Reference
Abraham et al. (2016)	United States	2016	3034	Older adults are comfortable accepting the introduction of technological innovations. However, there are some concerns about the desirability in adopting AVs.	[21]
Robertson et al. (2019)	Canada	2016	2662	Older drivers (65+) show great interest and enthusiasm for automated vehicles, if certain conditions are met (safety guarantee, low costs, cheap maintenance, insurance policies).	[22]
Payre et al. (2014)	French	2013	441	Most participants have a positive opinion of fully automated driving. Even though they had never tried an autonomous vehicle before.	[23]
Choi et al. (2015)	Korea	OF[1]	552	People are willing to adopt AVs if this technology provides confidence and a sense of usefulness.	[24]
Zhang et al. (2020)	China	2018	647	People who like to experience new sensations and those who are more willing to have novel experiences are more likely to accept AVs, while neurotic people are less inclined to accept AVs.	[25]
Liljamo et al. (2018)	Finland	2017	2036	People with a high level of education (master's or doctorate) and those who live in a densely populated area tend to have a positive attitude towards AVs.	[26]
Bansal et al. (2016)	United States	2014	347	Estimates of willingness to pay (WTP) for new technologies suggest that men	[27]

				with high incomes, who are familiar with autonomous technology and experience with accidents, have a higher WTP for AVs.	
Kyriakidis et al. (2015)	Netherlands	2014	5000	It was found that although people are concerned about software piracy/misuse and the legal and safety aspects, most agree that fully automated driving would be enjoyable.	[28]
Sener et al. (2019)	United States	2016	3097	People with physical conditions that make it difficult to drive, young people and owners of vehicles with highly automated functions (adaptive cruise control, lane keeping or automated parking), are more likely to use AVs.	[29]
Wintersberger et al. (2019)	Austria	OF[1]	192	Although most people are well aware of the meaning and implications of AVs, there are still concerns about cybersecurity, reliability, and vehicle sharing.	[30]
Stoiber et al. (2019)	Switzerland	2018	709	People surveyed prefer AVs sharing rather than using a single autonomous vehicle. In addition, if the vehicle is associated with three important factors such as (1) cost, (2) time and comfort, the likelihood of adoption increases.	[31]
Krueger et al. (2016)	Australia	2015	435	The results show that the adoption and use of shared autonomous vehicles (SAVs) are closely related to the cost of travel, travel time and waiting time that SAVs perform.	[32]
Hulse et al. (2018)	United Kingdom	2016	925	Survey participants mentioned that they consider AVs to be a "low-risk" form of transportation despite concerns (cybersecurity, hacking, and vehicle road safety).	[33]

[1] Not available

Based on different aspects and concerns that can lead to the acceptance and use of AVs. These studies do not consider respondents' perception when presented with positive and negative information about AVs. Therefore, this study aims to deepen the perception of young Ecuadorians about AVs, shedding light on their attitudes, opinions and expectations. To achieve this goal, a comprehensive survey was developed, employing a before-and-after approach to measure participants' perception after introducing AVs related accidents. Using the snowball technique, 518 surveys were collected in a city located in the southern region of Ecuador. Through the analysis of the collected data, this study seeks to identify differences in perception based on the information received by the participants, gender disparities and variations derived from driving frequency.

By providing insight into the perceived benefits and concerns associated with the adoption and acceptance of AVs in Ecuador, this research contributes to a better understanding of the potential challenges and opportunities ahead. Such knowledge is critical for policymakers, researchers and stakeholders in the transportation sector, enabling them to make informed decisions regarding the integration of AVs into the Ecuadorian transportation system. Furthermore, as technological advances continue to reshape societies, understanding public perceptions towards AVs is crucial to fostering public acceptance and addressing any reservations or concerns that may hinder its widespread adoption.

2. Materials and methods

The following section provides a detailed description of the methodology employed in this study. It begins by focusing on the details of the sample, specifying the target population as young university students from the city of Loja, Ecuador. It then describes the data collection instrument, which was a survey developed in Survey123 from ArcGIS Online. Subsequently, the data collection process is discussed, including the elimination of surveys with invalid information, the scoring of responses on a Likert scale, the calculation of average values, and the evaluation of variations in perception before and after learning about AVs. The Materiality Index (RII) was used to measure the effect of shared information on public opinion. Changes in public perception were assessed and demographic variables were analysed using graphs and statistical values.

2.1. Sample details

This study focused on young university students from the city of Loja, Ecuador. The sample was collected mainly from the community of the Universidad Técnica Particular de Loja (UTPL). The sample must have a similar local population distribution, composed of 48% men and 52% women. According to the 2010 population census, the population of the Loja canton was 214,855 inhabitants, of which 16.1% were young people between 20 and 29 years old. Thus, the number of young people in this age group was 36,202. With this population, a confidence level of 95% and a margin of error of 5%, a sample size of 381 respondents is required [34].

2.2. Instrument

The data collection instrument used was a survey developed in ArcGIS Online's Survey123. The survey, using the before–and–after approach, consisted of four sections: general respondent information, previous perception of AVs, positive and negative information about them, and after perception of AVs. The purpose of the survey was to assess participants' previous perception of these types of vehicles without providing them with certain details, and then to assess whether their perception changed after they were presented with additional information about AVs. This instrument was validated with master's students in civil engineering with specialization in mountain roads from the UTPL to determine if each of the questions and their answer options were easily understandable. If necessary, the elements of the instrument were corrected. Detailed information on each section of the survey is provided in Table 2 [35].

Table 2. Four sections of the survey in this study.

Section 1: Defendant General Information
• Select your age (18–29 years, 30–39 years, ≥40 years) • Gender (male, female, I'd rather not say it) • Level of education (high school, university or college, graduate) • Driving frequency (I don't drive, up to 1 day a week, 2 to 4 days a week, more than 4 days a week) • Level of knowledge about autonomous vehicles (Very little, little, neutral, much, expert) • If you were in a fully autonomous driving vehicle, what would you spend the extra time on instead of driving? (Work, read, watch movies or series, rest, exercise, relax and meditate, send messages (email, chat), monitor the road even if its interaction with the autonomous vehicle is not necessary, I would not get into a fully autonomous vehicle)
Section 2: Previous perception of autonomous vehicles
• What's your take on autonomous vehicles? (very negative, negative, neutral, positive, very positive) • Can autonomous cars improve the level of safety compared to human–driven vehicles? (Strongly disagree, disagree, neutral, agree, strongly agree) • What is your level of concern about traveling in autonomous vehicles? (Not worried at all, little worried, neutral, worried, extremely worried)

- What is your level of interest in buying an autonomous vehicle? (Not at all interested, not very interested, neutral, somewhat interested, very interested)

- Autonomous vehicles allow:

1. Improve road safety (strongly disagree, disagree, neutral, agree, strongly agree)
2. Reduce traffic accidents and traffic congestion (strongly disagree, disagree, neutral, agree, strongly agree)
3. Improve the mobility of the elderly, disabled, etc. (Strongly disagree, disagree, neutral, agree, strongly agree)
4. Increase efficiency and fuel economy (strongly disagree, disagree, neutral, agree, strongly agree)
5. Productivity and time savings by not "wasting time" driving (Strongly disagree, disagree, neutral, agree, strongly agree)
6. Improve traffic management as vehicles communicate with each other and with infrastructure (strongly disagree, disagree, neutral, agree, strongly agree)
7. Optimization of parking, as passengers stay and the vehicle continues (Strongly disagree, disagree, neutral, agree, strongly agree)

- Autonomous vehicles concern me about:
- Road safety (Not at all worried, little worried, neutral, worried, extremely concerned)
- Technological limitations of cameras, sensors, algorithms (Not worried at all, little worried, neutral, worried, extremely worried)
- High implementation costs (not worried, little worried, neutral, worried, extremely worried)
- Legal and regulatory challenges (Not worried at all, not worried, neutral, worried, extremely worried)
- Commuting work, for example, taxi drivers will no longer be needed (Not worried at all, little worried, neutral, worried, extremely worried)
- Security and privacy risk as vehicles collect and process information from their owners' employers (Not worried at all, not worried, neutral, worried, extremely concerned)
- Ethical considerations, such as dilemmas between deciding the safety of pedestrians or vehicle occupants in the event of an accident (Not worried at all, not worried, neutral, worried, extremely worried)

Section 3: Positive and negative information on autonomous vehicles

- Autonomous Parking – Prius Hybrid – 2003. Toyota launched the Prius Hybrid in 2003, which included autonomous parking technology. Parallel parking assist sensors worked incredibly well for the time. Other manufacturers, such as Lexus and BMW, followed suit and released modified versions of this technology in 2003 and 2009, respectively.
- Autopilot – Tesla – 2015. Tesla introduced the Autopilot feature in 2015, which used cameras, radar, sonar technology and incorporated traffic data. Other features included monitoring stop signs, traffic signals, other vehicles, pedestrians, road lanes, etc.
- Fatal accident – Tesla, USA, July 2016. This marked the first fatal autonomous vehicle (AV) accident. The car's sensor system could not distinguish a wheeled truck when the car tried to drive under it at full speed.
- Fatal accident – Tesla, China, January 2016. Tesla initially reported that the damage made it impossible to determine whether the Autopilot system was on or not. However, in 2018, Tesla confirmed that the Autopilot system was indeed engaged. The car was in the left lane before turning and colliding with a truck.
- Non-fatal injuries – Tesla, Russia, July 2019. The passengers suffered minor injuries, but the car exploded after the accident. The driver had activated the driver assistance function (not Autopilot), and his hands were on the wheel when the car veered into a truck in the left lane. The driver stated that he did not see the truck that collided with them.
- Autonomous Private Taxi – Waymo – Google – 2023. Waymo One is the world's first autonomous travel service, launched in 2023. It offers on-demand private shuttle service, shuttling travelers daily from the Phoenix and San Francisco metropolitan areas. It helps them get to their destinations, whether it's a grocery store, their workplace, or a date night.

Section 4: After the perception of autonomous vehicles

- Same questions and options as section 2

2.3. Data collection

Data collection was conducted between June and July 2023. UTPL civil engineering students collected the surveys. They were the first to respond to the survey and then received instructions on how to use Survey123 and understand the questions and answer options. Students were tasked with collecting data from at least five additional students, such as the snowball technique. As a measure of information quality control, the app recorded the date, time, location and photographs of respondents.

2.4. Data processing

First, we analyzed the database and removed all surveys with invalid information or inconsistent responses. Responses were rated on a Likert scale, with 1 assigned to the most unfavorable answer option (e.g., "Not at all concerned," "Strongly disagree") and 5 assigned to the most favorable answer option (e.g., "Very positive," "Very interested"). This score allowed the calculation of mean values and the evaluation of variations in responses before and after analyzing six AVs events. To measure the effect on public opinion, he calculated the average values or the relative importance index (RII) for each factor tested. The RII is determined using equation 1:

$$RII_{n=} \frac{\Sigma_{i=1}^{5} iX_i}{n}$$

Where: RIIn is the relative importance index for a specific question n; i is the rating given to each factor (in this case, 1 to 5); Xi is the number of respondents who give a grade i for that specific question n; and n is the number of respondents.

Changes in public perception before or after showing positive and negative information about autonomous vehicles were assessed using equation 1. The differences between the demographic and driving frequency variables were analyzed using graphs and statistical values.

3. Results

The results section presents the findings and analyses derived from the collected data. It begins with an exploration of respondent demographics, providing an overview of the characteristics of the participants involved in the study. After this, the section delves into the overall results, highlighting key observations and trends that emerged from the survey responses. In addition, the section examines possible gender differences in perception and attitudes towards AVs. Finally, the section investigates any disparities that may exist based on driving frequency, shedding light on how often people drive and how it relates to their perceptions of AVs.

3.1. Demographic data of respondents

For this study, 518 responses were collected (see https://arcg.is/eO1ur), exceeding the required sample size of 381 for the chosen level of confidence and error. This sample size reduced the error to 4.28%. The demographic variables of the participants are presented in Table 3. The distribution between men and women was about 50%. The dominant age group was 18 to 29 years, which corresponds with the typical age range to start college studies (around 18 years) and complete a degree within 3 to 5 years. Similarly, a significant proportion of students had a high school or university/college level, which is also consistent with their age. As for driving frequency, most participants do not drive because most of them are students who cannot afford their own vehicles.

Table 3. Summary of respondent demographics.

Demography		Percentage (%)
Gender	Male	53.86
	Female	45.75
	I'd rather not say	0.39
Adge	18–29 years	97.10
	30–39 years	2.89
	≥40 years	0.77
Education	High school	37.84
	University or college	59.46
	Postgraduate	2.70
Driving frequency	I don't drive	41.89
	Up to 1 day per week	19.31
	Between 2 and 4 days a week	17.76
	More than 4 days a week	21.04

To assess the level of knowledge among the participants, the relative importance index of their answers was calculated. Respondents rated their knowledge 2.51 out of 5, with 1 indicating very little knowledge and 5 indicating expert-level knowledge. This suggests that their knowledge falls into the category of low knowledge on the subject. This could be attributed to the fact that Ecuador is not currently involved in the development of this technology.

3.2. Overall results

Table 4 shows the general changes in public opinion among young people before and after positive and negative information about AVs. Opinion on AVs decreased slightly, as did opinion on road safety. However, there was an increase in the level of concern regarding AVs travel, as well as an increase in interest in purchasing such a vehicle.

Table 4. The general perception changes in public perception when evaluating the responses before and after presenting positive and negative information about autonomous vehicles (AVs).

Question	Before[1]	After[1]	Percentage change in mean
What's your take on autonomous vehicles?	3.35	3.31	−1.19
Can autonomous cars improve the level of safety compared to human-driven vehicles?	3.33	3.23	−3.00
What is your level of concern about traveling in autonomous vehicles?	2.92	3.01	+3.08
What is your level of interest in buying an autonomous vehicle?	2.84	2.92	+2.82

[1] Before or after displaying positive and negative information about autonomous vehicles.

On the other hand, Figure 1 illustrates the perception of benefits measured before and after presenting positive and negative information about AVs. To analyze this figure, the answers to the questions were coded as follows: 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree. The figure represents variation, indicating changes in public perception for the same set of questions. Most benefits changed after showing positive or negative aspects of AVs, except for increased productivity and time savings. The highest reduction values were observed in terms of accidents and congestion, followed by improvements in mobility.

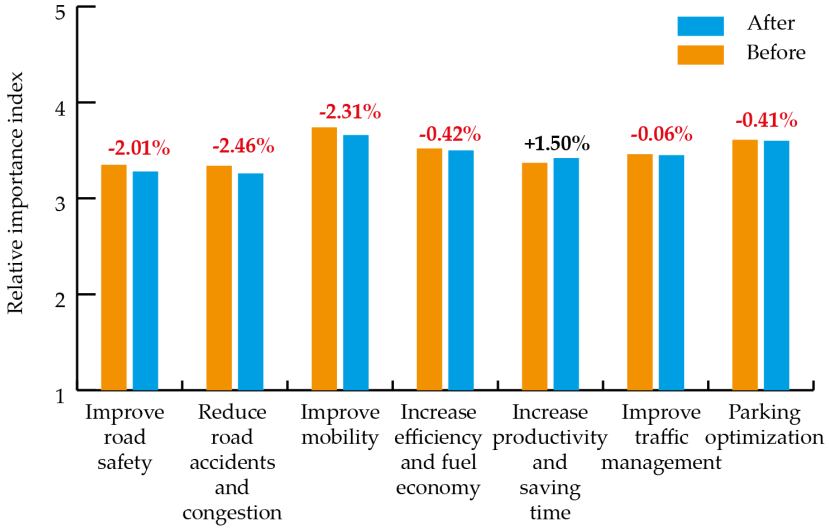

Figure 1. General changes in public perception regarding the various benefits of autonomous vehicles (AVs) (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree).

Regarding the perception of concerns related to various aspects of AVs, Figure 2 presents the results of the indices before and after presenting positive and negative information about AVs. The scale is as follows: 1 = not at all worried, 2 = little worried, 3 = neutral, 4 = worried, 5 = extremely worried. In addition, Figure 2 illustrates the variation, indicating changes in public perception for the same set of questions. Concerns about road safety and technological constraints and, to a lesser extent, job displacement and ethical considerations increased. Similarly, there was a decrease in concern about high AV costs, legal issues, and security and privacy risks.

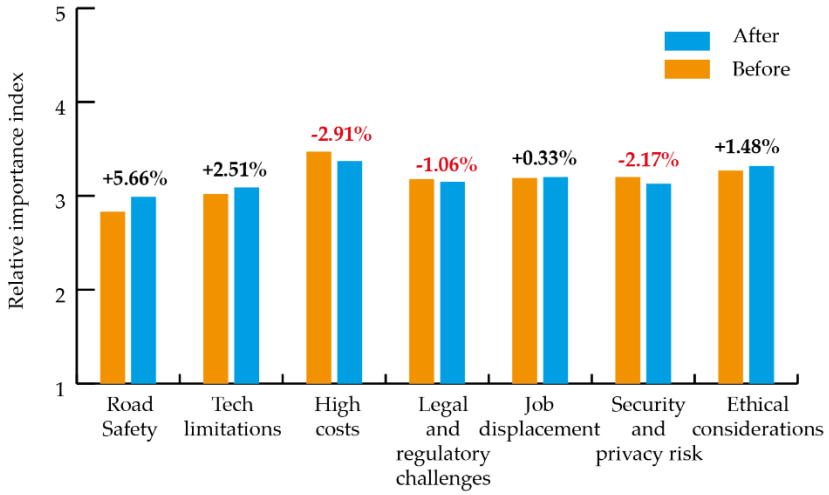

Figure 2. General changes in public perception regarding the various concerns of autonomous vehicles (AVs) (1 = not worried at all, 2 = little worried, 3 = neutral, 4 = worried, 5 = extremely concerned).

The result of the question, 'If you were in a fully autonomous driving vehicle, what would you spend the extra time on instead of driving?' is shown in Figure 3. In general, most respondents think they will continue to pay attention to the road, even if it is not necessary to maneuver the vehicle. They also mentioned activities such as working and resting. The least chosen activity was relaxing and meditating.

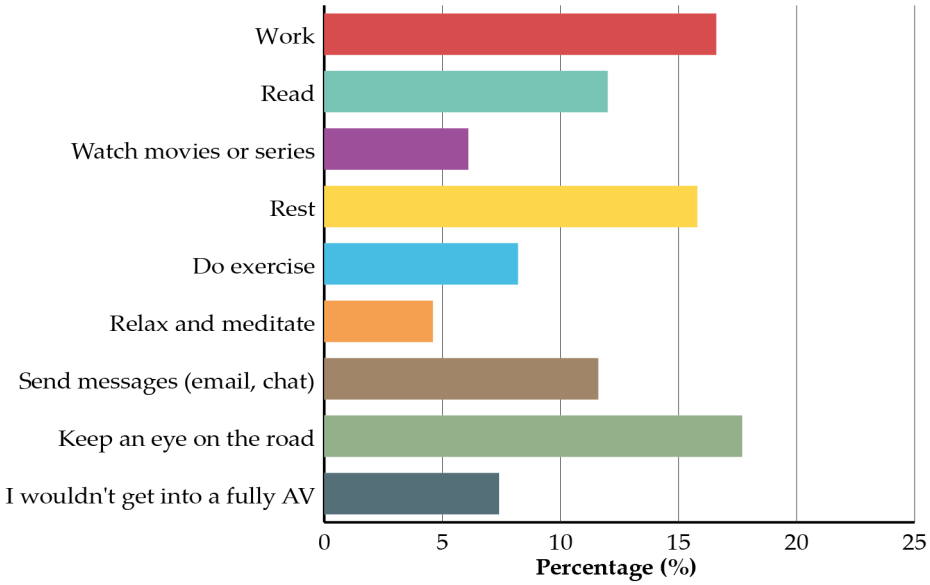

Figure 3. Overall percentage of respondents' responses regarding their actions in a fully autonomous vehicle (AVs).

Table 5 shows gender differences in public opinion among young people before and after presenting them with positive and negative information about AVs. Only 2 respondents preferred not to disclose their gender, so the analysis was conducted between men and women. Even though both sexes (male, female) showed similar trends in their before and after responses, women showed greater reductions in their opinions and confidence levels compared to men. Similarly, women expressed a greater increase in concerns compared to men. Finally, men expressed a stronger desire to acquire AVs compared to women, who, although their desire also increased, was only slightly.

Table 5. Gender perception changes in public perception by evaluating responses before and after presenting positive and negative information about autonomous vehicles (AVs).

Question	Men			Women		
	Before[1]	After[1]	% change	Before[1]	After[1]	% change
What's your take on autonomous vehicles?	3.35	3.33	−0.92	3.39	3.29	−2.89
Can autonomous cars improve the level of safety compared to human-driven vehicles?	3.29	3.26	−0.94	3.42	3.19	−6.69
What is your level of concern about traveling in autonomous vehicles?	2.96	3.02	**+1.96**	2.86	3.00	**+4.74**
What is your level of interest in buying an autonomous vehicle?	2.76	2.89	**+4.47**	2.97	2.98	**+0.31**

* Before or after displaying positive and negative information about autonomous vehicles (AVs).

Figure 4 illustrates the perception of benefits measured before and after presenting positive and negative AVs information for the genders analyzed. There is a reduction in the perception of both genders regarding traffic accidents, congestion and improved mobility. However, the reduction in perception is greater among women than men when it comes to reducing traffic accidents and congestion. In other benefits, genders have opposite perceptions after receiving information about AVs. This trend is interesting, especially when you consider the introduction of AVs into the market. Despite the results of this study, the details need to be explored further in further studies. Regarding extreme values, women experience a greater reduction (−4.76%) in their initial perception that AVs improves road safety and reduces road accidents and congestion (−4.37%). On the other hand, men show an average increase in perception index (+3.52%) in relation to the fact that AVs increase productivity and save time.

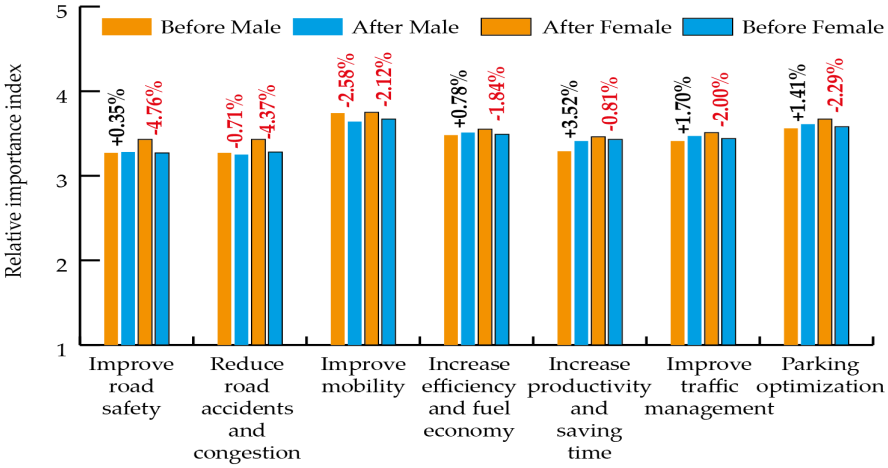

Figure 4. Gender perception shifts in public perception regarding the various benefits of autonomous vehicles (AVs) (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree).

Regarding the perception of concerns related to various aspects of AVs, Figure 5 presents the results of the indices before and after presenting positive and negative information on autonomous vehicles for the genders analyzed. Concerns that showed the same trend across all genders (men and women) were road safety, high implementation costs, and legal and regulatory challenges. However, other concerns showed opposite trends. As for the greater variations, women, in general, experienced greater increases or decreases in perception compared to men. For example, women increased their perception of road safety (+10.15%), technological constraints (+6.06%), ethical considerations (+4.59%) and high implementation costs (−3.81%). On the other hand, men reduced their perception of security and privacy risks (−3.85%), while the remaining variations were lower than these values.

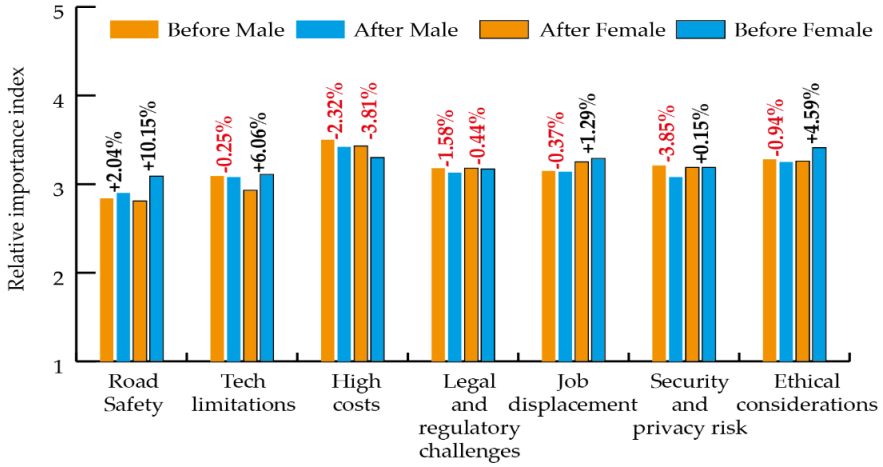

Figure 5. Gender perception shifts in public perception regarding the various concerns of autonomous vehicles (AVs) (1 = not worried at all, 2 = little worried, 3 = neutral, 4 = worried, 5 = extremely worried).

The result of the question, 'If you were in a fully autonomous driving vehicle, what would you spend the extra time on instead of driving?' is shown in Figure 6. First, both genders (male and female) provided more responses related to observing walking, work, and rest. There are also variations in the answers to this question between genders. Men indicated a greater tendency to concentrate on the road compared to women. The same trend applies to work, where men mentioned it more often than women. Conversely, women expressed a greater inclination toward rest and exercise compared to men. Women indicated that they would not be completely dependent on AVs more than men. These differences can be observed when genera are analyzed separately, as opposed to studies where all data is analyzed unfiltered.

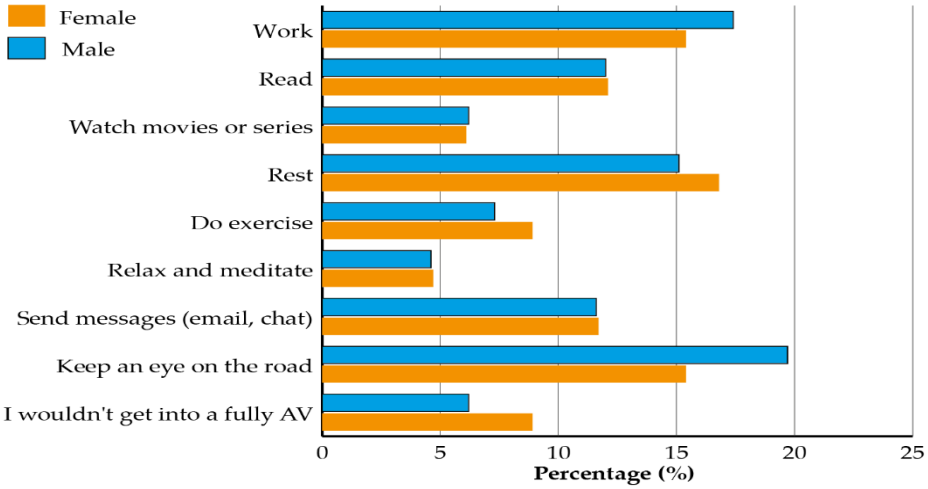

Figure 6. Percentage of responses from respondents (male and female) regarding their actions in a fully autonomous vehicle (AVs).

3.4. Differences between driving frequency

Table 6 shows the gender differences in public opinion among young people before and after presenting them with positive and negative information about AVs. Driving frequency influences the perception of responses. For example, people who don't drive experience a reduction in their opinion about road safety, while their concern index and interest in buying AVs increase. Those who drive at least once a week exhibit a similar trend, except for their opinion on AVs, which is opposite to those who don't drive. These drivers are people who possess a driver's license, but may not have as much freedom to drive. Occasional drivers (2–4 days per week) decrease their opinion of AVs and their interest in buying one, but their perception of road safety and level of concern increase. Finally, regular drivers (>4 days per week) show no significant variations in opinion, road safety or concern. The biggest increase is seen in their interest in buying AVs. Those who drive more often have and should have a different opinion compared to those who don't drive or do so less often.

Table 6. Driver perception changes in public perception by evaluating responses before and after presenting positive and negative information about autonomous vehicles (AVs).

Question	≤ 1 day			2–4 days			> 4 days			No unity		
	Bef.1	For pop. 1	%	Bef.1	For pop. 1	%	Bef.1	For pop. 1	%	Bef.1	For pop. 1	%
What's your take on autonomous vehicles?	3.32	3.40	**+2.41**	3.33	3.23	**–3.00**	3.36	3.36	0.0	3.36	3.28	**–2.38**
Can autonomous cars improve the level of safety	3.37	3.15	**–6.53**	3.27	3.34	**+2.14**	3.24	3.25	**+0.31**	3.39	3.20	**–5.60**

compared to human-driven vehicles?												
What is your level of concern about traveling in autonomous vehicles?	2.88	3.00	**+4.17**	2.93	3.12	**+6.48**	3.06	3.04	– 0.65	2.86	2.95	**+3.15**
What is your level of interest in buying an autonomous vehicle?	2.83	2.94	**+3.89**	2.93	2.90	– 1.02	2.72	2.91	**+6.99**	2.86	2.93	**+2.45**

* Before or after displaying positive and negative information about autonomous vehicles (AVs).

Figure 7 illustrates the perception of benefits measured before and after presenting positive and negative AVs information for the analysis of both sexes (male and female). Driving frequency influences the perception of responses. For example, people who don't drive experience a reduction in their opinion of improving road safety, while their rate of concern and interest in buying an AVs increases. Those who drive at least once a week exhibit a similar trend, except for their opinion on AVs, which is opposite to those who don't drive. These drivers are people who possess a driver's license, but may not have as much freedom to drive. Occasional drivers (2–4 days per week) decrease their opinion of AVs and their interest in buying one, but their perception of road safety and level of concern increase. Finally, regular drivers (>4 days per week) show no significant variations in opinion, road safety or concern. The biggest increase is seen in their interest in buying AVs. Those who drive more often have and should have a different opinion compared to those who don't drive or do so less often.

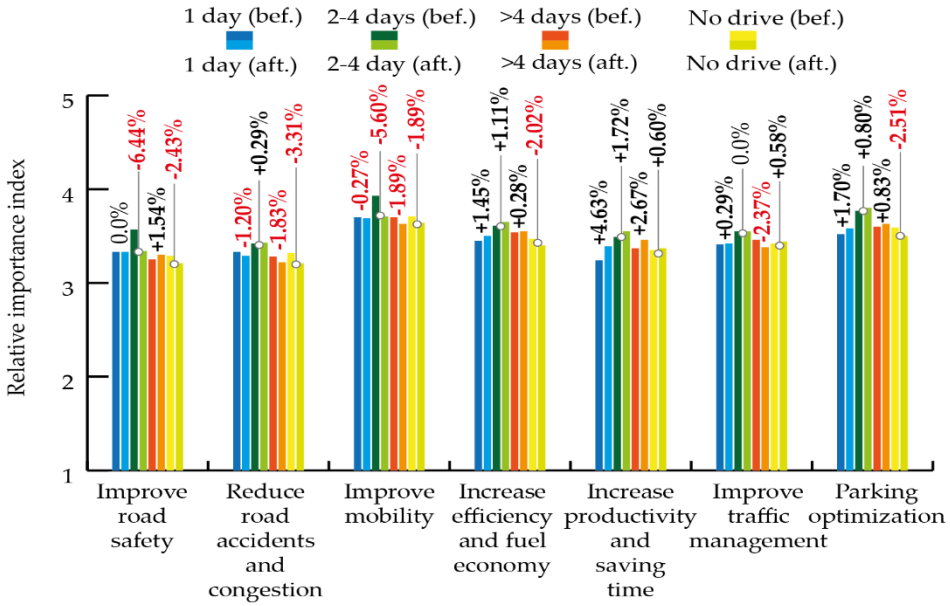

Figure 7. Driver perception changes in public perception regarding the various benefits of autonomous vehicles (AVs) (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree).

Regarding the perception of concerns related to various aspects of AVs, Figure 8 presents the results of the indices before and after presenting positive and negative information about AVs for the driving frequency analyzed. In this case, all respondents increased their perception of concerns about road safety and technological limitations. The remaining concerns showed high variability. Regarding the maximum values, occasional drivers (2–4 days) and non-drivers experienced positive variations of 6.29% and 8.63%, respectively, in terms of road safety. These high ratings were also recorded for ethical considerations among the same groups. Non-drivers also scored highly with +4.01% in terms of technological limitations. On the other hand, drivers

who drove only for one day and frequent drivers (> 4 days) experienced reductions in their perception by −5.04% and −4.93% respectively. In terms of safety and privacy risks, as well as ethical considerations, frequent drivers showed a decrease in their level of concern after being exposed to positive and negative information about autonomous vehicles. The remaining concerns showed no significant differences between groups. However, it is interesting to note that those who drive do not express concerns about job displacement, while those who do not drive do. A future study could focus on young relatives of taxi or bus drivers, to further contribute to this area of research.

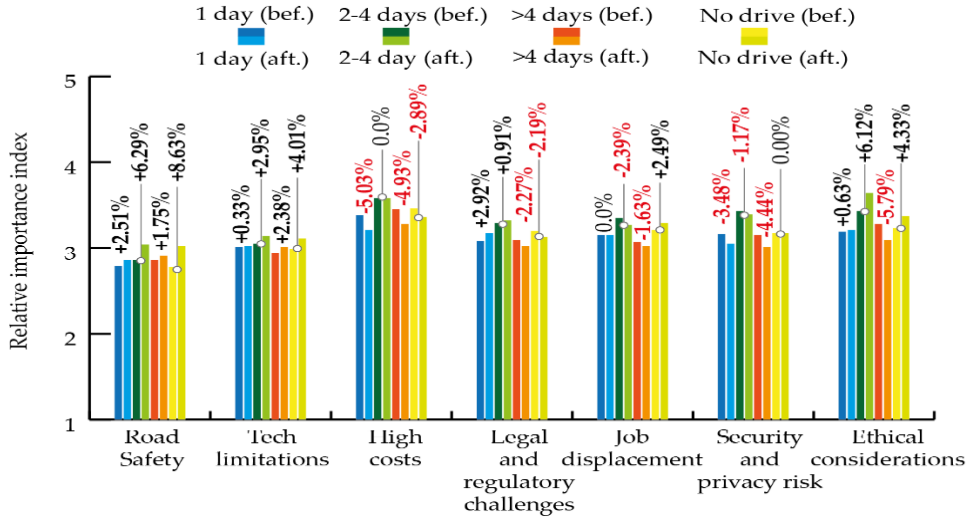

Figure 8. Driver perception changes in public perception regarding the various concerns of autonomous vehicles (AVs) (1 = not worried at all, 2 = little worried, 3 = neutral, 4 = worried, 5 = extremely worried).

The result of the question, 'If you were in a fully autonomous driving vehicle, what would you spend the extra time on instead of driving?' is shown in Figure 9. The most common responses among drivers who drive for up to a day include resting, looking at the road, and working. Occasional drivers (2–4 days) prioritize work, looking at the road, and reading during their driving time. Frequent drivers (> 4 days) concentrate on observing the road, working and resting. Finally, people who don't drive spend their time working, watching the road, and resting. It's important to note that even in fully autonomous vehicles, people would still monitor the vehicle's actions while driving.

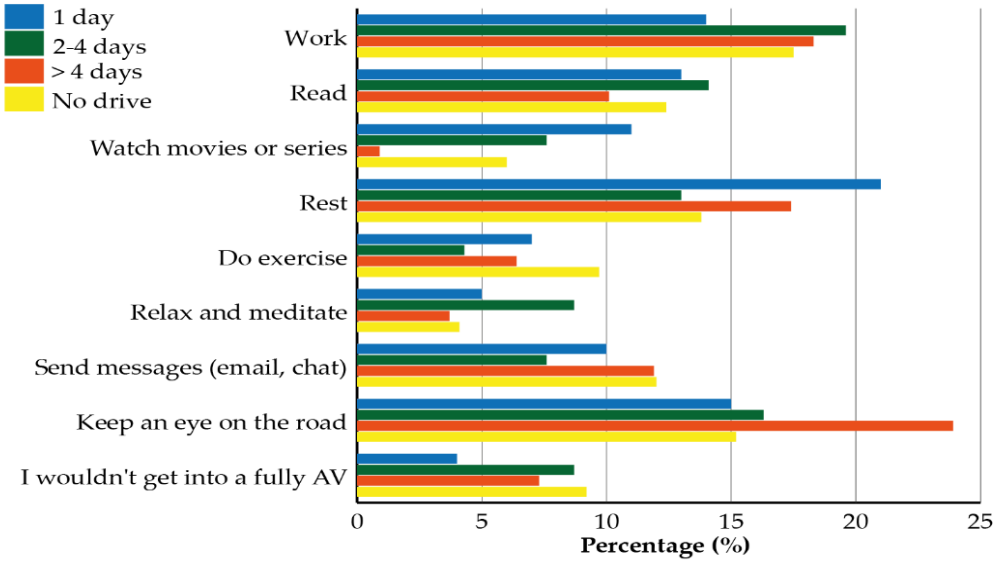

Figure 9. Percentage of respondents' responses (driving frequency) regarding their actions in a fully autonomous vehicle (AVs).

4. Discussion

This section focuses on understanding respondents' public opinion once they were shown positive and negative information. To this end, a survey questionnaire was developed and 518 complete responses were collected among young Ecuadorians. Generally, a change in perception occurs when people are presented with negative information, such as accidents involving AVs, while positive information, such as autonomous parking, causes the opposite effect. This can be observed in detail by measuring the relative importance index with respect to the perception of benefits and concerns.

In terms of perceived benefits, respondents went from positive to negative, except for increased productivity and time savings, which were perceived positively. In terms of perceptions of concerns, road safety, technological limitations, job displacement and ethical considerations showed a positive increase despite awareness of the negative aspects of AVs. These results can be compared with other studies in which negative perception increased as a result of the introduction of AVs accidents [36,37].

This variation can best be observed by segregating respondents by gender (men and women). Thus, it was identified that in terms of perception of benefits, women have a lower perception of benefits, particularly with regard to the reduction of traffic accidents and congestion and the improvement of mobility. On the other hand, men show a greater perception of benefits for other aspects. A similar trend is evident for perceived concerns, where both men and women show an increasing negative trend only due to high costs and legal and regulatory challenges. For all other concerns, women showed a greater negative increase compared to men. Previous studies have also reported gender differences, noting that men have higher positive attitudes toward AVs than women, despite their knowledge of accidents involving AVs [36, 37, 38].

For perception according to driving frequency, respondents exhibited different perceptions of benefits and concerns before and after being informed about AVs. The results suggest that people who drive more frequently, both before and after, have higher levels of interest in buying AVs compared to those who don't drive or drive less often. In terms of perception about potential problems, drivers did not demonstrate significant concerns before and after receiving information about AVs. However, non-drivers presented higher levels of concern compared to drivers. Driving frequency is a factor that should be considered because, similar to the trend of women showing less interest in AVs, the same is seen with non-drivers who also have a negative perception of AVs [41,42].

Finally, the results revealed that, overall, respondents indicated that they would still keep their eyes on the road even though AVs do not require a driver to operate them. This trend holds true when analyzing the results for men, women, drivers and non-drivers.

This study has several limitations that should be considered when interpreting the findings. First, the sample size was limited to one city in the southern region of Ecuador, which could restrict generalizability of the results to the entire country. In addition, focusing exclusively on young individuals who consume and enjoy technology may not capture the perspectives of other age groups with different concerns and attitudes. The survey design, while carefully crafted, could introduce bias into participants' responses due to the framework of the questions and the details of the autonomous vehicles presented. External factors, such as cultural and socio-economic data, which can influence perceptions, were not fully taken into account. In addition, the study's findings are based on data collected at a specific point in time, which might overlook the dynamic nature of public perceptions as technology continues to evolve. Finally, reliance on self-reported data introduces the possibility of recall bias, social desirability bias, and misinterpretation. These limitations emphasize the need for more research to build and validate the insights gained from this study. Working on these limitations could offer a fascinating continuation of this research.

Despite these limitations, this article offers several notable benefits. First, it fills a significant research gap by investigating the public perception of autonomous vehicles (AVs) specifically in Ecuador, a context where such studies are scarce. By focusing on young Ecuadorians, the article provides insight into a demographic that plays a crucial role in shaping future trends and technology adoption. The before-and-after approach used in the study adds a valuable dimension by examining how participants' perceptions changed after they were presented with positive and

negative characteristics of AVs development. In addition, identifying differences in gender-based perception and driving frequency contributes to a deeper understanding of possible variations in attitudes. The findings of this study can inform policymakers, researchers and stakeholders in Ecuador's transport sector, aiding in the formulation of strategies and decisions related to the integration of autonomous vehicles. In addition, by shedding light on public perceptions and concerns, the article contributes to fostering public acceptance and addressing reservations, ultimately facilitating the successful adoption of autonomous vehicles in Ecuador.

5. Conclusions

This study aimed to analyze the public opinion of young Ecuadorians towards AVs by presenting them with positive and negative information about the development of AVs. The study highlighted the potential benefits and concerns associated with AVs and identified differences in perception based on information participants received, gender disparities, and driving frequency. By exploring public attitudes towards AVs in Ecuador, this research contributes to a better understanding of the perceived advantages and concerns around its adoption and may even delay its implementation. The findings can inform policymakers and stakeholders in the transportation sector, helping them make informed decisions regarding the integration of AVs into the Ecuadorian transportation system. Therefore, it is important for companies developing these new technologies (AVs) to consider the concerns associated with the use of AVs. Future research should continue to address the limitations of this study and further explore the dynamics of public perception towards AVs in various contexts, especially with other age groups and in other parts of the country.

Supplementary materials: The following supporting information can be downloaded at: https://arcg.is/eO1ur.

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Data availability statement: This study analyzed publicly available datasets. This data can be found here: https://arcg.is/eO1ur.

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