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Impact of Prior Knowledge about Autonomous Vehicles on the Public Attitude

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Abstract

It is anticipated that AVs will offer multiple benefits, such as an improvement in the level of mobility, increasing the level of comfort, and reducing the number of traffic accidents. However, the public attitude is the main determinant factor that will face the deployment of AVs and in turn affect their implications. Over the last few years, there was a debate on the impact of the level of knowledge about AVs on public attitudes. While some studies show that people with higher levels of knowledge about AVs are the most optimistic, some other studies show that the public attitude moves in the negative with an increase in the level of knowledge. Thus, this study focuses exclusively on quantifying and understanding the impact of the level of knowledge and the public attitude in the US. A questionnaire survey was designed and conducted between June and November, 2022. A total of 5778 complete responses were received from all over the US and the analysis was conducted to estimate the public attitude and level of knowledge by region. The results show that there is a negative shift in public attitude with the increase in the level of knowledge about AVs. In addition, the results show that 1% increase in the level of knowledge about AVs is associated with 0.65%, 0.68%, and 2466 (USD) $ decrease in the level of interest, trust, and willingness to pay for AV and 0.56% increase in the level of concern about traveling in AVs. Moreover, the results are discussed in light of both the diffusion of innovation theory and the Gartner Hype curve.

Keywords: Autonomous Vehicles; Diffusion of Innovation Theory; Gartner Hype Curve; Prior Knowledge; Public Attitude.

1. Introduction

Over the last few years, autonomous vehicles (AVs) or self-driving cars have been proposed as a solution for multiple transportation problems, such as traffic safety [1]. It is frequently argued that AVs have the ability to improve traffic safety by 90% as a result of the illumination of human error that contributes to the majority of traffic accidents [2, 3]. While traffic safety is one of the main benefits of AVs, AVs have the potential to offer other benefits. It is expected that AVs will allow the vehicles to follow the optimal traffic assignment, which minimizes the overall energy consumption and traffic emissions. In addition, it is expected that AVs will improve the level of comfort, increase the accessibility of people with disabilities or people with limited transportation modes, such as people who live in devastated areas or rural areas, and increase the level of productivity as the travel time will not be considered as an economic loss anymore because the passengers will not be driving anymore and can use this time in productive activities [4-6]. On the other side, it is anticipated that AVs will offer risks too. For example, it is expected that AVs might increase the vehicle kilometers traveled as a result of empty trips, which in turn increases the level of congestion on the transportation network [7, 8]. In general, autonomous vehicles have been frequently discussed with regard to their implications and technological realization [2]. On the other hand, less emphasis has been placed on the public's perception of AVs and

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the factors that influence that perception [9]. However, the main barrier to any new technology is not technological but rather behavioral as the public traditionally resists any new technology, similar to what happened when the first car was invented. AVs are not an exception, and it is anticipated that the public attitude towards AVs is the main barrier that might hinder the deployment of this emerging technology [10]. 100 years ago, the public was hostile towards cars, and there was a large debate about the introduction of Automobiles [11–13].

In general, numerous studies have examined how people in various countries around the world feel about Avs [14-22]. These studies focus on analyzing the impact of the demographic properties (such as age, gender, educational level, etc.) on the public attitude towards AVs. These studies mainly focus on developing models that draw the relationship between these demographic properties and the public attitude. However, only a few studies investigate the relationship between the level of knowledge and the public attitude. In two recent review papers that investigated and reviewed previous public attitude studies towards AVs, the results show that the relationship between the level of prior knowledge about AVs and the public attitude has been rarely discussed because only 6% of the public attitude studies mention the level of knowledge and without detailed analysis [15, 23, 24], leaving this area to be explored. However, the level of knowledge is one of the main factors that affect the adoption behavior of emerging technologies. In general, Rogers Theory (also called the theory of diffusion) is the theory that analyzes how the public adopts new technologies over time [25]. The theory shows that four main factors affect the public behavior towards any new technology: the technology itself, the level of knowledge about the technology, time, and the social system [26].

The theory shows that both knowledge and time are two of the four main factors that affect the public attitude. In addition, the theory state that the change in the level of knowledge can positively or negatively affect the public attitude depending on the technology and the surrounding news. Past research on the public's perception of AVs has revealed that the public's perception is positively influenced by the public's level of awareness about AVs [27-30]. These studies analyze this relationship in a specific country and at a specific time. On the other hand, the public attitude towards AVs is not a static measure but rather dynamic and changes over time and distance as mentioned in the Rogers Theory. For example, two studies by the American Automobile Association (AAA) in the USA in 2016 and 2019 show that the public attitude moved in the negative direction moving from 63% of the public afraid of AVs in (2016) [31] to 71% in (2019) [32]. In addition, the two studies show that the level of awareness about the technology increased from 2016 to 2019. The two studies [9, 33] show that there is an inverse relationship between the public attitude and level of awareness. Similar results can be observed in the study by Lienert [34] that concluded that the public attitude moves in the negative discretion over years. Thus, these studies suggest that while the level of knowledge of AVs increases over time, the public opinion becomes more pessimistic. These results contradict the results of the public attitude studies that investigated the public attitude. As a result, there is a debate about the impact of the level of knowledge about AVs on the public attitude towards AVs. While some studies indicate that people who are more knowledgeable about AVs are more positive towards it [35-40], other studies indicate an adverse link between public opinion and AV expertise [9]. As a result, a microscopic analysis will be done in this study to determine the relationship between the public's perception of AVs and their level of awareness among residents of the USA.

In general, news and media coverage are the major factors that affect the public attitude, especially in the context of emerging technologies. For example, analyzing the opinions of the public who were exposed to positive, negative, and neutral news about a specific policy shows that the news provided to the public had a major impact on their options; however, the policy verbiage never changed [41]. In the same context, previous studies drew a relationship between exposure to specific news and the public attitude and the results show that exposure to a specific media can bias the public attitude even if this exposure lasted for a small amount of time [42-45]. The impact of the news is more significant for the case of emerging technologies as the public is building their knowledge about these technologies through the information received from the different media channels. Thus, news is a major factor that influences the public decision and attitude towards new technologies and AVs. Media coverage of AVs has been widely increasing and covering different areas of AVs including the benefits, technological realization, concerns, and crashes [46-48]. However, the number of crashes that involve AVs is increasing over time and the media coverage of these accidents is extensive [49] and focuses on the fatal accidents, malfunctions, issues, and concerns of AVs [50, 51]. This can be observed comparing the public attitude in the US in 2016 and 2019, as mentioned earlier, which shows a negative shift in the attitude over time [31, 32]. On the other hand, the studies that analyze the public attitude towards AVs fail to address this behavior as these studies show a contradicting behavior. More research is required to understand how the public's attitude towards AVs is influenced by their level of knowledge, as this link has not been addressed in earlier studies that look at public opinion. Thus, given the lack of studies that analyze the impact of the level of knowledge on the public attitude, this study focuses exclusively on drawing the relationship between the level of knowledge and the public attitude toward AVs.

In this research, a questionnaire survey was carried out in the USA in 2022 to ascertain the public's awareness of AVs and attitudes towards them in terms of their level of interest (LOI), trust (LOT), concern (LOC), and willingness

to pay (WTP) more for AVs in various US states. In addition, the study draws the relationship between the level of knowledge of AVs from one side and the public attitude on the other side (in terms of the LOI, LOT, LOC, and WTP more for AVs). The paper is organized as follows: section one provides an introduction and background information about the topic. Section two provides the details of the methodology used in this study. Section three represents the analysis and draws the relation between the level of knowledge of AVs and the public attitude. Finally, section four shows the main conclusions of this study.

2. Research Methodology

This study focuses on drawing the relationship between the level of knowledge of AVs and the public attitude towards this technology for residents of the USA. Thus, to gauge the public's perception of AVs in the US, a questionnaire survey was developed. The methodology followed in this study for designing the survey is summarized in Figure 1.

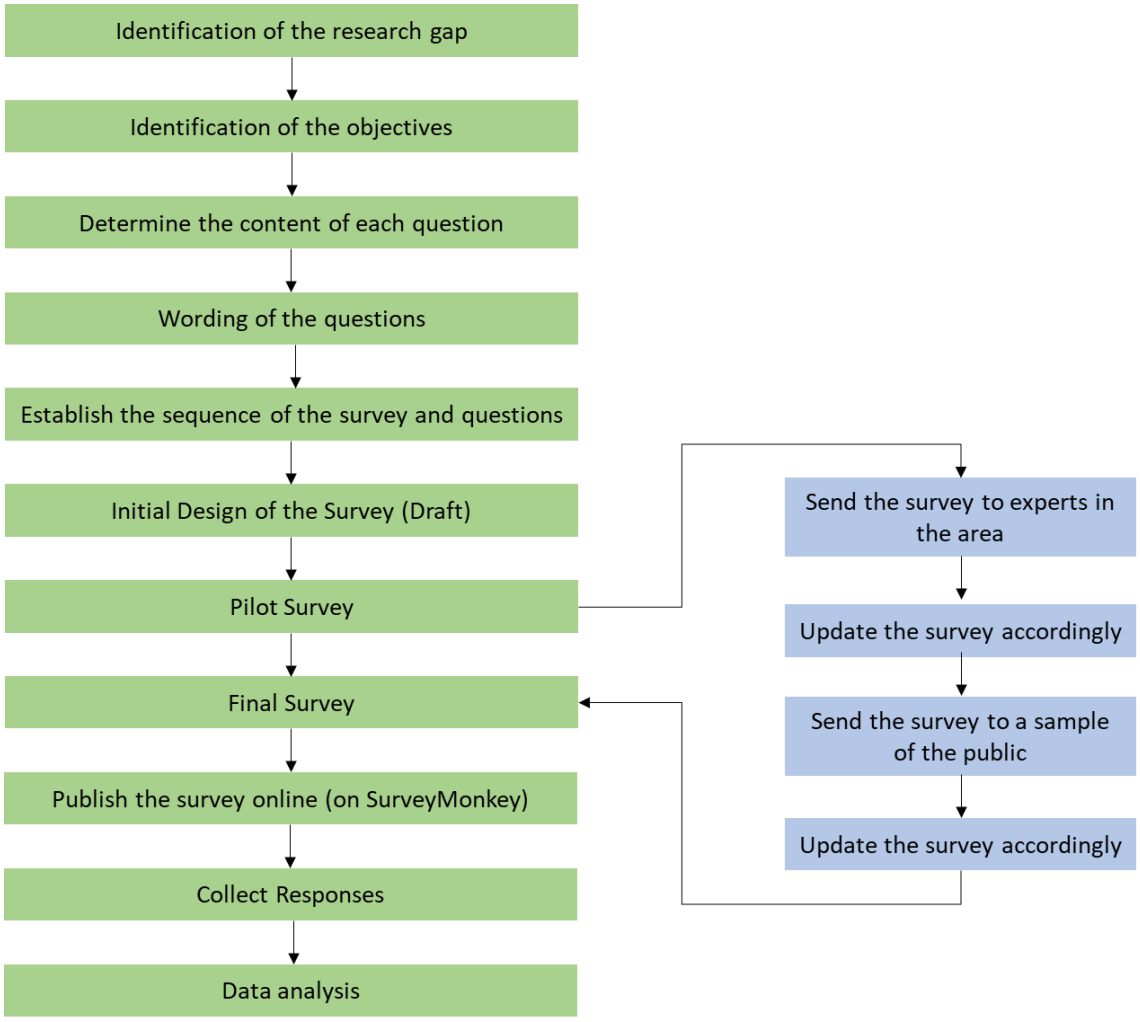

Figure 1. Summary of the research methodology followed in this study

The survey was conducted between June and November of 2022 through the SurveyMonkey platform and the survey is presented in the appendix at the end of the paper. In order to ensure that the survey is in line with the study's goals, a pilot survey was first conducted. The pilot survey consists of two stages. The first stage focuses on testing the survey questions and during this stage the survey was sent to eight researchers who work in the same area of research which focuses on testing the public opinion about AVs. Then, the survey was updated according to their recommendations. The second stage of the pilot survey focuses on making sure that the survey is fair, and easy to understand and respond to. During this stage, the survey was sent to 28 respondents of the public in the US and their opinion about the survey were collected. There was an agreement, among all the respondents, that the survey is fair, understandable, easy to navigate, and easy to respond to. At this stage, the survey was sent to the public and a total of 5778 complete responses were collected from respondents who live all over the US. The survey consisted of three sections. The first section focused on providing the respondents with some background information about the nature of the study. In addition, this section gives the respondents some background information about AVs in general.

The second section focuses on collecting the demographic properties of the respondents such as their age, gender, income, and prior awareness about AVs before the survey. The respondents were asked to choose the age range, gender, and income group that most accurately reflected their demographics. On the other hand, using a Likert scale from 1 to 5, respondents were asked to rate their level of familiarity with AVs before taking the survey, where 1 represents that the respondent has no prior knowledge about AVs while 5 represents respondents with the highest level of knowledge about AVs. The third section focuses on analyzing public perceptions of AVs. On a Likert scale from 1 to 5, the participants were given the opportunity to rate their LOI, LOT, and LOC towards AVs. Finally, the respondents were asked to write the additional money they are WTP to buy an AV. In order to investigate the relationship between the level of awareness and public attitude towards AVs, the analysis will be conducted by state and the relationship between the level of awareness and the public attitude will be investigated. The responses were collected from all over the US. In general, a total of 5778 responses were received; however, the number of received responses varies across the different states. While a total of 240 responses were received from one state, zero responders were received from other states. Thus, the analysis will be conducted by region rather than by state to make sure that every region is well represented and to avoid underrepresenting any state. In this case, the US was divided into nine main regions: New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, and Pacific. Figure 2 shows the states included in every region.

Figure 2. Map showing the states included in every region used in the analysis

As the number of responses from every state from 0 to 240 responses, the analysis was conducted by region. In order to make sure that the sample well represents the spatial distribution of the population of the US, the number of responses from every region was calculated (as shown in Figure 3) and compared with the 2022 US census [52] and the comparison is shown in Table 1. The table shows the number of responses collected during the survey and the percentage of responses received from every region besides the percentage of the US population that lives in the region. The results show that the survey sample is representative of the entire population as the percentage of responses received from every region is similar to the percentage of the US population that lives in the area with a maximum error of 0.15%. Thus, the survey sample well represents the overall US population.

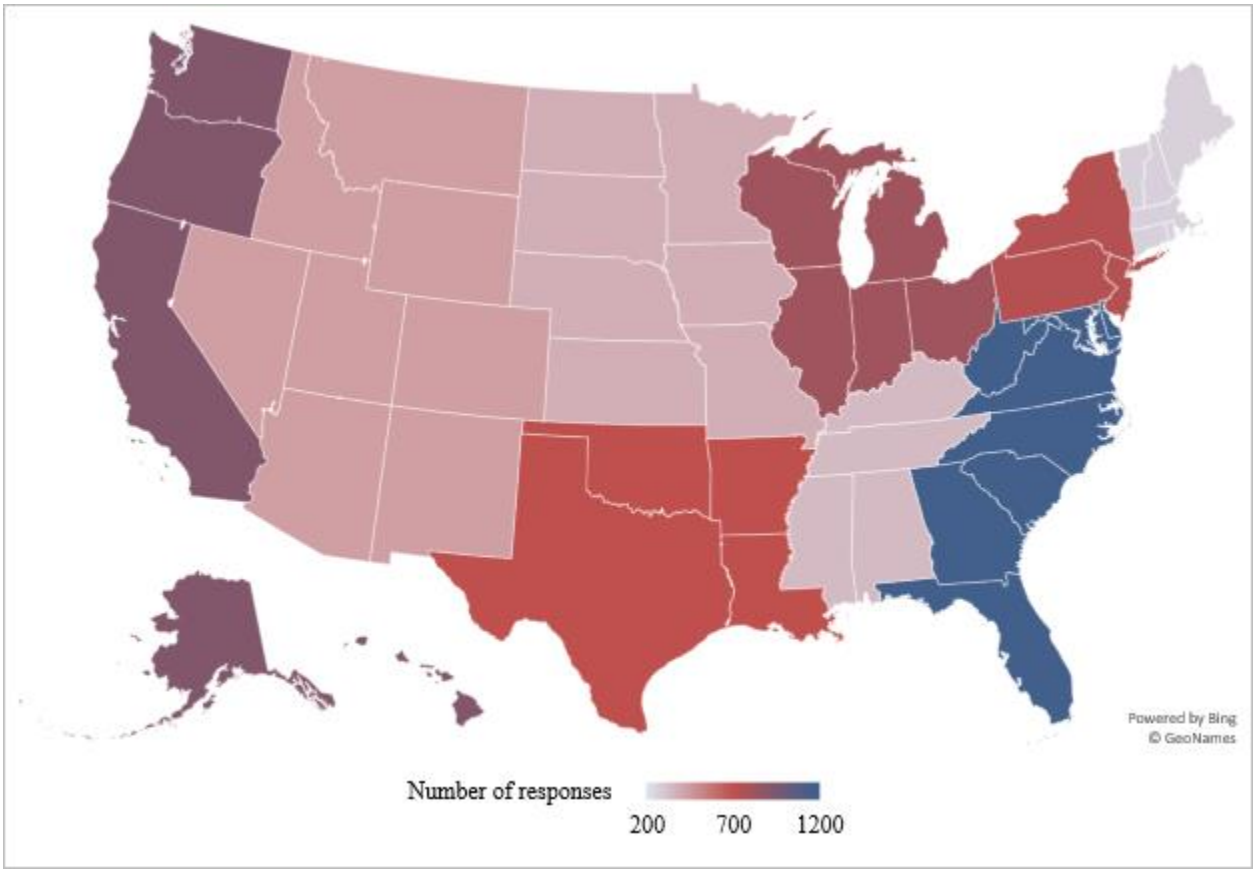

Figure 3. Number of responses received from every region

Table 1. Summary of the number and percentage of responses received by region besides the percentage of the population that lives in every region

Region	% Of the population lives in the region [52]	Number of responses received	% Of responses received	Error (%)
New England	4.56	269	4.66	0.09
Mid-Atlantic	12.82	739	12.79	-0.03
South Atlantic	19.94	1155	19.99	0.05
East South Central	5.85	342	5.92	0.07
West South Central	12.30	704	12.18	-0.12
East North Central	14.29	822	14.23	-0.06
West North Central	6.52	382	6.61	0.09
Mountain	7.52	438	7.58	0.06
Pacific	16.19	927	16.04	-0.15

3. Analysis and Results

This study focuses on understanding the relationship between the public awareness of AV technology and the public attitude. Thus, the analysis is conducted by region, and the average level of knowledge and public attitude parameters were calculated for every region the results are summarized in figures 4 to 8. Figure 4 shows the average level of knowledge of the respondents from every region and the heatmap is colored so that the red color represents the regions with the lowest level of knowledge about AVs while the green color represents the regions where respondent shows the highest levels of knowledge about AVs.

Figure 5 shows the average LOI in AVs as highlighted by respondents from every region and the heatmap is colored so that the red color shows the regions with the lowest LOI while the green color shows the regions with the highest LOI in AVs. Figure 6 shows the average LOC about riding or driving AVs for respondents from different regions. The heatmap is color coded so that the green color shows the regions with the lowest LOC about AVs while the red color represents the regions with the highest LOC about AVs. Figure 7 summarizes the average LOT of the respondents from the different regions. The figure is color coded so that the regions with the highest LOT in AVs are highlighted in color while the regions with the lowest LOT in AVs are highlighted in red.

Finally, Figure 8 summarizes the average WTP extra to buy an AV across the different regions and the heatmap is coded so that the red color shows the regions with the lowest WTP more for AVs while the green color represents the regions with the highest WTP more for AVs. The statistics reveal that the regions that have the largest prior information of AVs tend to be negative about AVs since they indicate the lowest rates of LOI, LOT and WTP for AVs as well as the highest degrees of fear about travelling in an AV. Contrarily, the data reveals that people from the zones with the least prior knowledge of AVs are the most positive towards AVs as they exhibit the highest LOI, LOT, and WTP more for AVs. In order to make the comparison clear, Table 2 summarizes the rank of the different parameters investigated in the analysis than rank is organized in descending order so that 1 is given to the region with the highest value of the parameter tested while 9 is given to the region with the lowest value of parameter tested. The table shows that the regions with the highest levels of knowledge about AVs are the East North Central, the West South Central, and the East South Central. These three regions are the regions with the lowest LOI, LOT, and WTP extra to get an AV. Similarly, these three regions are amongst the regions with the highest LOC about AVs. Mountain, New England, and the South Atlantic, on the other hand, have the lowest levels of foreknowledge about AVs, according to the data in the table. On the other side, the table shows that the regions with the lowest levels of prior knowledge about AVs are Mountain, New England, and South Atlantic. The findings indicate that individuals from these areas have the lowest levels of fear about travelling in an AV and the highest LOI, LOT, and WTP more to purchase an AV.

As a result, the analysis demonstrates that there is a negative correlation between prior awareness of AVs and the LOI, LOT, and WTP more for AVs. The findings demonstrate a direct correlation between the level of pre-existing awareness about AVs and the degree of anxiety associated with riding in one. On the contrary, there is a negative correlation between knowledge and LOI and LOT in AVs. Consequently, it can be argued that there is a negative correlation between the level of background knowledge about AVs and the public's perception of AVs because an increase in AV knowledge is associated with a change in the public's perception of AVs that is less favorable (in terms of the increase in the LOC and the decrease in LOI and LOT). These findings concur with those of the study by Othman (2021) [9], and the two surveys by the American Automobile Association (2016) [31] and (2019) [32] that concluded that while the level of knowledge about AVs increases, the LOI in AVs deceases.

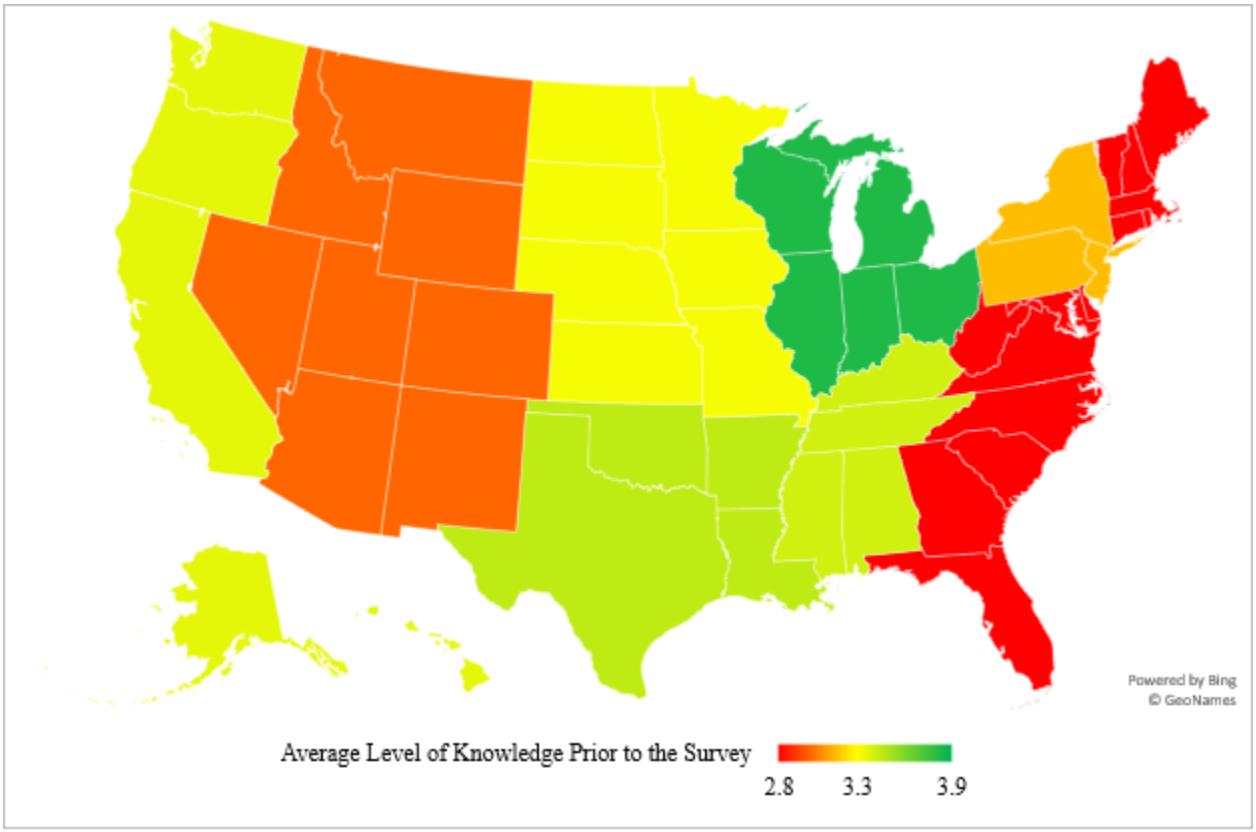

Figure 4. Average level of familiarity with AVs among responders from various locations

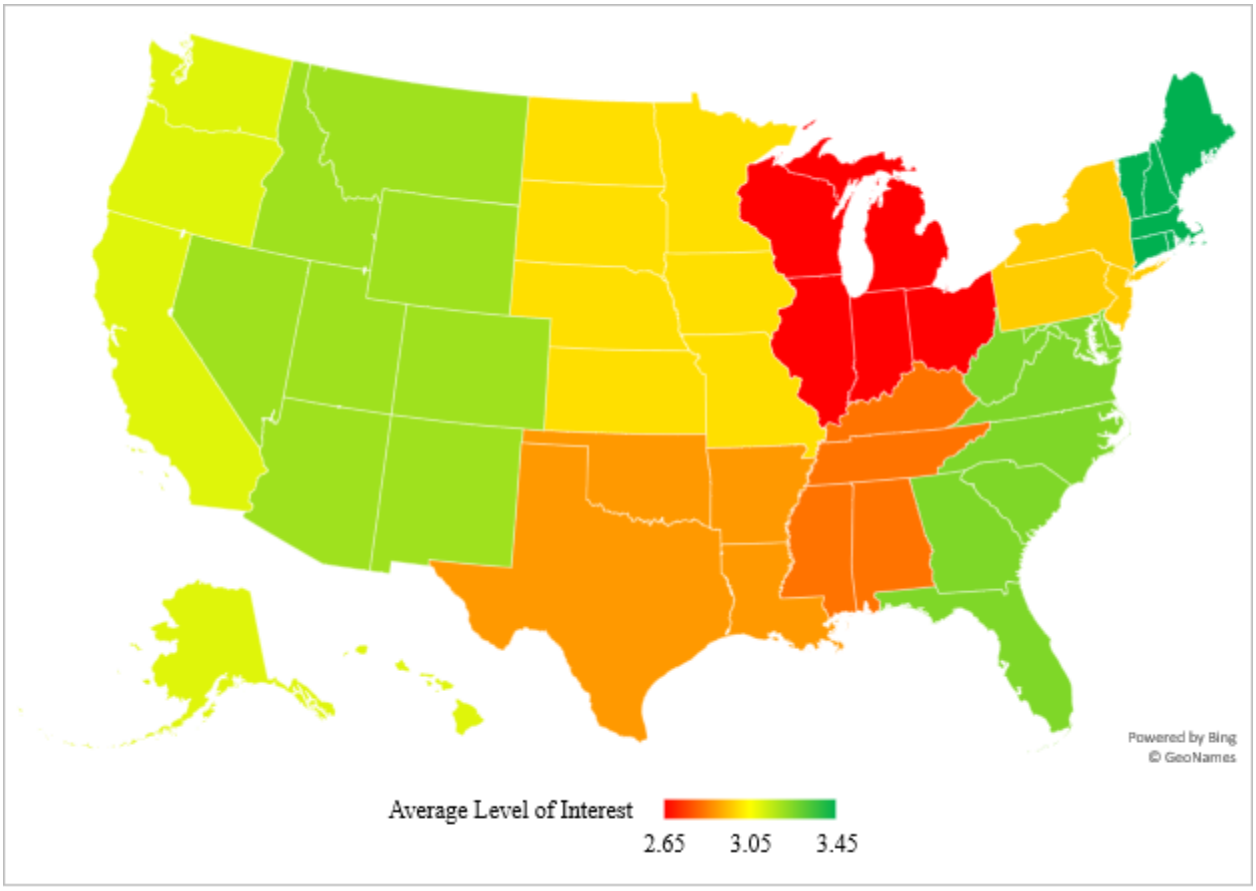

Figure 5. Average level of interest in AVs among responders from various areas

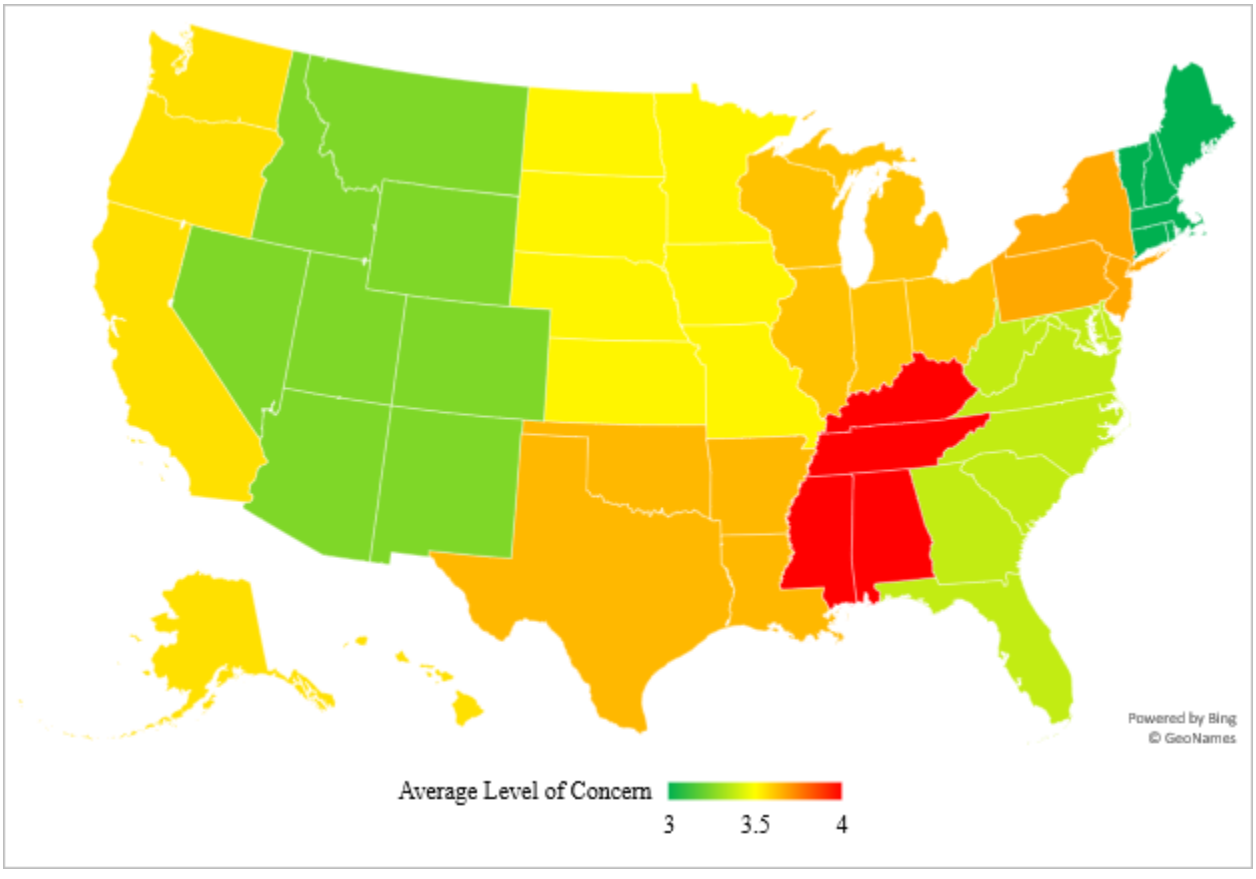

Figure 6. Average level of AV-related concern among responders from various locations

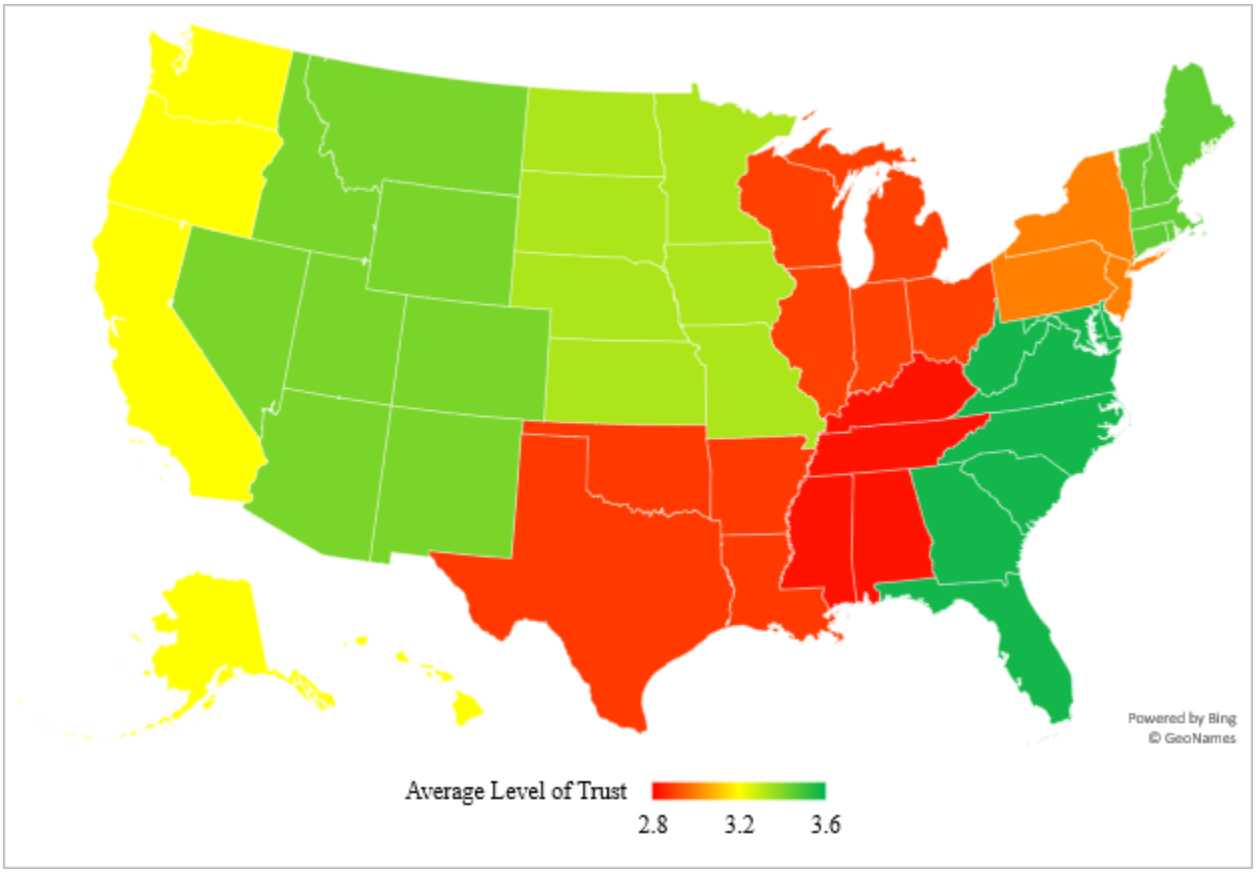

Figure 7. Average degree of trust people from various locations have in Avs

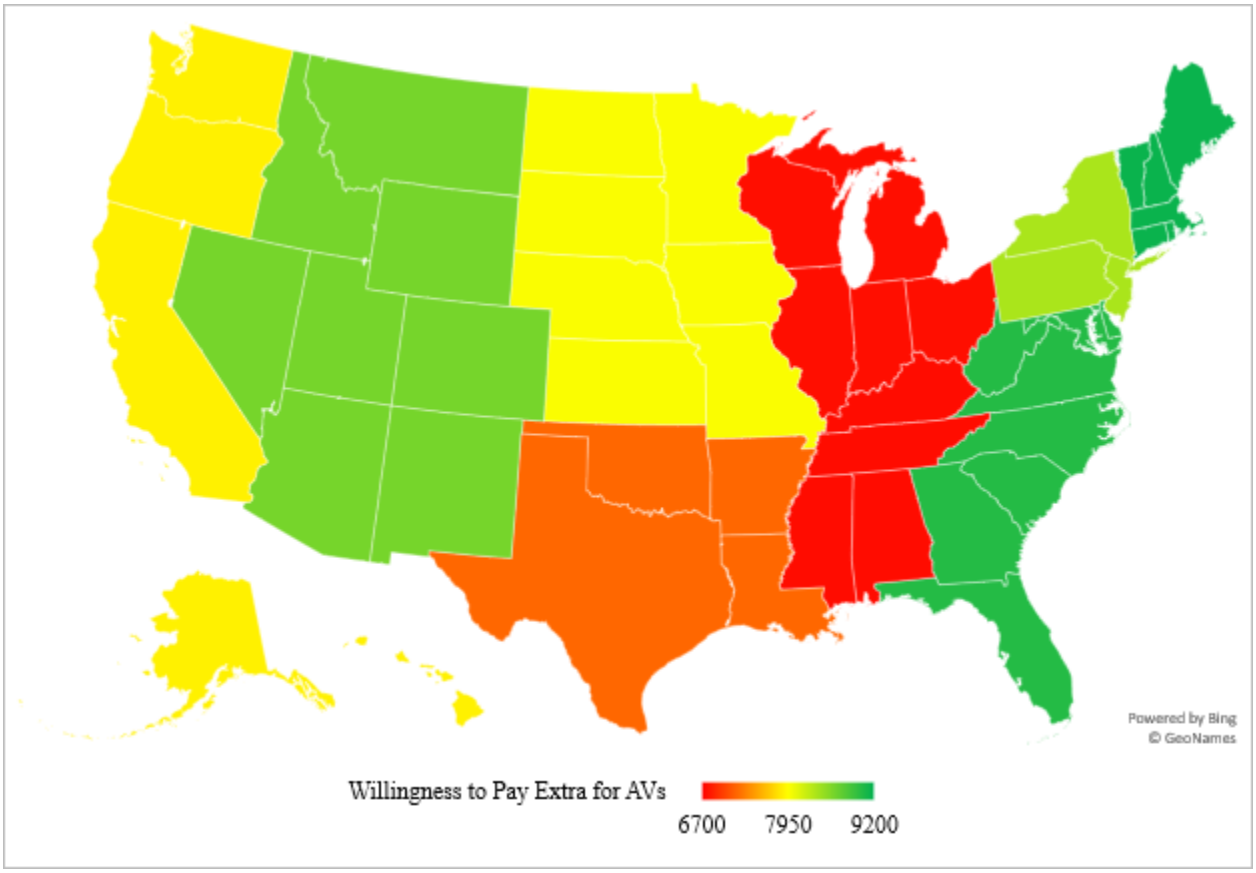

Figure 8. Average WTP extra for AVs for people from different regions

Table 2. Rank of the different parameters investigated in this study

	Average Level of Knowledge Prior to the Survey	Average Level of Interest	Average Level of Concern	Average Level of Trust	WTP Extra for AVs
East North Central	1	9	4	7	8
West South Central	2	7	3	8	7
East South Central	3	8	1	9	9
Pacific	4	4	5	5	6
West North Central	5	5	6	4	5
Middle Atlantic	6	6	2	6	4
Mountain	7	3	8	3	3
New England	8	1	9	2	1
South Atlantic	9	2	7	1	2

While the previous discussion sheds light on how the relationship between the level of knowledge and the public attitude looks like, it is also important to draw this relation to clearly understand how the level of prior knowledge about AVs affects the public attitude. As a result, this part focuses on drawing the relationship between the level of knowledge on the x-axis and the public attitude parameters (LOI, LOT, LOC, WTP extra) on the y-axis in order to quantify the relationship between the level of prior knowledge and the public attitude parameters.

Figures 9 to12 show the relation between the average level of prior knowledge about AVs on the x-axis and the average LOI, LOT, LOC, and WTP for AVs. Firstly, the relationship between the average level of prior knowledge and the average LOI in traveling in AVs. The figure shows that there is an inverse relationship between the two factors and the model that summarizes this relation is shown in Equation 1. The coefficient of determination (R^2) shows that there is a strong relationship between the two parameters as it has a high value of 0.88. This relation indicates that 1% increase in the level of knowledge about AVs is subjected to 0.653% reduction in the level of inters in traveling in an AV.

Secondly, the relationship between the average level of knowledge about AV and the average LOC about traveling in AVs is summarized in Figure 10. The figures show that there is a direct relationship between the average level of knowledge about AVs and the average LOC about traveling in AVs. In addition, there is a moderate relation between the two parameters as the R^2 for the relation between the two parameters is 0.5 and the model that describes the relationship between the two parameters is summarized in Equation 2. This model indicates that 1% increase in the level of knowledge about AVs is subjected to 0.56% increase in the LOC about traveling in an AV.

Thirdly, the relationship between the average level of prior knowledge and the average LOT in AVs is summarized in Figure 11. The figure shows that there is an inverse relationship between the two parameters and Equation 3 describes the relationship between the two parameters. This model has an R^2 value of 0.72 indicating a strong relationship between the two parameters. Furthermore, the model indicates that 1% increase in the level of knowledge of AVs is subjected to 0.684% decrease in the LOT in AVs. Finally, Figure 12 shows the relation between the average level of prior knowledge about AVs and the average level of WTP extra to buy an AV. The figure shows an inverse relationship between the two variables and the model that summarize the relationship between the two variables is shown in Equation 4.

The R^2 value of the developed model is high (=0.895) indicating a strong relationship between the two parameters. This model indicates that 1% increase in the level of knowledge about AVs is associated with 2466.4 (USD $) reduction in the WTP extra to buy an AV. Thus, these results show that the increase in the level of knowledge about AVs is associated with a negative shift in the public attitude towards AVs in terms of the LOI, LOT, LOC, and WTP extra to buy an AV.

$$Average\ level\ of\ interest\ (LOI) = 5.16 - 0.6531 * Average\ level\ of\ prior\ knowledge \quad (1)$$

$$Average\ level\ of\ concern\ (LOC) = 1.69 + 0.5577 * Average\ level\ of\ prior\ knowledge \quad (2)$$

$$Average\ level\ of\ trust\ (LOT) = 5.43 - 0.684 * Average\ level\ of\ prior\ knowledge \quad (3)$$

$$Average\ willingness\ to\ pay\ (WTP) extra\ (\$) = 15981 - 2466.4 * Average\ level\ of\ prior\ knowledge \quad (4)$$

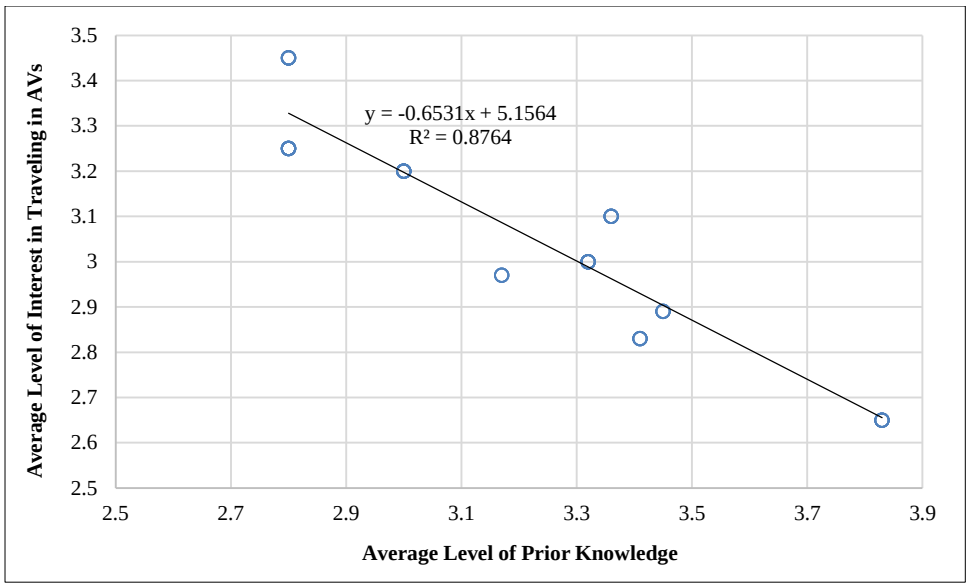

Figure 9. Relationship between the average level of prior knowledge and the average level of interest in traveling in Avs

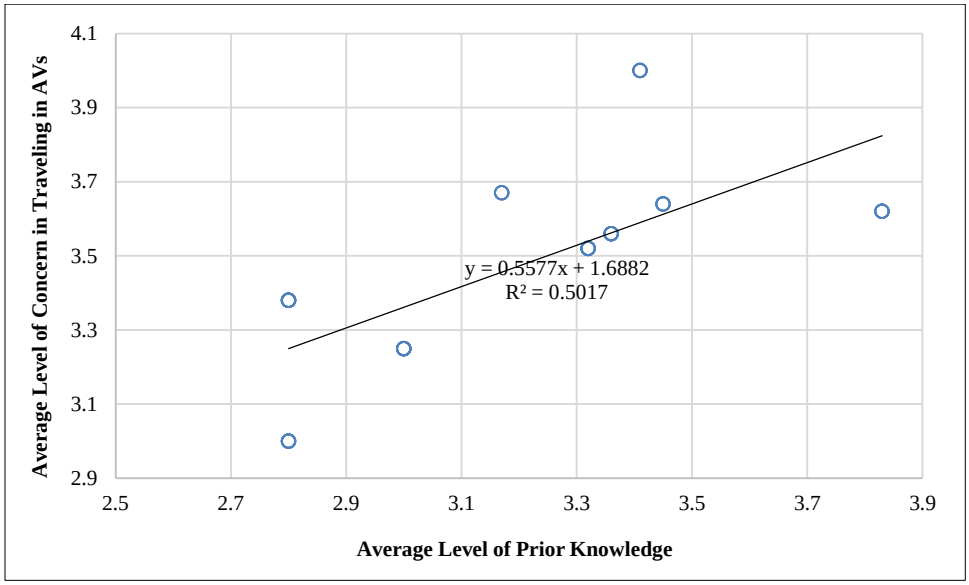

Figure 10. Relationship between the average level of prior knowledge and the average level of concern in traveling in AVs

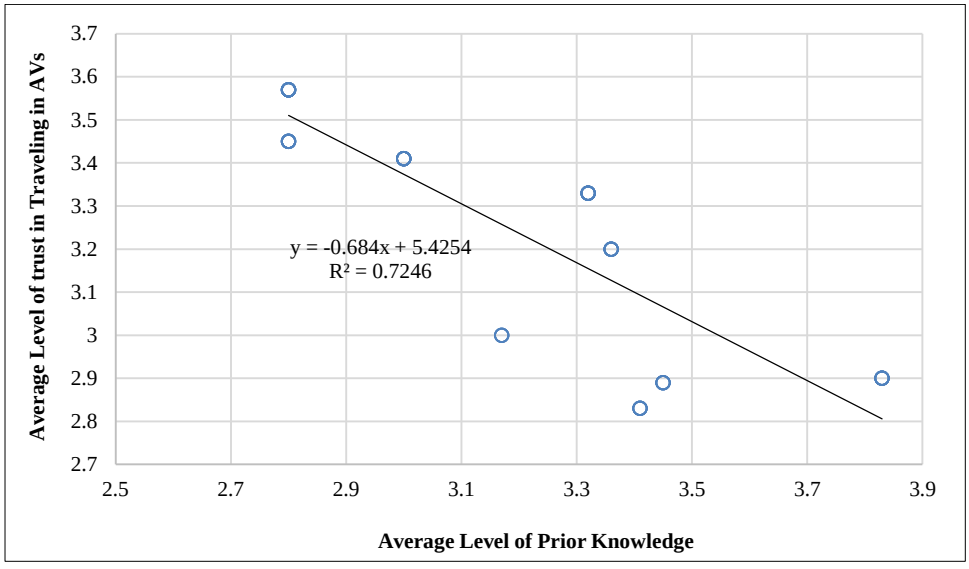

Figure 11. relationship between the average level of prior knowledge and the average level of trust in traveling in Avs

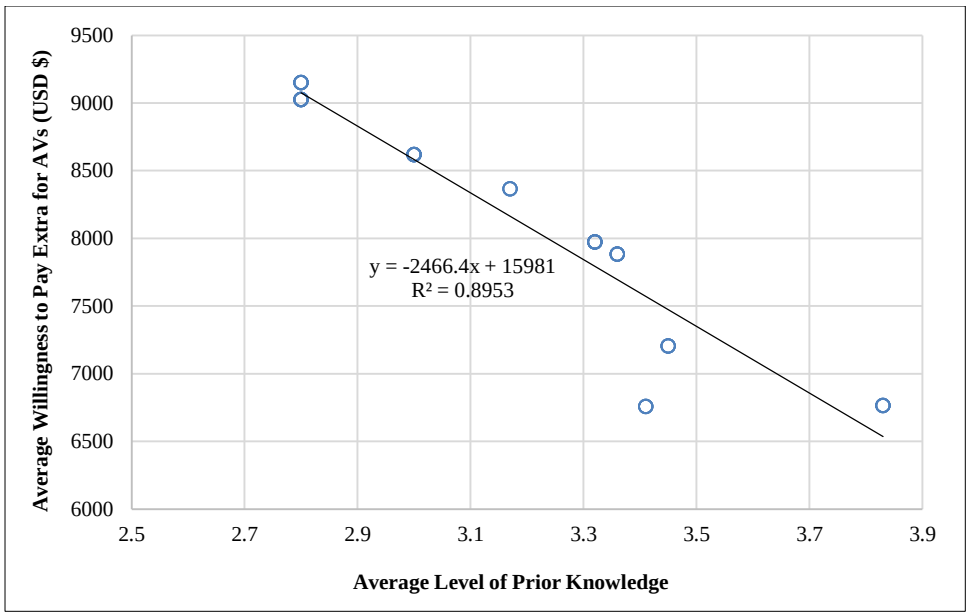

Figure 12. Relationship between the average level of prior knowledge and the average level of WTP extra to buy an AV

The previous analysis shows how the public attitude changes with the level of knowledge about the technology. These results show that regions with higher levels of knowledge are generally more negative towards AVs. In other words, the results show that people with higher knowledge about AVs are less optimistic about AVs, indicating that their options are affected by negative factors or negative news. In general, news about AV crashes are widely covered and extensively spread all over the different media platforms. In addition, the number of AV accidents is increasing over time (as shown in Figure 13). Thus, it can be expected that the public direction will be shifted in the negative attitude with the increase in the level of knowledge, indicating that people with higher levels of knowledge are more exposed to negative news about AVs. In addition, it is expected that this negative shift will continue to occur in the future with the increase in the negative news. The Gartner Hype curve of innovation is a recent methodology that was developed to explain how new technologies can be deployed through five phases as shown in Figure 14. This curve was developed to explain the different adoption states of different artificial intelligence technologies (AI) [53].

The curve shows that AI technologies pass through five main phases till achieving the expected productivity or capacity. The first phase is called the "Innovation Trigger" and it is the point at which a new technology is introduced with early proof of concept and positive media coverage. At this point, the technology is not in the market yet and its commercial viability and benefits are not explored yet. The second phase is the "Peak of Inflated Expectations" and this is the early stage in the life of the product with a number of success stories of some prototypes. In this stage, some investors enter this market while many do not. Then, the technology enters a phase of wider experimentation and failures showing issues in the technology and this stage is called the "Trough of Disillusionment". This stage is critical for any technology as it determines whether the technology can be adopted or abandoned. Investment in this stage continues only if the investors and providers of the technology can improve the technology in a way that satisfies the public expectations. Then, the technology enters the "Slope of Enlightenment" and in this stage the public starts to realize the benefits of the technology and further investors enter the market. In addition, in this phase, the technology producers develop new generations of the technology that are more reliable, mature, and innovative.

Finally, the technology enters the "Plateau of Productivity" phase which indicates the wide acceptance and deployment of the technology. In addition, this phase shows the true benefits and impacts of the technology. Although the Gartner Hype curve was not developed for AVs, it can be used to translate the adoption phases of AVs, especially AV technology is following the same phases. Firstly, the invention of the self-driving car concept was accompanied by positive news about the technology with some speculations about its benefits [9]. Then, AV technology passed the second phase "Peak of Inflated Expectations" during which there was massive news, articles, reports, and research papers that discusses the benefits and implications of AVs with a very positive eye [1, 2]. During this phase, large investments were devoted to AV technology from both the industrial and research sides [2]. Then, over the last few years, AVs entered the third phase and the most critical one "Trough of Disillusionment" as AVs got involved in a large number of accidents showing the imperfection side of the technology and changing the public attitude. Thus, the current state of AV technology in the Gartner Hype curve is shown in Figure 14 as this survey was conducted at some point showing that the LOI in AVs decreases with the increase in the level of knowledge. Thus, it can be expected that the negative shift in the attitude towards AVs will continue for some years till the "Slope of Enlightenment" phase is achieved. Thus, it is anticipated that AVs is currently in the most critical stage that will determine whether the technology is acceptable or not. In addition, further experimentation failures with more negative news and negative shift in the public attitude are anticipated in the near future based on the hype curve.

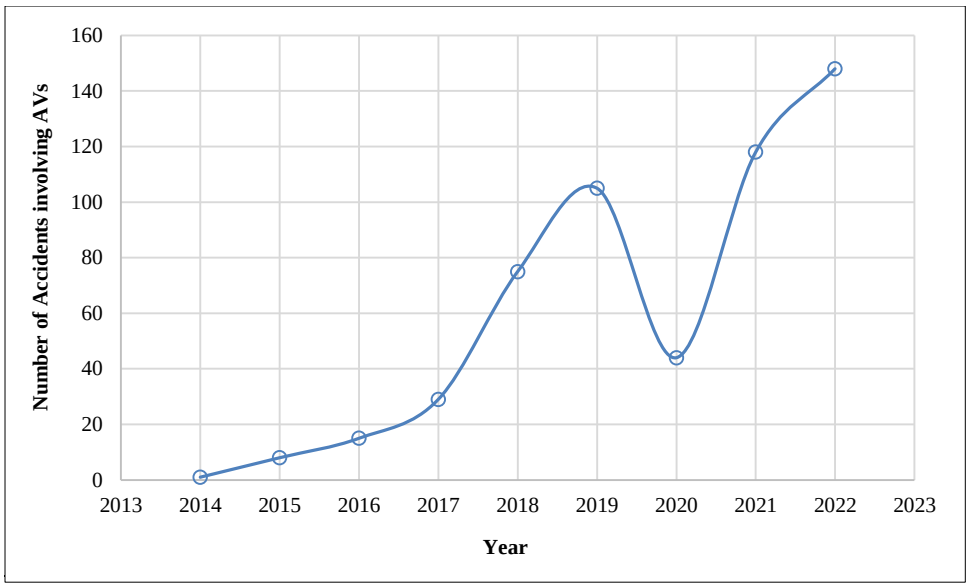

Figure 13. Number of autonomous vehicles accidents in the US over the years [54]

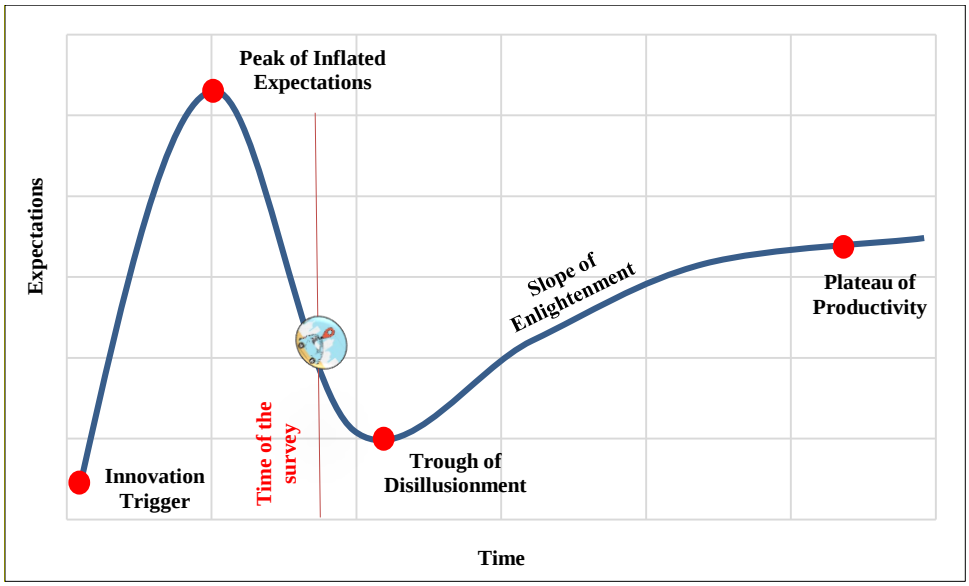

Figure 14. Illustration of the Gartner Hype curve showing the current state of AVs

Similarly, the theory of diffusion of innovation or the Rogers theory, mentioned in the introduction, focuses on explaining how and when emerging technologies can be deployed or adopted by the public [55]. The theory analyzes and presents how the public makes decisions about the adoption of emerging technologies. The decision of innovation adoption is a five-step decision-making process: awareness, interest, decision, implementation, and confirmation [56] as summarized in Figure 15. The theory shed light on the importance of the knowledge for the adoption of innovation especially since this is the first decision point that affects future decisions for the adoption of the technology. Thus, knowledge is the most critical decision point for the success of emerging technologies. During the knowledge decision point the public gets exposed to the technology without realistically testing it. In other words, the public gets exposed to the technology through the media without true information or real-world information about its impacts. This point is critical and failing to pass this decision point might hinder the public from adopting any new technology. Currently, AV technology is in this phase as most of the public is building their expectations of AVs throughout the media and news. If the innovation managed to convince the public about its benefits, the public decision point will move to the second decision point which is the interest. In the second decision point, the public's LOI about the technology increases to collect information about the technology seeking to try it themselves to test it. Then, this is followed by the third decision point, which is called the "Decision", during which the public take the decision to change to the new technology based on the previous two decision points. At this point, the public compares the advantages and disadvantages of emerging technology and decided whether to adopt the technology or not. The fourth decision point is the implementation and during this stage the public starts to see the real impacts of the innovation on their lives. Finally, the fifth decision point is called the confirmation and during this stage the public takes the decision of whether to continue using the technology or not. Thus, the diffusion of innovation theory has made it clear that the level of knowledge about new technologies is critical for their success.

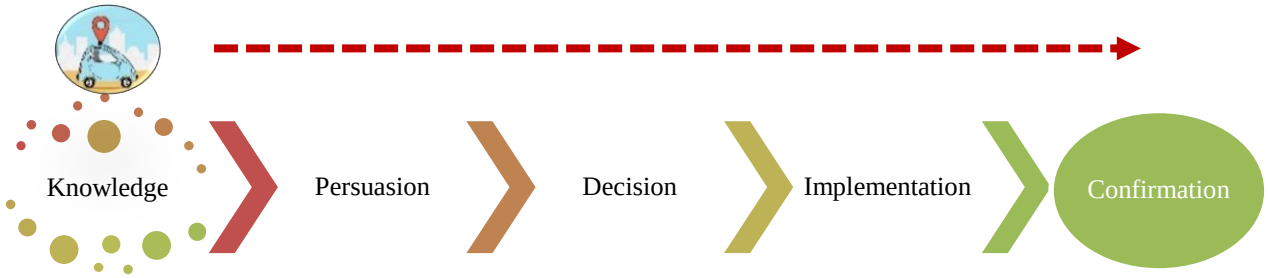

Figure 15. Visualization of the innovation decision making

The theory of diffusion has also discussed how new technologies are adopted and it shows that the adoption rate follows an S-curve that is called the innovation S-curve. While the S-curve shows the market share of new technologies, the adoption rate is another curve that shows the adoption rate. The adoption rate curve shows the five categories of adopters of emerging technologies as summarized in Figure 16. The first category is the innovators, and it refers to people who are willing to take risks and adopt the technology. In general, the adopters are people with the highest social status and have the finical ability to pay for the technology. Furthermore, this category has close contact with scientific sources and takes the risk of adopting the technology while knowing the probability of failure of technology, but the finical security makes it possible to deal with these failures. The second category is the early adopters, and it includes people who have high social status, educational levels, and finical security that help them afford the costs of new technologies. The third category is called the early majority and these people have an average social status and are in close contact with the early adopters who inform them about the technology and its benefits. The fourth category is the late majority and this category represents people who adopt the technology after the average participant, and they are skeptical about the technology as they do not have the financial security to allow for technology failure. These people have a below average social status and are in close contact with the early majority. Finally, the Laggards are the least adopters of the technology and they adopt the technology only when they have to [57, 58]. Currently, AV technology is in the first category as only the innovators category is the only category that owns AVs at the moment, as shown in Figure 16, while knowing the immaturity of the technology and accepting this risk. Thus, based on the previous discussion, it can be stated that the public knowledge about AVs is critical for the adoption of the technology in light of both the diffusion of innovation theory (or Rogers theory) and the Gartner Hype curve.

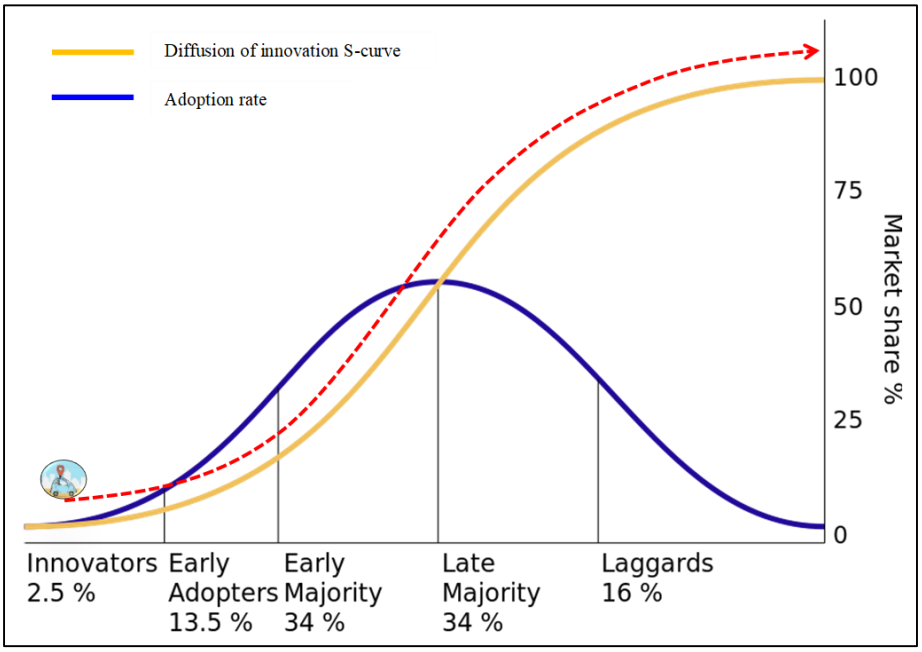

Figure 16. Visualization of the diffusion of invocation S-curve and the rate of adoption curve (adopted from [53])

4. Conclusion

AVs provide numerous advantages, including increased traffic safety due to the elimination of the human factor, which is responsible for 90% of traffic accidents. However, the extent to which these gains can be realized is largely determined by public sentiment and appreciation of this emerging technology. There is dispute surrounding the influence of public perception of and awareness of AVs. While some studies suggest that individuals with greater AV knowledge have more positive attitudes towards AVs, other research suggests that the opposite is true. Yet, there are no studies in

the literature that look into how past knowledge affects the public's perception of AVs. So, the sole goal of this study is to ascertain how the public's perception of AVs is affected by the extent of public knowledge about them in the US. As a result, an online survey was created and carried out to evaluate the public's thoughts about AVs in the US. A total of 5778 complete responses were collected from all over the US and the US was divided into nine main regions. For every region, the average level of knowledge about AVs, the average LOI in traveling in AVs, the average LOT in AVs, the average LOC in traveling in AVs, and the avenge WTP extra to buy an AV were calculated. Then, the relationships between the level of knowledge and the public attitude parameters (LOT, LOI, LOC, WTP extra) were investigated to understand and quantify the relationship between the level of prior knowledge and the public attitude.

The findings indicate that there is a negative connection between the public's attitude and their level of prior knowledge. The three regions with the highest levels of knowledge about AVs were the most pessimistic towards AVs, The three regions with the lowest knowledge levels had the most favourable attitudes regarding AVs. In addition, the results of the regression modeling between the level of knowledge and the public attitude parameters show that 1% increase in the level of knowledge about AVs is associated with 0.65%, 0.68%, and 2466 (USD) $ decrease in the LOI, LOT, and WTP for AV and 0.56% increase in the LOC about traveling in AVs. In light of this, it may be said that people's optimism declines as their awareness about AVs grows. This negative shift can be caused by the negative news surrounding AVs, especially with the increase in the number of reported accidents over the years as explained in the study by Othman [9] that showed that the percentage of people afraid of AVs increases with the increase in the number of reported accidents. Projecting AVs conditions on the Gartner Hype curve shows that AVs technology has passed the first two phases (Innovation Trigger and Peak of Inflated Expectations) and is currently in the third phase "Trough of Disillusionment" which is the most critical phase for the success of emerging technologies as the challenge is to keep the fund and investment in AV technology with the large amount of negative news that surrounds its failure stories. Thus, it is anticipated that the negative news about AVs will continue for a few more years till the technology meets the public expectations.

5. Declarations

5.1. Data Availability Statement

Data sharing is not applicable to this article.

5.2. Funding

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5.3. Conflicts of Interest

The author declares no conflict of interest.

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