Analyzing of Impact Factors of Residents' Choice of Autonomous Vehicle: A Network Questionnaire Survey in Nanchang, China

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Abstract. Autonomous vehicle technologies provide effective opportunities to improve the driving environment and reduce the number of traffic accidents. However, due to technical limitations and social ethics challenges, the acceptance and recognition of autonomous driving among residents still need to be improved. For this purpose, a network questionnaire survey with 251 volunteers was conducted in Nanchang, China. The impact factors such gender, age, education, income and others, which may associated with the residents' choice of autonomous vehicle were collected. Three indexes which included the degree of residents' satisfaction and acceptance were adapted to calibrate the reported residents' choice. A multiple linear regression model was applied to identify significant factors and to establish the identification model. The results indicated that the type of driver's license, passenger’s comfort and safety and the age of driver with license are significant positive correlated to residents' satisfaction in the data (Approx. Sig<0.01). In addition, the relationship between curiosity, expectation, desire to buy and residents' acceptance is positive correlation (Approx. Sig<0.01). The identification model also demonstrated a high predictive power with a prediction accuracy of 0.80. The conclusions provide theoretical support for improving residents' acceptance and satisfaction with autonomous vehicle, and promote the marketization operation of self-driving technology.

1. Introduction

Currently, with the development of economy increasing rapidly, automobiles are favored by most people because of their convenience and speed, which have become the primary means of transportation for many people. The number of cars in China has also kept a sustained and rapid growth trend. In 2017, they have taken the total number to 217 million in China, increasing by 23.04 million compared to 2016, with a growth rate of 11.85% [1].

The emergence and development of autonomous vehicle technology has undoubtedly brought great potential and many opportunities to the automotive industry. The death in traffic accidents in China ranked second around the world in recent years. If the vehicle technology can be furtherly developed and put into the market, the problem will be solved effectively. In addition, the autonomous vehicle technology in China is becoming more mature for the national policy and the capital investment of many enterprises, which will effectively alleviate the congestion problem, save fuel and transit time, improve traffic efficiency and driving comfort. In July 2016, the National Development and Reform Commission and the Ministry of transport jointly released Implementation plan about promoting "Internet +" convenient transportation to develop intelligent transportation. In the implementation plan, the internet of vehicles and automatic vehicle are regarded as advanced technologies that should be
actively improved and applied for intelligent transportation. And it also clearly stated that promoting the research and development of fully automatic self-aware driving vehicle is fairly necessary, beneficial to improve the automation of vehicle driving. Additionally, autonomous driving has also been included in the comprehensive transportation system during “the 13th Five-Year Plan” period [2]. Based on the current status quo, studying the acceptance and satisfaction of autonomous vehicle technology is pretty necessary, which will be of great significance to the landing time and development direction of autonomous vehicles.

Attitudes and confidence of people with different genders, ages, educational levels and income levels on autonomous vehicle technology was explored in this study using methods of literature analysis, questionnaire survey, and statistical analysis. The impact of various factors on residents' acceptance and satisfaction is the emphasis of the study. Finally, the residents' acceptance of autonomous vehicle technology and the direction of development, and provides objective theoretical support for the market-oriented operation of autonomous vehicle technology was determined.

2. Survey designing and analyzing

2.1. Questionnaire designing

This study mainly focuses on two aspects of residents' acceptance and satisfaction. In order to increase the accretion, a secondary standard for acceptance and satisfaction are established, and the questionnaire survey is designed by using straightway language to ensure the clear demarcation.

The content of the questionnaire in this study mainly contains the following two parts: the first part aims to investigate the basic personal condition of the respondents, including gender, age, education, marriage, monthly income, vehicle condition, driving license and driving age, the second part is about the respondents’ understanding of autonomous vehicle technology, expectation for maturity, total acceptance, total satisfaction, attention, curiosity, expectation, and desire to buy as well as the evaluation of practicability, functionality, comfort and safety of autonomous cars. Among these factors, total acceptance, total satisfaction, attention, curiosity, and desires to buy draw lessons from the Likert five-point subscale, and the survey results are set [3].

2.2. Reliability and validity analyzing

Reliability and validity analysis are essential when making questionnaire analysis. Reliability can reflect the degree of concentration and reliability of the data[4]. Validity refers to a measurement tool or means that can effectively measure the degree of conformity between the measurement result and the expected content [5]. This paper uses Cronbach’s α reliability coefficient to analyze the reliability of this questionnaire. According to the empirical coefficient of greater than or equal to 0.9, the inherent reliability of the scale is considered to be high; If 0.7≤α<0.9, the internal reliability is considered to be higher or in an acceptable range. The mathematical definition of Cronbach’s α reliability coefficient is:

\[
a = \left( 1 / (k - 1) \right) \times \left( 1 - \sum s_i^2 / s^2 \right)
\]

In order to ensure the stability and reliability of the survey, the results of the questionnaire were analyzed by spss19.0 software. The reliability coefficient obtained by software analysis is 0.889, indicating that the internal reliability of the survey is high. The validity of the data of the questionnaire was analyzed by KMO value and Bartlett sphere test with a KMO value of 0.901. According to the commonly used KMO metrics given by Kaiser, the questionnaire variables are highly correlated; Bartlett's sphere test value is 1229.347(sig.<0.05), indicating that each variable has correlation, and the data is very suitable for factor analysis. In summary, the data of this survey passed the reliability and validity test, so it is suitable for regression analyzing.

3. The prediction of residents' choice of autonomous vehicle

3.1. The influence of personal condition on total acceptance of autonomous vehicle technology
The result of regression equation of the total acceptance for autonomous vehicle technology is shown in table 3-1, and the regression equation is as follow:

\[ y_1 = -0.097x_3 \]  

(3-1)

| Model                  | Unstandardized Coefficients | Standardized Coefficients | Beta | t  | Sig. |
|-----------------------|-----------------------------|---------------------------|------|----|------|
| Education Background  | -0.097                      | 0.057                     | -0.106 | -1.687 | 0.093 |

The result of regression equation shows that the education background passes the test of significance 0.01, and there is a negative correlation between the academic qualification and the total acceptance of auto-driving technology, so the lower the educational background is, the higher the acceptance of automatic-driving technology becomes.

3.2. The influence of personal condition on total satisfaction with autonomous vehicle technology

The result of regression equation of the total satisfaction for autonomous vehicle technology is shown in Table 3-2, and the regression equation is as follow:

\[ y_2 = -0.308x_7 + 0.174x_8 \]  

(3-2)

| Model                  | Unstandardized Coefficients | Standardized Coefficients | Beta | t   | Sig. |
|-----------------------|-----------------------------|---------------------------|------|-----|------|
| Driving license       | -0.308                      | 0.116                     | 0.172 | 2.651 | 0.009 |
| Driving age           | 0.174                       | 0.09                      | 0.126 | 1.935 | 0.054 |

As can be seen from the above table, driving license passes the test of significance 0.01; driving age passes the test of significance 0.1. Driving license and driving age are positively correlated with the total satisfaction for autonomous vehicle technology, so residents without driving license are more satisfied with autonomous vehicle technology. And the older the driving age is, the higher the satisfaction becomes.

3.3. The influence of personal conditions on the attention to autonomous vehicles technology

The results of regression equation of personal attention to autonomous vehicle technology is shown in Table 5, and the regression equation is as follow:

\[ y_3 = 0.357x_1 - 0.095x_3 - 0.133x_6 \]  

(3-3)

| Model                  | Unstandardized Coefficients | Standardized Coefficients | Beta | t   | Sig. |
|-----------------------|-----------------------------|---------------------------|------|-----|------|
| Gender                | 0.357                       | 0.102                     | 0.216 | 3.497 | 0.001 |
| Monthly income        | -0.095                      | 0.045                     | -0.137 | -2.105 | 0.036 |
| Vehicle condition     | -0.133                      | 0.071                     | -0.121 | -1.872 | 0.062 |

As can be seen from the above table, gender has passed the test of significance 0.01, and gender and attention have a positive correlation, so females pay more attention to autonomous vehicle technology than men. The monthly income passes the test of significance 0.05, and the vehicle condition at home passes the test of significance 0.1. Both the monthly income and the vehicle condition are negatively correlated with attention to autonomous vehicles. Therefore, the higher the
monthly income is and the more vehicles people have, the less people pay attention to the autonomous vehicle technology.

3.4. The influence of personal condition on the curiosity of autonomous vehicle technology
The result of regression equation of curiosity about autonomous vehicle technology is shown in table 3-4, and the regression equation is as follow:

\[ y_4 = -0.163x_3 + 0.28x_7 \]  \hspace{1cm} (3-4)

| Model                  | Unstandardized Coefficients | Standardized Coefficients |
|------------------------|----------------------------|---------------------------|
|                        | B  | Std.Error | Beta | t   | Sig. |
| Educational Background | -0.163 | 0.056 | -0.18 | -2.92 | 0.004 |
| Monthly income         | 0.28  | 0.117 | 0.148 | 2.39  | 0.018 |

From the above table, the following result can be obtained: the educational background passes the test of significance 0.01; the driving license passes the test of significance 0.05. There is a negative correlation between educational background and curiosity. And the higher educational background is, the lower the curiosity becomes. Additionally, there is a positive correlation between the condition of driving license and curiosity of driving technology. So residents without driving license are more curious about automatic driving technology.

3.5. The influence of personal condition on the desire to purchase autonomous vehicle technology
The result of regression equation of the desire to purchase autonomous vehicle technology is shown in table 3-5, and the regression equation is as follow:

\[ y_5 = -0.128x_3 + 0.174x_8 \]  \hspace{1cm} (3-5)

| Model                  | Unstandardized Coefficients | Standardized Coefficients |
|------------------------|----------------------------|---------------------------|
|                        | B  | Std.Error | Beta | t   | Sig. |
| Educational Background | -0.128 | 0.062 | -0.129 | -2.065 | 0.04 |
| Driving age            | 0.174  | 0.101 | 0.108  | 1.73  | 0.085 |

As shown in the table, educational background has passed the test of significance 0.05, and driving age has passed the test of significance 0.1. This illustrates that people with relatively low educational background and old driving age have higher desire to purchase autonomous vehicles, which they are more willing to pay for.

4. Summary
By conducting in-depth investigations, collecting resident questionnaires, and using SPSS for statistical analysis, we examined factors that have a significant impact on the acceptance and satisfaction of autonomous driving techniques. We conclude that education has an impact on most of the acceptance and satisfaction criteria, and the remaining basic conditions, such as the availability of a driver's license, have a certain degree of relationship with acceptance and satisfaction. The secondary standards under total acceptance and total satisfaction have a significant effect on the level of their scores.

Based on these factors, improving the research direction of autonomous driving technology will effectively promote the attitude of residents in China on autonomous driving technology, and the acceptance and satisfaction of residents will be further improved. As an important part of the future
transportation system, autonomous vehicles need the correct guidance and policy support of the government, as well as the trust and confidence of the residents. While studying autonomous driving techniques, we should also coordinate these influencing factors to promote the development of autonomous driving technology.

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