Chinese Tourists' Perceptions and Attitudes to Autonomous Vehicles:Factors affecting technology acceptance

Yang Zhao Rebecca De Coster Mazen Mossa

Harbin University of Commerce, Harbin, 150028, China 101662@hrbcu.edu.cn Brunel University London, Uxbridge, UB8 3PH, UK Rebecca.DeCoster@brunel.ac.uk Brunel University London, Uxbridge, UB8 3PH, UK Mazen.Mossa@brunel.ac.uk

Abstract: The travel behaviors and consumption patterns of Chinese tourists are undergoing significant changes, with a notable shift from traditional sightseeing tours to a more diverse range of sightseeing and leisure vacations. This research predominantly utilises a quantitative research approach to examine the perceptions of Chinese tourists towards the adoption of autonomous vehicles for their holiday tours with the Technology Acceptance Model (TAM) by integrating additional factors identified in recent studies conducted in China. The outcomes of this research reveals that Personnel Innovativeness exerts a significant impact on the adoption of autonomous vehicles by Chinese tourists. Further, Hedonic Motivation emerges as the prime influencer of attitude towards the adoption of autonomous vehicles among Chinese tourists. This empirical study identified Group Conformity as the highest external factor which is an important cultural aspect in China.

Keywords: Autonomous Vehicles (AV), Technology Adoption, Chinese Tourists, TAM

Introduction

In recent years, domestic tourism in China has shown a change from low level to high quality and greater diversification, from focusing on predominantly sightseeing tours to enjoying a wider variety of sightseeing and leisure vacations. The traveling mode and consumption preferences of Chinese tourists are undergoing profound changes. "Transportation+Tourism" has become an important strategic content of both transportation and tourism industry. The emergence and popularization of autonomous vehicles has undoubtedly opened up a broader prospect for the development of "Transportation+Tourism^[1]".

An autonomous vehicle, often known as a self-driving car, is a vehicle that, upon startup, operates without human involvement, utilising computerised systems to detect and gather information on the surrounding environment (such as traffic lights, road, signage and obstacles). The information will be analysed to regulate the vehicle's response actions (such as steering, acceleration, and braking) ^[2-5] for safe navigation (Hulse et al., 2018). In smart cities, there is a growing interest in the potential of autonomous vehicles to enhance road safety and reduce traffic congestion, gas emissions and fuel consumption with the associated sustainability benefits (Chehri & Mouftah, 2019).

This empirical study aims to understand Chinese tourists' intention to adopt autonomous vehicles (AV) for tours during holidays (not for work) integrating the Technology Acceptance Model (TAM) with adoption predictors. By addressing the gap in the literature regarding AV acceptance among specific consumer groups in China, the study contributes to understanding tourist preferences in AV adoption. Importantly, it provides practical implications for AV utilisation in China, offering valuable insights into a significant aspect of future transportation and tourism trends.

1 Theoretical Background and Hypothesis Development

To promote AV technology adoption for tourism purpose, it is important to understand which factors influence travelers' intention to use AV (Jing et al., 2020). The influencing factors of tourist acceptance of AV is a complex and diverse research field, involving many factors. There has been a considerable accumulation of research on the public acceptance of AV in the academic circle, and many scholars focus on the influence factors of acceptability from various angles, such as the perspective of technology acceptance model (Tussyadiah et al., 2017), social and psychological (Dubey et al., 2022), cultural and regional (Edelmann et al., 2021), tourism experience (Cohen et al., 2019), marketing and policy (Cho et al., 2018) ^[6-8].

1.1 Innovation theories

Since the technical acceptance model (TAM) (Davis, 1989) was proposed, being fully verified and widely used, it is considered to

be one of the most influential theoretical models in the field of technology acceptance (Venkatesh et al., 2003). TAM could be used to explain the process of new technology adoption, such as autonomous vehicles adoption. TAM research emphasises the user's subjective attitude and behaviour toward new technology products, ignoring the characteristics of the product and social factors.

According to TAM, the two main variables of perceived usefulness (PU) and perceived ease of use (PEOU) influence user acceptance. PU is defined as the extent to which an individual believes that using an innovation will enhance performance. PEOU refers to the extent to which an individual believes that using an innovation will be free of effort (Jing et al.,2020) . The validity of the TAM has been verified in many technology and innovation areas (Müller, 2019). The comprehension of consumer acceptance behaviour has been further explored through the integration of the Innovation Diffusion Theory (IDT) (Yuen et al., 2020) [9-12].

1.2 Users' acceptance of AVs

Scholars point out the need to better understand the impact of consumer characteristics on technology acceptance and the psychological aspects behind technology adoption, particularly in the early phase of product introduction such as in the case of AVs (Hegner et al., 2019) . Extant literature suggests that consumers' personal characteristics influence the acceptance and adoption of new technologies and that their personality traits (the characteristics of an individual that exert a pervasive influence on a broad range of attitudinal and behavioral responses) drive

decision making (Acheampong et al., 2019).

Most of researches have shown different effects on the acceptance of autonomous driving technology, such as age, gender, cost, legal and policy risks, however, few have focused on each specific factor in China. Chen et al. (2021) conducted research from the perspective of gender and age to analyse how they play a key role on acceptance intention. Tang et al. (2022) and Jing et al. (2019) mainly studied Chinese consumers' intention to adopt autonomous vehicles and its influencing factors. These studies found that individual psychological factors (such as perceived usefulness, perceived ease of use, and entertainment) and policy measures (such as financial incentives, information dissemination, convenience, and legal regulation) significantly impact AV

adoption intentions. These effects are moderated by individual characteristics (such as gender, education level, income, number of private cars owned by the family, and type of city), which have practical significance for the future promotion and development of AV in China^[13-16].

1.2.1 Framework factors

In addition to TAM factors, other factors will be considered during this research to conduct a comprehensive study of Chinese tourists' perspectives. A review of previous studies concerning the acceptance of AV has highlighted the importance of Trust (Ribeiro et al., 2022), and Personal Innovativeness (Raue et al., 2019). The theoretical framework to be tested during field research will focus on the following factors, as shown in Figure 1.

Figure 1. The Conceptual Framework



1.3 Hypothesis Development

The conceptual framework encompasses fifteen hypotheses, which are designed to illustrate the diverse range of internal and external factors that play a significant role in shaping the intentions of Chinese tourists to utilise AV. As can be seen in Table 1, the initial cluster of hypotheses, comprising H1, H2, H3, and H4, delineates the critical elements of the TAM. Within this subset, several key variables are examined, including BI, which stands for Behavior Interaction to use, indicating the tourists' willingness to engage with the technology. ATU reflects Chinese tourists' preferences and feelings about adopting AVs. Additionally, the hypotheses explore PU and PEOU, both of which are vital in determining how Chinese tourists perceive the technology's value and the level of effort required to utilise it effectively^[17-21].

The second cluster of hypotheses, including H5a, H5b, H6a, H6b, H7a, H7b and H7c shows the internal factors that influence an individual's adoption and usage of AVs, namely Hedonic Motivation (HM), Trust (TRU), and Personal Innovativeness (PI). Hedonic Motivation refers to the subjective experience of $(\mathbf{H}\mathbf{M})$ pleasure and enjoyment that an individual derives from engaging with and utilising a novel technology or system. Trust involves the faith and confidence in the technology. Trust (TRU) plays a crucial role in various interactions in the sharing economy (Hawlitschek et al., 2018). From the perspective of influencing factors for the adoption of autonomous vehicles by users, trust is especially reflected in users' recognition of the safety and other technical performance of autonomous vehicles. Personal Innovativeness (PI) refers to a person's natural tendency to be an early adopter and experimenter with new technologies. It reflects a person's willingness to accept change and innovation, motivated by a pursuit of uniqueness or a proactive stance on Table 1. Research hypotheses

Construct	No.	Research Hypothesis
TAM factors	H1	The Perceived Usefulness of the technology has a positive influence on the Attitude Towards Using.
	H2	The Perceived Ease of Use of the technology has a positive influence on its Perceived Usefulness.
	H3	The Perceived Ease of Use of the
		technology has a positive

technology.

The third cluster of hypotheses with H8a, H8b, H9 and H10 shows the external factors incorporating Social Influence (SI), Image (IMG), and Group Conformity (GC). When consumers decide to adopt a new technology, social impact reflects the extent to which their decision is influenced by the opinions and actions of others, including peers, family members colleagues. Adoption of technology by friends and family members may create social pressure and increase individual's an self-confidence, which may motivate the individual to purchase such technology (Bansal et al., 2016). Image pertains to the perception of how using a particular technology can enhance one's social status. Yuen (2021) agreed when people in society widely believe that they should perform a behavior, performing it will tend to enhance their image in society, which can be referred to social identification. Group Conformity (Zhang et al., 2020) captures the inclination to conform to the norms or expectations of a community or group when it comes to technology adoption.

The fifteen hypotheses, providing a clear roadmap for the empirical investigation that follows in subsequent sections of following research, which form the backbone of the research model.

		influence on the Attitude Towards Using.
	H4	The Attitude Towards Using of the technology has a positive influence on the Behavioral Intention to Use.
Internal factors	H5a	The Personal Innovativeness has a positive influence on the Perceived Usefulness of the technology.
	H5b	The Personal Innovativeness has a positive influence on the

		Perceived Ease of Use of the technology.
	H6a	The Trust has a positive influence on the Perceived Usefulness of the technology.
	H6b	The Trust has a positive influence on the Perceived Ease of Use of the technology.
-	H7a	The Hedonic Motivation has a positive influence on the Perceived Usefulness of the technology.
	H7b	The Hedonic Motivation has a positive influence on the Perceived Ease of Use of the technology.

2 Methodology

2.1 Survey design

To obtain a good breadth of responses from adults across China an electronic survey was conducted. The Sojump platform was adopted to make the survey and to collect data electronically, which is a widely recognised and utilised questionnaire survey platform in China. This study posted questionnaires to Sojump to which there were 500 respondents via a random selection method from April to May, 2024.

2.2 Measures

A questionnaire comprised of two parts was designed to collect data. The first part collected demographic information of the respondents, as shown in Table 3, and the second part included the measurement items of various constructs. In addition, the research model was involved external factors, internal factors and TAM, with the total ten variables as behavioral intention, attitude, perceived usefulness and perceived ease of use; hedonistic motivation, trust, personal innovativeness; social Influence, image, and group conformity. The measuring method was based on a 7-point Likert scale ranging from

	H7c	The Hedonic Motivation has a positive influence on the Attitude Towards Using.
External factors	H8a	The Social Influence has a positive influence on the Perceived Usefulness of the technology.
	H8b	The Social Influence has a positive influence on the Perceived Ease of Use of the technology.
	Н9	The Image has a positive influence on the Perceived Usefulness of the technology.
	H10	The Group Conformity has a positive influence on the Attitude Towards Using.

disagree to completely agree, with more positive options to better distinguish respondent's views on AV.

2.3 Respondents and Data Collection

Among the 500 respondents, the proportion of male (46.6%) and female (53.4%) respondents was quite evenly distributed. Respondents were between the ages of 18-25 at 10%, the age group of 26-34 consist of 43.8%, the age group of 35-44 consist of and 17.4%, the age of group 45-54 consist of 19%, the age of group of 55-64 consist of 8.2% whereas the age of group above 65 only comprised a small number of respondents of 1.6%. The survey categorises respondents according to their driving experience and their travel preference. The majority of respondents have more than one-year experience for driving (84.2%), and 94.6% of respondents travel at least once a year.

2.4 Data analysis

The study employed the robust SPSS software to run multiple regression for hypothesis testing, a data analysis method known for its reliability and accuracy. All questionnaires were meticulously completed online, and the returned answers were thoroughly checked, ensuring no missing numbers. Notably, the study did not detect any outliers where scores fell below the minimum or exceeded the maximum threshold.

3 Hypothesis Testing Results

3.1 Internal factors

The impact of internal factors on attitude AV towards using technology was comprehensively examined. This examination encompassed several crucial aspects, namely Hedonic Motivation, Personal Innovativeness and Trust. This analysis was conducted with the aim of gaining a deeper understanding of the factors that influence people's perception and willingness to adopt such technology. The statistical data revealed that the findings of the multiple regression analysis indicated a statistically significant model (P value < 0.05).

As a pivotal factor among the various motivations for travel, HM exerted a profound influence on respondents' perspectives regarding the utilisation of AV for transportation purposes. Based on the adjusted R-squared value, HM contributed to a substantial 74.6% of the variance in explaining PU, indicating a strong correlation between HM and respondents' usefulness. perceived Analogously, HM accounted for 70.2% of the variance in PEOU, further emphasising its crucial role in shaping respondents' attitudes. Notably, the impact of HM was even more pronounced in its influence on respondents' attitudes towards ATU, with adjusted R-squared values revealing that HM accounts for up to 76.4% of the variance. This data underscored the significant role of HM in redirecting respondents' preferences away from traditional modes of driving towards AV.

According to the adjusted R-square value, TRU accounted for up to 71.5% of the variance of PU, which clearly revealed the important impact of TRU on PU. It could be seen that the significant role of TRU was that it directly affected the PU for AV applications in tourism. At the same time, TRU not only had a significant impact on PU, but also played a key role in influencing PEOU. The data showed that the significantly effect of TRU on PEOU, which means that when users' trust in AV technology increases, they were more likely to see the technology as easy to use, thus increasing their willingness to adopt and use it.

The findings from the PI regression analyses revealed a statistically significant impact on PU, with p-values of 0.001, which are well below the threshold of significance set at p-value < 0.05. According to the adjusted R square value, PI accounted for 62.8% of the variance in PU. This suggested that Chinese tourists' tendency to seek out and embrace novel technologies plays a pivotal role in shaping their perception of the utility and value of AV. Additionally, PI accounted for 68.3% of the variation in PEOU, suggesting that personal innovative tendencies not only influence their perception of usefulness but also their perception of the ease of using AV. This finding underscores the importance of considering individual differences in innovativeness when predicting and understanding the adoption of new technologies.

3.2 External factors

A thorough examination was conducted to assess the impact of external factors on Chinese tourists' attitude towards the utilisation of AV. These factors included Social Influence (SI), Image (IMG), and Group Conformity (GC). The multiple regression analysis on these factors indicated a statistically significant model (P value < 0.05).

In addition to SI, the analysis conducted through the regression model revealed a profound impact of various factors on PU. Based on the adjusted R-square value, SI on the variance of PU accounts for 64.6%, and accounted for 69.9% of the variance observed in PEOU, scoring the pivotal role of SI in shaping users' experiences. Given that tourism is inherently a social activity, tourists' attitudes and behaviors are inevitably influenced by their social networks. Consequently, SI held a crucial position in determining tourists' adoption AV during their travel experiences.

IMG accounted for 58.7% of the variance of PU. Although this data clearly showed that IMG had a significant impact on whether tourists choose autonomous vehicles for travel, the degree of its impact was relatively low compared with other variables. To some extent, this reflected that IMG's influence on AV has not yet reached a dominant position in the Chinese travel market.

Based on the adjusted R-squared values, GC played a significant role in ATU variation, accounting for up to 71.7%. This ratio was relatively high among all external factors, indicating that group conformity played a significant role in ATU fluctuations. When individuals were in a group, they tended to be influenced by the group's opinions and behaviors, thus adjusting their decisions.

3.3 TAM factors

About the influence of TAM on individuals' attitudes towards utilisation, specifically through the perceived usefulness and the perceived ease of use, the statistical data revealed that the findings of the multiple regression analysis indicated a statistically significant model (P value < 0.05).

In terms of the adjusted R-square, PU was identified as the primary contributor, accounting for 74.8% of the variance observed in ATU. The findings from the PU regression analyses revealed a statistically significant impact on ATU, with p-values of 0.001, which are well below the threshold of significance set at p-value < 0.05.

Regression analysis revealed that the impact of PEOU on ATU accounted for a substantial portion of the variance explanation rate, specifically up to 72.1%. This statistically significant influence implied that the ease of use perceived by Chinese tourists towards AV had a considerable bearing on their willingness to accept and utilise it over an extended period.

Through regression analysis, the significant influence relationship between attitude (ATU) and behavior (BI) was demonstrated, and the proportion of such influence was as high as 82.1%. As a very important parameter in the regression model, Beta coefficient represented the degree and direction of the influence of the independent variable on the dependent variable. The Beta coefficient related to attitude reaches 0.906, which further confirming that attitude had a significant positive impact on behavior. In other words, the more positive a person's attitude, the more positive their behavior tended to be.

The Beta coefficient results were significant for all fifteen hypothesis and are shown on the theoretical framework where the highest external factor is Group Conformity which is an important cultural aspect in China (Beta 0.847). The other regression analysis results showed in Figure 2 indicated that the highest internal factor is Hedonic Motivation on attitude (Beta 0.874). This study indicates that for tourists in China they will actively use AV to travel if they perceive it will bring pleasure and

fun during their holidays. This three-phase theoretical framework that has been tested during this research will contribute to technology adoption theory by enhancing TAM and the understanding of consumers' perceptions and adoption behaviour towards autonomous vehicles in the area of tourism.





4 Discussion

The results of this study show that TAM factors, internal and external factors in theoretical framework are determinants of adoption of AV by Chinese tourists.

Under the framework of TAM, the analysis results of the study are consistent with a series of previous studies, which reveals the important impact of PU and PEOU on consumer adoption attitudes and behavioral intentions. Among the factors influencing Chinese tourists' attitudes towards AV travel, PU plays a particularly prominent role (Beta= 0.865). When tourists believe that AV can meet their travel needs and provide real value, they tend to have a more positive attitude toward AV adoption. This

conclusion has been confirmed in a number of studies (Herrenkind et al., 2019). At the same time, PEOU also has a positive impact on consumer adoption attitudes (Beta= 0.850), although its impact may be less than that of perceived usefulness. A product that is easy to understand and operate can often reduce user learning costs, improve the user experience, and thus increase the likelihood of user adoption. Especially for tourists, ease and pleasure is the purpose of tourism. Attitude is often the key factor in determining behavior. In terms of the attitude towards the use of AV as a travel mode (Beta= 0.906), it means that potential consumers hold a positive attitude on the whole, which lay the foundation for the formation of subsequent use intention. Moreover, personal attitude towards AV is an important factor affecting their intention to use it. This study supports the above views, with the results suggesting that AV must be perceived as useful and simple in order to be accepted by Chinese tourists.

In addition to TAM factors, this study emphasises the significance of various factors that influence the acceptance of AV among Chinese tourists, encompassing both internal and external aspects. Specifically, it focuses on hedonic motivation (HM), trust (TRU), personal innovation (PI), social influence (SI), image (IMG), and group conformity (GC). The categorisation into internal and external factors is based on two primary dimensions: the subjective willingness and objective influence of Chinese tourists utilising AV as a travel tool.

The findings of the study reveal that PI exerts a significant impact on the adoption of AV by Chinese tourists, thereby indicating that those who possess a greater degree of innovativeness and openness novel to experiences are more likely to perceive AV technologies as highly useful and beneficial. However, when compared to other variables, PI does not demonstrate the strongest explanatory power for the overall model in explaining the variation of the dependent variable. This observation contrasts with some prior studies, which found that respondents who placed greater emphasis on innovative technology and vehicle performance tended to prioritise convenience for traveling and leisure experiences during their trips.

Trust in autonomous vehicles is seen as one of the important determinants of Chinese

tourists' willingness to use AV when traveling. When tourists have a high level of trust in AV technology, they are more likely to trust the provide technology to accurate, useful information, which increases its perceived usefulness. At the same time, high trust also reduces users' concerns about the difficulty of using technology and improves perceived ease of use. Overall, TRU plays a crucial role in influencing user adoption of AV technology. It not only directly affects users' perceived usefulness and perceived ease of use of technology, but also indirectly promotes the adoption of technology by influencing users' psychological expectations and behavioral tendencies. Therefore, when promoting and applying AV technology, full attention should be paid to enhancing the trust of users to improve the adoption rate and use effect of technology.

Emotions used to be emphasised for tourists' decision to adopt AV for travel purpose (Ribeiro et al., 2022) . The comprehensive analysis of this study demonstrates that HM, following attitude, emerges as the prime influencer of ATU in the adoption of AV among Chinese tourists. However, HM as the most important factor affecting users' use of AV travel is different from previous studies. This conclusion underscores the widespread acknowledgment among tourists of the paramount importance of amusement and relaxation during their travel experiences. This indicates they are inclined to believe that vehicles offer an autonomous improved performance, could mitigate driver fatigue, and elevate the enjoyment associated with holiday travel, especially during self-driven excursions.

The effect of IMG on PU is slightly less

pronounced compared to other variables, with a beta coefficient of 0.767 and a standardised coefficient of 0.715. Given that autonomous driving technology is still in a phase of rapid development in China, and has not yet achieved widespread adoption or maturity, many tourists might concern regarding the safety and reliability of autonomous vehicles. Such concerns are likely to influence their decision to opt for AV travel. Furthermore, as competition within China's tourism market intensifies and a plethora of tourism products and services emerges, the impact of IMG on tourists' preference for autonomous vehicles may be overshadowed by other more appealing factors.

Former research indicated that social influence indirectly modulates consumers' willingness to embrace autonomous driving technology, mediated by PU and PEOU (Zhang, 2020). In this research consumers who perceive that these key individuals endorse their utilisation of AV, they are more susceptible to the sway of such social influence, ultimately fostering their acceptance and willingness to adopt this innovative technology.

This study assessed group conformity, which has been a cultural phenomenon in Chinese social life although younger age groups might be less influenced by this. While the statistical findings reveal a notable influence on the acceptance of AV among Chinese tourists, it is noteworthy that the associated comments in response to open-ended questions illustrated less uniform perspectives amongst respondents. Furthermore, considering that the majority of respondents fell within the age range of 26 to 34, belonging to a generation that is increasingly exhibiting traits of individuality and autonomy, it is anticipated that the influence of GC will gradually wane in the future.

5 Conclusion

Employing TAM and IDT principles, this study delves into the influential elements that Chinese tourists consider when traveling with autonomous vehicles. The research extends the theoretical horizons by broadening the range of applicability and presenting a comprehensive framework. Additionally, it enhances the existing academic discourse on the role of enjoyment motivation in technology adoption. These theoretical enhancements serve to further the development of interdisciplinary tourism research, while also offering novel directions and concepts for future studies in related domains.

In future studies, the research will expand the sample size, optimise the rigour of the study design, and comprehensively consider more potential influencing factors to promote the application of AV in more practical scenarios such as urban tourism, so as to further consolidate and expand the results of this study.

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