World Electric Vehicle Journal

MDPI

Article

Understanding the Adoption of Autonomous Vehicles in China Based on TRI and TAM

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Abstract: Autonomous vehicles (AVs) represent a notable advancement in automotive technology, with the potential to enhance road safety, decrease energy consumption, and mitigate environmental pollution. This study aims to advance the understanding of AV development by proposing a research framework centered on the framework of "personality–perception–behavioral intention". This framework is utilized to examine the influence of consumers' personality traits and perceptions on their intention to adopt AVs. The research model was empirically tested using data collected from 310 questionnaires. The findings indicate that consumers' personality traits, specifically optimism and innovativeness, along with their perception of the usefulness of AVs, exert a significant positive influence on their adoption intentions. Furthermore, the impact of these factors varies considerably across different consumer segments. Conversely, factors such as discomfort, insecurity, and perceived ease of use do not demonstrate a significant effect on the intention to adopt AVs.

Keywords: autonomous vehicles; adoption intention; personality; perception

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Academic Editor: Nabil Benamar

Received: 29 November 2024
Revised: 28 December 2024
Accepted: 31 December 2024
Published: 2 January 2025

Citation: He, X.; Zhang, H.; Guo, J.; Wang, Y. Understanding the Adoption of Autonomous Vehicles in China Based on TRI and TAM. *World Electr. Veh. J.* **2025**, *16*, 23. https://doi.org/10.3390/wevj16010023

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1. Introduction

Autonomous vehicles (AVs) represent a significant technological advancement within the automotive sector, offering numerous benefits such as the mitigation of traffic accidents, alleviation of traffic congestion, and a reduction in resource consumption and environmental pollution [1–3]. The Chinese government places considerable emphasis on the development of AVs. In 2020, the State Council promulgated the "Development Plan for New Energy Vehicles (2021–2035)" which aims to facilitate the commercial deployment of highly autonomous vehicles in designated areas and in specific contexts by 2025, with the goal of achieving widespread application of AVs by 2035. Additionally, the National Development and Reform Commission introduced the "Innovation Development Strategy for Intelligent Vehicles" in 2020, which delineates objectives for the mass production of intelligent driving vehicles by 2025. Moreover, China has established unmanned driving testing facilities in major cities, including Beijing, Shanghai, and Changsha. The sustainable advancement of AVs is contingent upon technological progress; however, it ultimately depends on the broad acceptance by consumers. Research indicates a notably low intention among consumers to adopt AVs. For example, reference [4] reported that 61.5% of consumers expressed reluctance to utilize AVs. Consequently, it is imperative to investigate consumer behavior regarding the adoption of AVs.

The current literature on the adoption of AVs suggests that consumer perceptions and individual characteristics are pivotal factors influencing this process. For example, reference [5] demonstrated that perceived usefulness and perceived ease of use significantly affect consumers' decisions to adopt Avs, and reference [6] indicated that perceived risk plays an important role in the intention to use AVs. Additionally, reference [7] identified that consumers' intentions to purchase AVs are shaped by demographic factors such as gender, age, income, and education level. It is important to note that consumer perceptions are inherently subjective and can differ based on individual characteristics. However, the existing studies have not thoroughly integrated consumer perceptions with these characteristics. Furthermore, consumer characteristics encompass both demographic attributes and personality traits. In contrast with demographic features, personality traits are considered more stable variables that can elucidate consumer behavior [8]. The prevailing research primarily focuses on the influence of demographic characteristics on the adoption of AVs, with comparatively less emphasis on the role of personality traits. Notably, the current demographic of AV consumers predominantly consists of individuals aged 25 to 34, commonly referred to as the millennial generation [9]. Millennials, born between 1980 and 1999, exhibit life concepts and values that markedly differ from those of preceding generations [10] and are characterized by distinctive personalities, making them early adopters of new technologies [11]. Consequently, consumer personality traits are essential to understanding the adoption of AVs.

Building upon the preceding discourse, this study formulates a research framework entitled "personality–perception–behavioral intention". This framework integrates the Technology Readiness Index (TRI) and the Technology Acceptance Model (TAM) to examine the influence of consumer personality traits and perceptions on the intention to adopt AVs.

Our study makes the following contributions. Firstly, our study developed a "personality–perception–behavioral intention" framework based on TRI and TAM to study consumers' intention to adopt AVs. Secondly, unlike previous research that has separately examined the impact of consumer perception and individual characteristics on AV adoption intention, our study considered the subjectivity of consumer perception and investigated the impact of consumer characteristics on perception. Thirdly, diverging from previous studies that predominantly examined the impact of demographic factors on AV adoption, our research concentrates on the influence of consumer personality, which is a stable trait, to explain consumer behavior.

The remainder of this paper is organized as follows. Section 2 presents the theoretical background of TRI and TAM. In Section 3, we present the research model and hypotheses of this study. Section 4 describes the research methodology, while Section 5 discusses the data analysis results. Section 6 includes the discussion of results, theoretical and practical implications, as well as the limitations and future research. Section 7 presents the conclusion.

2. Theoretical Background

2.1. Technology Readiness Index

Researchers have undertaken comprehensive investigations into the Technology Readiness Index (TRI), which is a framework that assesses individuals' inclination to adopt new technologies in order to fulfill personal or professional objectives. This index serves as a tool for evaluating an individual's preparedness to integrate and utilize new technologies across various contexts [12]. The TRI encompasses four personality traits that collectively gauge an individual's overall readiness to engage with new technology: optimism, innovativeness, discomfort, and insecurity. Optimism denotes a favorable perception of technology, while innovativeness signifies a propensity to be at the forefront of technological advancements

and thought leadership. Conversely, discomfort reflects a perceived lack of control over technology, leading to feelings of being overwhelmed, and insecurity pertains to a general distrust of technology and skepticism regarding its reliability. The first two traits function as "motivators" that enhance individuals' willingness to adopt new technologies, whereas the latter two traits act as "inhibitors" that may diminish this willingness. Together, these factors shape an individual's readiness to embrace new technological solutions [13].

Consumer technology adoption has been studied through the lens of the TRI. For instance, reference [14] examined the influence of customer satisfaction and behavioral intentions regarding self-service technology utilizing the TRI framework. Similarly, reference [15] explored consumer acceptance and actual usage patterns of internet technologies, also grounded in the TRI. Notably, reference [16] demonstrated that integrating the TRI with the Technology Acceptance Model significantly enhances the predictive capacity concerning consumers' adoption of electronic systems, thereby facilitating a more profound comprehension of individuals' acceptance of emerging technologies. Consequently, the present study seeks to amalgamate the TRI and TAM to analyze consumer adoption behaviors pertaining to AVs.

2.2. Technology Acceptance Model

The Technology Acceptance Model (TAM), introduced by Davis in 1989 [17], serves as a framework for examining user acceptance of information systems through the lens of the Theory of Reasoned Action. The TRA was proposed by Martin Fishbein and Icek Ajzen in 1975. It is an important theory used to explain and predict individual behavior. The TRA states that an individual's actual behavior is determined by behavioral intention, while behavior intention is jointly determined by attitude and subjective norm. The TAM follows this core logical architecture and makes innovations in the technical field on this basis. It specifically refines users' attitudes toward technology usage behavior into two key dimensions: perceived usefulness and perceived ease of use. Thus, TAM encompasses three fundamental constructs: attitude, perceived usefulness, and perceived ease of use. Attitude pertains to an individual's subjective emotional response to the utilization of a system or technology; perceived usefulness denotes the belief that engagement with a system or technology can enhance work efficiency; and perceived ease of use reflects the belief that a system or technology is straightforward to learn and operate. According to TAM, the utilization of a system or technology is influenced by behavioral intention, which is in turn shaped by attitudes and perceived usefulness. Furthermore, attitudes are influenced by both perceived usefulness and perceived ease of use.

TAM offers a theoretical basis for investigating the acceptance of emerging systems and technologies, including internet technologies and e-commerce platforms, and has emerged as a prominent model in research concerning the acceptance and utilization of new technologies by individuals. However, it is important to note that TAM does not account for the impact of individual differences on technology acceptance and adoption. Research conducted by reference [18] indicates that individuals characterized by a propensity for stimulation and openness to experience are more inclined to trust and adopt AVs. Consequently, neglecting the influence of personality traits on technology adoption may result in an incomplete understanding of individuals' behaviors regarding technology acceptance.

3. Research Model and Hypotheses

This research establishes a framework of "personality–perception–behavioral intention", informed by the TRI and the TAM, to examine the influence of consumer personality traits and perceptions on the intention to adopt AVs. The personality dimensions con-

sidered in this study are optimism, innovativeness, discomfort, and insecurity, while the perception factors encompass perceived usefulness and perceived ease of use. The research model is illustrated in Figure 1.

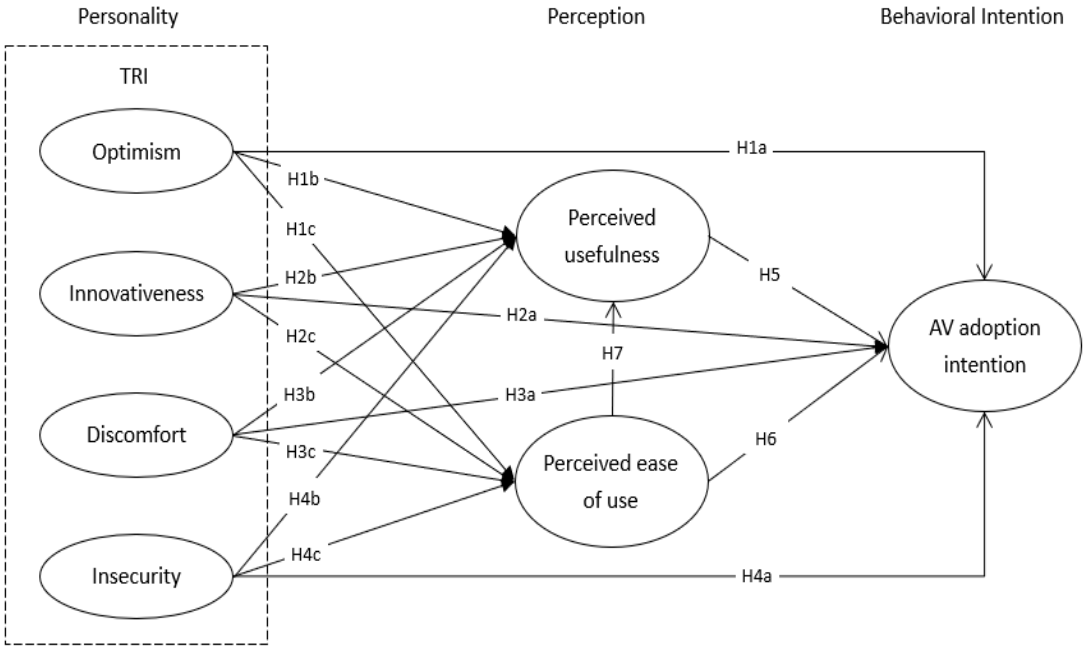


Figure 1. Research model.

3.1. Personality

3.1.1. Optimism

Optimism is characterized by consumers' favorable perceptions of technology, encompassing beliefs in its controllability, flexibility, convenience, and efficiency [12]. Prior research has established a positive correlation between optimism and the adoption of new technologies. For instance, reference [19] demonstrated that optimism enhances consumers' intentions to embrace smart home technologies. Similarly, reference [20] conducted a survey of 778 users in Chile, revealing that optimism significantly influences their intention to engage in online shopping. Furthermore, reference [21] identified that optimism fosters millennials' intentions to utilize virtual try-on systems.

Moreover, the existing literature indicates that individuals with optimistic dispositions are more inclined to recognize the usefulness and ease of use associated with new technologies. For example, reference [22] reported a positive association between optimism and perceived usefulness in their investigation of passengers' adoption of airport self-service systems. Likewise, reference [23] found a positive relationship between optimism and perceived ease of use in their study concerning individuals' willingness to employ retail service robots. Building on this foundation, the present study posits that consumers exhibiting higher levels of optimism are more likely to believe that AVs can mitigate traffic accidents, alleviate traffic congestion, and decrease resource consumption and environmental pollution. Additionally, they are more likely to perceive AVs as manageable. Consequently, this study formulates the following hypotheses:

H1a: *Optimism positively influences consumers' intention to adopt AVs.*

H1b: *Optimism positively influences consumers' perceived usefulness of AV adoption.*

H1c: *Optimism positively influences consumers' perceived ease of use of AV adoption.*

3.1.2. Innovativeness

Innovativeness is defined as an individual's propensity to be a pioneer in technology and their willingness to engage with new technological advancements [12]. Consumers who exhibit higher levels of innovativeness are more likely to experiment with novel concepts and embrace innovative ideas. The existing body of literature suggests that individual innovativeness positively influences the adoption of new technologies. For instance, reference [24] demonstrated that early adopters of new technologies are typically individuals characterized by high innovativeness, who display increased trust in emerging technologies and are inclined to utilize them even in contexts where their potential value and benefits are uncertain. Reference [25] further established that individual innovativeness positively affects the intention to purchase electric vehicles. Additionally, reference [26] found that preparatory teachers with elevated levels of innovativeness are more amenable to utilizing Internet of Things technologies. Reference [27] also identified a relationship between innovativeness and users' behavioral intentions to adopt mobile augmented reality games.

Individuals with pronounced innovativeness attribute considerable significance to the perceived usefulness of new technologies and are more likely to evaluate technological systems favorably in terms of their utility. Prior research has identified a positive correlation between innovativeness and perceived usefulness. For example, reference [14] found that individuals with higher innovativeness levels perceive greater usefulness in self-service technologies. Reference [21] reported that individual innovativeness positively influences performance expectations, specifically, the perceived usefulness of virtual reality try-on technology. Furthermore, studies have indicated that individuals with high innovativeness are more likely to view new technologies as user-friendly. For instance, Chen and Lin [28] found that users with higher innovativeness perceive health-eating applications as easier to navigate. Reference [29] also identified a positive correlation between innovativeness and perceived ease of use in their investigation of e-payment behaviors. Drawing from this literature, the present study posits the following hypotheses:

H2a: *Innovativeness positively influences consumers' intention to adopt AVs.*

H2b: *Innovativeness positively influences consumers' perceived usefulness of AV adoption.*

H2c: *Innovativeness positively influences consumers' perceived ease of use of AV adoption.*

3.1.3. Discomfort

Discomfort is characterized by a perceived lack of control over technology and feelings of being overwhelmed by it [13]. Prior studies have indicated that such discomfort can lead individuals to cultivate negative attitudes toward technology [30]. Reference [31] provided evidence that discomfort adversely affects electronic health literacy, while reference [32] identified a negative correlation between discomfort and the utilization of online shopping platforms.

Individuals who experience discomfort with technology often perceive it as complex and unsuitable for the average user, leading to a sense of being dominated by technological systems. Those with lower comfort levels regarding new technologies frequently associate their discomfort with heightened perceptions of complexity and uncertainty [33]. Consequently, for these individuals to exhibit a willingness to adopt new technology, it must be perceived as more user-friendly compared with the experiences of those with higher comfort levels. Furthermore, these individuals tend to believe that the benefits of using new technology are more pronounced for those who already possess a higher level of comfort.

Reference [30] found that discomfort negatively influences both perceived usefulness and perceived ease of use. Therefore, we propose the following hypotheses:

H3a: *Discomfort negatively impacts consumers' intention to adopt AVs.*

H3b: *Discomfort negatively impacts consumers' perceived usefulness of AVs.*

H3c: *Discomfort negatively impacts consumers' perceived ease of use of AVs.*

3.1.4. Insecurity

Individuals experiencing feelings of insecurity exhibit a lack of confidence in new technologies, primarily due to uncertainties regarding the technology's functionality and apprehensions about its potential adverse effects [13]. Research conducted by reference [34] demonstrated that insecurity adversely affects the intention to adopt mobile payment systems. Similarly, reference [35] identified significant negative repercussions of insecurity on consumer acceptance of electric vehicles.

Those with elevated levels of insecurity tend to maintain a skeptical perspective regarding the reliable operation of technology. They are inclined to engage with such technologies only when they perceive substantial benefits to be gained from their use. Prior studies have indicated that insecurity negatively influences the perceived usefulness and ease of use associated with technology. For instance, reference [26] found that preparatory teachers exhibiting higher levels of insecurity reported a diminished perception of the usefulness of Internet of Things technology. Additionally, reference [36] revealed that the trait of insecurity among tourists negatively impacts their perceived ease of use of online tour guides. Consequently, we propose the following hypothesis:

H4a: *Insecurity negatively impacts consumers' intention to adopt AVs.*

H4b: *Insecurity negatively impacts consumers' perceived usefulness of AVs.*

H4c: *Insecurity negatively impacts consumers' perceived ease of use of AVs.*

3.2. Perception

3.2.1. Perceived Usefulness

Perceived usefulness is defined as the extent to which consumers recognize the utility of AVs. A substantial body of research has examined the relationship between perceived usefulness and the intention to adopt new technologies, consistently demonstrating a positive correlation. For example, reference [37] established that perceived usefulness significantly influences consumers' intentions to adopt telemedicine services. It is posited that when consumers identify AVs as offering concrete advantages in their daily lives—such as enhanced energy efficiency, environmental sustainability, alleviation of traffic congestion, and a reduction in accidents attributable to factors such as impaired driving, excessive speed, and distractions—they are more inclined to contemplate the adoption of this innovative technology. Consequently, we propose the following hypothesis:

H5: *Perceived usefulness positively influences consumers' intention to adopt AVs.*

3.2.2. Perceived Ease of Use

Perceived ease of use pertains to the extent to which consumers find the operation of AVs to be straightforward. As AVs represent an emerging technology, they introduce a novel experience for consumers, thereby rendering perceived ease of use a critical factor [38]. Previous studies have established that perceived ease of use positively influences attitudes

and behavioral intentions regarding the adoption of new technologies. For example, reference [39] demonstrated that perceived ease of use significantly impacts students' intentions to engage with e-learning systems. Similarly, reference [40] found that perceived ease of use affects consumer behavioral intentions toward the utilization of mobile payment systems. This study similarly posits that consumers are more inclined to adopt self-driving cars when they perceive that minimal effort and time are required to learn their operation. Moreover, reference [38] identified a direct relationship between perceived ease of use and perceived usefulness. Reference [41] further indicated that the perceived ease of use and perceived usefulness of new technologies are interrelated; specifically, perceived ease of use positively influences perceived usefulness and indirectly affects the intention to use. When users regard a new technology as simpler and easier to master, they are more likely to perceive it as having greater utility. Consequently, we propose the following hypothesis:

H6: *Perceived ease of use positively influences consumers' intention to adopt AV.*

H7: *Consumers' perceptions of the ease of use of AVs positively influences perceived usefulness.*

4. Methodology

4.1. Measurement Development

To ensure the rigor and validity of the study, the measurement items for the majority of the concepts were derived from prior research and subsequently adapted to fit the specific context of this investigation. The items measuring the intention to adopt AVEs were informed by the works of reference [42] and reference [25]. Additionally, the constructs of perceived usefulness and perceived ease of use were based on the foundational research of reference [17] and the more recent contributions of reference [5]. Furthermore, the measurement items addressing optimism, innovativeness, insecurity, and discomfort were referenced from the study by reference [13].

A back-translation method was employed to accurately translate the measurement items into Chinese. Specifically, a Chinese native researcher initially translated the original items into Chinese, followed by another researcher translating them back into English. Subsequently, we compared the two English versions to finalize the Chinese questionnaire. Additionally, we circulated the questionnaires among four professors and made further refinements based on their feedback. A pilot study involving 80 respondents was conducted before the main large-scale survey to ensure the scale's reliability and validity. The questionnaire underwent further refinement following the analysis of the pilot study results. A 7-point Likert scale was utilized for measurement, enabling respondents to express their level of agreement, ranging from strongly disagree (1) to strongly agree (7), in accordance with their genuine opinions.

4.2. Data Collection

This research utilized the professional survey data collection platform JianShu (available online: https://www.credamo.com/) (accessed on 28 December 2024) to disseminate a questionnaire aimed at consumers with knowledge of AVs. Following the elimination of invalid responses—such as those containing incorrect or missing information, uniform answers across all items, or surveys completed in unusually short or excessively long timeframes—we obtained a total of 310 valid responses. Table 1 presents the demographic characteristics of the sample, indicating that male respondents comprised 46.5% of the total, while female respondents constituted 53.5%. The majority of the participants were aged between 26 and 40 years and held bachelor's degrees.

Table 1. Descriptive statistical analysis of the study samples (N = 310).

Variables	Category	Frequency	Percentage	Variables	Category	Frequency	Percentage
Gender	Male	144	46.5%	Profession	Students	36	11.6%
	Female	166	53.5%		Employees	238	76.8%
Age	≤18	1	0.3%		Teachers	17	5.5%
	18–25	62	20.0%		Others	19	6.1%
	26–30	111	35.8%	Monthly income (CNY)	<3000	37	11.9%
	31–40	108	34.8%		3000–6000	57	18.4%
	41–50	21	6.8%		6000–9000	93	30.0%
	51–60	6	1.9%		9000–12,000	71	22.9%
	≥60	1	0.3%		>12,000	52	16.8%
Education Background	High school or below	15	4.8%	Vehicles owned	0	15	4.8%
	Associate degree	33	10.6%		1	254	81.9%
	Bachelor's degree	212	68.4%		2	38	12.3%
	Master's degree or above	50	16.1%		≥3	3	1.0%

5. Data Analysis and Results

5.1. Common Method Bias

Since the data are self-reported, we employed two methodologies to assess common method bias. First, we conducted Harman's one-way test with SPSS 27. Multiple factors were extracted, and the largest factor accounted for 32.563% of the variance. This figure is significantly below the threshold of 40%, indicating that common method bias is not a concern in our study [43]. Second, we introduced a common method factor, including all indicators of the principal variables in the model, to further test common method bias. As shown in Table 2, the standardized factor loadings (R1) were all significant ($p < 0.001$), while the common method factor loadings (R2) were significant for only three of the measurement items ($p < 0.05$), with most being non-significant ($p > 0.05$). Moreover, the mean ratio of explained variance was 164:1. These results confirm that common method bias was not a significant concern in this study.

Table 2. Common method bias.

Construct	Item	Standardized Factor Loading (R1)	$R1^2$	Common Method Factor Loading (R2)	$R2^2$
AV adoption intention (AI)	AI1	0.896 ***	0.803	−0.064	0.004
	AI2	0.874 ***	0.764	0.037	0.001
	AI3	0.886 ***	0.785	0.027	0.001
Optimism (OPT)	OPT1	0.757 ***	0.573	0.182 *	0.033
	OPT2	0.851 ***	0.724	−0.019	0.000
	OPT3	0.855 ***	0.731	−0.027	0.001
	OPT4	0.823 ***	0.677	−0.113 *	0.013
Innovativeness (INN)	INN1	0.833 ***	0.694	−0.020	0.000
	INN2	0.874 ***	0.764	0.004	0.000
	INN3	0.801 ***	0.642	−0.071	0.005
	INN4	0.803 ***	0.645	0.085	0.007
Discomfort (DIS)	DIS1	0.786 ***	0.618	0.053	0.003
	DIS2	0.868 ***	0.753	−0.023	0.001
	DIS3	0.881 ***	0.776	−0.052	0.003
	DIS4	0.764 ***	0.584	0.022	0.000
Insecurity (INS)	INS1	0.725 ***	0.526	0.036	0.001
	INS2	0.728 ***	0.530	0.008	0.000
	INS3	0.735 ***	0.540	−0.021	0.000
	INS4	0.715 ***	0.511	−0.024	0.001

Table 2. *Cont.*

Construct	Item	Standardized Factor Loading (R1)	$R1^2$	Common Method Factor Loading (R2)	$R2^2$
Perceived usefulness (PU)	PU1	0.840 ***	0.706	0.003	0.000
	PU2	0.877 ***	0.769	0.038	0.001
	PU3	0.801 ***	0.642	−0.033	0.001
	PU4	0.870 ***	0.757	−0.012	0.000
Perceived ease of use (PEOU)	PEOU1	0.758 ***	0.575	−0.010	0.000
	PEOU2	0.765 ***	0.585	0.043	0.002
	PEOU3	0.745 ***	0.555	0.096	0.009
	PEOU4	0.720 ***	0.518	−0.139 *	0.019
Average value		0.809	0.657	0.000	0.004

Note: * $p < 0.05$; *** $p < 0.001$.

5.2. Reliability and Validity

This research employed confirmatory factor analysis to evaluate the reliability and validity of the measurement model. As presented in Table 3, the Cronbach's alpha coefficients for the seven variables within the measurement model exceeded 0.7, signifying a strong internal consistency for each construct [44]. Furthermore, all factor loadings for the measurement items were greater than 0.7, and the average variance extracted (AVE) values surpassed 0.5, demonstrating adequate convergent validity of the scale [44]. Additionally, the composite reliability (CR) for each construct was above 0.8, indicating a commendable level of internal consistency for the scale. Moreover, as illustrated in Table 4, the square root of all AVEs was greater than the correlation coefficients of the corresponding constructs, thereby confirming the scale's good discriminant validity [45].

Table 3. Measurement model results.

Construct	Item	Factor Loading	Cronbach's α	CR	AVE
Optimism (OPT)	OPT1	0.745	0.700	0.816	0.526
	OPT2	0.720			
	OPT3	0.729			
	OPT4	0.707			
Innovativeness (INN)	INN1	0.832	0.847	0.897	0.686
	INN2	0.873			
	INN3	0.793			
	INN4	0.812			
Discomfort (DIS)	DIS1	0.704	0.840	0.891	0.672
	DIS2	0.851			
	DIS3	0.862			
	DIS4	0.852			
Insecurity (INS)	INS1	0.763	0.844	0.895	0.682
	INS2	0.867			
	INS3	0.876			
	INS4	0.790			
Perceived usefulness (PU)	PU1	0.761	0.736	0.834	0.558
	PU2	0.772			
	PU3	0.746			
	PU4	0.706			
Perceived ease of use (PEOU)	PEOU1	0.841	0.869	0.911	0.718
	PEOU2	0.878			
	PEOU3	0.801			
	PEOU4	0.869			
AV adoption intention (AI)	AI1	0.891	0.862	0.916	0.784
	AI2	0.875			
	AI3	0.890			

Table 4. The correlation coefficient and the square root of AVE.

	AI	DIS	INN	INS	OPT	PEOU	PU
AI	**0.885**						
DIS	−0.343	**0.820**					
INN	0.480	−0.306	**0.828**				
INS	−0.334	0.551	−0.314	**0.826**			
OPT	0.439	−0.222	0.306	−0.160	**0.725**		
PEOU	0.517	−0.367	0.539	−0.344	0.374	**0.848**	
PU	0.628	−0.332	0.457	−0.339	0.496	0.674	**0.747**

Note: The bolded values are the square root of the average variance extracted (AVE), and the off-diagonal elements are the correlation coefficients between the individual variables.

5.3. Structural Model

In the assessment of the structural model, this research employed the coefficient of determination (R^2), predictive relevance (Q^2), and standardized root-mean-square residual (SRMR) to evaluate the quality and fit of the model [42]. Reference [44] suggests that R^2 values of approximately 0.25, 0.5, and 0.75 correspond to weak, moderate, and strong explanatory power of the independent variables concerning the dependent variable, respectively. As illustrated in Table 5, the predictive variables in this study exhibited low to moderate explanatory power for perceived ease of use (R^2 = 0.372) and AV adoption intention (R^2 = 0.469) while demonstrating moderate to high explanatory power for perceived usefulness (R^2 = 0.530). The Q^2 values of approximately 0.00, 0.25, and 0.50 indicate low, medium, and high predictive relevance, respectively. In this investigation, the predictive variables revealed moderate predictive relevance for perceived usefulness (Q^2 = 0.282), perceived ease of use (Q^2 = 0.266), and AV adoption intention (Q^2 = 0.357). The SRMR serves as an absolute fit index by measuring the average discrepancies between the observed and expected correlation matrices. The SRMR value obtained in this study was 0.056, which is below the acceptable threshold of 0.08, thereby indicating a satisfactory overall fit of the model.

Table 5. Structural model assessment results.

Variable	Coefficient of Determination (R^2)	Predictive Relevance (Q^2)	SRMR
Optimism	-	-	
Innovativeness	-	-	
Discomfort	-	-	
Insecurity	-	-	0.056
Perceived usefulness	0.530	0.282	
Perceived ease of use	0.372	0.266	
AV adoption intention	0.469	0.357	

5.4. Hypothesis Testing

This research employed the Bootstrapping method within SmartPLS 3.0 software to estimate the path coefficients of the proposed model and evaluated the significance of these coefficients through the analysis of T-values, thereby testing the research hypotheses. As illustrated in Table 6 and Figure 2, optimism was found to exert a positive influence on the intention to adopt AVs (β = 0.138, $p < 0.05$), as well as significantly enhancing perceived usefulness (β = 0.269, $p < 0.001$) and perceived ease of use (β = 0.203, $p < 0.001$). These findings provide support for hypotheses H1a, H1b, and H1c. Furthermore, innovativeness positively affects the intention to adopt AVs (β = 0.162, $p < 0.05$) and significantly enhances the perceived ease of use (β = 0.400, $p < 0.001$), thereby supporting hypotheses H2a and H2c. However, innovativeness does not have a significant effect on perceived usefulness

(β = 0.073, $p > 0.05$), leading to the rejection of hypothesis H2b. Discomfort is shown to negatively influence perceived ease of use (β = −0.138, $p < 0.05$), which supports hypothesis H3c. Conversely, discomfort does not significantly impact the intention to adopt AVs (β = −0.069, $p > 0.05$) or the perceived usefulness (β = −0.017, $p > 0.05$), resulting in the rejection of hypotheses H3a and H3b. Additionally, the absence of safety concerns does not significantly affect perceived usefulness (β = −0.094, $p > 0.05$), perceived ease of use (β = −0.110, $p > 0.05$), or the intention to adopt AVs (β = −0.050, $p > 0.05$); thus, hypotheses H4a, H4b, and H4c are also not supported. Perceived usefulness demonstrates a significant positive effect on the intention to adopt AVs (H5) with a positive path coefficient (β = 0.401, $p < 0.001$), thereby supporting hypothesis H5. However, perceived ease of use does not significantly influence the intention to adopt AVs (β = 0.041, $p > 0.05$), indicating that hypothesis H6 is not supported. Lastly, perceived ease of use has a significant positive impact on perceived usefulness (β = 0.495, $p < 0.001$), thereby supporting hypothesis H7.

Table 6. Test results of hypothetical model.

Hypothesis	Path Relationships	Path Coefficients	T-Statistics	*p*-Values	Results
H1a	OPT -> AI	0.138 *	2.061	0.039	Supported
H1b	OPT -> PU	0.269 ***	4.754	0.000	Supported
H1c	OPT -> PEOU	0.203 ***	3.835	0.000	Supported
H2a	INN -> AI	0.162 *	2.297	0.022	Supported
H2b	INN -> PU	0.073	1.066	0.286	Not Supported
H2c	INN -> PEOU	0.400 ***	6.281	0.000	Supported
H3a	DIS -> AI	−0.069	1.345	0.179	Not Supported
H3b	DIS -> PU	−0.017	0.358	0.720	Not Supported
H3c	DIS -> PEOU	−0.138 *	2.091	0.037	Supported
H4a	INS -> AI	−0.050	0.806	0.420	Not Supported
H4b	INS -> PU	−0.094	1.444	0.149	Not Supported
H4c	INS -> PEOU	−0.110	1.487	0.137	Not Supported
H5	PU -> AI	0.401 ***	3.932	0.000	Supported
H6	PEOU -> AI	0.041	0.47	0.638	Not Supported
H7	PEOU -> PU	0.495 ***	6.823	0.000	Supported

Note: *, *** indicate significance at $p < 0.05$, and $p < 0.001$ levels, respectively.

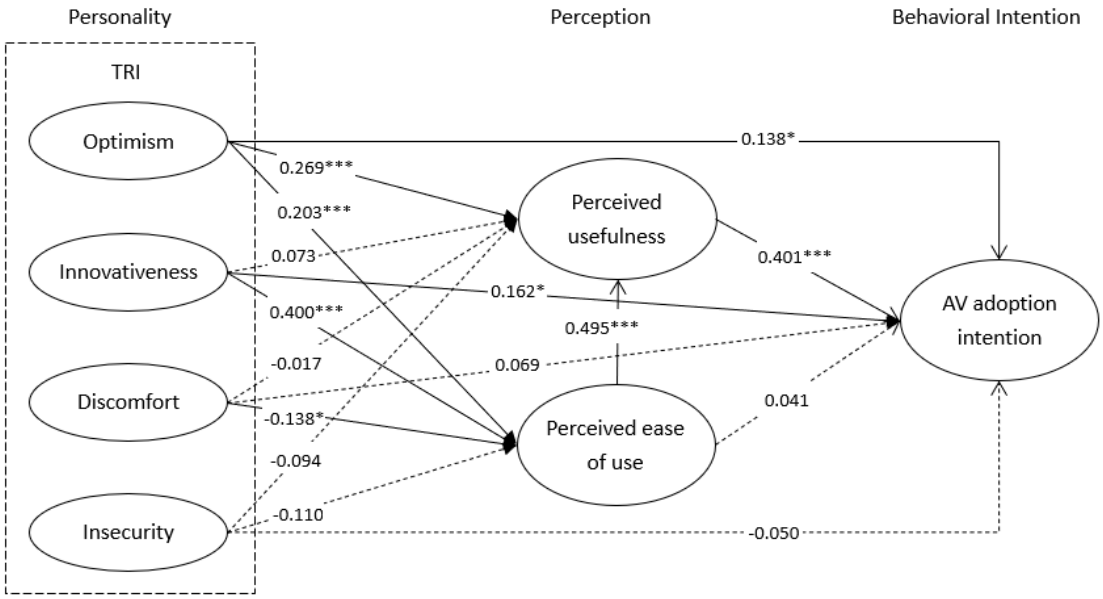


Figure 2. Test results of structural equation modeling. Note: *, *** indicate significance at $p < 0.05$, and $p < 0.001$ levels, respectively.

6. Discussion and Implication

6.1. Discussion of Results

This research conducted an empirical examination of the influence of consumer personality traits and perceptions on the intention to adopt AVs, utilizing the Technology Readiness Index (TRI) and the Technology Acceptance Model (TAM) as frameworks. The primary findings are summarized as follows.

The primary determinants influencing the intention to adopt AVs include consumer optimism, innovativeness, and perceived usefulness. In alignment with the findings of reference [15] in the realm of information technology, both optimism and innovativeness exert a significant positive effect on the intention to adopt AVs. This implies that consumers who maintain an optimistic perspective regarding technology and perceive it as offering controllability, flexibility, and convenience are more inclined to embrace AVs. Furthermore, individuals characterized by high levels of innovativeness typically exhibit curiosity and a desire to explore novel technologies, making them more amenable to experimenting with new solutions and thereby increasing their likelihood of adopting AV technology. Additionally, consistent with the research conducted by reference [46], perceived usefulness was found to positively influence the intention to adopt AVs, indicating its substantial impact on user intentions regarding AV utilization.

Furthermore, consumer optimism and perceived ease of use are positively correlated with perceived usefulness. This correlation is supported by previous studies that demonstrate a significant positive relationship between optimism and perceived ease of use across various contexts, including automated retail environments [47] and mobile internet services [48]. Moreover, consumer optimism, innovativeness, and discomfort serve as antecedents to perceived ease of use. Optimism among consumers positively affects their perception of the ease of use of AVs. Individuals with an optimistic disposition tend to be more proactive, willing to engage with new technologies, and likely to take the initiative to comprehend the operational methods and processes associated with AVs, thereby facilitating their perception of ease of use. This observation is consistent with findings from reference [49], which suggest that consumers exhibiting optimistic traits are more likely to perceive AVs as user-friendly. Additionally, innovativeness among consumers positively influences their perception of the ease of use of AVs, indicating that those with innovative characteristics are generally more open and inquisitive about new technologies, leading to a greater likelihood of mastering the use of AVs. Conversely, consumer discomfort negatively impacts their perception of the ease of use of AVs, corroborating the conclusions drawn by reference [50] that discomfort is a significant factor affecting perceived ease of use.

Lastly, it is noteworthy that consumer discomfort and insecurity do not significantly influence their intentions to adopt AVs. It is inconsistent with TRI that discomfort and insecurity inhibit consumers from adopting new technology. This phenomenon may be explained by the continuous progress of autonomous driving technology. This progress has effectively enhanced the performance and safety of AVs, which in turn has led to an increase in consumers' trust and acceptance of this technology. Consequently, the influence of consumer discomfort and insecurity on adoption intentions may be diminishing. Furthermore, the study's findings indicate that perceived ease of use does not directly affect the adoption intentions of AVs. This finding is not aligned with the statement of the TAM that perceived ease of use is a key factor influencing the acceptance and use of technology, but it is consistent with the findings of the prior research conducted by reference [51] and reference [52]. The reason why perceived ease of use is not significant may be that consumers' concern about AVs is not ease of use but safety. AV is a disruptive technological innovation that operates under a fully autonomous driving system without manual intervention. Consumers will have doubts about the safety of AVs. Even if consumers perceive

AVs to be easy to use, it is difficult to build enough trust to decide to adopt them, thus weakening the positive impact of perceived ease of use on adoption intention.

6.2. Implications

6.2.1. Theoretical Implications

Previous research has largely neglected the role of consumer characteristics in shaping perceptions regarding the adoption of AVs. Furthermore, investigations into consumer characteristics have primarily concentrated on demographic variables, with insufficient attention given to enduring personality traits. This paper proposes a research framework that integrates "personality–perception–behavioral intention" to thoroughly explore the influence of consumer personalities and perceptions on the intention to adopt AVs, thereby addressing a notable gap in the existing literature. The findings reveal that both consumer personality and perceptions significantly affect the intention to adopt AVs, thereby contributing to the theoretical discourse surrounding AVs and enhancing the understanding of adoption behaviors.

Additionally, this study develops a research framework of "personality–perception–behavioral intention", informed by TRI and TAM, to analyze consumer adoption behaviors concerning AVs. The results indicate that consumer traits such as optimism and innovation, along with perceived usefulness, positively influence the willingness to adopt AVs. Conversely, factors such as discomfort, insecurity, and perceived ease of use do not significantly affect the intention to adopt AVs. Notably, consumer optimism and perceived ease of use significantly enhance the perceived usefulness of AVs. Furthermore, optimism, innovation, and discomfort serve as antecedents that influence the perceived ease of use of AVs. This study contributes to the expansion of the TRI and TAM theories within the context of AV adoption.

6.2.2. Practical Implications

Firstly, consumer personality significantly influences the propensity to adopt AVs. Individuals exhibiting diverse personality traits demonstrate varying levels of willingness to utilize AVs. Consequently, suppliers of AVs can develop targeted marketing strategies that align with distinct consumer personality profiles. For instance, initial promotional efforts could focus on optimistic and highly innovative consumers as these individuals are more inclined to embrace AVs and may serve as early adopters.

Secondly, the perceived usefulness of AVs has a positive correlation with consumers' intentions to adopt these vehicles. Therefore, it is imperative for AV suppliers and governmental bodies to enhance the promotion of the benefits and value associated with AVs in order to improve consumer perceptions of their utility. For example, governments and businesses can utilize various platforms, such as media, exhibitions, and experiential activities, to demonstrate how autonomous vehicles can save time, enhance safety, and contribute to environmental sustainability. This approach will enable consumers to recognize that AVs can facilitate a more convenient, healthier, and efficient daily life.

6.3. Limitations and Future Research

Several limitations must be acknowledged when interpreting the findings of this study. Firstly, the research focuses on consumers' intentions to adopt AVs rather than their actual adoption behaviors. Although there is a significant correlation between consumers' intentions and their subsequent behaviors, studies that utilize actual adoption behavior as the dependent variable may yield more comprehensive insights. Consequently, future research should consider examining actual AV adoption behavior as the dependent variable within the research framework. Secondly, a majority of the respondents lacked direct experience with AVs, leading to their understanding being primarily derived from online

sources or marketing initiatives by manufacturers. This lack of practical experience may limit the depth of their responses. Therefore, future studies should include participants who possess AV driving experience to enhance the validity of the findings. Finally, our sample was obtained from China. This may limit the applicability of our study to other cultural and regional contexts. Future research could conduct cross-country comparative studies to test the applicability of the proposed framework and findings in different cultural contexts.

7. Conclusions

We established a research framework titled "personality–perception–behavioral intention" to investigate the effects of consumer personality traits and perceptions on the intention to adopt AVs. Drawing upon the Technology Readiness Index theory, we identified four dimensions of consumer personality: optimism, innovativeness, discomfort, and insecurity. Additionally, informed by the Technology Acceptance Model, we delineated two dimensions of consumer perception: perceived usefulness and perceived ease of use. Our findings indicate that both consumer personality and perceptions significantly influence the intention to adopt AVs. Specifically, consumers exhibiting higher levels of optimism and innovativeness, along with a strong perception of the usefulness of AV technology, demonstrate a greater likelihood of adopting such vehicles.

Author Contributions: X.H. contributed to the conceptualization, supervision, validation, and writing—review & editing; H.Z. contributed to formal analysis, writing—original draft, and data analysis. J.G. contributed to writing—review & editing and funding of this study. Y.W. contributed to the conceptualization methodology, data analysis and writing—original draft. All authors have read and agreed to the published version of the manuscript.

Funding: This research was supported by the Special Fund of Wuhan Textile University under Grant [number 2024388]; the Opening Foundation of Hubei Key Laboratory of Digital Textile Equipment under Grant [number DTL2024008]; National Natural Science Foundation of China under Grant [72072139] and [72304216].

Institutional Review Board Statement: In China, non-interventional studies such as surveys, questionnaires, and social media research typically do not require ethical approval. This is in accordance with the following legal regulations: Measures of People's Republic of China (PRC) Municipality on Ethical Review; Measures for Ethical Review of Biomedical Research Involving People (revised in 2016); Measures of National Health and Wellness Committee on Ethical Review of Biomedical Research Involving People (Wei Scientific Research Development [2016] No. 11).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data presented in this study are available on reasonable request from the corresponding authors.

Conflicts of Interest: The authors declare no conflict of interest.

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