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The Influence of Task-technology Fit on Purchase Intention of Autonomous Driving Cars

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Abstract

Few studies currently investigate the factors influencing consumers' willingness to purchase autonomous vehicles. This study extends the conventional technology acceptance model by introducing the Task- Technology Fit Model (TTF) to investigate how the alignment of automated driving technology (autonomous vs. non-autonomous driving) and task requirements influences consumers' willingness to purchase autonomous vehicles within the primary application contexts of automated driving technology, especially in complex driving scenarios.

Keywords

Autonomous driving; Task-technology fit; Ttechnology acceptance model.

1. Introduction

With the advancement and maturation of artificial intelligence and automation, autonomous driving has gradually entered the automotive market and captured the attention of consumers in recent years. A primary goal of autonomous driving technology is to reduce traffic accidents caused by drivers in complex driving conditions. Whether consumers need autonomous vehicles for their daily driving scenarios is likely to influence their purchasing decisions. As Level 3 autonomous vehicles approach the stage of large-scale commercialization, exploring the factors that influence consumers' willingness to purchase autonomous vehicles is undoubtedly crucial.

2. Levels of Autonomous Driving

In January 2014, the Society of Automotive Engineers International (SAE) established the "Classification Standards for Automated Driving Systems," which categorizes autonomous vehicles into six levels. The national standard "Classification of Driving Automation for Vehicles" , implemented in China on March 1, 2022, is largely consistent with the SAE standard, as shown in the Table 1 below.

When autonomous driving reaches Level 3, the vehicle's onboard system significantly takes over control from the driver. For this reason, the SAE's updated 2021 standard refers to Levels 0 to 2 as "Driver Assistance Systems," while Levels 3 to 5 are termed "Autonomous Driving Systems." In other words, only vehicles achieving Level 3 can truly be called "autonomous." Since Level 5 fully autonomous driving technology is not yet mature, and policies are promoting the introduction of Level 3 conditional autonomous driving technology to the public, this study selects Level 3 autonomous driving as the research subject to explore factors influencing public purchase intentions. This research holds significant guiding importance for advancing the development of autonomous driving.

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Table 1. Classification of Autonomous Vehicle Levels (SAE)

Level of Autonomous Driving	Driving Operation	Environment Monitoring	Takeover Responsibility
Level 0	Driver	Driver	Driver
Level 1	Driver and Machine	Driver	Driver
Level 2	Machine	Driver	Driver
Level 3	Machine	Machine	Driver
Level 4	Machine	Machine	Machine
Level 5	Machine	Machine	Machine

3. Theoretical Foundation

3.1. Technology Acceptance Model

In the field of new technology acceptance, the most widely used theoretical framework is the Technology Acceptance Model . In 1986, Davis first proposed the TAM model in his paper, which was derived from the Theory of Reasoned Action (TRA) [1]. The model was designed to examine the influence of external variables on individuals' intentions to use information systems. However, the TAM model has limitations in providing practitioners with actionable guidance on how to develop appropriate interventions and mechanisms to encourage users to actively change their adoption, acceptance, and usage behaviors toward new technologies [2, 3]. To address these issues, scholars have continuously refined the model. Venkatesh and Bala (2008) proposed the TAM3 model to resolve these shortcomings [4].

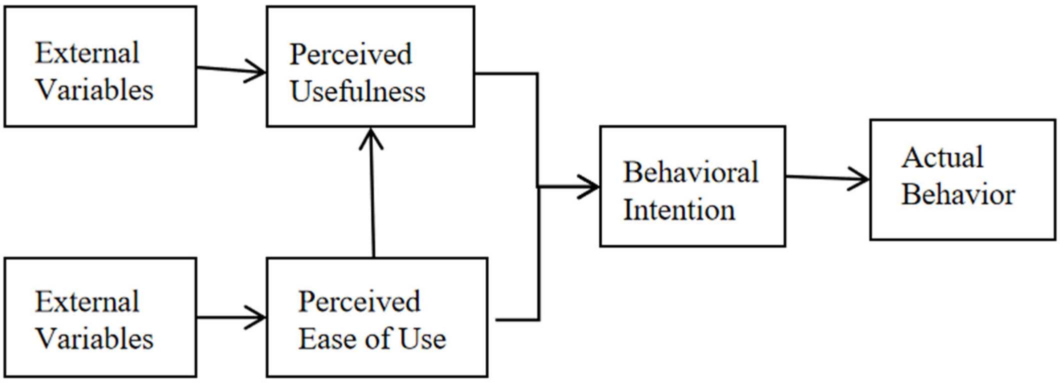

Figure 1. TAM3(2008)

3.2. Task-Technology Fit Model

The Task-Technology Fit (TTF) model originates from the Technology-to-Performance Chain (TPC) model [5]. The TPC model emphasizes the concept that for an information technology tool to be effective, it must first be used and must functionally align with the requirements of the tasks it is intended to accomplish. Goodhue focused on the core aspects of the TPC model, particularly highlighting the role of task-technology fit. He argued that the relationship between information systems and user work performance stems from the influence of task characteristics and technology characteristics. In 1995, he proposed the model shown in Figure 2 [6].

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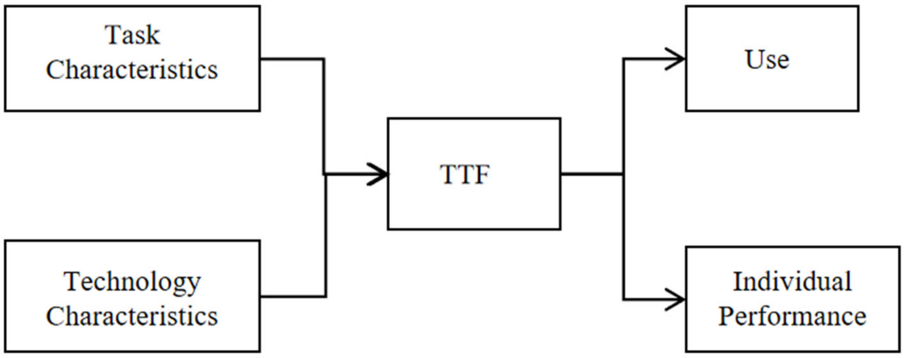

Figure 2. Task-Technology Fit Model

3.3. The Integrated TAM-TTF Model

The Technology Acceptance Model (TAM) focuses on individuals' behavioral attitudes toward the acceptance of information technology but lacks attention to tasks and technology. On the other hand, the Task-Technology Fit (TTF) model emphasizes the impact of the fit between tasks and technology on individual performance but overlooks user usage behavior. Empirical results from the TTF model also indicate that the direct influence of task-technology fit on usage behavior is weak. In this regard, Dishaw et al. pointed out that this is because TAM and TTF explain the influencing factors and mechanisms of user adoption of information technology and performance generation from different perspectives. Combining the two models can compensate for their respective shortcomings [7]. Dishaw and Strong (1999) integrated TTF theory with the TAM model, resulting in the integrated TAM-TTF model, as shown in Figure 3 [8]. This integrated model has been widely applied in various fields but has not yet been introduced into research on autonomous vehicle purchase intentions. Therefore, it is worth considering the introduction of the TAM-TTF integrated model into the field of autonomous driving research.

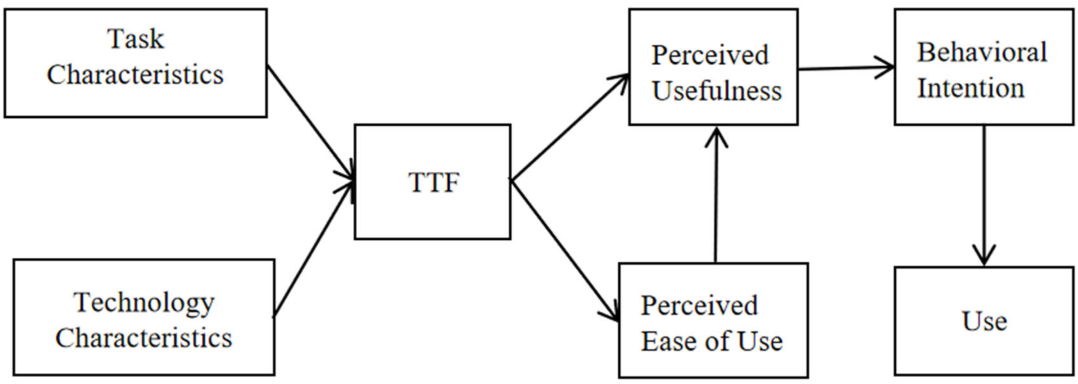

Figure 3: TAM-TTF Model

4. Proposal of the Hypothetical Model

Based on the preceding literature review and the characteristics of autonomous vehicles, this paper proposes the following hypotheses: In complex driving task scenarios, (1) the task-technology fit of autonomous vehicles is higher than that of non-autonomous vehicles; (2) task-technology fit significantly influences purchase intention; and (3) perceived usefulness and

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perceived ease of use mediate the impact of task-technology fit on consumers' purchase intentions. The hypothetical model is illustrated in Figure 4.

The definitions of the research variables are as follows:

Task-Technology Fit(TTF): The degree to which users perceive a match between the technology (features) of autonomous vehicles and the characteristics of complex driving tasks.

Perceived Usefulness(PU):The extent to which consumers perceive that autonomous vehicles improve their driving efficiency.

Perceived Ease of Use(PEU):The extent to which consumers perceive that autonomous vehicles are easy to use.

Purchase Intention (PI):Consumers' intention to purchase autonomous vehicles.

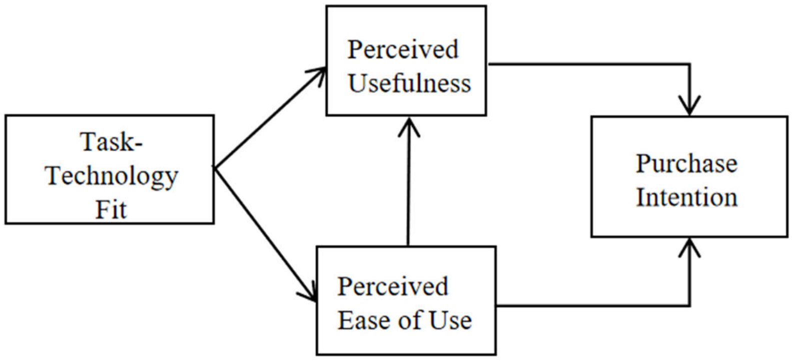

Figure 4. Hypothetical Model

5. Experimental Study

5.1. Validation of Task-Technology Fit (High vs. Low)

This experiment aims to verify that the task-technology fit of autonomous vehicles is higher than that of non-autonomous vehicles in complex driving tasks. First, by searching online for videos of Level 3 autonomous vehicles undergoing road tests, covering the majority of daily driving scenarios (both simple and complex), the performance of Level 3 autonomous vehicles in these scenarios was recorded. Five driving scenarios were selected as materials for complex driving situations: (a) Mixed scenarios involving pedestrians, motor vehicles, and non-motorized vehicles; (b) Intersections without traffic signals, where non-motorized vehicles unexpectedly cross from the side; (c) Scenarios where pedestrians unexpectedly emerge from blind spots ahead; (d) Narrow roads with parked vehicles or obstacles on both sides, requiring oncoming vehicle interaction; (e) Parking in narrow spaces with vehicles or obstacles on both sides.

A single-factor between-subjects design was used, with Level 3 autonomous vehicles (high-feature group) as the experimental group and Level 0 manually driven vehicles (low-feature group) as the control group. The task-technology fit of autonomous vehicles was measured across four dimensions: responsive, applicable, reliable, and safe [9-11]. Each dimension included three questions, totaling 12 measurement items.

A total of 130 valid questionnaires were collected, with 64 from the high-feature group (L3 autonomous vehicles) and 66 from the low-feature group (L0 manually driven vehicles). A 7-point Likert scale was used for scoring (1=strongly disagree, 7=strongly agree).

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The four measurement dimensions of task-technology fit (responsive, applicable, reliable, and safe) passed both the homogeneity of variance test and the independent samples t-test ($p < 0.001$) in both the experimental group (L3) and the control group (L0). The scores for the high task-technology fit group (L3) across the four dimensions were M1=5.62, M2=5.47, M3=5.50, and M4=4.97, in contrast, the scores for the low task-technology fit group (L0) were M1=2.90, M2=2.41, M3=2.47, and M4=2.69.From the total score statistical test results, the high task-technology fit group (L3) scored significantly higher than the low task-technology fit group (L0) (Mhigh=21.56, Mlow=10.67). The homogeneity of variance test yielded F=0.404, P=0.526 > 0.05, and the t-test result was t=59.254, $p < 0.01$, indicating that the scale has significant discriminative power, and the dimensions and their items meet the experimental requirements. The results confirm that Experiment 1 validates Hypothesis H1: In complex driving scenarios, the task-technology fit of autonomous vehicles is higher than that of non-autonomous vehicles.

5.2. Validation of the Mediating Role of Perceived Usefulness and Perceived Ease of Use

This experiment aims to verify that, in complex driving task scenarios, perceived usefulness (PU) and perceived ease of use (PEU) mediate the impact of task-technology fit (TTF) on consumers' purchase intentions, thereby validating Hypotheses H2 and H3. The experimental materials were the same as those used in the previous experiment. After excluding invalid responses, a total of 185 valid questionnaires were collected, with 91 from the high-feature group (L3) and 94 from the low-feature group (L0). The effective response rate was 91.58%. The experimental data were analyzed using SPSS 25.0, and the results are as follows:

5.2.1. Reliability Test

The Cronbach's alpha coefficient for PU was 0.899, for PEU was 0.891, and for PI was 0.862. The overall reliability was 0.895. The Cronbach's alpha coefficients for all latent variables, as well as the overall reliability, ranged between 0.8 and 0.9, with values closer to 0.9. This indicates strong internal consistency in the data and questionnaire, providing a reliable data foundation for establishing relationships between latent variables and observed variables. It also demonstrates that the survey questionnaire has high credibility.

5.2.2. Convergent Validity Test

The experiment utilized AMOS for calculations, and the factor loadings of all 16 observed items were greater than 0.6. For PU, the AVE (Average Variance Extracted) was 0.694, and the CR (Composite Reliability) was 0.900. For PEU, the AVE was 0.673, and the CR was 0.891. For PI, the AVE was 0.620, and the CR was 0.866. These results indicate that the measurement data exhibit good convergent validity.

5.2.3. Discriminant Validity Test

The correlation coefficient between PU and PEU was 0.335, which is less than the square root of the AVE for PU(0.833) and the square root of the AVE for PEU(0.820). This confirms that the discriminant validity between these two latent variables is ideal. Similarly, the correlation coefficient between PU and PI was 0.363, and the correlation coefficient between PEU and PI was 0.389, both of which satisfy the condition of being less than the square root of their respective AVEs. These data demonstrate that the discriminant validity among the latent variables is ideal.

5.2.4. Independent Samples t-Test

Significant differences were observed between the two groups for PU and PEU ($t_1 = 5.117$, $t_2 = 4.111$, $p_1 < 0.01$, $p_2 < 0.01$). This indicates that the higher the automation level of autonomous vehicles, the better the match between their technological features and complex driving tasks, leading to higher perceived usefulness and ease of use among consumers. Additionally, a significant difference in PI was found between the two groups(M_{high}=4.94, M_{low}=4.07, t=4.156,

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p<0.01), suggesting that as the match between autonomous vehicle technology and complex driving tasks improves, consumers' purchase intention for autonomous vehicles also increases.

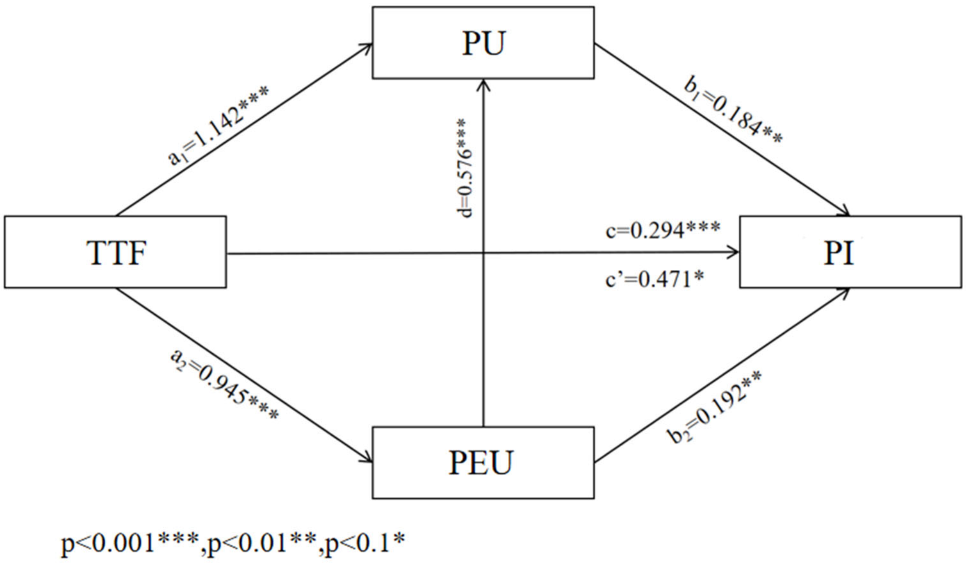

Figure 5. Mediation Pathway Diagram for PU and PEU

6. Conclusion

In exploring the factors influencing consumers' purchase intentions for L3 autonomous vehicles, this study employed experimental research methods to validate that task-technology fit positively affects consumers' purchase intentions. Specifically, in complex driving tasks, the task-technology fit of L3 autonomous vehicles better aligns with consumer expectations, significantly enhancing their purchase intentions. Perceived usefulness and perceived ease of use play mediating roles in the relationship between task-technology fit and purchase intentions. When consumers perceive that L3 autonomous vehicle technology can provide them with convenience, safety, and efficiency in complex driving tasks, they are more likely to develop purchase intentions.

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