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The Sustainability and Energy Efficiency of Connected and Automated Vehicles from the Perspective of Public Acceptance towards Platoon Control

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Abstract: This study examines the public acceptance of platoon control for connected and automated vehicles (CAVs) and analyzes it from a sustainability perspective. A questionnaire survey was conducted targeting a diverse social group to collect data on public attitudes, acceptability, and factors related to the environment, social responsibility, personal economy, and behavior. Factor analysis was then performed to reduce these data into three factors: "attitudes and acceptance", "environment and social responsibility", and "personal economy and behavior". Further, multiple regression analysis was employed to investigate the relationship between these three factors and the willingness to accept platooning control, as well as the willingness to actively adopt it. The findings indicate that the "attitude and acceptance" factor significantly influences the public's acceptance of platoon control. Moreover, the "environment and social responsibility" and "personal economy and behavior" factors also have a certain influence on decision-making. This study not only contributes to understanding public attitudes towards CAVs' platoon control but also explores how to promote the development of sustainable intelligent transportation systems. By gaining a better understanding of public attitudes, policymakers and relevant stakeholders can take measures to enhance the acceptance of CAVs, thereby driving the sustainable development of transportation systems.

Keywords: connected and automated vehicles; public acceptance; platoon control; questionnaire survey; factor analysis; multiple regression analysis

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1. Introduction

Connected and Automated Vehicles (CAVs) are vital for sustainable transportation, as they improve road safety [1,2], reduce traffic incidents [3,4], alleviate congestion [5], and lower carbon emissions [6]. Platoon control, a key technology in CAVs, aims to enable multiple vehicles to form a closely knit convoy and maintain short distances while driving on highways, and improve road utilization and fuel efficiency, leading to economic and environmental advantages [7]. Platoon control involves coordinating and controlling the speed, distance, and behavior of vehicles in the convoy, allowing them to drive in a highly synchronized manner [8]. The technologies involved in platoon control include vehicle-to-vehicle communication (V2V) [9], vehicle-to-infrastructure communication (V2I) [10], path planning [11], formation maintenance and adjustment [12], etc.

While the benefits of platoon control technology are evident, its widespread deployment and practical application on public roads face numerous challenges, one of which is public acceptance of new technologies such as autonomous driving and platoon control. Some individuals may have concerns about ethical and social issues, including job

opportunities and privacy concerns. It may impact employment in the transportation sector, affecting traditional roles such as truck drivers [13]. While improving efficiency and safety [14], it may lead to job displacement. Addressing potential impact on employment is essential, including retraining or creating new job opportunities in related industries. Privacy concerns arise from extensive data collection and vehicle-to-vehicle communication [15]. In addition, robust data protection measures and informed consent from users are crucial. Clear regulations and guidelines on data usage, retention, and access should be established to protect privacy rights [16]. Public reservations regarding platoon control could very well hinder the broad adoption and implementation of this technology on public thoroughfares [17]. Therefore, it is necessary and of paramount importance to understand the factors influencing public acceptance towards this novel mode of transportation, and strive for a more balanced discussion that considers both positive and negative aspects.

CAVs and their associated technologies have become a research hotspot in recent years. While many studies have focused on the safety, reliability, and efficiency of CAVs, relatively fewer have delved into their public acceptance, and among those, the focus is more on CAVs themselves rather than on platoon control. For instance, Kacperski et al. (2021) [18] conducted a survey and found that although the majority of respondents had a positive disposition towards CAVs, they remained reserved about fully automated systems. Furthermore, Guo et al. (2019) [19] mentioned in their findings that public acceptance of CAVs is influenced by various factors such as safety, convenience, cost, and privacy concerns. In terms of platoon control, the extant research primarily emphasizes technological and economic aspects, with a spotlight on how to reduce fuel consumption and emissions, and enhancements in traffic flow characteristics through platooning. Liu et al. (2020) [20] proposed a distributed cooperative platoon control method to address the issues of hybrid vehicle platooning. This approach integrates nonlinear model predictive control techniques with distributed intelligent cruise control schemes, effectively reducing the platoon's fuel consumption. Chen et al. (2020) [21] presented platooning strategies for CAVs on regular roads and designed a route planning strategy employing deep reinforcement learning, indicating that this method can considerably reduce a convoy's fuel consumption. Ding et al. (2019) [22] proposed a rule-based adjustment algorithm to achieve optimal lane merging when platoons from on-ramps approach each other, addressing the efficient and safe coordination of two vehicle columns on highway ramps in the longitudinal direction. Smith et al. (2020) [23] introduced a vehicle queuing strategy for urban roads based on model predictive control methods and demonstrated that vehicle queuing can significantly enhance intersection throughput. Additionally, some studies have attempted to explore public perceptions and expectations regarding platoon control. However, it is worth noting that such studies are predominantly centered in North America and Europe, which implies that knowledge on public acceptance of CAV platoon control in non-Western cultural and economic contexts remains scant [24,25].

Existing literature predominantly focuses on the technological advancement, safety assessments, and road testing of CAVs. Research concerning public acceptance mainly addresses the use of autonomous vehicles as individual entities, with scant literature exploring public attitudes towards platoon control technology from a sustainability perspective. Additionally, a significant portion of the existing studies relies on data and perspectives from Western countries, thereby limiting a comprehensive understanding of public acceptance in Asian nations, especially within diverse cultural and societal contexts. This article aims to investigate the acceptance of platoon control technology among the public in Asia, and China especially, from a sustainability perspective, which can to some extent solve the lack of studies from non-Western contexts. The research on this issue includes the following content. Firstly, a questionnaire survey is conducted targeting a diverse social group to collect data on public attitudes, acceptability, and factors related to the environment, social responsibility, personal economy, and behavior. Factor analysis is then performed to reduce these data into three factors: "attitudes and acceptance", "environment and social responsibility", and "personal economy and behavior". Further, multiple regression analysis is

employed to investigate the relationship between these three factors and the willingness to accept platooning control as well as the willingness to actively adopt it. In essence, this research endeavors to offer a comprehensive and in-depth perspective to understand the public's acceptance of platoon control technology, thereby facilitating its widespread deployment in road transportation. Table 1 displays the nomenclature of this study.

Table 1. Nomenclature.

Variables or Abbreviations	Explanation
CAV	connected and automated vehicle
X	the observed variables
L	the factor loading matrix, which shows the relationships between observed variables and latent factors
F	the latent factors
E	the error terms
i	the serial number of observed variables
m	the serial number of latent factors
Q	the object question
$\beta_1, \beta_2, \ldots, \beta_k$	the regression coefficients
$X_1, X_2, \ldots, X_k$	different independent variables
k	the number of items in the questionnaire
s^2	the variance of each item
s_t^2	the total variance of all items
F0	attitude and acceptance factor
F1	environment and social responsibility factor
F2	personal economy and behavior factor

2. Materials and Methods

2.1. Questionnaire Survey

In order to investigate the willingness to accept platoon control and the willingness to actively adopt it, we conducted a questionnaire design. The questionnaire consisted of a series of questions covering multiple factors that may influence these two decisions, including: attitude and acceptance-related questions, environment and social responsibility-related questions, and personal economy and behavior-related questions. The description of the questionnaire is presented in Table 2. The questionnaire includes four dimensions, namely individual information (Q1–Q3), economic status (Q5–Q6), driving habits (Q4, Q7–Q11), and attitude (Q12–Q19).

Table 2. Questionnaire Design and Description.

Variable	Question	Options
Q1	Gender	1 = Male; 2 = Female
Q2	Age	1 = 18–35; 2 = 36–50; 3 = 51–60; 4 = Over 60
Q3	Education	1 = Primary school and below; 2 = Middle school; 3 = High school; 4 = Bachelor's degree; 5 = Master's degree and above
Q4	Occupation	1 = Driver; 2 = Non-driver
Q5	Income	1 = Within CNY 5000; 2 = CNY 5000–CNY 7999; 3 = CNY 8000–CNY 9999; 4 = CNY 10,000–CNY 15,000; 5 = Over CNY 15,000
Q6	The monthly cost of electricity or fuel.	1 = Within CNY 200; 2 = CNY 200–CNY 399; 3 = CNY 400–CNY 599; 4 = CNY 600–CNY 799; 5 = Over CNY 799
Q7	The frequency of traffic violations in a year.	1 = Within 3 times; 2 = 3–5 times; 3 = 5–10 times; 4 = Over 10 times
Q8	Driving years	1 = Within 3 years; 2 = 4–6 years; 3 = 7–10 years; 4 = Over 10 years
Q9	Monthly mileage	1 = Within 400 km; 2 = 400–650 km; 3 = 651–1300 km; 4 = Over 1300 km
Q10	Vehicle type	1 = Car; 2 = SUV; 3 = Jeep; 4 = Truck; 5 = Bus or taxi
Q11	Advanced driver assistance	1 = Yes; 2 = No
Q12	Concern about the impact of vehicles on the environment	1–5 represent 5 levels of attitude ranging from negative to positive.
Q13	The recognition of the effectiveness of platoon control in reducing traffic congestion	1–5 represent 5 levels of attitude ranging from negative to positive.
Q14	The recognition of the effectiveness of platoon control in enhancing sustainability	1–5 represent 5 levels of attitude ranging from negative to positive.
Q15	The recognition of the effectiveness of platoon control in saving energy costs	1–5 represent 5 levels of attitude ranging from negative to positive.
Q16	The recognition of the effectiveness of platoon control in improving traffic safety	1–5 represent 5 levels of attitude ranging from negative to positive.
Q17	The recognition of the effectiveness of platoon control in saving travel time	1–5 represent 5 levels of attitude ranging from negative to positive.
Q18	The willingness to accept platoon control	1–5 represent 5 levels of attitude ranging from negative to positive.
Q19	The willingness to proactively form platoon	1–5 represent 5 levels of attitude ranging from negative to positive.

The participants in the study were selected through a systematic sampling approach to ensure diversity in the social group. Our questionnaire was distributed in an online format, ensuring the randomness of the respondents and a wide geographical coverage of their locations. The selection criteria aimed to include individuals from various demographic backgrounds, such as different genders, age groups, educational levels, occupations, and income brackets.

2.2. Factors Analysis

After data collection, we performed factor analysis to identify underlying factors and reduce data dimensionality. Factor analysis is a multivariate statistical method utilized to detect latent variables or structures within collected data. In this study, we employed the factor analysis technique to determine potential factors influencing individuals' willingness to accept and adopt platoon control measures in the context of sustainable transportation systems. In the context of questionnaire surveys, factor analysis is used to determine the factors that influence respondents' preferences or intentions. It helps identify the underlying constructs or dimensions that drive the observed responses. By analyzing the interdependencies among the variables, factor analysis can uncover the key factors that explain the common variance among the items in the questionnaire. Using factor analysis in a questionnaire survey allows researchers to identify the underlying factors that contribute to respondents' preferences or attitudes. It provides insights into the underlying structure of the data, helps reduce the complexity of the analysis, and simplifies the interpretation of the results.

The factor analysis was conducted using the collected dataset, which consisted of various variables related to individuals' attitudes, behaviors, and perceptions towards platoon control. Through factor analysis, we aimed to uncover the underlying constructs that explain the common variance among these variables. The factor analysis process is mathematically represented as follows [26]:

$$X_i = l_{i1}F_1 + l_{i2}F_2 + \cdots + l_{im}F_m + E_i \quad (1)$$

$$X = LF + E \quad (2)$$

where: X is the observed variables; L is the factor loading matrix, which shows the relationships between observed variables and latent factors; F is the latent factors; E is the error terms; i is the serial number of observed variables; and m is the serial number of latent factors.

The factor analysis results revealed three primary factors that accounted for a significant portion of the variance in the data. We named these factors based on the characteristics of the variables that loaded heavily on each factor.

The first factor, "attitude and acceptance", represented individuals' attitudes, beliefs, and acceptance towards platoon control measures. This factor captured variables such as perceived benefits, willingness to comply, and positive attitudes towards platoon management systems.

The second factor, "environment and social responsibility", reflected individuals' concerns and sense of responsibility towards the environment and sustainable transportation. Variables related to environmental impact, social responsibility, and sustainability consciousness loaded significantly on this factor.

The third factor, "personal economy and behavior", encompassed variables related to personal economic considerations and individual behavioral tendencies. This factor included variables such as cost-related factors, convenience, and habitual behaviors towards platoon control.

These factors, namely "attitude and acceptance", "environment and social responsibility", and "personal economy and behavior", collectively provided valuable insights into the factors influencing individuals' actions and perspectives towards sustainable transportation systems with platoon control measures.

By comprehending the underlying factors, transportation policymakers and practitioners can design effective interventions and strategies to promote the adoption of platoon control measures and facilitate sustainable transportation practices. Further, we employed factor analysis to identify covariates for multiple regression. The study focuses on the latent factor structure among covariates, ensuring that the selected covariates in the multiple regression model are independent [27].

2.3. Multiple Regression Analysis

In this study, we employed multiple regression analysis as a method to further investigate the factors influencing individuals' willingness to accept and adopt platoon control measures in the context of sustainable transportation systems. The utilization of multiple regression models to construct regression models for each influencing factor in the questionnaire is supported by several reasons. Firstly, following the completion of factor analysis, whereby three key factors were selected, employing multiple regression enables a simultaneous examination of the relationships between these factors and the dependent variable under consideration. Moreover, employing multiple regression makes it possible to control for the potential influence of other variables, thereby ensuring a more rigorous analysis of the selected factors. By utilizing multiple regression models, it becomes possible to assess the unique contribution of each factor in explaining the variability observed in the dependent variable. This approach facilitates the determination of the statistical significance and magnitude of the impact exhibited by each factor. In doing so, a comprehensive understanding of the relative influence and significance of each factor in relation to the desired outcome can be garnered. Given these considerations, using multiple regression models is deemed an appropriate and robust approach to construct regression models for each identified influencing factor. This analytical framework allows for a systematic and thorough investigation of the relationships between the selected factors and the dependent variable while considering the potential confounding effects of other variables. By adopting this approach, valuable insights can be obtained regarding the nature and extent of the impact exhibited by each factor, thereby strengthening the overall validity and rigor of the study's findings.

Multiple regression analysis is a widely used statistical method for analyzing the relationships between multiple independent variables and a dependent variable. It helps us understand how different independent variables affect the dependent variable while controlling for the influence of other variables. The multiple regression model used in this study is as follows:

$$Q = \beta_1 \cdot X_1 + \beta_2 \cdot X_2 + \cdots + \beta_k \cdot X_k \quad (3)$$

where: Q is the object question; $\beta_1, \beta_2, \ldots, \beta_k$ are the regression coefficients, indicating the impact of each independent variable on Q; and $X_1, X_2, \ldots, X_k$ are different independent variables, including the three factors identified in our factor analysis: "attitude and acceptance", "environment and social responsibility", and "personal economy and behavior", as well as other potential factors that may influence acceptance willingness.

Multiple regression analysis relies on several key assumptions to ensure the validity of its results. These assumptions include the presence of a linear relationship between variables, absence of multicollinearity, homoscedasticity, normality of residuals, and independence of errors.

3. Results

3.1. Questionnaire Results Statistics

In the process of conducting our questionnaire survey, we employed the online survey platform, Wenjuanxing (https://www.wjx.cn/ (accessed on 10 January 2024)), widely used in China. To ensure the representative nature of our participants, we strategically distributed the survey among various automotive enthusiast groups, encompassing individuals with diverse vehicle brands and models. Notably, the demographic characteristics of participants within these groups, including age, educational attainment, occupation, and

income, exhibited considerable heterogeneity. The adoption of this purposive sampling method allowed us to obtain a sample that reflects the diversity present among automotive enthusiasts. The questionnaire design aimed to capture insights from participants across different demographic categories, enhancing the generalizability of our findings.

In this study, we collected and analyzed extensive data related to drivers and platoon control technology. A total of 550 questionnaires were distributed, and 510 valid questionnaires were received. Prior to the analysis, it is necessary to conduct a reliability and validity test on the questionnaire data. The reliability formula is as follows:

$$\alpha = \frac{k}{k-1} \cdot \left(1 - \frac{\sum s^2}{s_t^2}\right) \tag{4}$$

where, k represents the number of items in the questionnaire; s^2 represents the variance of each item; and s_t^2 represents the total variance of all items.

The reliability result is 0.854, indicating that the questionnaire data are reliable and trustworthy. Additionally, the validity of the questionnaire results was analyzed using SPSS, yielding a validity coefficient of 0.947, demonstrating that the questionnaire data are valid.

The distribution of response options for each question is depicted in Table 3. Firstly, it is noteworthy that in terms of gender, male participants constitute a significantly higher proportion than female participants, making up 65.29% of the total sample. This observation may reflect a greater male engagement in driving and related technologies. Furthermore, the age distribution demonstrates a relatively even trend, with the 36–50 years age group comprising the highest number of participants at 36.27%, while the younger 18–35 years age group also has a considerable representation at 34.71%. In contrast, participants aged 51–60 years and over 61 years are relatively less prevalent. Concerning educational levels, those with a high school/secondary vocational education account for the highest proportion at 49.02%, followed by individuals with undergraduate degrees at 40.59%. Participants with junior high school education and those with master's or higher degrees are comparatively less numerous. It is worth noting that the majority of participants (91.18%) are not employed in driver-related occupations, with only 8.82% engaged in such professions. Regarding income levels, 43.53% of participants have a monthly income ranging from CNY 5000 to CNY 7999, while 28.04% earn between CNY 8000 and CNY 9999 monthly, and the proportions with lower and higher income levels are relatively smaller. Additionally, we discovered that approximately 41.37% of participants spend between CNY 400 and CNY 599 per month on electricity or fuel costs. Furthermore, the majority of participants have committed traffic violations no more than three times, making up 58.63%. In terms of driving experience, 42.75% have 7–10 years of experience, 30% have more than 10 years of experience, while those with less than 3 years and 3–6 years of experience constitute 8.24% and 19.02%, respectively. Concerning types of vehicles, sedans are the most prevalent, accounting for 47.45%, followed by SUVs at 27.45%. In the realm of advanced driver assistance equipment, the majority of participants (70.78%) claim ownership of such devices. Moreover, participants exhibit a favorable attitude and willingness to adopt platoon control technology. Across the survey questions, a relatively high proportion of participants express positive opinions, with a significant number holding either a level 4 or 3 attitude rating, indicating their generally favorable view of platoon control technology. Analyzing the distribution of participant characteristics, as illustrated in Table 3, reveals that educational levels and income exhibit an approximation to a normal distribution. Moreover, the predominant age group is characterized by individuals in their mid to young adulthood. These findings are consistent with established patterns observed in prior studies conducted by Zhang et al. [28], Li [29], and Xiao et al. [30]. The alignment of our results with those of previous research contributes to the robustness and representative quality of our questionnaire outcomes. This comprehensive survey process, grounded in methodological rigor and alignment with existing literature, enhances the credibility and validity of the gathered data.

Table 3. The options distribution for Q1–Q19.

Item	1	2	3	4	5
Q1	65.3%	34.7%	-	-	-
Q2	34.7%	36.3%	21.6%	7.5%	-
Q3	0%	5.9%	49.0%	40.6%	4.5%
Q4	8.8%	91.2%	-	-	-
Q5	5.5%	43.5%	28.0%	18.2%	4.7%
Q6	4.7%	18.8%	41.4%	25.3%	9.8%
Q7	58.6%	31.0%	6.5%	3.9%	-
Q8	8.2%	19.0%	42.7%	30.0%	-
Q9	18.2%	47.8%	28.6%	5.3%	-
Q10	47.5%	27.5%	15.5%	4.3%	5.3%
Q11	70.8%	29.2%	-	-	-
Q12	0.6%	8.8%	32.4%	43.5%	14.7%
Q13	1.0%	9.0%	31.2%	44.9%	13.9%
Q14	1.6%	7.5%	27.6%	47.8%	15.5%
Q15	1.8%	7.3%	27.6%	49.6%	13.7%
Q16	1.0%	6.7%	28.0%	49.8%	14.5%
Q17	0.4%	7.8%	32.2%	46.3%	13.3%
Q18	1.6%	7.6%	29.6%	46.1%	15.1%
Q19	1.2%	9.2%	31.8%	42.9%	14.9%

3.2. Correlation Analysis

In this study, we conducted a comprehensive survey of various factors pertaining to drivers, including gender, age, education level, occupation, income level, monthly electricity or fuel expenditure, frequency of traffic violations, driving experience, monthly mileage, and vehicle type. We subsequently analyzed the correlations between these factors and the level of acceptance and willingness to adopt platoon control technology.

Initially, the analysis revealed that gender (Q1) exhibited relatively weak correlations with other factors, with the highest correlation coefficient at 0.055780 (see Figure 1). This suggests that gender is only weakly associated with the other variables. While the analysis did not reveal strong gender-related correlations, it does not necessarily imply that gender has no impact on other factors. Further investigation may be warranted in this regard.

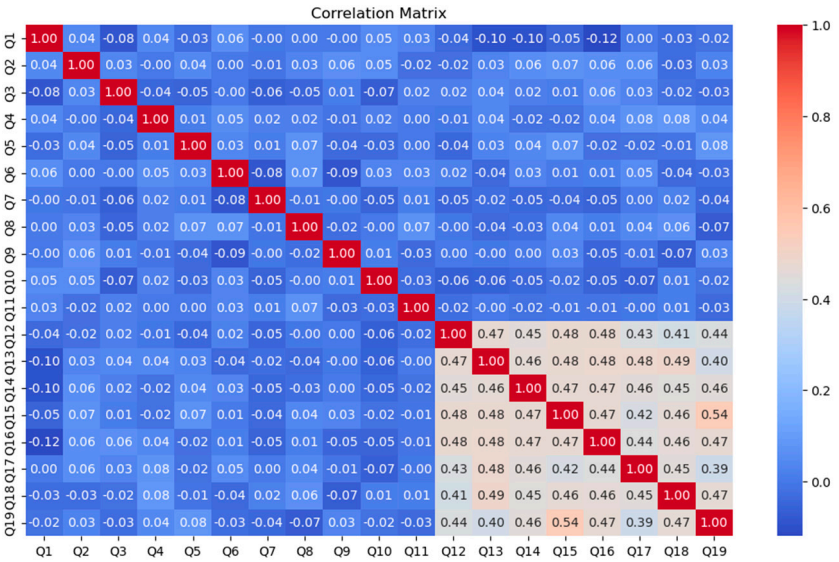

Figure 1. Correlation matrix.

Age (Q2) similarly displayed relatively weak correlations with other factors, with the highest correlation coefficient at 0.066031, indicating a slight positive correlation between age and attitudes towards the sustainability-enhancing aspects of platoon control technol-

ogy (Q14). This suggests that older participants may hold a somewhat more positive view regarding the sustainability benefits of platoon control technology, although the correlation strength is not high.

The utilization of advanced driver assistance equipment (Q11) demonstrated relatively weak correlations with other factors, with the highest correlation coefficient at 0.067661, pointing to a modest positive correlation with driving experience (Q8). This might imply that drivers using advanced assistance equipment are more likely to possess extensive driving experience; however, the correlation remains moderate at best.

Conversely, the questions relating to acceptance and willingness to adopt platoon control technology (Q12–Q19) exhibited stronger correlations. Most of these correlations were above 0.4, with some approaching 0.5, signifying a notable interrelationship between acceptance and willingness to adopt. This is a significant finding, suggesting a synergistic relationship between attitudes towards platoon control technology in these aspects. These correlations provide in-depth insights into the associations between participants' attitudes and behaviors across various dimensions. Such insights hold crucial implications for policy formulation, decision-making, and further research. Nevertheless, it is imperative to conduct additional research to ascertain the statistical significance and offer deeper interpretations of these correlations.

3.3. Factor Analysis Results

In this research, we conducted factor analysis to explore the latent structure and causal relationships within the set of questions (Q1 to Q19). Based on an analysis of the factor loading matrix, we assigned names to these three factors to enhance our understanding of the concepts and characteristics they represent (see Figures 2–5). In addition, the first factor has the highest contribution (approximately 22.3% of the total variance), while the second and third factors contribute around 16.6% and 16.1%, respectively.

1. Attitude and Acceptance Factor (F0): This factor encapsulates participants' attitudes and acceptance levels regarding platoon control technology. Questions Q12, Q13, Q14, Q15, Q16, Q17, Q18, and Q19 exhibited significant positive loading values on this factor, indicating their substantial influence on participants' attitudes and acceptance levels. This factor reflects participants' attitudes towards platoon control technology, their endorsement of its utility, and their associated perspectives. This factor consisted of questions primarily related to attitudes and acceptance towards a specific concept or phenomenon. Since the questions that fell under this factor focused on individuals' perspectives and willingness to embrace certain ideas, we designated it as the "attitude and acceptance" factor.
2. Environment and Social Responsibility Factor (F1): This factor concentrates on participants' considerations of the impact of platoon control technology on the environment and social responsibility. Questions Q3 and Q9 displayed notably high negative loading values on this factor, suggesting their association with environmental and social responsibility concerns. This factor mirrors participants' views regarding the technology's effects on environmental sustainability and social responsibility. The questions grouped under this factor encompassed variables such as educational background and driving distance. These variables are closely associated with social and environmental aspects. Therefore, we named this factor the "environment and social responsibility" factor to highlight the connection between these variables and their broader implications.
3. Personal Economy and Behavior Factor (F2): This factor centers around participants' personal economic status and related behaviors. Questions Q2, Q5, and Q10 demonstrated significant positive loading values on this factor, signifying their close association with participants' personal economic circumstances and related behaviors. This factor reflects participants' perceptions of how platoon control technology affects their personal economic situation and behaviors. The questions within this factor predominantly explored individuals' economic status and the types of vehicles as-

sociated with their driving behaviors. As such, we named this factor the "personal economy and behavior" factor to capture the main themes of the questions related to personal finance and driving habits. The summary of factors is in Table 4. In addition, the description statistics of factors is in Table 5.

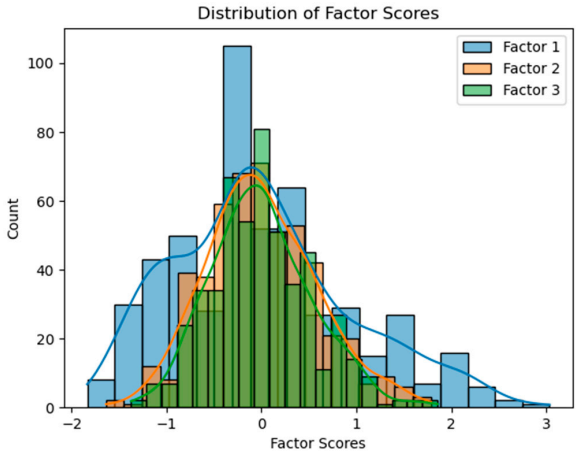

Figure 2. Distribution of factor scores.

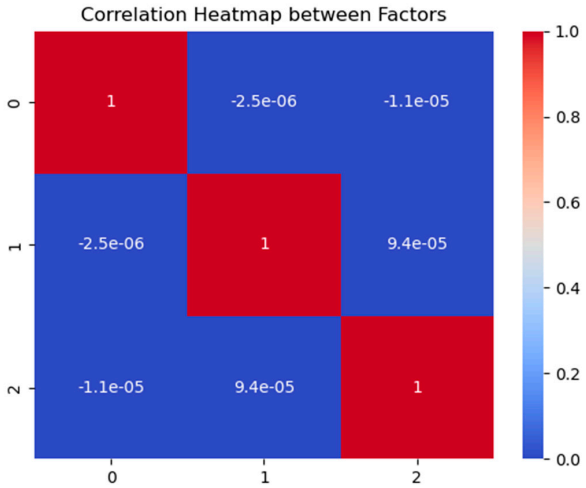

Figure 3. Correlation heatmap between factors.

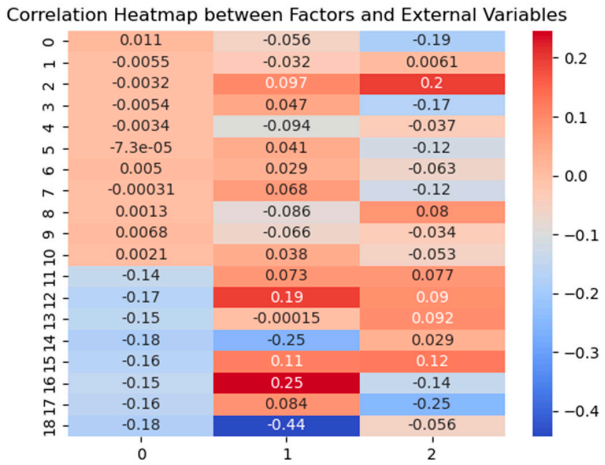

Figure 4. Correlation heatmap between factors and external variables.

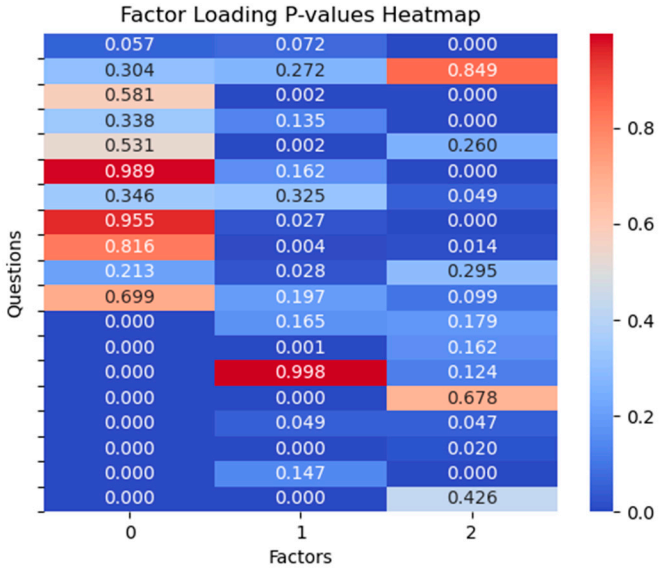

Figure 5. Factor loading *p*-values heatmap.

Table 4. The summary of factors.

Factor	Question
Attitude and Acceptance Factor	Q12, Q13, Q14, Q15, Q16, Q17, Q18, Q19
Environment and Social Responsibility Factor	Q3, Q9
Personal Economy and Behavior Factor	Q2, Q5, Q10

Table 5. Descriptive statistics of factors.

Factor	0	1	2
Count	510	510	510
Mean	0.000	0.000	0.000
Std.	0.94	0.58	0.53
Min	−1.84	−1.64	−1.37
Max	3.04	1.79	1.86

3.4. Multiple Regression Results

This section employs factors derived from factor analysis as covariates for modelling, aiming to explore the underlying relationships between each factor and Q19.

Table 6 shows the regression results between Q19 and F0. The model's R-squared value is 0.966, indicating that the independent variables jointly explain 96.6% of the variability in Q19. The adjusted R-squared value is 0.965, which suggests a good fit of the model considering the degrees of freedom. The coefficients for the independent variables (Q12, Q13, Q14, Q15, Q16, Q17, and Q18) represent the change in Q19 for a one-unit change in each independent variable, holding all other independent variables constant. In this model, Q12, Q14, Q15, Q16, and Q18 have statistically significant coefficients ($p < 0.05$), indicating that they have a significant effect on Q19. On the other hand, Q13 and Q17 are not statistically significant ($p > 0.05$), suggesting that they do not have a significant impact on Q19.

Table 6. Regression results (Q19–F0).

Item	Coef	Std Err	t	$p > \|t\|$	[0.025	0.975]	R^2	Adj. R^2	F
Q12	0.117	0.045	2.610	0.009	−0.029	0.205			
Q13	0.012	0.046	0.257	0.797	−0.079	0.103			
Q14	0.139	0.044	3.122	0.002	0.051	0.226			
Q15	0.303	0.045	6.690	0.000	0.214	0.392	0.966	0.965	2015
Q16	0.169	0.047	3.601	0.000	0.077	0.261			
Q17	0.069	0.046	1.496	0.135	−0.021	0.159			
Q18	0.174	0.044	3.972	0.000	0.088	0.260			

Table 7 shows the regression results between Q19 and F0. The model demonstrates a good fit with the data, as indicated by the high R-squared value of 0.915. This means that approximately 91.5% of the variance in the dependent variable (Q19) is explained by the independent variables (Q3 and Q9). The adjusted R-squared value of 0.914 further supports the model's strong fit, considering the number of independent variables. The coefficients of the independent variables Q3 and Q9 are both statistically significant, as evidenced by their *p*-values being less than the critical threshold of 0.05. The coefficient for Q3 is estimated to be 0.7639, implying that a one-unit increase in Q3 leads to an average increase of 0.7639 units in the dependent variable, holding other variables constant. Similarly, a one-unit increase in Q9 is associated with an average increase of 0.3980 units in the dependent variable, all else being equal.

Table 7. Regression results (Q19–F1).

Item	Coef	Std Err	t	$p > \|t\|$	[0.025	0.975]	R^2	Adj. R^2	F
Q3	0.764	0.036	21.271	0.000	0.693	0.834	0.915	0.914	2719
Q9	0.398	0.054	7.433	0.000	0.293	0.503			

Table 8 shows that the regression model between Q19 and F2 has a high level of fit, indicated by the R-squared value of 0.891. This means that 89.1% of the variation in the dependent variable (Q19) can be explained by the independent variables (Q2, Q5, Q10) in the model. The coefficients of the independent variables indicate their individual impact on the dependent variable. For every unit increase in Q2, Q5, and Q10, the dependent variable, Q19, is expected to increase by 0.4765, 0.6737, and 0.3103 units, respectively. The low *p*-values for the coefficients indicate that each independent variable significantly contributes to the model.

Table 8. Regression results (Q19–F2).

Item	Coef	Std Err	t	$p > \|t\|$	[0.025	0.975]	R^2	Adj. R^2	F
Q2	0.477	0.051	9.296	0.000	0.376	0.577			
Q5	0.674	0.040	16.680	0.000	0.594	0.594	0.891	0.890	1382
Q10	0.310	0.044	7.089	0.000	0.224	0.224			

In this study, we conducted multivariate linear regression analyses with the aim of exploring the factors that may underlie individual decisions regarding their willingness to actively adopt platoon control (Q19). Through six distinct regression equations, we have demonstrated the impact of various factors on these two decisions.

First and foremost, we have discovered that individual attitudes and acceptance play a pivotal role in determining both the acceptance of platoon control and the willingness to actively adopt it. In several equations, a positive attitude and acceptance significantly increase the likelihood of accepting platoon control and, simultaneously, enhance the likelihood of actively adopting platoon control. This underscores the significance of positive emotions and acceptance in influencing decision-making.

In the context of the study, the "environment and social responsibility" factor becomes particularly relevant, as it encapsulates the participants' considerations regarding the environmental sustainability of platoon control technology. A focus on sustainability extends to energy efficiency, as it directly impacts the reduction in fuel consumption, greenhouse gas emissions, and overall ecological footprint.

Moreover, the "personal economy and behavior" factor also assumes heightened significance in the context of energy efficiency. This factor encompasses participants' perspectives on how platoon control technology may affect their personal economic situation. By reducing fuel costs and increasing operational efficiency, platoon control aligns with energy efficiency and economic benefits. It is imperative to underscore the potential economic advantages associated with energy-efficient practices and the use of CAVs.

In addition, from the perspective of *p*-values, it can be observed that in Factor 0, there is a significant impact of Q12, Q14, Q15, Q16, and Q18 on Q19. Furthermore, all coefficients are positive, indicating a positive correlation between these questions and Q19. It is important to note that questions related to traffic efficiency (Q13 and Q17) are not statistically significant. This suggests that the public's willingness to accept platoon control of autonomous vehicles is not influenced by efficiency but rather prioritizes safety, sustainability, and energy efficiency.

In terms of Factor 1, Q3 and Q9 both exhibit statistical significance, with positive coefficients. This indicates a positive correlation between education level and monthly kilometers traveled, and the public's acceptance of platoon control in autonomous driving. It suggests that social division of labor and sustainable driving are among the important factors influencing the public's perception of platoon control.

In terms of Factor 2, Q2, Q5, and Q10 all exhibit statistical significance, with positive coefficients. This indicates that the acceptance of platoon control by the public is influenced by economic level and driving behavior.

Based on the outcomes of the factor analysis, wherein Factor 0 demonstrates a higher degree of representativeness, a plausible deduction can be made regarding the public's inclination to prioritize the ability of platoon control to furnish them with a driving environment that is not only safer but also more sustainable and energy efficient. Crucially, safety stands as the bedrock upon which platoon control is built, and its widespread implementation shall solely come to fruition upon fulfillment of the imperative safety prerequisites. Consequently, it is warranted to assert that during the developmental and evaluative stages of platoon control, utmost attention should be given to the aspects of sustainability and energy efficiency.

4. Conclusions

This study provides critical insights into the public's acceptance of platoon control for Connected and Automated Vehicles (CAVs) and explores these insights from a sustainability perspective. Firstly, our factor analysis results have categorized the factors related to public attitudes and acceptance, as well as those pertaining to the environment, social responsibility, personal economics, and behavior, into three primary factors: "attitude and acceptance", "environment and social responsibility", and "personal economy and behavior".

In the multivariate regression analysis, we found that the "attitude and acceptance" factor plays a crucial role in explaining the public's willingness to accept platoon control. This emphasizes the paramount importance of public attitudes and acceptance in the successful adoption of CAVs. Furthermore, the "environment and social responsibility" factor and the "personal economy and behavior" factor also exert some influence on these decisions, particularly among individuals who prioritize environmental sustainability and social responsibility, as well as those who exhibit a more positive attitude towards economic and behavioral aspects.

These findings offer valuable insights for policymakers and relevant stakeholders on how to enhance the acceptance of CAVs and promote sustainable development within the transportation system. When promoting CAVs, particular attention should be given to public attitudes and acceptance, while concurrently implementing policies to foster

social responsibility and stimulate positive individual economic and behavioral attitudes. Ultimately, this approach contributes to the establishment of a more sustainable intelligent transportation system, making a positive contribution to the future of the transportation sector. In subsequent research, we will further analyze the public's acceptance of platoon control and specify control strategies based on the conclusions of this paper.

While efforts were made to include a diverse social group, it is important to acknowledge that achieving complete representativeness of the entire population is challenging. The study's findings should be interpreted within the context of the sampled population, and generalizations to the broader population should be made cautiously. Any biases or limitations in the sample selection process should be transparently discussed to provide a comprehensive view of the study's scope. Furthermore, building upon the conclusions drawn in this study, our future research endeavors will prioritize targeted questionnaire design and employ survey methodologies with enhanced theoretical underpinnings. Additionally, we intend to incorporate more theoretical support into the statistical analysis of data.

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