The Potential of Autonomous Vehicles to Improve Road Safety and Sustainability: An Empirical Study of Driver Acceptance of Connected Technology in the UK

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Abstract

Traffic levels have increased such that congestion is a major occurrence in many urban areas, creating uncertainty around journey times as well as more incidents with significant damage and accidents, placing lives at major risk. Our focus is on the development of mobile connective technology, such as vehicle-to-vehicle (V2V) or vehicle-to-infrastructure (V2I), where vehicle manufacturers have begun to devise real-time travel information systems that may reduce traffic delays (and hence pollution) and the possibility to improve road safety and travel for vehicle users. Transport fleets have increased over time, leading to increasing damage and accidents, placing lives at major risk and creating uncertainty. Given this context, there is interest in using autonomous vehicles (AVs) to improve efficiencies and safety in the transport sector for commercial journeys as well as passenger vehicles.

The existing literature on the acceptance of autonomous vehicles has been developing; however, the study of users' acceptance of emerging autonomous vehicles and connected technology is still in its infancy. This research explores the user perspective with regard to relevant factors and the potential of connected technology to overcome the shortcomings of sensors for autonomous vehicles such as cameras, radar, ultrasonic and LiDAR during adverse driving conditions. In this study, we supplement the Technology Acceptance Model (TAM) with driver context (from pervasive computing studies) and technology attributes (compatibility, trust and safety) with some personal attributes to investigate non-professional and professional drivers' perspectives.

The respondent data obtained from 203 users in the UK were analysed quantitatively using Structural Equation Modelling (SEM) to establish relationships amongst factors that influence user's attitudes to these emerging technologies. The study results indicated that the factors that most influence users' perceptions of AVs were shown to be perceived usefulness, driver context, and trust, which demonstrates that TAM is still relevant to understanding users' attitudes towards AVs. In addition, it signifies the relevance of pervasive computing as a body of study that contributes to user perceptions of connected technology in terms of driver context. Further study into individual attributes such as personal innovativeness is strongly recommended to better understand users' attitudes towards connected technology and mobility.

Keywords: autonomous vehicle (AV), vehicle-to-vehicle (V2V), technology acceptance model (TAM)

1. Introduction

Urban areas are becoming increasingly congested with delays and longer travel times polluting the environment. Due to increasing innovation and technological improvements, vehicle manufacturers have started strategising significant approaches to improve journey efficiency and safety by adopting connective technology [1]. This has resulted in the onset of the development of technology real-time information and connective applications, such as V2V and V2I, which are emerging networking applications that are inherently ubiquitous (or Pervasive) computing in nature for drivers, both professional and non-professional.

Given the interest in autonomous vehicles by the transport sector and manufacturers, it is crucial to understand the factors affecting their adoption. [2] emphasizes the importance of examining user adoption behaviour in the automotive industry during the diffusion of innovation. Similarly, [3] argues that it is too early to assume widespread public support for autonomous vehicles, as there are still many factors that may discourage people from adopting the technology. This underscores the need for further research and understanding in this area, which can help government institutions and the automotive industry to drive the widespread adoption of this technology [4].

2. Research Approach

Recent studies of user acceptance of autonomous vehicles have been conducted at the early stage of their development, when drivers may, in certain cases, take control of the vehicle. There is a need to update these studies as the level of automation increases and

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new technologies become available. V2V and V2I enable information sharing in real-time to provide updates and identify potential hazards. The applications of mobile connective technology are still developing and aim to enhance road safety, reduce traffic accidents, and improve traffic flow.

This paper reports on an empirical study that examines drivers' perceptions towards autonomous vehicle applications as well as mobile connective technologies with a focus on V2V and V2I applications. Additionally, this research will evaluate how this technology can assist the autonomous vehicle industry to be successful and reach its potential with knowledge and insights into the factors affecting user's technology acceptance. A survey that utilised online questionnaires was distributed to both professional and non-professional drivers to gain insights into users' perspectives. The respondents were selected through different methods, including technical companies and Brunel University London postgraduate students.

2.1. Background and Related Work

In order to communicate with other vehicles in front of them, the use of V2V technology is utilised and helps vehicles obtain more accurate routes [5] and [6]. Mobile connective technology was fundamentally developed to enable V2V sharing and real-time data exchange from vehicles to technologies. It enhances the potential for short range communications and increases safety and awareness applications between interconnected vehicle systems and sensors. It enables vehicles to access real-time information based on speed, distance, and journey efficiency from another V2V application accessed from a wireless connection such as a 5G connection [7] and [8]. It aims to alert drivers of other V2V-connected vehicles, which could reduce the possibility of accidents through the awareness of hazards and collision avoidance.

The applications include equipment breakdown, dedicated short-range communications technology, and V2V sensors that are being applied to more intelligent navigation. The V2V cruise control system aims to detect hazardous traffic and road conditions and identify challenges that may arise within 300 meters of the vehicle. This presents drivers with the possibility of understanding and analysing the conditions and behaviour of other vehicles under adverse driving conditions. It also included definitions of overlaps that analyse the potential behaviour of other drivers who might alter routes without notice [6]. The application defines how the previous vehicle can interact and maintain speed and distance from other cars without causing any damage or noticeable accidents. The V2V application has also been developed and divided into separate categories for more modern applications such as lane change, electronic emergency brake light and forward collision warning [9].

The application of comprehensive computing to automotive technology is essential since cars have become an integral part of modern life [10] and [11]. At present, computers are largely built into cars, such as the automatic reflection system for airbags, the anti-lock braking system (ABS) system, and a central locking system [12] and [13]. Moreover, with the development of such technologies (including communication innovations), the computing power that exists within one chip is excelled because it allows the car to have more opportunities and facilitate the activities of drivers, allowing them to enjoy better performance, comfort, and safety. The extent literature on pervasive computing has been utilised during this research with Driver Context being included as part of the conceptual model as this explicitly recognises the situation of a driver.

3. Theoretical Framework

The study will follow the basic assumptions of the original TAM proposed [14] and [15]. Hence, the findings are in line with previous consumer acceptance research in the field, such as the model proposed by [16] the model proposed by [17]. Consequently, this study will conduct an in-depth analysis of their perspectives and treat them as helpful information that will assist this study in determining how these technologies have evolved and whether any new ones have been developed expressly for autonomous vehicles.

The model is an adaptation of the one proposed by [18] extending their findings for autonomous vehicles and connected technologies. Figure 1 comprises TAM (on the right); Professional Setting (in the middle) and Personal Attributes (on the left).

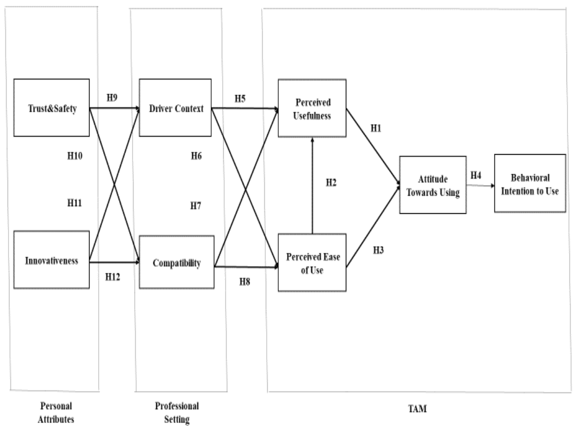

Figure 1. Theoretical Framework

In this study TAM has been utilized in Personal Attributes of the conceptual model and supplemented with driver context (from pervasive computing studies); technology attributes (compatibility; trust and safety) and with some personal attributes that assesses some individual characteristics.

Professional Setting comprises firstly, driver context (from the pervasive computing literature) and secondly, compatibility (with regards to other equipment being used by a driver).

As indicated in Table 1, the many constructs recommended to develop a conceptual framework for this research that aims to affect TAM to enhance the road safety and productivity of AV technology discovered in the existing literature.

Table 1. Framework Constructs of the Research

Construct	Conceptualisation
Behavioural Intention to Use (BI)	The individual's motivational readiness to use or not to use autonomous driving.
Attitude Towards Using (ATU)	The degree to which an individual has a favourable or unfavourable evaluation of using autonomous driving.
Perceived Usefulness (PU)	The degree to which autonomous driving results in a positive use–performance relationship.
Perceived Ease of Use (PEOU)	The degree to which an individual believes that using autonomous driving is free of effort.
Driver Context (DC)	The degree to which autonomous driving results in better visibility and communication management.
Compatibility (COP)	The degree to which autonomous driving is perceived as consistent with existing mobility options.
Trust (TR) and Safety (SF)	The ability to forecast the predictability and functionality of autonomous driving.
Innovativeness (INV)	The willingness of an individual to try out autonomous driving.

4. Hypotheses Development

4.1. TAM

Popular constructs (perceived utility from the TAM framework) were used by [19] to explain technological uptake. Beliefs that adopting a particular piece of technology would improve one's efficiency are measured by its PU. Moreover, PEOU refers to the degree to which a person feels that utilising a specific technology would be effortless.

The studies conducted by [20] demonstrated that potential users' intentions to utilise AV improved significantly as their perception of its PU increased. Moreover, there was a moderate increase in the intentions of prospective users to utilise AV technology as their perception of its PEOU enhanced. In addition, according to research cited by [19], the TAM components may be used to forecast user adoption of various new technologies. Therefore, it is anticipated that AVs will provide additional advantages to users by improving road safety, creating decreased traffic, and having lower energy consumption, which will lead to greater adoption of the technology. Notably, the current AV technology does not have a standardised architecture design [21]. Hence, PEOU will have a significant impact on BI and ATU since the user may have high expectations regarding how to operate or navigate an AV. These assumptions are summarised in the following hypotheses:

H1: The Perceived Usefulness of the technology has a positive influence on the Attitude Towards Using. H2: The Perceived Ease of Use of the technology has a positive influence on its Perceived Usefulness.

H3: The Perceived Ease of Use of the technology has a positive influence on the Attitude Towards Using.

H4: The Attitude Towards Using of the technology has a positive influence on the Behavioural Intention to Use.

4.2. Professional Setting

In the context of driving, [22] found that DC was a mediator between environmental factors, especially traffic congestion, and driving behaviour. These factors reflect the increasing pressure on the transport sector and impact sustainable mobility. Understanding various driving contexts makes it possible to verify theories about how a driver would behave in those scenarios. Furthermore, this information can be used to provide helpful recommendations aimed at enhancing their driving ability. Consequently, TAM has been widely employed and extended in the context of driving scenarios to predict drivers' acceptance and utilisation of various AV technologies and additional features needed in a transportation system [23].

In addition, in the context of autonomous driving, the concept of COP has been described by [24] as the extent to which potential users consider innovation compatible with their current values, prior experiences, and requirements. As a kind of innovation, AVs might alter people's current travel patterns and ideas. Besides, [25] indicates the positive influence of compatibility on attitude, while [26] established a favourable relationship between ATU, PU, COP and BI. With respect to a piece of research done by [27], COP greatly determines PU and BI. Thus, the following hypotheses were advanced:

H5: The Driver Context of the technology has a positive influence on its Perceived Usefulness.

H6: The Driver Context of the technology has a positive influence on its Perceived Ease of Use.

H7: The Compatibility of the technology has a positive influence on its Perceived Usefulness.

H8: The Compatibility of the technology has a positive influence on its Perceived Ease of Use.

4.3. Personal Attributes

As stated by [18], the original TAM and prior research have demonstrated that innovativeness influences a user’s acceptability of automobile solutions. Perceived usefulness and perceived ease of use are positively affected by the elements in the case of autonomous vehicles, as demonstrated by innovative users' more favourable positive perceptions and adoption rates.

In addition, [20] defined trust as the willingness to place oneself in a vulnerable position regarding technology in anticipation of a beneficial outcome or positive future behaviour. However, [16] mentioned that the TR construct should be included to explain the individual acceptance of driving assistance technologies. Consequently, Ghazizadeh's studies have explored numerous trust-affecting constructs based on the current literature on automation. Additionally, research studies of [17] and [28] investigated that TRandSF is a significant variable of drivers' attitudes regarding AVs; it should be emphasised, however, that because the majority of users have not yet interacted with AVs [29]. Thus, this study advocated including TRandSF in the original TAM and anticipated that:

H9: Trust and Safety have a positive influence on the Driver Context of the technology.

H10: Trust and Safety have a positive influence on the Compatibility of the technology.

H11: Innovativeness has a positive influence on the Driver Context of the technology.

H12: Innovativeness has a positive influence on the Compatibility of the technology.

5. Methodology

Between November 2022 and January 2023, a collection of data was generated by surveying 203 individuals in the United Kingdom. The survey utilised online questionnaires that were distributed to both professional and non-professional drivers. The respondents were selected through different methods, including technical companies and Brunel postgraduate students. The questionnaires used a Likert scale with seven points, ranging from 1 (strongly disagree) to 7 (strongly agree). This scale was adapted from existing literature. The primary objective of this study is to collect the perspectives and attitudes of the participants on autonomous vehicles and connected technologies. Prior to conducting SEM analysis, it is essential to provide a comprehensive description of the demographic characteristics of the participants. Additionally, it is essential to check for outliers, examine box plots, and evaluate the reliability and normality of the data [30].

As reported by [31], the use of AMOS programs to modify this structural equation modelling (SEM) approach is highly suitable, as it has been argued that the study conducted using this software would yield more precise outcomes. SEM was employed to assess the magnitude of the association between factors and user attitudes. The analysis of structural equation modelling (SEM) was performed using AMOS 28.0 software, which incorporates two primary models for analysis: the measurement model and the structural model. The measurement model examines the association between research instruments and the research variable through the use of reliability and validity analysis, followed by factor analysis to assess the fit indices of the variable. The structural model involves executing path analysis and hypothesis testing [32]. In addition, factor analysis was used to illustrate the factor loading and determine the convergent validity. Consequently, the validity and reliability of the study instrument were assessed using Cronbach's alpha (α), average variance extracted (AVE), and composite reliability (CR) as indicated by [33].

5.1. Participants and Data Collection

As evidenced by the data presented in Table 2, the participants in the study provided their basic demographic details and subsequently completed a variety of questions related to the eight constructs. The survey initially included participants from various age groups, which can be classified into four categories. The majority of the participants of this survey are non-professional drivers, with 54.7% of respondents classifying themselves as non-professional drivers and the remaining 45.3% identifying as professional drivers. Moreover, in terms of the amount of driving experience that the respondents had, the majority of the participants (39.5%) had between 4 to 9 years of experience.

Table 2. Demographics of Respondents

Characteristics	Items	Frequency (n=203)	(%)
Age group	18-24	69	34
	25-34	63	31
	35-54	57	28.1
	55+	14	6.9
Gender	Male	143	70.4
	Female	60	29.6
Are you a professional driver	Yes	92	45.3
	No	111	54.7
Driving experience (years).	1-3	54	26.6
	4-9	80	39.5
	10-15	40	19.7
	16-or more	29	14.3
Weekly mileage	0-49	52	25.6
	50-99	64	31.5
	100-199	64	31.5
	200-499	16	7.9
	500-or more	7	3.5

5.2. Survey Data Analysis

The survey, which was designed and utilised online questionnaires, was distributed to both professional and non-professional drivers, surveying 203 individuals in the United Kingdom. As previously published by [30], outlying values are shown by small circles that lie outside of the box plot. As shown in Figure 2, this paper discovered twelve points beyond the minimum and maximum values. Box plots display the potential range of scores for every factor and identify any exceptional values for AV and V2V.

The initial set of hypotheses (H1, H2, H3, and H4) examine four variables, namely, behavioural intention to use (BI), perceived usefulness (PU), perceived ease of use (PEOU), and attitude towards using (ATU). The following hypotheses (H5, H6, H7, and H8) examine the impact of compatibility (COM) and driver context (DC). The third group of hypotheses (H9, H10, H11, and H12) analyse the impact of applications utilising trustandsafety (TRandSF) and innovativeness (INV).

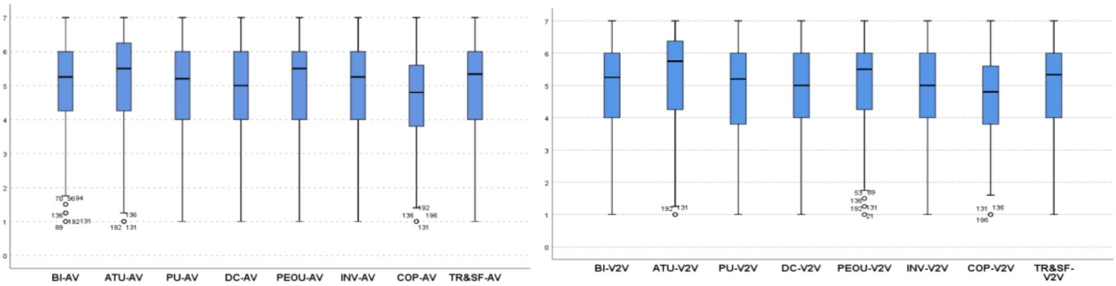

Figure 2. Constructs Box Plots AV and V2V

Additionally, Cronbach's alpha scores for all constructs in the various technologies indicate that all constructions received a score of more than 0.7, indicating that all constructs are highly reliable [34]. Whereas the highest AV and V2V reliabilities were ATU at 0.886 and 0.885 for all constructs, the lowest reliabilities were DC at 0.697 and 0.693. [35] noted that the normality assumption was examined before proceeding with SEM. [36] the normality should be ≤ 2.58.

Table 3. Reliability, DS and Normality Tests

Construct	Tech	(α)	Mean	Skewness	Kurtosis
BI	AV V2V	0.886 0.885	5.13 5.02	-0.76 -0.68	-0.20 -0.44
ATU	AV V2V	0.853 0.871	5.30 5.37	-0.91 -0.91	0.20 -0.07
PU	AV V2V	0.697 0.693	5.00 5.01	-0.68 -0.59	-0.19 -0.58
DC	AV V2V	0.877 0.873	4.84 4.92	-0.50 -0.47	-0.48 -0.48
PEOU	AV V2V	0.854 0.872	5.19 5.23	-0.89 -0.72	-0.04 -0.23
INV	AV V2V	0.778 0.765	5.04 4.98	-0.67 -0.70	-0.30 -0.28
COP	AV V2V	0.778 0.772	4.76 4.75	-0.57 -0.62	-0.10 -0.14
TR and SF	AV V2V	0.886 0.885	5.05 4.99	-0.92 -0.80	0.26 -0.02

As shown in Table 3, the data demonstrates a normal distribution in all AV and V2V constructs, with Skewness values ranging from 1.013 to 0.47 and Kurtosis values between - 0.58 and 0.34. Moreover, the table also shows the means of the constructs. The descriptive statistics reveal that all items of AV and V2V constructs have a mean score of larger than 2.5 and a small standard deviation, indicating that most participants agreed with them, reinforcing the research's validity.

6. SEM Results

This study concerns the potential of connective technology to improve road journeys and sustainability, particularly in urban areas. SEM was utilised to better model the factors that influence drivers. The SEM incorporates two primary models for analysis: the measurement model and the structural model. The measurement model examines the association between research instruments and the research variable through reliability and validity analysis, followed by factor analysis to assess the fit indices of the variable. The structural model involves executing path analysis and hypothesis testing [32]. Confirmatory factor analysis (CFA) was conducted as a preliminary step to evaluate the measurement and structural model [37]. Moreover, [36] reported that all observable variables or items' factor loadings (FLs) are proven to be above the essential threshold of 0.50. Similarly, [31] emphasised that factor loadings below 0.5 are excluded during this procedure.

Initially, CFA was used to illustrate the factor loading and determine the convergent validity, as recommended by [37]. Consequently, the validity and reliability of the survey instrument were assessed using Cronbach's alpha (α), average variance extracted (AVE), and composite reliability (CR), as indicated by [33]. However, in relation to V2V, the CFA loadings for all items exhibit values greater than 0.5, except for one item, which was at 0.27. In addition, as [38] criteria presented in the results of the V2V study indicated that the CFA performed did not meet the requirements. Consequently, it is recommended to re run the CFA to enhance the fit indices [33] and [39]. After adjustments to the CFA, the RMSEA was found to be 0.061, the CMIN/DF=1.709 and the AGFI exceeded the threshold of 0.80.

During testing, variables need to have an average variance extracted (AVE) value of at least 0.5, which [36] were able to achieve. In addition, Table 4 illustrates the constructs demonstrated composite reliability (CR) of ≥ 0.7, indicating the validity of the scale by [35]. However, the results of this research agree with [40], whose studies aimed to achieve the mandatory level of value for AVE and CR, which are greater than or equal to 0.455 and 0.6.

Table 4. FLs, AVE and CR

Construct	Items	FLs-AV	FLs-V2V	AVE	CR
BI	B1	0.748	0.778		
	B2	0.783	0.898	0.574	0.843
	B3	0.743	0.835	0.695	0.901
	B4	0.756	0.818		
ATU	A1	0.773	0.857		
	A2	0.817	0.814	0.644	0.878
	A3	0.816	0.809	0.681	0.895
	A4	0.802	0.819		
PU	P1	0.662	0.781		
	P2	0.691	0.771	0.490	0.827
	P3	0.655	0.740	0.580	0.874
	P4	0.729	0.729		
	P5	0.756	0.786		
DC	D1	0.686	0.721	0.539	0.700
	D2	0.780	0.736	0.531	0.693
PEOU	E1	0.833	0.801		
	E2	0.852	0.891	0.642	0.877
	E3	0.780	0.699	0.610	0.861
	E4	0.735	0.718		
INV	N1	0.727	0.769		
	N2	0.790	0.796	0.623	0.868
	N3	0.882	0.861	0.654	0.883
	N4	0.748	0.807		
COP	C2	0.683	0.727		
	C3	0.760	0.846	0.556	0.833
	C4	0.754	0.705	0.579	0.846
	C5	0.781	0.758		
TRandSF	TS1	0.741	0.699	0.580	0.806
	TS2	0.749	0.747	0.533	0.774
	TS3	0.794	0.743		

Regarding the SEM analysis performed in this investigation, the AV and V2V did not initially meet the standards. Therefore, as mentioned by [38], steps were taken to re-run the SEM to meet the GOF test requirements. Figure 3 displays the SEM of V2V after modifications, which indicated RMSEA =0.061 and CMIN/DF =1.715

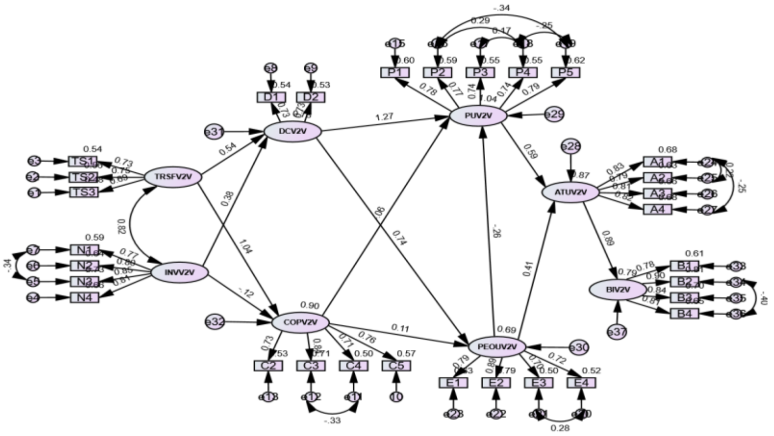

Figure 3. SEM for V2V after the modifications

As shown in Table 5, the results of the current work demonstrated that β estimates were investigated and found to be within an acceptable range for eight of the latent constructs. Furthermore, a significant correlation was observed between most of the constructs, as evidenced by the critical ratios (CR), exceeding 1.96. The statistical significance of this result was determined using AMOS (***). According to the results of [41] when the critical ratio (CR) is greater than or equal to 1.96, and the t statistics have a p-value less than 0.05, which means the result is significant.

Table 5. Summary of Accepted and Rejected Hypotheses

Construct.	Tech	Est (β)	S.E.	C.R.	Sig P	Result
H1 (PU --> ATU)	AV V2V	0.947 0.697	0.142 0.099	6.691 7.064	*** ***	Sig. Sig.
H2 (PEOU --> PU)	AV V2V	-0.149 -0.291	0.146 0.192	-1.022 -1.521	0.307 0.128	Insig. Insig.
H3 (PEOU --> ATU)	AV V2V	0.220 0.543	0.097 0.108	2.276 5.025	0.023 ***	Sig. Sig.
H4 (ATU --> BI)	AV V2V	0.986 0.799	0.093 0.072	10.583 11.092	*** ***	Sig. Sig.
H5 (DC --> PU)	AV V2V	0.949 1.314	0.221 0.288	4.291 4.559	*** ***	Sig. Sig.
H6 (DC --> PEOU)	AV V2V	0.682 0.679	0.151 0.149	4.512 4.556	*** ***	Sig Sig
H7 (COP --> PU)	AV V2V	-0.100 -0.065	0.146 0.177	-0.686 -0.368	0.493 0.713	Insig Insig
H8 (COP --> PEOU)	AV V2V	0.057 0.115	0.160 0.146	0.355 0.789	0.723 0.430	Insig Insig
H9 (TRSF --> DC)	AV V2V	0.583 0.520	0.134 0.131	4.355 3.962	*** ***	Sig Sig
H10 (TRSF --> COP)	AV V2V	0.922 0.879	0.141 0.157	6.523 5.613	*** ***	Sig Sig
H11 (INV --> DC)	AV V2V	0.464 0.322	0.122 0.108	3.797 2.983	*** 0.003	Sig Sig
H12 (INV --> COP)	AV V2V	-0.026 -0.087	0.106 0.109	-0.247 -0.795	0.805 0.427	Insig Insig

The research hypotheses explored in this survey are presented in the previous table, which displays the outcomes of the SEM analyses. This table indicates whether each hypothesis was accepted or rejected as shown in the last column. The results of this study as indicated in Figure 4, show that this part of the analysis is statistically significant (P value< 0.05). Furthermore, the SEM results showed that the TAM regarding AV and V2V is significantly affected by H1, H2, and H4. However, AV and V2V had no significant effect on H2. In contrast, AV and V2V had a significant impact on H5 and H6 indicating the contribution of driver context as a factor influencing users' acceptance. Whereas, H7 and H8 demonstrated no significant influence on the professional setting factors which suggests that the system compatibility is not of concern at present. In addition, the findings of the survey revealed that the factors of personality attributes had a statistically significant impact on H9, H10 and H11 which indicates that individual attributes should be considered in future studies in this field of technology acceptance.

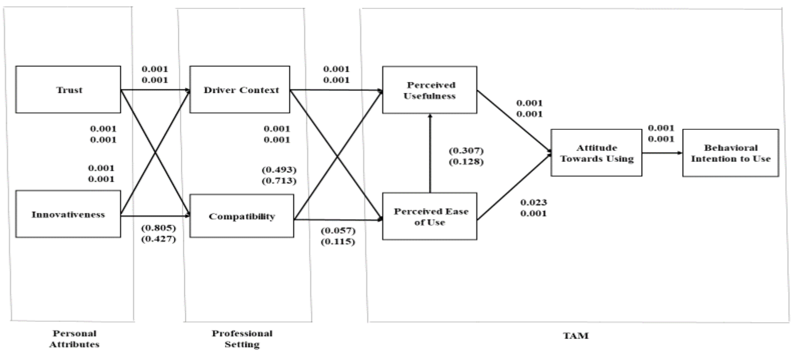

Figure 4. SEM with P-value for AV and V2V

7. Discussion

This study examines the relationships between eight constructs regarding autonomous vehicle technology. The TAM is conceptualised on the basis of a model created by [14] and [15]. According [42] this consequence was predicted due to the data's limited size and the respondent population's demographic focus. Similarly, the present study collected from 203 professional and nonprofessional drivers in the UK initially failed the initial goodness-of-fit (COF) tests for CFA and SEM. [31] considered RMSEA, CFI, TLI, and Chisq/df to reach the GOF tests with near-perfect results. Moreover, [43] argues that CFA and SEM should include at least four model fit tests, as no single model can guarantee a perfect fit. Therefore, the model of the present study of CAF and SEM have successfully undergone GOF tests after modifications, demonstrating strong results for AV and V2V.

The TAM showed a positive influence among the hypotheses, as previously demonstrated by [18] in terms of PU, PEOU and ATU for autonomous vehicles. Additionally, [44] and [45] stated PU is a main effect of BI which has been confirmed in this study. In addition, users might utilise the autonomous vehicle to do different internet activities inside their vehicle. Consequently, this increases the PU of AVs, which will significantly impact their adoption [46]. Respondents exhibited a positive attitude towards AVs as suggested in this study. This is supported by the research conducted by [46]; who discovered that ATU is the most significant predictor of a user's interest in driving AVs in their prediction model. [47] performed a questionnaire survey directly on the respondents; in line with this study's approach ATU across different age groups.

Notably, the present study exposed that the driver context variable was employed for the first time as a construct to assess user adoption of AV and V2V. A strong positive relationship was discovered through H5 and H6. This was due to understanding various driving contexts, such as environmental factors and driving behaviours [48]. As a result, the information presented in the study evaluates how these factors enhance driver safety. In turn, this enables users to confidently accept V2V technology. Consequently, pervasive computing and TAM the applications and elements have been widely employed. This extends in the context of driving scenarios to predict drivers' acceptance and utilisation of various AV technologies and additional features needed in a transportation system [23]. However, [22] reported the challenge in determining the driving contexts results from a need for more environment and/or driver monitoring; therefore, the authors recommended monitoring environments with the use of cameras installed inside vehicles.

The compatibility hypotheses such as H7 and H8 showed a negative relationship between constructs for both technologies AV and V2V. Nevertheless, [49] evaluate the interaction between the driver's inattention and vehicle automation. This can be complicated and should be considered during the development of an upcoming vehicle. Moreover, [25] stated COP and DC constructs have an ambiguous effect on TAM, which requires further research [24]. Furthermore, based on analyses of the statistics, it appears that the constructs related to AV and V2V exhibit insignificant results. To obtain statistical significance in hypothesis testing, it is recommended to include extra items in the questionnaire due to a lack of sufficient understanding of these new technologies by the general public [50]. Similarly, [51] note that AVs are arguably more compatible with the existing lifestyle, past experiences and transport needs of the public. As a result, this provides greater convenience for individuals with active lifestyles who may need multiple pick-ups and drop-offs.

Furthermore, trust is one of the most common phrases in the collected literature, it was observed that DC and COP are positively affected by TRandSF towards H9 and H10 as suggested in this study. In addition, this study confirmed the work of [52], who noted that trust in AVs has a significant impact on AV for users' safety. However, a recent study [24], noted that respondents are more receptive to AVs with manual driving alternatives than to wholly autonomous vehicles without steering wheels for safety issues. Additionally, [50] observed various trust and safety applications. For instance, cruise assistance blind spot warning and lane change and electronic emergency brake light systems. However, they are currently not fully developed and are deployed in mainstream industry. Despite INV affecting DC positively through H11, COP was negatively affected by INV with respect to the personal attributes. This finding is consistent with [33], who referred to individuals using autonomous vehicles accepting and interacting with new technologies such as V2V, which aims to disseminate and enhance acceptance of these technologies. This indicates more research needs to be done into the disparity between individuals' intention to use technology and ability in doing so [19].

8. Directions for Future Research

This study searched for factors that affect users' perceptions of autonomous vehicles and connected technologies, especially AV and V2V; however, the review had some limitations: First, this study predominantly used a quantitative research approach, which would benefit from a follow-up study that is qualitative to gain insights into the patterns observed from this primary research. In addition, the data sample was targeted at a cross-section of users comprising professional and non-professional drivers which did not specifically address industry concerns. Hence, future studies could focus on different industry segments, their operational setting and requirements.

The research study was focused on UK users whose demographics are well observed however in developing countries other demographics may be significant and should be included (for example education; income etc). Further studies are advised regarding these connected technologies, particularly V2V and V2I, which users are not familiar with as it's in its infancy. As this emerging technology evolves, further research would benefit users. Additionally, the research model was developed based on data from a study of professional and non-professional drivers in the United Kingdom; therefore, adopting this model for other countries is recommended.

9. Conclusion

The efforts by vehicle manufacturers to develop real-time travel information applications that may reduce traffic delays (and hence pollution) is ongoing. The relevance of studying driver context that originates from pervasive (or ubiquitous) computing studies has shown to be a significant factor that influences users' interests in adopting these emerging technologies. Further study of this aspect should be made to inform automotive manufacturers at the design stage to improve user perceptions on the convenience and reliability of these connected technologies and hence their adoption

The existing literature on pervasive computing and technology acceptance for autonomous vehicles and connected technologies has been utilised during this research and the developed framework modelled using SEM. To verify the relationships between the twelve study hypotheses with users' acceptance of autonomous vehicle technologies. Driver perceptions and attitudes towards autonomous vehicles and mobile connective technology were examined in the UK including vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) applications where real-time travel information is exchanged. The results revealed positive attitudes towards the adoption of AVs and mobile connective applications that are influenced to a great extent by PU and also PEOU which indicates that Technology Acceptance Model (TAM) is still relevant to understanding perceptions towards these emerging technologies.

Furthermore, the study revealed that the personal attributes stage demonstrated a statistically significant effect between trust and safety towards driver context and compatibility. Trustandsafety construct displays that professional and non-professional drivers trust that V2V and V2I can provide reliability, privacy, and security when using autonomous vehicles. Thus, this research strongly suggests that automotive manufacturers consider this when designing and promoting enhanced vehicle capabilities. These sophisticated performance and safety-related applications lead to the evolution of automotive technology.

10. References

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