To share or not to share? A Sequential SEM Analysis of Shared and Non-Shared Autonomous Vehicle Adoption Intentions across Europe

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SHORT SUMMARY

Cooperative, Connected and Autonomous Mobility (CCAM) promises to improve transport efficiency and sustainability, yet people's intention to use them remains unclear. This study investigates socio-cultural and psychological determinants of CCAM adoption across six European countries, focusing on factors such as Technological Affinity and Trust in automation. It examines both shared and non-shared autonomous mobility solutions using an integrated model based on the Technology Acceptance Model (TAM) and the Theory of Planned Behaviour (TPB). First survey responses show that the core TAM mechanisms generalise across both modes. However, psychological concepts differ between both modes as extending the model with Subjective Norms revealed significant effects for both groups, with a stronger influence for non-shared autonomous mobility. These findings suggest that while core TAM dynamics generalise across AV types, non-shared autonomous mobility adoption is more sensitive to social influence and additional factors beyond TAM.

Keywords: Autonomous mobility, Behavioural Intention, Shared Mobility, Cross-country Comparison, SEM

1. INTRODUCTION

Reducing emissions from the transport sector while improving traffic flow and safety has become a central priority in sustainable mobility planning. Cooperative, Connected, and Automated Mobility (CCAM) services, especially shared mobility solution, hold considerable promise in this regard, contributing to the United Nations' Sustainable Development Goals by mitigating environmental impacts and supporting more efficient mobility systems (United Nations, 2024). In addition to substituting traditional automobiles, CCAM is expected to facilitate new mobility solutions such as autonomous demand-responsive transport (European Climate, Infrastructure and Environment Executive Agency, 2023), with the potential to meet the mobility needs of diverse user groups. However, realising these benefits depends on the basic requirement that people are willing to use them. Understanding what drives that willingness is more complex than the majority of the existing literature acknowledges. Research on CCAM adoption has often relied on

practical models emphasising functional perceptions, mainly Perceived Usefulness and Perceived Ease of Use, while overlooking the psychological and socio-cultural factors that influence how individuals adapt to new technologies (Sitinjak et al., 2024). This is especially important in the CCAM context, where acceptance includes not only an evaluation of the technology's usefulness but also concerns regarding trust, social influence, and individual differences in how people relate to technology (Burghard & Scherrer, 2022).

The fact that not all CCAM configurations are the same is another complexity that is often left out. A non-shared autonomous robotaxi (NSAV) and a shared autonomous shuttle (SAV) represent different mobility solutions that could cause individual psychological and social considerations. Previous research has shown that non-shared use cases are evaluated more positively (Nielsen & Haustein, 2018). By treating CCAM as a single mobility solution, we risk ignoring these differences and creating poorly targeted adoption strategies. Therefore, in addition to the well-known theoretical frameworks of the Technology Acceptance Model (TAM; Davis, 1989) and the Theory of Planned Behaviour (TPB; Ajzen, 1991), this study suggests an expanded integrated model of SAV and NSAV adoption that incorporates psychological and socio-cultural determinants.

As shown in Figure 1, the model is built around a core TAM and TPB chain in which Perceived Ease of Use (PEOU) predicts Perceived Usefulness (PU), which in turn predicts Behavioural Intention (BI), the main outcome variable, along with a direct effect of Social Norm (SN) on BI from the TPB. TAM was selected because it has a high reliability and has been validated as a widely used model for acceptance of autonomous mobility services (Al Haddad et al., 2020; Huang, 2023). The TPB was chosen because it offers a useful model for explaining mobility behaviour intention through attitudes, subjective norms, and perceived behavioural control (Ajzen, 1991) and has strong empirical support in mobility research (Hunecke et al., 2007). Perceived Behavioural Control was excluded following recent evidence that it does not significantly explain the intention to use in CCAM-related contexts (Gößwein et al., 2024).

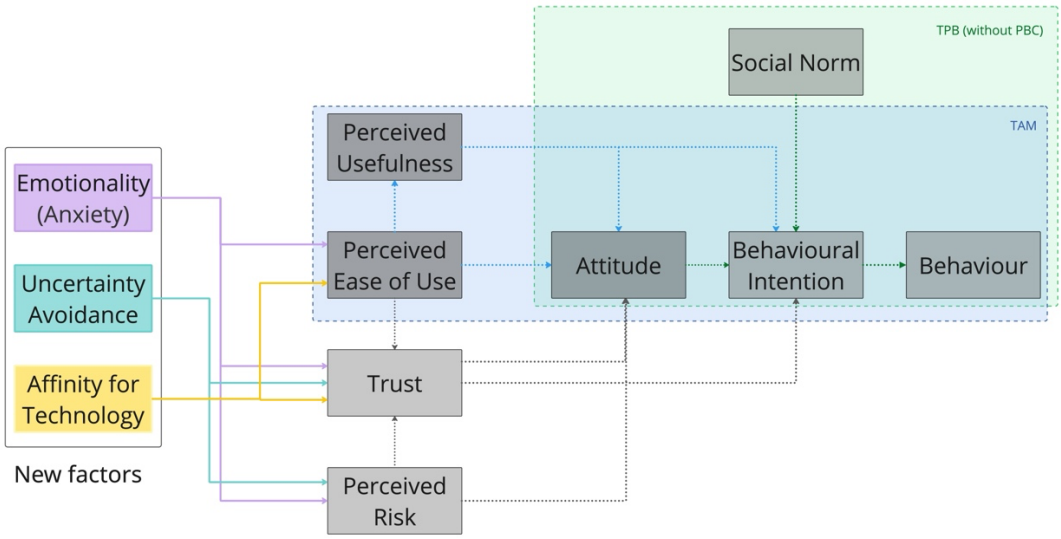


Figure 1: Conceptual Model using TAM and TPB (without PBC) and the additional socio-cultural and psychological determinant

Beyond an essential model we included Trust as a mediating construct positioned as an antecedent of both PEOU and PU because users who trust automated systems are more likely to think of them as practical and user-friendly. Three psychological and cultural antecedents in turn predict trust. The 12-item TAEG scale, which captures self-assessed competence, enthusiasm, and perceived positive and negative consequences of technological innovation, is first used to measure Technology Affinity (Roesler et al., 2025). Second, the HEXACO model's Sociability facet of extraversion is included, since higher extraversion has been associated with a stronger need for control, which previous studies have linked to a lower acceptance of automated vehicles (Volosin et al., 2024). Third, Hofstede's Uncertainty Avoidance (UA) dimension is included because research on CCAM adoption has not sufficiently examined UA and there is evidence that trust serves as a crucial coping mechanism for uncertainty (Wu et al., 2021). Because risk perception has been shown to be a barrier to CCAM uptake, Perceived Risk is also included as a predictor of Behavioural Intention, which is predicted by Uncertainty Avoidance.

The study intends to determine not only which factors drive CCAM adoption intention generally, but also whether and how those factors differ across vehicle solutions by testing this model for a shared autonomous shuttle and a non-shared on-demand robotaxi in a European sample. This distinction has direct implications for how CCAM services should be designed and deployed.

2. METHODOLOGY

This study uses a cross-national online survey including six European countries (UK, Denmark, Germany, Spain, Slovenia and Israel). The present analyses focus on the UK subsample, as data collections in the other countries are ongoing. The UK sample consists of 205 participants (Age: m = 49.1 years, SD = 16.7, range 19–81). The sample comprised 54.6% women, 44.9% men, and 0.5% identifying as other, and was highly educated, with over 60% holding a university degree. The most common occupations were full-time employment (44.9%) and retirement (21.5%).

The survey consisted of three main sequential blocks in a randomised within-subjects design. The first block assessed Trust, Social Norm, and Perceived Risk, all related to a general CCAM solution which was presented to the participants prior to the questionnaire blocks. Blocks 2 and 3 introduced the Shared and Non-Shared Autonomous Vehicle solution, measuring PEOU, PU, Attitude, and Behavioural Intention for each. Blocks 2 and 3 were counterbalanced, and no order effects were detected, removing the need for an order covariate.

To minimise a content-induced bias, Technology Affinity was assessed prior to the presentation of the CCAM solutions using the 12-item TAEG scale. Sociability used three HEXACO items and Uncertainty Avoidance used three items. Trust, Social Norm, and Perceived Risk used three, two, and three items respectively. PEOU, PU and Behaviour Intention each used three items, specified separately for SAV and NSAV. Each psychological construct was assessed on a 5-point Likert scale. Attitude was removed after proving empirically indistinguishable from BI (r = .988 SAV; r = .993 NSAV) (like suggested in Teo, 2009). An attention check item was included in the survey, and 27 participants failing the attention check were excluded. Background variables included socio-demographics, general mobility behaviour (mode choice and frequency) as well as questions regarding any disabilities or mobility restrictions.

All analyses used R with MLR estimation. Models were built gradually across four steps to isolate each theoretical framework's contribution. For this abstract focus will be on step 1 and 2 of the SEM approach. Step 1 specified the TAM baseline model. Step 2 added the TPB extension, with incremental fit assessed using the Satorra-Bentler scaled test.

3. RESULTS AND DISCUSSION

Before the sequential structural models, descriptive statistics and correlations were analysed. The means for each construct were within the middle range of the five-point scale as presented in Table 1, and no floor or ceiling effects were observed. Uncertainty Avoidance exhibited the highest mean (M = 4.16) and Behavioural intention was moderate for both vehicle types, with SAV slightly exceeding NSAV (M = 3.30 vs. M = 3.23). Reliability was acceptable to excellent across all constructs (Cronbach's α = .65 - .96).

Table 1: Construct Descriptive Statistics and Reliability

Construct	M	SD	α	ω
Technology Affinity	3.52	0.67	.697	.723
Sociability	3.22	0.79	.671	.703
Uncertainty Avoidance	4.16	0.60	.741	.745
Trust	3.28	0.82	.896	.898
Social Norm	2.88	0.89	.783	.786
Perceived Risk	3.14	0.78	.651	.664
SAV Perceived Ease of Use	3.73	0.87	.821	.825
SAV Perceived Usefulness	3.28	1.02	.843	.847
SAV Behavioural Intention	3.30	1.16	.932	.933
NSAV Perceived Ease of Use	3.63	0.87	.826	.831
NSAV Perceived Usefulness	3.21	1.06	.865	.868
NSAV Behavioural Intention	3.23	1.21	.948	.948

(M = mean; SD = standard deviation; α = Cronbach's alpha; ω = McDonald's omega. All constructs measured on a 1-5 scale.)

Representative of the descriptive statistics of the psychological constructs, Figure 2 illustrates the distribution of TAEG subscale scores across age and gender in the sample. Enthusiasm, Competence, and Positive Attitudes all show a consistent negative age trend, with scores declining from younger to older participants and a steeper decline visible for female participants. Negative Attitudes toward technology, by contrast, remain stable and low across the full age range for both genders, suggesting that sceptical orientations toward technology are not strongly age-dependent even as enthusiasm and perceived competence decline. Given that Technology Affinity is positioned in the present model as a key antecedent of Trust and PEOU, this demographic variation in TAEG underscores the importance of accounting for individual differences in technology affinity when modelling CCAM acceptance.

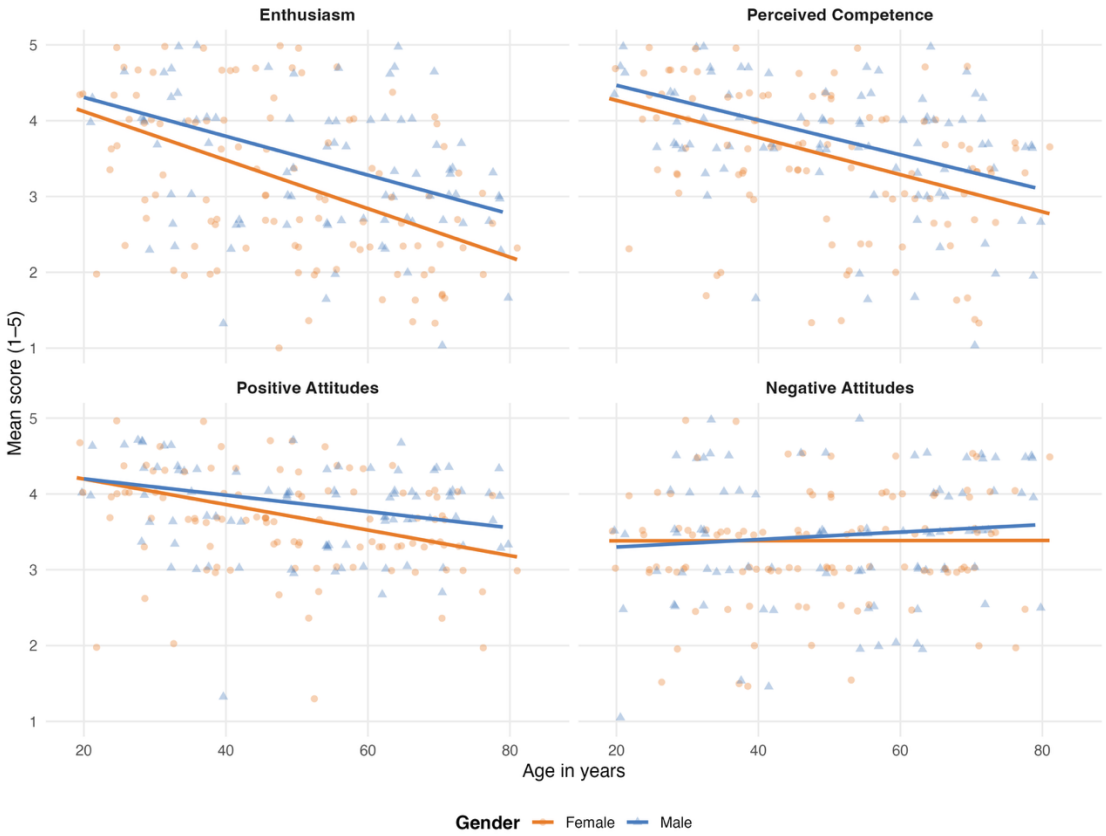


Figure 2: Scatterplots depicting the relationship between the psychological dimensions of TAEG, age, and gender

The CFA confirmed good measurement model fit for both vehicle types (SAV: CFI = .969, RMSEA = .045; NSAV: CFI = .967, RMSEA = .047) and all factor loadings met the .50 threshold.

Step 1: Conventional TAM

The TAM model showed acceptable fit for both vehicle types (CFI/TLI >.95; RMSEA = .075 - .080, within reasonable boundaries and not indicative of misspecification). Both core TAM relationships were strongly supported. PEOU was a strong positive predictor of PU, with near-identical effects across vehicle types (SAV: $\beta = .913$; NSAV: $\beta = .893$, both $p < .001$). PU in turn strongly predicted BI (SAV: $\beta = .951$; NSAV: $\beta = .913$, both $p < .001$), confirming PU as the primary driver of adoption intention. Together, these relationships accounted for 90.4% of BI variance for SAV and 83.4% for NSAV.

Step 2: Extended TAM

Social Norm was incorporated into the second step of the analysis and significantly improved the fit for both vehicle type models (SAV: $\Delta\chi^2(1) = 7.23$, $p = .007$; NSAV: $\Delta\chi^2(1) = 22.6$, $p < .001$). With the larger improvement observed for NSAV indicating a stronger role of social norms in non-shared vehicle adoption. Fit indices improved as well, with the NSAV model now satisfying

all conventional thresholds (CFI = .983, RMSEA = .059) while the core TAM relationships remained stable (PU → BI: SAV β = .903; NSAV β = .872, both p <.001) as shown in Table 2.

Table 2: Sequential SEM: Model Fit Indices and Explained Variance (R^2) for Steps 1 and 2

	Step 1		Step 2	
Index	**SAV**	**NSAV**	**SAV**	**NSAV**
CFI	.971	.969	.976	.983
TLI	.961	.959	.967	.977
RMSEA	.075	.080	.069	.059
SRMR	.045	.049	.038	.030
R^2(PU)	.834	.797	.815	.761
R^2(BI)	.904	.834	.903	.857

Social Norm was a significant positive predictor of BI in both models (Figure 3), but the effect was stronger for NSAV (β = .281) than for SAV (β = .160). Furthermore, the addition of Social Norm produced a meaningful increase in explained BI variance for NSAV (+.023), whereas the gain for SAV was negligible (<.001). This discrepancy suggests that Social Norms might have a greater influence on adoption decisions that are individually made and socially visible, as it is the case for a non-shared vehicle, whereas the shared shuttle, which resembles a form of public transportation, might be less susceptible to social influence.

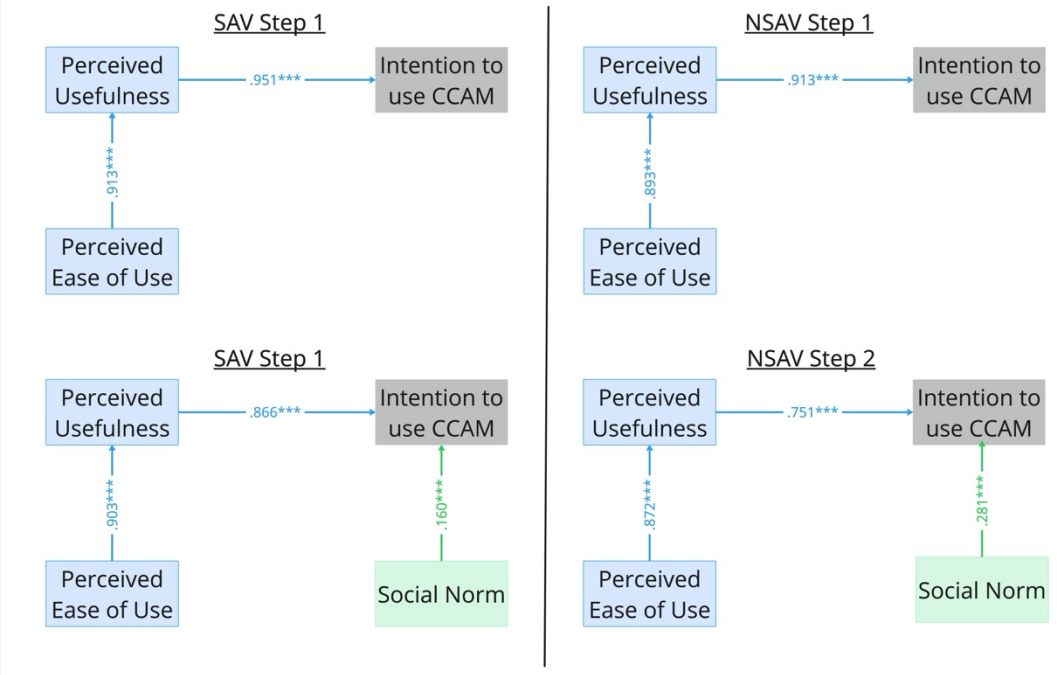


Figure 3: Structural equation models for SAV and NSAV across Steps 1 and 2

Taken together, the results of Steps 1 and 2 establish two main findings. First, the TAM chain is strongly supported both vehicle types, with PU as the dominant driver of adoption intention. Second, SAV and NSAV show partially distinct adoption pathways even at this early analysis stage as SAV adoption seems more utilitarian driven, with the TAM constructs alone explaining over 90% of BI variance and Social Norm adding negligible value, while NSAV adoption is more socially embedded, with a stronger SN effect and more unexplained variance remaining. These

differences have potential practical implications for tailoring adoption strategies across vehicle configurations.

In the next analytical steps, the sequential SEM will be extended to Steps 3 and 4, gradually adding Perceived Risk and Trust to the structural model along with Uncertainty Avoidance, Technology Affinity, and Sociability. These steps have two main objectives: first, to determine whether each of these psychological and cultural factors influences CCAM adoption intention in a meaningful and statistically significant way beyond the TAM and TPB baseline reported here. Second, to assess whether their effects vary systematically between the SAV and NSA.

4. CONCLUSIONS

This study examines socio-cultural and psychological determinants of CCAM adoption intention across a shared autonomous shuttle and a non-shared autonomous vehicle using an integrated TAM and TPB framework testing through a sequential SEM approach in a European sample.

The core TAM relationships for the UK sample were robustly supported across both vehicle types, with perceived usefulness emerging as the dominant predictor of adoption intention in both conditions confirming the applicability of the PEOU–PU–BI pathway within the CCAM context. Notably, however, the sequential analysis reveals meaningful variation between vehicle types as SAV adoption seems predominantly utilitarian, with PU accounting for the large majority of adoption intention variance and SN adding negligible incremental value, while NSAV is more socially embedded, with SN exerting a stronger effect and a larger proportion of intention variance remaining unexplained by TAM constructs alone. This distinction likely reflects that choosing a non-shared on-demand vehicle is a more socially visible and personally attributable act than boarding a shared shuttle resembling public transport, a difference that has direct implications for how adoption strategies should be designed across vehicle configurations.

These findings demonstrate that the relative importance of social norms versus functional evaluation varies systematically across CCAM configurations, and that the conditions under which TPB adds meaningful explanatory value deserve more careful theoretical attention. More broadly, SAV and NSAV appear to represent meaningfully distinct adoption contexts that require differentiated theoretical treatment, a distinction that the subsequent analytical steps, incorporating psychological and cultural factors, will be well positioned to examine in greater depth.

The empirical collapse of Attitude and Behavioural Intention may contribute to ongoing TAM and TPB debates about the distinctiveness of these constructs, particularly in emerging technology contexts where public mental representations may not yet be sufficiently differentiated.

The present findings represent the first stage of a broader ongoing research project. Data collection is currently ongoing, and the present findings will therefore be analysed in the context of a larger dataset with observations from different socio-cultural contexts. Once data collection across the remaining five European countries is complete, the sequential SEM pipeline will be extended to Steps 3 and 4, applied to each national subsample, and culminating in a multi-group SEM cross-national comparison testing path coefficients across countries.

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