Investigating User Acceptance and Safety Perceptions of Cooperative, Connected, and Automated Mobility (CCAM) Systems in Greece

Paper 30

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Introduction

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The Challenge

- Autonomous and connected vehicles are transitioning from research to real-world applications
- CCAM technologies promise improved road safety, reduced congestion, and lower emissions (Greenwald & Kornhauser, 2019)
- Successful deployment depends critically on public acceptance, trust, and safety perceptions

The Gap

- Acceptance varies significantly across countries due to culture, infrastructure, and driving behaviour (Nordhoff et al., 2018)
- Research on CCAM acceptance in Greece is very limited despite its unique driving environment
- Greek traffic: heterogeneous conditions, varying digital literacy, distinct cultural attitudes toward technology

This Study

- Explores acceptance, safety perceptions, and behavioural intentions of Greek drivers toward CCAM systems
- Identifies key factors influencing willingness to adopt conventional, semi-autonomous, and fully autonomous vehicles
- Uses stated preference (SP) survey + discrete choice models (binary logistic + multinomial logit)

Literature Review

Literature Review

Trust & Perceived Risk

- Trust is the most influential factor in AV acceptance (Kaur & Rampersad, 2018)
- Perceived risk (system failure, cyberattack) reduces adoption intention (Park et al., 2025)

Cost Barriers

- High upfront costs are the primary adoption barrier; economic factors dominate (Yuen et al., 2020)

Safety Perceptions

- Safety concerns remain a principal hurdle despite AVs' accident-reduction benefits (Wang et al., 2020)
- Uncertainty about real-world performance and ethical/legal issues affect perceptions (Diaz-Piedra et al., 2023)

Familiarity & Control

- Prior ADAS exposure increases trust in automation (Lee et al., 2024)
- Users prefer semi-automated systems retaining human control over full automation (S&P Global, 2020)

Greek Context

- Most Greek users unwilling to fully trust automation due to safety & trust barriers (Gaitanidou & Bekiaris, 2022; Niavis et al., 2025)

Methodology

Survey & Data

Survey Design

- Structured web-based questionnaire targeting active Greek drivers holding a valid driving licence
- 105 respondents via convenience sampling through online networks and professional mailing lists
- Four sections: (1) travel behaviour, (2) familiarity with CCAM, (3) stated preference (SP) scenarios, (4) demographics

Stated Preference Experiment

- SP method: widely used for emerging technologies where real-world data are unavailable (Louviere et al., 2000)
- Three vehicle alternatives presented in hypothetical travel scenarios:
- Conventional vehicle: fully human-controlled, no automation (SAE Level 0)
- Semi-autonomous vehicle: partial automation (adaptive cruise control, lane-keeping), driver remains in the loop (SAE Levels 2–3)
- Fully autonomous vehicle: all driving tasks without human input under operational design domain (SAE Levels 4–5)
- Attributes varied: travel cost (€/trip), travel time (minutes), safety level (1=high safety/low risk, 3=low safety/high risk)

Sample Profile

- Male 61.9%, Female 38.1%, Skewed young: 46.7% aged 18–25, non-random, limited generalizability

Modelling Framework

Random Utility Maximisation (RUM)

- Each individual chooses the alternative that maximises their utility: U_in = V_in + e_in
- V_in = deterministic (observable) component; e_in = random error capturing unobserved factors

Model 1 — Binary Logistic Regression

- Decision: willingness to purchase an AV (yes/no)
- V_in specified as linear function of explanatory variables; probability via logistic transformation
- Identifies factors influencing purchase intention: perceived safety, cost, user attitudes

Model 2 — Multinomial Logit (MNL)

- Decision: choice among conventional, semi-autonomous, fully autonomous vehicles in SP scenarios
- Choice probability: P_in = exp(V_in) / sum_j[exp(V_jn)]
- Estimates how travel attributes and individual characteristics affect vehicle-type choice

Estimation & Evaluation

- Parameters estimated by Maximum Likelihood Estimation (MLE)
- Fit assessed via McFadden pseudo-R2, log-likelihood, coefficient significance, and sign consistency

Results

Descriptive Analysis

Sample Characteristics (N = 105)

- Gender: Male 61.9%, Female 38.1%
- Age: 18–25 (46.7%), 26–35 (27.6%), 36–50 (17.1%), >50 (8.6%)
- Income: Low 34.3%, Medium 41.0%, High 24.7%
- Driving experience: <5 yrs 39.0%, 5–10 yrs 28.6%, >10 yrs 32.4%

Key Attitudes

- General level of CCAM technology awareness: moderate
- Attitudes toward autonomous vehicles: hesitant

Vehicle Preference Pattern

- Majority prefer traditional and semi-autonomous vehicles
- Fully autonomous vehicles are the least accepted option
- Consistent with apprehensions regarding safety, trust, and loss of control identified in the literature

Table 1. Socio-demographic characteristics of respondents

Variable	Category	Percentage (%)
Gender	Male	61.9
	Female	38.1
Age	18–25	46.7
	26–35	27.6
	36–50	17.1
	>50	8.6
Income	Low	34.3
	Medium	41.0
	High	24.7
Driving Experience	<5 years	39.0
	5–10 years	28.6
	>10 years	32.4

Binary Logistic Regression

Model Fit

- McFadden pseudo-R2 = 0.582, Log-likelihood = -13.803, N = 105

Significant Predictors of AV Purchase Intention

- Perceived safety of AV (beta=+1.087, p=0.042, OR=2.965): higher perceived safety strongly increases purchase probability
- Travel cost (beta=-1.182, p=0.025, OR=0.306): price increases significantly reduce purchase likelihood
- Travel time (beta=-2.310, p=0.003, OR=0.099): strongest negative effect, longer trips strongly discourage purchase
- Travel cost sensitivity (beta=+1.698, p=0.016, OR=5.465): cost-sensitive users more likely to purchase when cost is low

Marginally Significant (p <= 0.10)

- In-vehicle activities permitted (beta=-1.222, p=0.096): permitting activities slightly reduces stated intention
- Urban home location (beta=+1.174, p=0.091): urban respondents show somewhat higher purchase intention

Key Takeaway

- Perceived safety and affordability are the two dominant drivers of AV purchase intention among Greek drivers

Multinomial Logit Model

Model Fit

- McFadden pseudo-R2 = 0.66, Log-likelihood = -113.32, N = 105 (315 choice occasions)

Generic Attributes

- Travel cost (beta=-0.029, p<0.001): higher cost strongly reduces probability of choosing any AV alternative
- Travel time (beta=-0.038, p<0.001): longer trips reduce AV choice probability
- Safety level (beta=-0.568, p<0.001): lower perceived risk (higher safety) strongly increases AV choice

Semi-Autonomous vs Conventional

- ASC = +0.908 (p<0.001): semi-autonomous strongly preferred over conventional, people want gradual automation with retained control

Fully Autonomous Key Predictors

- Positive: driving experience (+1.603), uses cruise control (+1.616), importance of control (+2.487), cost sensitivity (+1.632)
- Negative: accident history (-1.641), safety concern (-1.543), fuel concern (-1.732), purchase price concern (-3.242), income (-1.375)

Key Takeaway

- Semi-autonomous vehicles are most preferred; safety is the dominant positive driver of AV choice

Sensitivity Analysis

Method

- Travel time varied 5-80 min; other attributes held fixed at scenario-specific levels
- Two contrasting profiles to isolate the role of safety perception

Profile 1: High Safety

- Code=1 (lowest risk), low cost, positive attitudes toward automation
- Conventional vehicles dominate short trips; semi-autonomous reaches 20% at 60 min

Profile 2: Low Safety

- Same demographics, code=3 (highest perceived risk)
- Probability of any automated option substantially reduced across all travel times

Key Takeaway

- Safety perception dominates vehicle-type choice; semi-autonomous vehicles benefit most from safety improvements

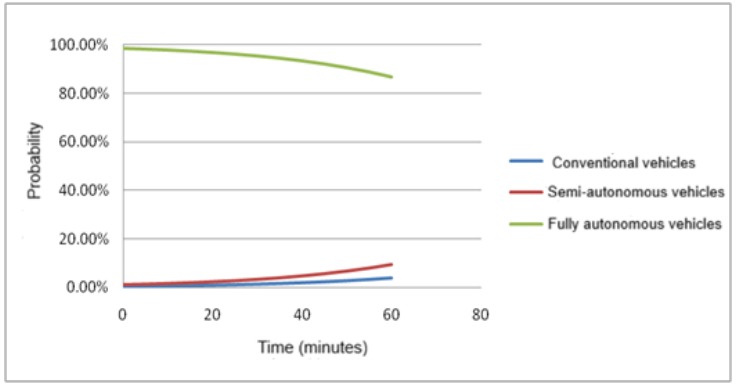

Fig. 1. High-safety profile (code=1, low perceived risk)

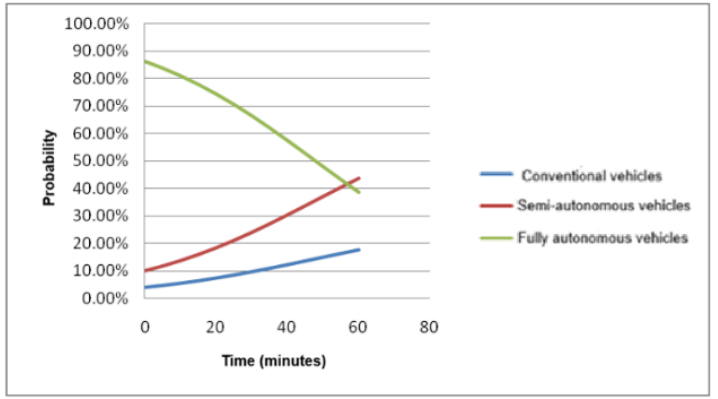

Fig. 2. Low-safety profile (code=3, high perceived risk)

Conclusions & Future Work

Conclusions & Future Work

Main Findings

- Semi-autonomous vehicles most preferred; fully autonomous vehicles least accepted
- Safety perception is the strongest positive predictor of CCAM adoption
- Cost is the primary barrier, travel cost and purchase price concerns strongly reduce AV choice
- Familiarity with automation (cruise control use) increases acceptance of full AV
- Accident history and high safety concerns significantly reduce probability of choosing full automation

Policy Implications

- Awareness campaigns and pilot AV deployments to build trust and familiarity
- Financial incentives and affordability measures to overcome cost barriers
- User-centred design addressing technological performance and psychological readiness

Limitations & Future Work

- 105 respondents, convenience sample, skewed toward 18-35 age group, not representative of all Greek drivers
- SP scenarios may not fully capture real-world decision-making
- Future: larger stratified samples, revealed preference data from AV pilots, richer behavioural variables

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