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User Acceptance of Advanced Driver Assistance Systems (ADAS) and Their Implications for Urban Mobility: Evidence from Focus Groups in Hungary

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Abstract

Advanced Driver Assistance Systems (ADAS) are increasingly shaping urban mobility and road safety, yet their benefits depend not only on technical performance, but also on driver acceptance. This study examines how Hungarian drivers perceive and evaluate key ADAS functions, Adaptive Cruise Control (ACC), Lane Keeping/Centering Assist (LKA/LCA), and Forward Cross Traffic Alert (FCTA), in urban driving contexts. The research is based on qualitative focus group discussions conducted in Győr, Hungary, involving drivers aged 20–50 from different age cohorts. Data were analyzed using thematic analysis. The findings show that the acceptance of ADAS is strongly context-dependent and function specific. ACC was perceived primarily as a comfort-enhancing tool, especially on longer or more monotonous routes, while LCA was often regarded intrusive and less reliable in urban conditions due to poor road markings, potholes, and frequent stop-and-go situations. On the contrary, blind spot and cross-traffic-related functions were evaluated more positively due to their direct safety benefits. Trust, perceived risk, and control emerged as key dimensions of acceptance, with many participants emphasising the importance of warning-based support rather than a strong autonomous intervention. In general, the study concludes that urban acceptance of ADAS is shaped by the interaction of infrastructure conditions, perceived usefulness, and driver trust, highlighting the need for more transparent, context sensitive, and user-centered system design in support of safer urban mobility.

Keywords: ADAS; user acceptance; trust in automation; focus groups; urban mobility; Hungary

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1. Introduction

The rapid pace of urbanisation is significantly transforming global mobility patterns, with more than 55% of the world's population now living in urban areas, a figure that is expected to reach 68% by 2050. The concentration of people and vehicles in cities has led to increased traffic congestion, air pollution, and road safety risks. Urban road accidents have become an urgent public health problem and contribute significantly to mortality [1]. Approximately 1.3 million people die in road accidents each year worldwide (and tens of millions are injured), with densely populated cities being particularly dangerous for vulnerable road users such as pedestrians and cyclists [2]. These trends demonstrate the urgent need for innovative strategies to improve the safety, efficiency, and sustainability of urban transportation. Vehicle automation and advanced driver assistance technologies (ADAS) offer promising tools for solving urban mobility challenges. ADAS include features such as adaptive cruise control (ACC), lane keeping assistance (LKA), and automatic emergency braking, among others, and are designed to assist drivers with various driving tasks, thereby increasing safety, comfort, and efficiency [3]. ADAS represents an intermediate step toward fully automated vehicles and is generally classified as SAE Level 1 to 2 systems that work in conjunction with a human driver [4]. In addition to making the driving experience more comfortable, these systems can help prevent accidents caused by human error through various warnings or automatic control interventions [5]. For example, collision avoidance systems such as lane departure warning and blind spot monitoring systems have been shown to reduce certain types of accidents by approximately 14%, while emergency braking can reduce rear-end collisions by half [6]. The introduction of ADAS does not only mean technical improvements to vehicles, but also a sociotechnical transformation of urban mobility. The practical realisation of the promised safety and efficiency benefits depends on how human drivers perceive, accept, and use these driver assistance systems [7].

Although the literature on ADAS acceptance is expanding, important gaps remain. Existing studies have largely relied on quantitative approaches, which may not fully capture how drivers interpret and evaluate ADAS in everyday driving contexts. In addition, previous research has mainly focused on North America, Western Europe, and East Asia, while Central and Eastern European contexts, such as Hungary, remain underrepresented. These gaps suggest the need for more context-sensitive research on how drivers perceive and accept ADAS in urban environments.

This research enriches the scientific literature on ADAS by providing a qualitative and context-sensitive perspective on the urban environment of Central and Eastern Europe, an area that has been under-represented in previous studies. From a policy and planning perspective, understanding how Hungarian drivers view ADAS can inform the development of strategies to improve the adoption and effective use of technology. Understanding user concerns can help car designers refine ADAS interfaces for greater transparency and usability, thereby increasing driver confidence. Urban transport authorities and policy makers can also use the results to support the introduction of ADAS in a manner that is aligned with user readiness, ensuring that investments in smart city transportation deliver real safety and efficiency benefits on the roads. This study addresses a real-world development problem by generating user-centered insights into the acceptance of ADAS functions in urban driving contexts. The research was conducted in cooperation with an ADAS development company, for whom the findings provide practical feedback from potential users regarding usability, trust, and function design.

The present study seeks to qualitatively explore how Hungarian drivers view and evaluate key ADAS technologies in urban mobility, with particular attention to age-related differences in acceptance. Focus group discussions were selected because the method is particularly suited to exploring how meanings, attitudes, and evaluations are constructed through participant interaction rather than elicited only as individual opinions [8]. In line with established focus group methodology, the discussions enabled participants to react to each other's experiences, compare viewpoints, and collectively elaborate on the perceived usefulness, risks, and controllability of ADAS functions in urban driving contexts [9,10].

The focus is on three prevalent driver-assistance characteristics (ACC, LCA, FCTA) that examine drivers' understanding, trust, and willingness to use these systems in city driving scenarios. To address the purpose of the study, four research questions (RQs) were formulated.

- RQ1: How do Hungarian drivers perceive the functionalities and benefits of ACC, LCA, and FCTA when driving in urban traffic conditions?
- RQ2: What age-related differences, if any, emerge in drivers' awareness, trust, and acceptance of these ADAS features?
- RQ3: What concerns or barriers (e.g., safety, trust, usability) do Hungarian drivers associate with using ACC, LCA, and FCTA in city driving?
- RQ4: What factors shape drivers' willingness to adopt and potentially pay for emerging assistance features such as turn assist systems in urban environments?

2. Literature Review

2.1. Urban Mobility, Traffic Complexity, and the Role of ADAS in Cities

Urban mobility systems are characterised by high density, multimodal interaction, and a dynamic traffic environment, which together create structurally complex driving conditions. As Cabrera-Arnau et al. [11] have shown, the spatial and behavioural patterns of urban road accidents differ from those in nonurban environments, reflecting the interaction between infrastructure design, traffic flow, and human decision-making. In cities, drivers must constantly process multiple stimuli, including vulnerable road users, traffic lights, parked vehicles, and unpredictable manoeuvres, increasing cognitive load and the likelihood of human error [11]. Several ADAS functions are particularly relevant in the urban transport environment. ACC, although originally optimised for highway driving, is increasingly being used in congested urban traffic corridors where stop-and-go conditions require continuous speed control. Empirical research shows that automated longitudinal control systems can stabilise traffic fluctuations and reduce aggressive acceleration patterns, contributing to a smoother traffic flow [12]. Lane-related systems, including lane change assist and blind spot monitoring, reduce the risk of side collisions and dense, multilane maneuvers that are common in metropolitan areas. Cicchino [13] showed that blind spot monitoring systems are associated with a reduction in the number of lane change accidents reported by the police, representing measurable safety benefits in real-world traffic conditions. Intersectional technologies are particularly important in cities, where conflict points are concentrated. Front Cross Traffic Alert (FCTA) and Automatic Emergency Braking (AEB) help drivers recognise the risk of side or forward collisions in environments with limited visibility. Field evaluations of forward collision warning and autonomous emergency braking systems have shown a significant reduction in the rate of front-to-rear collisions [12,13]. Although these technologies were not developed exclusively for urban environments, their effectiveness is particularly noticeable when traffic density and the presence of pedestrians increase the risk. In addition to mitigating accidents, ADAS can also influence urban traffic efficiency and environmental performance. Stabilised speed profiles and reduced sudden braking can moderate fuel consumption and emissions at the vehicle level, which can translate into system-level benefits when widely adopted. Although the magnitude of these effects varies depending on penetration rates and traffic conditions, modelling studies suggest that partial automation can reduce traffic jams in congested networks [14]. In urban environments, where drivers frequently switch between automated assistance and manual control, misunderstandings about the system's limitations can lead to underutilisation or inappropriate reliance on the system. Furthermore, empirical studies of driver knowledge show that knowledge and understanding of ADAS features remain uneven between user groups [15,16]. This unevenness is particularly relevant in urban environments, where the benefits of technology depend on correct and context-sensitive use.

2.2. Previous Research on ADAS Acceptance

Previous research has shown that the acceptance of ADAS is shaped by driver characteristics, prior experience, and contextual factors. Empirical studies have identified important differences across demographic groups, experience levels, and regional settings. Age and gender emerge as significant factors in several surveys. Younger drivers, especially younger male drivers, tend to report higher confidence in and acceptance of ADAS than other groups [17]. Greenwood et al. [18], in a sample of 634 U.S. drivers, found that young males expressed the most positive attitudes toward ADAS, whereas older drivers and some female drivers were relatively less trusting or slower to adopt such technologies. Older adults often appreciate the safety support offered by ADAS, but they may also be more critical of system complexity and less willing to rely on automation [19]. Previous experience with ADAS is another strong predictor of acceptance. Drivers who have direct experience with features such as lane-keeping assist or adaptive cruise control generally show greater willingness to continue using them and to try new assistance functions, likely because hands-on use builds familiarity and trust. By contrast, individuals with no first-hand experience may express interest in principle while also harbouring scepticism or unrealistic expectations, which can lead to disappointment or non-use once they encounter the systems' actual limitations [17]. The literature also suggests that knowledge and understanding of ADAS features remain uneven across user groups. In urban environments, where drivers frequently shift between automated support and manual control, misunderstandings about system capabilities and limitations may result in underuse or inappropriate reliance. Empirical studies of driver knowledge confirm that awareness, understanding, and trust in ADAS vary substantially between users [15,16]. These findings indicate that acceptance is not determined solely by technological availability, but also by how drivers understand, interpret, and evaluate these systems in their everyday mobility context.

A growing body of literature suggests that there is often a gap between the purported benefits of ADAS and users' actual understanding, trust, and willingness to use these systems. Drivers without prior experience or sufficient knowledge may misunderstand system capabilities and limitations, leading to incorrect use or non-use, which can reduce potential safety benefits [20]. Direct practical experience and user education have therefore been identified as important factors in the acceptance and appropriate use of ADAS [21]. Moreover, much of the existing literature has relied on quantitative approaches to measure ADAS-related attitudes [22], while fewer studies have explored personal experiences, concerns, and expectations in a qualitative and context-sensitive way. Another limitation of the current literature is its geographical concentration in North America, Western Europe, and East Asia, whereas Central and Eastern European contexts, such as Hungary, remain underrepresented.

3. Theoretical Background

3.1. Technology Acceptance and Driver Behaviour

To understand how and why drivers accept or reject ADAS in urban environments, technology acceptance theory must be linked to observable driver behaviour [23]. Over the past two decades, the Technology Acceptance Model (TAM) [24] and the Unified Theory of Acceptance and Use of Technology (UTAUT) have become dominant conceptual frameworks for explaining user acceptance across many fields, including intelligent transportation systems. These models provide structured insight into the cognitive and social mechanisms that shape driver decisions regarding the use of automation-related technologies in urban transport environments [25]. In automated urban transport, driver acceptance is strongly related to how ADAS functions influence real-time driving behaviour, such as speed control, headway, lane keeping, and attention, and to how drivers interpret the intent of the system. Quantitative acceptance research typically models this through a belief–attitude–intention pathway moderated by factors such as experience and sociodemographic characteristics. Large-scale SEM validation of the Unified Model of Driver Acceptance (UMDA) further shows that acceptance of ADAS bundles can be systematically explained by cognitive and normative predictors rather than being purely individual or random [26]. Importantly, in the context of urban mobility, drivers assess ADAS not only in terms of usefulness or ease of use, but also in terms of behavioural compatibility with dense, interruption-rich city traffic. Cross-national UMDA findings suggest that although overall acceptance may be comparable across settings, the specific drivers of acceptance vary according to sociocultural and market conditions. As a result, the same ADAS function may be interpreted differently depending on local mobility norms and traffic contexts [26]. These theoretical perspectives provide an important basis for understanding why urban drivers may evaluate the same technological features in markedly different ways.

3.2. Trust, Usability, Perceived Risk, and Mental Models

The successful integration of ADAS into urban mobility fundamentally depends on trust, perceived risk, and the development of accurate mental models. In automation research, trust is interpreted as the driver's willingness to rely on a system even in uncertain circumstances, based on their belief in its competence, predictability, and reliability [27]. In urban traffic, where complexity, density, and unpredictability are high, trust becomes particularly critical because drivers must constantly decide whether to rely on the system's feedback or override it. Trust in automation is not binary, but requires calibration. Excessive trust can lead to overreliance and reduced vigilance, while too little trust can lead to failure to use potentially safety-enhancing features [28]. Perceived risk is closely linked to trust. Drivers evaluate ADAS not only on the basis of expected benefits, but also on the basis of perceived technological risks, such as system failure, delayed detection, or loss of control. Studies that examine automation acceptance show that higher perceived risk significantly reduces the behavioral intent to use advanced driver assistance features, even when perceived usefulness is high [29]. Trust and risk perception are based on the concept of mental models, which are defined as internal representations of the functioning and limitations of a system. Accurate mental models enable appropriate trust; inaccurate or incomplete mental models increase the likelihood of misuse or non-use. In the context of vehicle automation, empirical studies show that many drivers have only partial knowledge of the capabilities and limitations of ADAS, leading to misconceptions about the system's limits [30]. Research also shows that experience modifies mental models over time. Drivers who have direct contact with ADAS tend to refine their understanding of the system's strengths and weaknesses, leading to a more balanced level of trust [31]. However, if early experiences involve unexpected interventions or false alarms, drivers may develop lasting scepticism.

4. Methodology

4.1. Case Study Context

In recent years, urban transport in Hungary has been shaped by congestion, road safety challenges, and an ageing vehicle fleet. Hungary's population was 9,603,634 in the 2022 census [32]. By 2025, 4,374,763 passenger cars and 5,340,836 motor vehicles were registered nationally, while the average age of passenger cars reached 16.5 years, indicating limited exposure to modern driver assistance technologies for many drivers [33,34]. Congestion is particularly visible in Budapest, where drivers lost an average of 55 h in 2024 according to the INRIX Global Traffic Scorecard [35]. Road safety also remains a relevant concern: 14,452 accidents of road traffic involving personal injury were recorded in Hungary in 2023 [36]. International evidence suggests that ADAS can mitigate such risks; for example, low-speed autonomous emergency braking reduced rear-end collisions by approximately 38% in a European multicountry analysis [37]. At the regulatory level, Regulation (EU) 2019/2144 has further strengthened the role of systems such as advanced emergency braking, intelligent speed assistance, and emergency lane maintenance in improving road safety [38]. This study focuses on Győr as the case-study location. Győr is a major regional and automotive center in northwestern Hungary and the sixth largest city in the country, with a population of approximately 124,000–130,000 at the beginning of 2025 [39]. Its location along the Budapest–Vienna corridor and the M1 motorway creates a relevant urban driving environment characterised by intersections, lane changes, and pedestrian interactions. Against this background, Győr provides an appropriate setting for examining how drivers interpret the usefulness, risks, and everyday usability of ADAS in urban mobility.

4.2. Data Collection

A qualitative focus group design was adopted to examine how drivers collectively interpret and evaluate ADAS functions in urban mobility contexts. Rather than treating responses as isolated individual accounts, the method was used to capture interactional data, including agreement, disagreement, comparison of driving experiences, and the co-construction of meanings related to trust, usefulness, risk, and control [9,10]. Three semi-structured focus group discussions were conducted, each involving 7–9 participants (total number of participants was 23), Group 2 was a mixed age group (20–50 years), and Group 3 consisted of adult drivers with broader driving experience (26–50 years). The age range of 20–50 years was selected to keep the sample sufficiently focused within the scope of this exploratory qualitative study, while still allowing variation in driving experience, life stage, and familiarity with ADAS to emerge. Given the small-scale focus group design, the study did not aim to represent the full age distribution of Hungarian drivers, but rather to compare perspectives across younger adult and mid-adult participants in an urban driving context. More specifically, the 20–25 subgroup was intended to capture younger adult drivers at an earlier stage of independent driving experience, while the 26–50 subgroup represented participants with broader adult driving and mobility experience. Participants aged over 50 were therefore not excluded on theoretical grounds, but fell outside the defined scope of the present study. Participants were recruited through an online application form distributed through email lists, social networks, and other groups. All participants signed an informed consent form, were assured of confidentiality and received an honorarium of 5000 HUF (approximately 13 EUR) for participation. The sessions were held in Győr, Hungary, between December 2024 and February 2025, in a quiet meeting room, and were moderated in Hungarian by an experienced researcher using a semi-structured interview guide. The focus group interview guide is provided in the Supplementary Materials. The moderator's role was not limited to asking questions; it also involved facilitating interaction among participants, probing points of convergence and divergence, and encouraging respondents to comment on each other's experiences. This interactional dynamic was central to the study design, as the aim was to understand not only what participants thought about ADAS, but also how these views were negotiated and expressed in a group setting. All discussions were recorded in audio. All participants signed a written informed consent form before participating in the study. The research protocol was reviewed and approved by the Ethics Committee of the Centre of Doctoral Studies and Habilitation at Széchenyi István University (Decision Nr. SZE/ETT-56/2025, 15 September 2025). The interview guide was structured around six thematic blocks: (1) experiences and first impressions of ADAS, (2) system use and behavioural adaptation, (3) trust and sense of control, (4) usability and perceived usefulness, (5) expectations regarding the turning assistant, and (6) customizability and suggestions for improvement. Although the discussion guide focused on ACC, LCA/LKA, and FCTA, participants were encouraged to freely share experiences with other ADAS features, allowing additional functions to emerge naturally during the discussions. The questions were designed to reflect key constructs from technology acceptance research, while also allowing spontaneous and context-dependent experiences to emerge. Open-ended questions and prompts were used throughout to encourage interaction and allow participants to build on each other's responses. Table 1 presents the structure of the focus group discussion guide, which was developed based on the literature review and theoretical background outlined in Sections 2 and 3. Table 1 represents the structure of the data collection instrument rather than the final thematic organization of the results.

Table 1. Overview of the Focus Group Interview Guide.

Thematic Dimension	No. of Questions	Example Questions	Constructs/Models
Experience and Awareness of ADAS	~12	• Have you ever heard of ADAS? • Do you use ACC/LCA/FCTA?	Diffusion of Innovation; Facilitating Conditions; Technology Readiness
System Use and Behavioural Adaptation	~8	• How much do you rely on ACC/LCA? • When do you override the system?	Behavioural Adaptation Theory; Performance Expectancy; Human–Automation Interaction
Trust and Control Experience	~10	• How much do you trust the system? • Where do you draw the line between human and machine?	Trust in Automation; Trust Calibration; Perceived Risk Theory
Ease of Use and Perceived Usefulness	~12	• How easy was it to learn? • In what situations is it most useful?	Perceived Usefulness & Perceived Ease of Use; Effort Expectancy
Turn Assist (ATA)—Future-Oriented Acceptance	~12	• How would you expect a turning assistant to help you? • Would you pay for it?	Behavioural Intention; Performance Expectancy; Willingness-to-Pay; Risk Perception
Customisation and Development Expectations	~6	• Would you allow the system to adapt to your driving style?	Adaptive Automation Theory; User Control; Facilitating Conditions

Table 1. *Cont.*

Thematic Dimension	No. of Questions	Example Questions	Constructs/Models
Attitudes towards Automation and Industry Direction	∼4	• Is the automotive industry moving in a useful direction?	Automation Attitude Scales; Technology Acceptance; Socio-technical Transition Theory

4.3. Data Analysis

The focus group data was analyzed using qualitative thematic analysis, which allows a structured exploration of the perceptions, attitudes, and interpretative patterns of the participants. The purpose of the analysis was not merely descriptive but to identify the underlying meaning structures and behavioural patterns that shape the acceptance of ADAS functions, particularly within urban driving contexts. Although the study included variation in age and driving experience, the primary aim of the analysis was not to produce formal subgroup comparisons, but to identify recurring patterns, shared meanings, and major differences across participants' accounts in an exploratory qualitative framework. All focus group discussions were recorded and transcribed verbatim. Following transcription, all personally identifiable information was removed to ensure participant anonymity. The analysis was conducted through multiple readings of the full text corpus to identify recurring themes and salient narrative elements. A combined deductive–inductive coding approach was applied. Deductive coding was guided by theoretical constructs presented in the theoretical background, including perceived usefulness, effort expectancy, trust, risk perception, behavioural intention, and control perception. This ensured theoretical alignment with technology acceptance models such as with TAM and UTAUT, as well as automation trust research. At the same time, inductive coding allowed the identification of emerging themes not directly captured by predefined constructs, such as frustrations related to urban traffic situations, generational narratives, and distrust based on negative experiences. The coding process followed three stages. First, open coding identified relevant meaning units in the transcripts. Second, related codes were grouped into higher-level categories through axial coding. Finally, thematic aggregation resulted in broader themes, including urban traffic complexity, perceived usefulness and comfort, trust and distrust dynamics, risk perception and control boundaries, behavioural adaptation and system override, and future-orientated acceptance and willingness to pay. The thematic blocks presented in Table 1 also informed the initial deductive coding framework used in the analysis. More specifically, the interview guide dimensions (e.g., system use, trust and control, perceived usefulness, and future-oriented acceptance) served as analytical entry points, while the final themes emerged through the combined deductive–inductive coding process. Then a higher-level synthesis were provided by linking these empirically derived themes to the research questions and their theoretical interpretation.

In analysing the transcripts, attention was paid not only to the substantive content of participants' statements but also to interactional features of the discussions, such as reinforcement, contrast, shared examples, and collective elaboration of viewpoints, which are central analytical strengths of focus group research [9]. Particular attention was paid to linking empirical findings with theoretical constructs. For example, the practice of disabling systems in uncertain situations was interpreted through trust calibration and perceived risk, while perceived usefulness in dense traffic was associated with performance expectancy. To ensure transparency and analytical consistency, coding decisions were documented, and categories were refined iteratively using a constant comparison approach. The interactive nature of the focus groups further strengthened the qualitative validity, as the participants responded to each other's statements, allowing both the consensus and contrasting points of view to emerge.

5. Results

5.1. Demographic Characteristics of the Respondents

A total of 23 participants participated in the focus group discussions, which were organised into three groups with different age compositions. Group 1 consisted primarily of younger drivers between 20 and 25 years of age, Group 2 was a mixed age group ranging from 20 to 50 years, and Group 3 included participants between 26 and 50 years of age. All respondents possessed a valid driver's licence, ensuring that the discussions reflected the views of active drivers. In addition to age and gender, information on vehicle ownership. These characteristics are summarised in Table 2.

Table 2. Demographic characteristics of the focus group respondents (n = 23).

Number of the Focus Group	Number of the Participants	Age	Gender	Driver's License	Owned/ Company Owned/ Leased Vehicle
Group 1 (between years 20–25)	Participant 1	22	Male	Yes	No
	Participant 2	20	Male	Yes	No
	Participant 3	22	Female	Yes	No
	Participant 4	21	Female	Yes	Yes
	Participant 5	23	Male	Yes	Yes
	Participant 6	23	Female	Yes	No
	Participant 7	25	Female	Yes	No
Group 2 (mixed group; between years 20–50)	Participant 8	22	Male	Yes	Yes
	Participant 9	28	Male	Yes	Yes
	Participant 10	21	Female	Yes	No
	Participant 11	47	Male	Yes	Yes
	Participant 12	50	Male	Yes	Yes
	Participant 13	36	Male	Yes	Yes
	Participant 14	25	Male	Yes	No
	Participant 15	32	Female	Yes	Yes
	Participant 16	26	Male	Yes	No
Group 3 (between years 26–50)	Participant 17	29	Female	Yes	No
	Participant 18	27	Female	Yes	No
	Participant 19	32	Female	Yes	Yes
	Participant 20	48	Female	Yes	Yes
	Participant 21	26	Male	Yes	Yes
	Participant 22	43	Male	Yes	Yes
	Participant 23	39	Male	Yes	Yes

As shown in Table 2, the sample included both male and female drivers in a broad age range, although male participants were slightly over-represented in some groups. Younger participants in Group 1 were typically early career drivers, many of whom did not yet own a personal vehicle, whereas participants in Groups 2 and 3 reported more frequently owning or regularly using a personal or company vehicle. This variation in vehicle access and driving experience is relevant because it may influence exposure to and familiarity with ADAS. Overall, the demographic composition of the sample ensured that the focus groups captured diverse driving experiences and perspectives on ADAS technologies in everyday urban driving environments.

5.2. Urban Driving Context and Perceived Functionality of ACC, LCA and FCTA (RQ1)

One of the most striking recurring themes in the focus group discussions was that participants did not view ADAS as abstract technological tools, but rather as a relation to the structural conditions of the urban transport environment. The city, especially Győr and the areas around Budapest, was not merely seen as a space for application, but as a dynamic and infrastructurally heterogeneous environment that fundamentally determines the perception of how the systems work. The quality of the infrastructure, especially the visibility of the lane markings and the condition of the road surface, played a central role in the evaluation of lane guidance systems. Several participants emphasised that the functioning of the system is directly dependent on the visual environment: "you look at the road markings... They are not perfect everywhere... after a while you switch off because you cannot see the lane." Another participant confirmed this in a regional comparison: "In Slovakia, there are many places where there are no road markings, so the LCA system doesn't work there either." Uneven and potholed road sections appeared as an additional source of conflict. Drivers often consciously deviate from the centre line of the lane to protect the car, which the LCA system does not always "understand." In such situations, the lane-keeping function appeared not as a support but as an obstacle to human adaptive strategy. The dynamics of urban traffic, frequent stops, lane changes, and short following distances also appeared as structuring factors in the interpretation of ACC. Several participants emphasised that cruise control makes no sense in an urban environment because traffic is too variable: "...I drive in a place where it makes no sense to use it." In other cases, using the system meant additional mental strain: "...one more thing to pay attention to... I turned the whole thing off." At the same time, in stop-and-go situations with congestion, some participants found adaptive cruise control to be a definite advantage, especially on longer, monotonous stretches. This duality suggests that urban dynamics are not homogeneous: dense downtown traffic and slow-moving suburban traffic shape the assessment of performance expectancy in different ways.

A recurring theme during the interviews was the sharp distinction between urban and highway environments. Several participants explicitly viewed ACC as a "highway function" that is useful for steady driving but has limited applicability in cities. As one participant put it, "you can only use this cruise control where there are few people." A similar distinction was made in the case of the system. On the highway, in a well-marked, predictable environment, many found it acceptable or even useful, while in urban environments the system was more often turned off. One participant summed it up succinctly: "It is never turned on," referring to their preference for manual control in urban environments. Based on the thematic analysis, the complexity of urban traffic appears not merely as a background factor, but as a fundamental dimension that structures the acceptance of ADAS. The quality of infrastructure, traffic rhythm, stop-and-go situations, and lane change restrictions collectively determine whether the ACC and LCA systems are perceived as supportive or disruptive. In this sense, the city is not a neutral application space, but an active contextual condition that reinterprets the usefulness, reliability, and integrability of technological functions in everyday driving practice. Table 3 illustrates the coding structure related to the topic of Urban Driving Complexity as a Structural Condition.

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Table 3. Urban Driving Complexity as a Structural Condition—Thematic Structure.

Participant Reporting Unit (Open Code)	Interpreted Dimension (Axial Category)	Theoretical Connection
"The system cannot see the lane... I would rather turn it off."	Infrastructure dependency of ADAS	Facilitating conditions (UTAUT); System reliability perception
"The system doesn't even see the pothole, so I would rather turn it off and drive the car..."	Human–system strategy conflict	Control perception; Human override behaviour
"cannot keep up with city traffic"	Urban traffic complexity	Contextual performance expectancy
"it makes no sense in the city"	Reduced usefulness in dense traffic	Perceived usefulness (TAM); Performance expectancy (UTAUT)
"one more thing to keep an eye on"	Cognitive load in urban driving context	Effort expectancy (UTAUT)
"Can only be used where there are few cars"	Contextual re-framing of ADAS functionality	Situational technology acceptance
"never turned on"	Driver adaptation and control preference	Trust calibration; Control perception

Table 3 shows how the open codes derived from the participants' statements were organised into higher-level interpreted dimensions and then into comprehensive thematic patterns. The problems articulated by the participants were organised into axial categories such as infrastructure dependency, human-system conflict, and context-dependent usefulness. The table also illustrates how the empirical results relate to the theoretical framework of technology acceptance models and perceived control.

5.3. Perceived Usefulness and Functional Differentiation

The second major aggregate theme of the thematic analysis was the clear differentiation between ADAS functions in terms of perceived usefulness. Participants did not talk about ADAS in general but rather made function-specific assessments. Acceptance thus emerged not as a systemic attitude but as a differentiated pattern that varied by function. This theme is closely related to the constructs of performance expectancy and perceived usefulness: intention to use and positive attitude always depended on the specific, situation-embedded usefulness of the given function. Adaptive cruise control (ACC) appeared in most groups through the comfort narrative. Participants described it as a stress relief feature, especially on longer trips, congested sections, or monotonous driving. One respondent, for example, said "I think I use the distance control on 70% of my trips." However, this positive assessment was highly context-dependent. In dense urban traffic, many felt that the system did not deliver the expected comfort benefits or required too much intervention. In such cases, performance expectancy decreased and use became occasional or ceased altogether. ACC was therefore perceived as fundamentally positive, but not as a universal solution, but rather as a situation-dependent comfort feature. The lane keeping system (LKA), on the other hand, was much more divisive. Several participants found it particularly irritating or distracting, especially in urban environments. One short but strong statement was "it is never on." Another participant said that the system was "one more thing to pay attention to," indicating that the feature increased rather than decreased the perceived cognitive load. At the same time, not all interpretations were negative. In certain situations, such as on the highway or when tired, some participants viewed it as an added safety feature. The thematic pattern is therefore ambivalent: perceived usefulness is not stable here, but strongly dependent on context and driving style. In the case of LKA, the dimensions of effort expectancy and control perception often overruled the potential safety benefits. Table 4 shows the coding structure related to the theme of perceived usefulness. The table illustrates how the participant report units were organised into interpreted dimensions and higher-order thematic patterns and how these can be linked to the relevant constructs of the acceptance models.

Table 4. Thematic Coding Structure of Perceived Usefulness.

Participant Reporting Unit (Open Code)	Interpreted Dimension (Axial Category)	Theoretical Connection
"Adaptive cruise control. . . is one of my favourites."	ACC as comfort technology and load reduction	Perceived usefulness (TAM); Performance expectancy (UTAUT)
"I think I use distance control on 70% of my trips."	Stabil acceptance via habitual use	Behavioural intention/Use behaviour
"No, because I am going somewhere where it doesn't make sense."	Conditional usefulness in urban settings	Contextual performance expectancy
"never turned on"	Consistent rejection/avoidance	Low perceived usefulness; Control perception
"one more thing to pay attention to"	Effort outweighs benefit	Effort expectancy (UTAUT); Perceived ease of use (TAM)
"absolutely a great help"	High acceptance of information-based safety aids	Risk reduction perception; Trust via transparency
"writes 'brake'"	Trust-supporting feedback	Trust calibration; Transparency → trust
"I turned the whole thing off"	Modular/feature-specific acceptance	Differentiált elfogadás; Situational adoption

One of the most important findings of the thematic analysis was that acceptance did not appear as a uniform construct. Participants often used a combined strategy: They regularly used certain functions and consistently turned off others. This differentiated use suggests that ADAS acceptance is a modular rather than a system-level phenomenon. ACC often appeared as a comfort feature, blind spot, and FCTA as safety features, while LCA appeared as a controversial, context-dependent tool. Therefore, the perceived usefulness and performance expectancy constructs were realized differently for each function, confirming that automation acceptance of automation is not a homogeneous attitude, but the result of a function-specific evaluation process.

5.4. Trust, Risk, and Control Boundaries

One of the most powerful and psychologically profound blocks of the thematic analysis was the issue of trust, risk perception, and control limits. The narratives of the participants repeatedly reflected the tension between technological intervention and managerial autonomy. Several participants reported experiences with LCA where the system suddenly intervened contrary to the driver's intentions. One of the most vivid descriptions was that the system "jerks the steering wheel at the last moment when turning a corner." This "jerk" generated not only a feeling of technical failure, but also an experience of loss of control. A similar narrative emerged when drivers consciously moved to the edge of the lane (e.g., due to a pothole or obstacle) and the system interpreted this as an error. In such situations, the technology was perceived not as a support, but as a constraint on human adaptive strategy. The discrepancy between the system and the driver's mental model led to a loss of trust. Automatic emergency braking elicited particularly strong emotional reactions. Several participants reported experiences where the system intervened unexpectedly and intensely. One young driver put it this way: "It slams on the brakes so hard that I almost hit the windshield." Such experiences reinforced the perceived risk dimension, even though objectively the system performed a safety function. Some participants feared that the system "places too much trust in the car," reflecting concerns about excessive automation. Thus, risk perception stemmed not only from the possibility of system failure, but also from the psychological uncertainty of technology taking over decision-making autonomy. Immediately turning off the system was a recurring behaviour pattern. Participants emphasised on several occasions that if the system did not meet their expectations, they would immediately deactivate it. In short, they stated categorically: "it is never turned on." In another case, regarding ACC, they said: "I turned the whole thing off." This behaviour cannot be interpreted merely as rejection, but rather as an act of trust recalibration. Managers continuously monitored the operation of the system and if it deviated from their own expectations or mental models, they reverted to manual control. Trust was therefore a dynamic, situation-dependent, and unstable attitude. Perception of control was particularly prominent among younger participants. Several expressed that driving experience and autonomous decision making were important to them. One participant put it this way: "I like to control the car myself." This statement suggests that technology is not only functional, but also has an identity dimension. Based on the thematic patterns, the boundary between trust and acceptance lies where the system exceeds the level of control that the driver considers acceptable. As long as the function provides information or subtle support, it is accepted; however, when it intervenes autonomously and intensively, trust can be damaged. In general, this thematic block shows that the psychological core of ADAS acceptance is a dynamic balance between trust, risk perception, and control perception. Systems do not elicit positive or negative attitudes on their own, but rather depend on how drivers experience the degree and predictability of intervention. This trust–risk–control triangle best structures the boundaries of urban acceptance of automation. Table 5 presents the multilevel coding structure underlying the trust–risk–control theme.

Table 5. Trust, Risk, and Control Boundaries: Thematic coding structure.

Participant Reporting Unit (Open Code)	Interpreted Dimension (Axial Category)	Theoretical Connection
"jerks the wheel"	Perceived over-intervention	Trust calibration
"It slams on the brakes so hard that I almost hit the windshield."	Risk amplification through automation	Perceived risk
"places too much trust in the car"	Overreliance concern	Automation trust theory
"never turned on"	Trust withdrawal behaviour	Trust recalibration
"I like to drive the car myself."	Control boundary definition	Control perception

5.5. Future Directions, Willingness to Pay, and Assessment of the Turning Assistant

The last major block of the thematic analysis focused on future development directions, the acceptance of new features, and the question of willingness to pay. During the discussions, special attention was paid to a potential turning assistant system that would help drivers recognise conflict situations at intersections or when turning left/right. Based on the responses of the participants, the acceptance of future ADAS features will depend heavily on how well the system adapts to complex urban traffic situations, especially in managing risks related to pedestrians, cyclists, and intersections. Several participants emphasised that one of the most stressful situations in urban traffic is turning and making decisions at intersections, where it is necessary to simultaneously process visibility conditions, traffic, and pedestrian movement. In this context, turn assist emerged as a potentially useful feature, especially if the system is able to alert the driver to hazards that are difficult to perceive. However, most of the participants considered warning-type assistance was acceptable, rather than automatic intervention. Several emphasised that a simple visual or audible signal would be sufficient: the system should "warn when something is coming," but the final decision should remain with the driver.

The method of feedback was also an important topic. Some participants preferred visual signals (such as icons or warnings displayed on a screen), while others considered audible signals or vibrations to be more effective, especially in situations where the driver's attention is divided in several directions. The difference in preferences suggests that customizability may be an important acceptance factor for future systems. Most of the participants were open to using new safety features in principle, but their willingness to pay depended heavily on the specific benefits offered by the system. Safety features, especially those that help detect pedestrians or cyclists, were more widely accepted, while participants were less willing to pay extra for convenience features. Many also emphasised that such systems should ideally be included as standard equipment in new vehicles. However, the acceptance of future ADAS features was also linked to a balance between trust and control in this case. The majority of participants supported the idea of a turning assistant, provided that it provides information and helps with situation recognition, but does not take over the driver's decision-making.

In general, the focus group discussions showed that the acceptance of future ADAS developments is primarily related to the ability to reduce urban traffic risks, maintain user control, and customise systems. The attitudes of the participants suggest that the acceptance of new features is not merely a technological issue but depends on the quality of the interaction between the driver and the automated system. Table 6 shows the thematic coding structure related to future ADAS features.

Table 6. Future ADAS Acceptance, Turning Assist, and Willingness to Pay.

Participant Reporting Unit (Open Code)	Interpreted Dimension (Axial Category)	Theoretical Connection
"If it warns me when someone comes from the side, that would be useful."	Safety-orientated perception of turning assistance	Perceived usefulness (TAM); Performance expectancy (UTAUT)
"It should just signal, not decide for me."	Preference for informational rather than autonomous support	Control perception; Human-in-the-loop automation
"At intersections, there are so many things happening at once."	Urban intersection complexity	Contextual technology usefulness
"A sound signal would be better, because then you would immediately notice it."	Feedback modality preference (auditory vs. visual)	Usability perception; Effort expectancy
"If it really improves safety, then I would consider paying for it."	Conditional willingness to pay based on safety value	Perceived value; Behavioural intention
"These systems should be included in the basic equipment."	Expectation of standard safety technology	Facilitating conditions; Technology diffusion
"As long as it helps but does not take control."	Acceptance limit based on driver autonomy	trust-control balance; Automation trust theory

6. Discussion

The aim of the research was to explore how Hungarian drivers interpret ADAS (ACC, LCA, and FCTA) in urban traffic environments and what factors influence their acceptance. The results show that the evaluation of ADAS functions is highly context-dependent and there are significant differences between the functions in terms of perceived usefulness, trust, and sense of control. RQ1 focused on how Hungarian drivers perceive the functioning of the ACC, LCA, and FCTA functions in urban traffic. Based on the results, the participants did not view ADAS as a unified system, but evaluated each technology in a function-specific manner. ACC was perceived primarily as a comfort feature, especially on longer journeys, while its perceived usefulness often decreased in dense urban traffic. In contrast, the lane keeping system was divisive, especially depending on the quality of the infrastructure and the inadequateness of the road markings. This is consistent with previous research, which found that the acceptance of ADAS is largely on the traffic environment and infrastructure [40]. Blind spot monitoring and cross-traffic alert systems, on the other hand, were generally rated more positively, as they offer direct safety benefits in lane change and intersection situations. RQ2 examined age-related differences in the acceptance of ADAS. The results showed that participants in the younger subgroup were generally more open to trying new technologies and often obtained information about the systems from online sources or personal experience. However, this openness did not automatically imply higher trust in the systems. In contrast, participants with broader driving experience tended to adopt a more cautious attitude and placed greater emphasis on predictability and maintaining driver control. At the same time, the findings suggested that differences related to prior ADAS experience were often more pronounced than differences based on age alone. These patterns are consistent with the UTAUT model, which suggests that age and technological experience can play a moderating role in technology acceptance [41]. RQ3 focused on the barriers and risks associated with the use of urban ADAS. Based on the focus groups, the most important issues were unexpected system interventions, increased cognitive load, and infrastructure dependency. In particular, experiences with lane keeping systems and automatic emergency braking reduced trust in the system. Such reactions often led to the system being switched off, which can be interpreted as a dynamic recalibration of trust. This is consistent with research on trust in automation, which suggests that excessive or unpredictable automation can undermine user trust [27]. RQ4 examined the acceptance of future systems, particularly turn assistants, and willingness to pay. Table 7 synthesizes the key empirical findings in relation to each research question and links them to the underlying theoretical constructs of technology acceptance and trust.

Table 7. Summary of Research Question-Based Findings and Theoretical Interpretations.

Research Question	Focus	Key Findings	Theoretical Interpretation
RQ1	Perception of ADAS in urban context	• ACC → comfort, congestion support • LCA → intrusive, infrastructure-dependent • FCTA/blind spot → strong safety value	• Context-dependent usefulness • Function-specific acceptance • Performance expectancy varies
RQ2	Generational differences	• (20–25 years old) → openness + control need • (26–50 years old) → cautious, experience-based trust • Differences mainly in trust/control	• Age as moderator (UTAUT) • Trust & control shape acceptance

Table 7. *Cont.*

Research Question	Focus	Key Findings	Theoretical Interpretation
RQ3	Barriers and concerns	• Over-intervention (“jerks”, braking) • Unpredictability • Cognitive load increase • Frequent system deactivation	• Trust–risk–control dynamic • Risk & effort > usefulness • Trust recalibration behaviour
RQ4	Future adoption & willingness to pay	• Preference: warning over automation • Acceptance → conditional (context) • Willingness to pay → safety-driven	• Trust calibration • Control preservation • Modular acceptance logic

The results showed that the participants were open to new features that increase traffic safety, especially at intersections or under poor visibility conditions. However, most participants envisioned a warning system that supports the driver, but does not take over decision-making. The willingness to pay showed mixed results: some would be willing to pay for features that have been proven to increase safety, while others believe that these should be standard equipment. This is consistent with the finding that the acceptance of ADAS technologies depends largely on perceived safety benefits and value perception [42]. In general, the results suggest that the acceptance of ADAS in urban environments is a function-specific, context-dependent, and trust-driven process. Therefore, predictable system operation, user control, and the development of technological solutions that are better adapted to the driving situation may be key factors in future developments.

7. Conclusions

The present research was conducted using qualitative methodology and focus group design in Győr, where active drivers from different age groups shared their experiences, perceptions, and attitudes regarding the use of driver assistance systems. The aim of the study was to explore how Hungarian drivers interpret and accept different ADAS functions in everyday urban traffic environments. Thematic analysis showed that ADAS acceptance is not a general pro- or anti-technology attitude, but a strongly context-dependent and function-specific evaluation process shaped by urban traffic situations, prior experiences, and perceived control. The findings clearly demonstrate that drivers distinguish sharply between ADAS functions according to their practical value in real traffic situations. In addition to the primary ADAS functions examined, participants’ references to related systems such as blind spot monitoring and AEB further reinforced the importance of function-specific acceptance patterns. ACC was primarily interpreted as a comfort and fatigue-reducing feature, especially on longer or more monotonous routes, whereas lane keeping systems were frequently perceived as intrusive, unreliable, or overly dependent on road markings and infrastructure quality. On the contrary, information-based safety functions such as blind spot monitoring and cross-traffic alert were evaluated far more positively, as they were seen to provide direct and tangible safety benefits without excessive interference with driver autonomy. A particularly important result is that trust in ADAS proved to be dynamic rather than stable: Participants tended to accept systems that supported their decisions but rejected or deactivated those perceived as unpredictable, overly interventionist, or misaligned with their own driving logic. The study also highlighted that urban complexity itself, namely dense traffic, poor road markings, potholes, frequent stops, and unpredictable interactions with other road users, is a decisive factor in shaping how ADAS is interpreted and whether it is accepted or switched off. The contribution of the research lies in showing, through qualitative empirical evidence, that ADAS acceptance in a Central European urban context is best understood as a threefold process shaped by urban driving conditions, function-specific perceived usefulness, and trust–control dynamics. Instead of treating ADAS acceptance as a single construct, the study demonstrates that drivers evaluate each function separately and through the lens of everyday urban usability. This provides a more nuanced understanding of the acceptance of technology in urban mobility and contributes to the literature by linking human factors, infrastructure conditions, and automation acceptance in a real-world city context. However, research has its limitations. Due to the qualitative nature of the study and its relatively small sample size, the results cannot be fully generalised to the entire Hungarian driver population. Furthermore, the research focused on a single urban context, Győr and its surroundings, so the transportation characteristics of other cities may result in different perceptions. Therefore, future research should focus on large-scale studies using quantitative methods and comparisons of different urban environments. Another limitation is that because of the exploratory qualitative design and the relatively small sample, the study was not intended to support strong subgroup generalisations. Although age- and experience-related differences emerged in the discussions, these should be interpreted as indicative patterns rather than as definitive group-level conclusions.

From a managerial perspective, the results suggest that more emphasis should be placed on the urban context of the use, the transparency of system operation, and the preservation of the driver's sense of control in the development and communication of ADAS technologies. Users, particularly, value systems that warn and support rather than override their decisions. This implies that future assistance systems are likely to achieve higher acceptance if developers prioritise predictable behavior, clear feedback, and user control alongside communicating safety benefits.

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Abbreviations

The following abbreviations are used in this manuscript:

ADAS	Advanced Driver Assistance Systems
ACC	Adaptive Cruise Control
LCA	Lane Centering Assist
LKA	Lane Keeping Assist
FCTA	Front Cross Traffic Alert (FCTA)

References

1. World Health Organization. Urban Health. 2025. Available online: https://www.who.int/health-topics/urban-health#tab=tab_1 (accessed on 10 December 2025).
2. Institute for Transportation and Development Policy. Road Safety. 2025. Available online: https://itdp.org/key-issues/health-safety/road-safety/#: :text=The%20World%20Health%20Organization%20estimates,of%20the%20world%E2%80%99s%20large%20cities (accessed on 10 December 2025).
3. Leonardi, S.; Distefano, N. ADAS Technologies and User Trust: An Area-Based Study with a Sociodemographic Focus. *Vehicles* **2025**, *7*, 67. [CrossRef]
4. SAE International. SAE Levels of Driving Automation™ Refined for Clarity and International Audience. 2021. Available online: https://www.sae.org/blog/sae-j3016-update (accessed on 12 October 2025).
5. Koteczki, R.; Balassa, B.E. Systematic literature review of user acceptance factors of advanced driver assistance systems across different social groups. *Transp. Res. Interdiscip. Perspect.* **2025**, *31*, 101486. [CrossRef]
6. Cicchino, J.B. Effects of blind spot monitoring systems on police-reported lane-change crashes. *Traffic Inj. Prev.* **2018**, *19*, 615–622. [CrossRef]
7. Nandavar, S.; Kaye, S.A.; Senserrick, T.; Oviedo-Trespalacios, O. Exploring the factors influencing acquisition and learning experiences of cars fitted with advanced driver assistance systems (ADAS). *Transp. Res. Part F Traffic Psychol. Behav.* **2023**, *94*, 341–352. [CrossRef]
8. Schuster, R.C.; Brewis, A.; Wutich, A.; Safi, C.; Vanrespaille, T.E.; Bowen, G.; SturtzSreetharan, C.; McDaniel, A.; Ochandarena, P. Individual interviews versus focus groups for evaluations of international development programs: Systematic testing of method performance to elicit sensitive information in a justice study in Haiti. *Eval. Program Plan.* **2022**, *97*, 102208. [CrossRef]
9. Kitzinger, J. The methodology of focus groups: The importance of interaction between research participants. *Sociol. Health Illn.* **1994**, *16*, 103–121. [CrossRef]
10. Morgan, D.L. Focus groups. *Annu. Rev. Sociol.* **1996**, *22*, 129–152. [CrossRef]
11. Cabrera-Arnau, C.; Prieto-Curiel, R.; Bishop, S.R. Uncovering the behaviour of road accidents in urban areas. *R. Soc. Open Sci.* **2020**, *7*, 191739. [CrossRef]
12. Spicer, R.; Vahabaghaie, A.; Bahouth, G.; Drees, L.; Martinez von Bülow, R.; Baur, P. Field effectiveness evaluation of advanced driver assistance systems. *Traffic Inj. Prev.* **2018**, *19*, S91–S95. [CrossRef] [PubMed]
13. Cicchino, J.B. Effectiveness of forward collision warning and autonomous emergency braking systems in reducing front-to-rear crash rates. *Accid. Anal. Prev.* **2017**, *99*, 142–152. [CrossRef]
14. González-Saavedra, J.F.; Figueroa, M.; Céspedes, S.; Montejo-Sánchez, S. Survey of cooperative advanced driver assistance systems: From a holistic and systemic vision. *Sensors* **2022**, *22*, 3040. [CrossRef] [PubMed]
15. Kaye, S.A.; Nandavar, S.; Yasmin, S.; Lewis, I.; Oviedo-Trespalacios, O. Consumer knowledge and acceptance of advanced driver assistance systems. *Transp. Res. Part F Traffic Psychol. Behav.* **2022**, *90*, 300–311. [CrossRef]
16. Reagan, I.J.; Cicchino, J.B.; Teoh, E.R.; Cox, A.E. New and used vehicle buyers' awareness, understanding, and trust in advanced driver assistance systems. *Transp. Res. Part F Traffic Psychol. Behav.* **2023**, *92*, 44–55. [CrossRef]
17. Balassa, B.E.; Choi, M.; Baquillas, J.C.; Koteczki, R. Identifying Consumer Segments for Advanced Driver Assistance Systems (ADAS): A Cluster Analysis of Driver Behavior and Preferences. *Future Transp.* **2025**, *5*, 182. [CrossRef]
18. Greenwood, P.M.; Lenneman, J.K.; Baldwin, C.L. Advanced driver assistance systems (ADAS): Demographics, preferred sources of information, and accuracy of ADAS knowledge. *Transp. Res. Part F Traffic Psychol. Behav.* **2022**, *86*, 131–150. [CrossRef]
19. Souders, D.J.; Charness, N.; Roque, N.A.; Pham, H. Aging: Older adults' driving behavior using longitudinal and lateral warning systems. *Hum. Factors* **2020**, *62*, 229–248. [CrossRef]
20. Payre, W.; Cestac, J.; Delhomme, P. Intention to use a fully automated car: Attitudes and a priori acceptability. *Transp. Res. Part F Traffic Psychol. Behav.* **2014**, *27*, 252–263. [CrossRef]

21. Wood, J.M.; Henry, E.; Kaye, S.A.; Black, A.A.; Glaser, S.; Anstey, K.J.; Rakotonirainy, A. Exploring perceptions of Advanced Driver Assistance Systems (ADAS) in older drivers with age-related declines. *Transp. Res. Part F Traffic Psychol. Behav.* **2024**, *100*, 419–430. [CrossRef]
22. Miskolczi, M.; Kökény, L.; Jászberényi, M. Rethinking the road ahead–generation Z's perspectives on AI-based mobility services. *Transp. Res. Interdiscip. Perspect.* **2025**, *31*, 101475. [CrossRef]
23. Damsara, K.D.P.; de Barros, A.G. A systematic review on user acceptance of advanced driver assistance systems (ADAS). *Transp. Res. Procedia* **2025**, *82*, 3472–3482. [CrossRef]
24. Davis, F.D. Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Q.* **1989**, *13*, 319–340. [CrossRef]
25. Rahman, M.M.; Lesch, M.F.; Horrey, W.J.; Strawderman, L. Assessing the utility of TAM, TPB, and UTAUT for advanced driver assistance systems. *Accid. Anal. Prev.* **2017**, *108*, 361–373. [CrossRef]
26. Khattak, M.W.; Brijs, K.; Tran, T.M.; Trinh, T.A.; Vu, A.T.; Brijs, T. Acceptance towards advanced driver assistance systems (ADAS): A validation of the unified model of driver acceptance (UMDA) using structural equation modelling. *Transp. Res. Part F Traffic Psychol. Behav.* **2024**, *105*, 284–305. [CrossRef]
27. Lee, J.D.; See, K.A. Trust in automation: Designing for appropriate reliance. *Hum. Factors* **2004**, *46*, 50–80. [CrossRef] [PubMed]
28. Hancock, P.A.; Billings, D.R.; Schaefer, K.E.; Chen, J.Y.C.; de Visser, E.J.; Parasuraman, R. A Meta-Analysis of Factors Affecting Trust in Human-Robot Interaction. *Hum. Factors J. Hum. Factors Ergon. Soc.* **2011**, *53*, 517–527. [CrossRef]
29. Choi, J.K.; Ji, Y.G. Investigating the importance of trust on adopting an autonomous vehicle. *Int. J. Hum. Comput. Interact.* **2015**, *31*, 692–702. [CrossRef]
30. Banks, V.A.; Eriksson, A.; O'Donoghue, J.; Stanton, N.A. Is partially automated driving a bad idea? Observations from an on-road study. *Appl. Ergon.* **2018**, *68*, 138–145. [CrossRef]
31. Piccinini, G.F.B.; Rodrigues, C.M.; Leitão, M.; Simões, A. Reaction to a critical situation during driving with Adaptive Cruise Control for users and non-users of the system. *Saf. Sci.* **2015**, *72*, 116–126. [CrossRef]
32. HCSO. Hungarian Central Statistical Office. Census 2022—Final Data: Main Population Characteristics (Population: 9,603,634 on 1 October 2022). 2022. Available online: https://nepszamlalas2022.ksh.hu/en/results/final-data (accessed on 4 March 2026).
33. HCSO. Hungarian Central Statistical Office. 24.1.1.23. Number of Road Vehicles per Vehicle Type at End of Year. 2025. Available online: https://www.ksh.hu/stadat_files/sza/en/sza0023.html (accessed on 4 March 2026).
34. HCSO. Hungarian Central Statistical Office. 24.1.1.26. Average Age of the Passenger car Fleet by Make (Total: 16.5 Years in 2025). 2025. Available online: https://www.ksh.hu/stadat_files/sza/en/sza0026.html (accessed on 4 March 2026).
35. INRIX. INRIX 2024 Global Traffic Scorecard (Europe Ranking: Budapest Delay per Driver 55 Hours in 2024). 2025. Available online: https://inrix.com/press-releases/2024-global-traffic-scorecard-uk/ (accessed on 4 March 2026).
36. HCSO. Hungarian Central Statistical Office. Road Traffic Accidents Involving Personal Injury, 4th Quarter 2023 (Annual 2023 Totals; Comparison vs. 2022). 2024. Available online: https://www.ksh.hu/health-care-accidents (accessed on 4 March 2026).
37. Fildes, B.; Keall, M.; Bos, N.; Lie, A.; Page, Y.; Pastor, C.; Pennisi, L.; Rizzi, M.; Thomas, P.; Tingvall, C. Effectiveness of low speed autonomous emergency braking in real-world rear-end crashes. *Accid. Anal. Prev.* **2015**, *81*, 24–29. [CrossRef] [PubMed]
38. European Parliament; Council of the European Union. Regulation (EU) 2019/2144 on Type-Approval Requirements for Motor Vehicles and Their Trailers as Regards Their General Safety and the Protection of Vehicle Occupants and Vulnerable Road Users. 2019. Available online: https://eur-lex.europa.eu/eli/reg/2019/2144/oj (accessed on 10 December 2025).
39. Népességinfó. Győr Népessége, Lakossága (2020–2025). 2025. Available online: https://nepesseginfo.hu/gyor-nepessege-lakossaga/ (accessed on 4 March 2026).
40. Kyriakidis, M.; de Winter, J.C.F.; Stanton, N.; Bellet, T.; van Arem, B.; Brookhuis, K.; Martens, M.H.; Bengler, K.; Andersson, J.; Merat, N.; et al. A human factors perspective on automated driving. *Theor. Issues Ergon. Sci.* **2019**, *20*, 223–249. [CrossRef]
41. Venkatesh, V.; Morris, M.G.; Davis, G.B.; Davis, F.D. User acceptance of information technology: Toward a unified view. *MIS Q.* **2003**, *27*, 425–478. [CrossRef]
42. Schoettle, B.; Sivak, M. The reasons for the recent decline in young driver licensing in the United States. *Traffic Inj. Prev.* **2014**, *15*, 6–9. [CrossRef]