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A multi-road user evaluation of the acceptance of connected and automated vehicles through the lenses of safety and justice

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ABSTRACT

As technological development towards connected and automated vehicles (CAVs) continues to rise, addressing the challenges associated with their integration is crucial, especially regarding public acceptance. This study explores the acceptability of CAVs, focusing on their potential role in enhancing safety and justice within the transport system. Semi-structured interviews were conducted with a diverse participant group, including 18 car drivers (aged 20–79, M = 48.3, SD = 18.77) and 12 pedestrians (aged 18–61, M = 36.0, SD = 12.94). Thematic analysis was employed to identify and contextualise factors influencing CAV acceptability, encompassing usefulness, ease of use, effectiveness, affordability, and social acceptability. Results emphasised safety as a top priority for both drivers and pedestrians. Trust and system reliability were also common concerns, varying with participants' roles and transport experiences. Both drivers and pedestrians identified cost and economic benefits as significant barriers to CAV acceptance. Moreover, shared apprehensions about justice in adopting CAVs acknowledged the imperfections inherent in technological advancements. Participants supported CAVs but raised concerns about potential harm to vulnerable road users. Both car drivers and pedestrians expressed concerns that introducing CAVs could exacerbate existing injustices these road users face. This study offers valuable insights into how individual differences influence CAV acceptability, contributing to understanding their preparedness to adopt advanced automotive technologies.

1. Introduction

The automotive industry has witnessed significant advancements in recent years with the emergence of technologies aiming at developing connected and automated vehicles (CAVs). A CAV has two technology sets—connectivity and automation (Society of Automotive Engineers, 2021). These capabilities are necessary to exchange information and cooperate with other vehicles and infrastructure (Deb et al., 2018). CAVs can display one of the six levels of automation, according to the Society of Automotive

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Engineers (SAE). The first three levels (0, 1 and 2) require human supervision of the driving environment, and the driver must constantly supervise the driving task. In contrast, in levels 3, 4, and 5, the automated system monitors the driving environment, and the driver is not required to take control of the driving task when the automation is activated. These vehicles promise to reshape how we travel, making the transport system safer, more efficient, and environmentally friendly. Many of the benefits of CAVs have gained worldwide attention; for example, from an economic perspective, CAVs can impact the reduction of transport costs (e.g., energy costs and fuel costs) (Jiang et al., 2022; Sciarretta & Vahidi, 2020; Taiebat, Stolper & Xu, 2022) and encourage an inclusive economic growth (Clements & Kockelman, 2017; Winston & Karpilow, 2020). Similarly, from a social perspective, CAVs are marketed as an option to eliminate the need for humans to drive, which could significantly reduce traffic congestion (Talebpour & Mahmassani, 2016), improve road safety by reducing crashes and the severity of injuries (Ye & Yamamoto, 2019; Haque et al., 2021), and facilitate social interactions that help promote health and well-being (Singleton et al., 2020). Additionally, from an environmental perspective, preliminary studies show that the potential of CAVs to reduce congestion and air pollution is high (Tu et al., 2019).

Researchers in the CAVs field argue that this new technology's acceptability is crucial for its success and hinges on how readily end-users embrace it. Research studies show that some researchers are more optimistic about deploying CAVs than others (Kroesen, Milakis & Van Wee, 2023; Swain et al., 2023). In their research, Kim et al. (2019) identified that most experts perceived safety improvement and social advantages as providing CAVs with the most essential and prioritised benefits, such as parking conveniences, operational efficiency, and multitasking. Conversely, in their study, Duboz et al. (2022) identified that experts found more societal consequences of CAVs in the transport system rather than non-experts; doing that, various concerns related to privacy, responsibility in case of a safety–critical event, and increased maintenance and repair costs were discussed. With these divergent forecasts from researchers, it is understandable that the general public might hold varying degrees of optimism or pessimism towards CAVs.

Acceptance of CAVs can also vary immensely based on the current roles of road users. Drivers, for instance, may be influenced by factors like trust in vehicle autonomy and safety assurances (Payre, Cestac & Delhomme, 2014). At the same time, vulnerable road users (VRUs) such as pedestrians or cyclists may prioritise improved interaction mechanisms with CAVs to ensure safety (Reyes-Muñoz & Guerrero-Ibáñez, 2022: Kaye et al, 2022; Li et al., 2023). Nonetheless, while certain studies explore the viewpoints of various road users, including VRUs (Li et al., 2023), the predominant focus lies in examining drivers' attitudes toward embracing CAVs (Kaye et al., 2020; Nordhoff et al., 2020). Regarding evaluating whether interaction experiences with CAVs influence perceptions among vulnerable road users (VRUs), for example, Dennis, Paz & Yigitcanlar (2021) contributed to the knowledge of public perceptions and opinions about CAVs by conducting two surveys, including one for the "general public", who were those without experience using CAVs and one for people who experienced a shuttle CAV, deployed in Las Vegas, Nevada. The results suggested that people who had exposure to CAVs, young, highly educated, and males, feel more positively about CAVs than their counterparts.

Remarkably, few studies have sought input from drivers and VRUs to accurately predict the potential changes in their acceptance when utilising or interacting with CAVs (see Table 1 for more details). For example, Rahman et al. (2019) conducted a study involving adults aged 60+ years to explore the acceptance of CAVs from the perspectives of drivers and pedestrians. Participants showed positive attitudes when considering CAVs from a driver's perspective, and attitudes were neutral when considering CAVs from a pedestrian's perspective. Schrauth et al. (2021) investigated the acceptance of conditional CAVs among 1,929 vulnerable road users (VRUs) and 3,898 car drivers. Their findings highlighted differences in acceptance levels; for example, pedestrians and cyclists reported slightly lower acceptance of conditional CAVs than car drivers. Ahmed et al. (2021) delved into users' perceptions regarding their inclination to embrace CAVs, examining the viability of various machine-learning techniques to predict CAV adoption. The results indicated that safety, trust, privacy, accessibility, and ethics emerged as predominant concerns for users, such as drivers, riders, pedestrians, and cyclists.

Transport justice is a normative state where no individual or group is hindered by inadequate access to the opportunities necessary for a meaningful and dignified life (Karner et al., 2020). It also stresses the importance of a more equitable distribution of transport benefits and burdens within society (Martínez-Buelvas, Rakotonirainy, Grant-Smith, & Oviedo-Trespalacios, 2022; Pereira, Schwanen, & Banister, 2017), ensuring that all individuals, regardless of socioeconomic status, race, or physical ability, have equal access to reliable and affordable transport options. As CAV technology advances, ensuring equitable access and preventing the exacerbation of social inequalities becomes paramount. Crucial concerns include the potential for crash-optimisation algorithms to reinforce social discrimination, uneven access to transportation benefits, and the need for inclusivity to overcome existing barriers faced by marginalised groups (Dogan, Costantini & Le Boennec, 2020).

While the equity implications of CAVs have been acknowledged, there needs to be more analysis of how adoption and utilisation rates might differ for transport-disadvantaged communities. While CAVs promise significant improvements in road safety, their impact on vulnerable road users is still not well comprehended, largely because of public skepticism and a lack of familiarity with this emerging technology (Martínez-Buelvas et al., 2024). Research by Nordhoff et al. (2016) emphasises the importance of considering equity in CAV acceptance, focusing on the distribution of costs and benefits. Vlassenroot & Brookhuis (2018) also stress that equity is vital for accepting intelligent transportation technologies. However, it is imperative to maintain a human-centric approach at the forefront of advancements in this technology since the interaction between CAVs and VRUs raises significant concerns about potential inequalities. For example, Anderson et al. (2014) propose a guide for state and federal policymakers on the many issues CAVs raise, indicating that human lives should be the highest priority throughout automated car development, given that academic research has been primarily dedicated to understanding and enhancing CAVs during their development phases. Although some progress has been made, such as Australia's safety regulations and infrastructure investments (Lee & Hess, 2020; Manivasakan et al., 2021), and studies like those by Emory et al. (2022) exploring equity implications of AV policies, global policies have yet to address the impact of CAVs on VRUs fully. Existing approaches to transport justice often overlook how personal characteristics like income, gender, and race intersect with CAV development, underscoring the need for more nuanced frameworks that consider these factors in VRU-CAV interactions. To

Table 1
Literature review associated with CAV acceptance studies – similarities and differences with the present study.

Study	Road Users	Focus	Methodology	Sample	Findings	Key similarities	Key Differences
Chan & Lee (2021)	All road users	Examine the factors that influence the behavioural intention towards 5G CAV adoption and to examine the mediating effect of trust.	Survey	n = 211	1. Perceived compatibility and personal innovativeness significantly influence behavioural intention. 2. Trust was found to mediate the relationship between perceived usefulness, perceived ease of use and social influence with behavioural intention to adopt 5G CAV.	1. Safety is important in the acceptance of CAVs.	1. Justice concerns related to CAV. acceptance are missing 2. No differentiation of road users.
Kyriakidis et al. (2015)	All road users	Investigate public opinion on CAV.	Survey	n = 5000	Respondents with higher neuroticism were less concerned about software and data hacking. The frequent commuters/ drivers were willing to pay more for CAVs.	1. Affordability, cost and driving pleasure may impact the uptake of CAVs.	1. Justice concerns related to CAV acceptance are missing. 2. No differentiation of road users.
Kyriakidis et al. (2020)	VRU	Importance of safety in the acceptance of AVs.	Survey	n = 1639	1. The elderly would travel in AVs with the presence of a human supervisor. People with disabilities have the same bias. 2. Next to safety, reliability, affordability, cost, driving pleasure and household size may also impact the uptake of AVs and shall be considered when designing relevant policies.	1. Safety is important in the acceptance of CAVs. 2. Affordability, cost and driving pleasure may impact the uptake of CAVs.	1. Justice concerns related to CAV acceptance are missing. 2. No inclusion car drivers.
Miller, Chng, & Cheah (2022)	VRUs (people with disabilities and elderly people)	Investigate user acceptance of shared AVs among people with different mobility and communication needs.	Survey/ Focus group	n = 300 (survey) n = 53 (focus group)	1. Anticipating AV in public transport with positive attitudes and emotions. 2. Concerns about various aspects of safety.	1. Safety is important in the acceptance of CAVs. 2. Shared CAVs and public transport improvement.	1. Justice concerns related to CAV acceptance are missing. 2. No inclusion car drivers and other VRUs.
Payre et al. (2014)	Car drivers	Acceptability, attitudes, personality traits and intention to use a fully automated vehicle.	Interview/ survey	n = 5 (interview) n = 421 (survey)	Predictors of intention to use a fully automated car were mainly attitudes, contextual acceptability and interest in impaired driving.		1. Justice concerns related to CAV acceptance are missing. 2. No inclusion of VRUs.
Xing et al. (2022)	VRU	Explore the differences in vulnerable road users' perceptions of AVs	Surveys	n = 998 (in 2017) n = 750 (in 2019)	VRUs's interactive experiences with AVs increased from 2017 to 2019 in Pittsburgh, and the interactive experiences with AVs positively affected VRUs' perceived safety and receptivity toward AVs.	1. Interactive experiences with CAVs positively affected VRUs' perceptions.	1. Justice concerns related to CAV acceptance are missing. 2. No inclusion car drivers.
Rahman et al. (2019)	Older adults	Perception of self-driving vehicles as pedestrians, and perception of self-	Survey	n = 173	If older adults are familiar with self-driving vehicles, they are more likely to have	1. Concern about the interaction between pedestrians and	1. Justice concerns related to CAV acceptance are

(continued on next page)

Table 1 (*continued*)

Study	Road Users	Focus	Methodology	Sample	Findings	Key similarities	Key Differences
		driving vehicles as users.			a favourable perception of CAVs.	self-driving vehicles 2. Familiarity with self-driving vehicles, more likely to have a favourable perception	missing. 2. More road users involved in the study.
Schrauth et al. (2021)	VRU and car drivers	Acceptance of CACs from the point of view of different road user groups.	Survey	n = 1929 VRU n = 3898 car drivers	Acceptance of CACs differs between road user groups in that VRUs demonstrated lower acceptance than non-automated car drivers.	1. Inclusion of car drivers and VRUs 2. VRUs express greater concerns about their subjective safety than car drivers.	1. Justice concerns related to CAV acceptance are missing.

close the gap in the literature, this study investigates the most latent issues regarding the acceptability of CAVs among car drivers and pedestrians through the lens of justice in the transport system. It also identifies differences and similarities among these road users regarding deploying CAVs designed to improve safety and justice. Our research goes beyond traditional CAV acceptance studies by focusing specifically on safety, transport justice and vulnerable road users.

1.1. *The context of the study*

As CAVs will be introduced to improve safety and justice in the transport system, it becomes crucial to understand the perspectives of different road users to ensure that deploying these technologies aligns with the principles of justice in transport (i.e. equality, fairness, and access). The context of the study revolves around examining the acceptability of CAVs among car drivers and pedestrians from the greater area of Brisbane (Queensland, Australia), with a specific focus on safety and justice in the transport system. The research aims to investigate the latent issues surrounding the integration of CAVs into the current transport system, exploring how drivers and pedestrians perceive and experience these technological advancements.

Queensland serves as the focus of this study due to its pivotal role in the early adoption and testing of CAV technologies, which is evident in proactive initiatives such as pilot projects. The state's diverse transport infrastructure, encompassing both urban and rural landscapes, offers an optimal environment for a comprehensive examination of the nuanced impact of CAVs on different settings and communities. Furthermore, Queensland's continual efforts to adapt its legal and regulatory framework to accommodate CAVs underscore the crucial need to understand the evolving regulatory context (Queensland Government, 2017).

The global significance of this research stems from the widespread relevance of CAVs, extending beyond specific regions. CAV deployment is a universal phenomenon, and insights gained from understanding their acceptability and challenges in one region can offer valuable guidance for others contemplating the adoption of similar technologies. The research findings can play a crucial role in informing the development and implementation of CAVs globally, ensuring they contribute to establishing a safe and equitable transport system for everyone. Moreover, the research in Queensland holds the potential to provide policymakers and regulatory bodies with valuable information, guiding the formulation of ethical and equitable regulations and policies for the integration of CAVs into the current transport system.

2. Method

2.1. *Participants*

Participants qualified to take part in this research if they were 18 years old or above, residing in the greater Brisbane area (Queensland, Australia), were currently engaged in walking or driving, and were open to participating in a face-to-face or MS Teams interview. Since all drivers also engage in pedestrian activities, and vice versa, participants were free to identify themselves as either pedestrians or drivers based on their primary mode of transport. The self-reported data served as the cornerstone for participation in this study and played a vital role in interpreting the results. The study involved 18 car drivers and 12 pedestrians. Car drivers aged between 20 and 79 years (M = 48.3, SD = 18.77) and pedestrians aged between 18 and 61 (M = 36.0, SD = 12.94). The gender distribution within the sample was as follows: 66.67 % female (12 car drivers and eight pedestrians), 30 % male (5 car drivers and four pedestrians), and 3.33 % non-binary (1 car driver). While all participants resided in the greater Brisbane area, 66.67 % were Australian citizens, and 33.33 % were from other countries.

We chose our sample size based on the data quality we aimed to achieve. Qu & Dumay (2011) suggest that semi-structured interviews work well with small samples, and Creswell (1998) recommends 20–30 participants for qualitative research to reach data saturation using a grounded theory approach. The results presented in this study are descriptive, local, and limited in scope. The sample size remains a small representation of Australian, specifically Brisbane, road users. Therefore, readers are encouraged to be cautious in interpreting or generalising these results. The contextual nature of qualitative research means that these findings are intended to be only partially applicable but serve as a starting point for further engagement (Leung, 2015).

2.2. Material

The interview protocol was adopted based on the research done by Regan et al. (2002), who created a refined definition of acceptability on in-vehicle intelligent transport systems based on the Technology Acceptance Model – TAM (Davis, 1985). It also included the attributes of system acceptability used by Nielsen (1994). However, we used the concept of acceptability, later revisited by Mitsopoulos-Rubens & Regan (2018), in terms of five key constructs: (1) usefulness, (2) ease of use/usability, (3) effectiveness, (4) affordability and (5) social acceptability (see Table 2 for definitions).

2.3. Interview procedure

The Queensland University of Technology Research Ethics Committee (reference number 6593) approved the study. A qualitative approach was chosen to gain insights into the complex field of individual acceptance of CAVs into level 5 of automation (See Society of Automotive Engineers – Levels of driving automation) among car drivers and pedestrians to identify differences and similarities in their perceptions and experiences. Their inherent vulnerability and frequent vehicle interactions supported the decision to include pedestrians in this study. Similarly, including car drivers offered a comprehensive perspective, given their substantial influence on the transport system, potential implications for policy, and distinctive user experiences. We used semi-structured interviews based on a predetermined interview guide of open questions (see Table 2). Longhurst (2010) and Osborne & Grant-Smith (2021) highlight that semi-structured interviews can strike a balance between structure and flexibility. This characteristic allows for thoroughly exploring the research topic, offering a holistic understanding. The value of this method lies in its effectiveness in capturing the intricate nuances of human experiences and perspectives (Osborne & Grant-Smith, 2021).

Using this approach, we explored the acceptability of CAVs among car drivers and pedestrians, focusing on safety and justice considerations. Before proceeding with the interview, each participant was informed of the confidential nature of the research and was required to provide verbal consent. Prior to delving into CAV-related topics, we asked participants about their familiarity with CAVs. For those who were unfamiliar, we provided a detailed explanation, including defining CAVs – Level 5 automation. We also clarified that our research focuses explicitly on private CAVs with Level 5 automation.

Participants were interviewed face-to-face or via MS Teams for between 45 and 60 min. Data were collected between February and April 2023. Participants received a $50 e-gift as a reimbursement. Interviews continued until data saturation was determined (i.e. when there was limited new information obtained from additional interviews). All interviews were audio-recorded and transcribed verbatim by the first author (LMB). Participants could contact the research team if they wished to share any additional information after the interview or if they wanted a brief report of the results.

2.4. Data analysis

Thematic analysis was employed through a deductive approach, prioritising interviewees' quotes over researchers' subjective impressions to condense the information into meaningful and manageable data sets (Hsieh & Shannon, 2005). This method allowed the identification of overarching themes aligned with the acceptability constructs defined by Regan, Mitsopoulos, Haworth, & Young (2002). Sub-theme coding utilised an inductive approach, deriving themes directly from the data without relying on pre-existing theoretical frameworks (Fereday & Muir-Cochrane, 2006). Participants' responses were organised into overarching themes, revealing detailed subcategories associated with these broader themes. The coding process involved a thorough manual examination of interview transcripts, which were meticulously reviewed. Each transcript was initially reviewed by the first author (LMB) to identify relevant codes, themes, and subthemes. To ensure reliability, the second researcher (OOT) independently reviewed each transcript and

Table 2
Interview questions based on Regan et al. (2002) definition of the acceptability of in-vehicle technology.

Construct	Definition	Questions
Usefulness	The extent to which an individual believes the technology will improve their performance	How useful would you find CAVs? Would it serve a purpose for you? In what ways? Under what conditions?
Ease of use/usability	The extent of effort required to use the application.	Please describe your immediate feeling towards CAVs What do you like about CAVs? What do you dislike about CAVs?Can you think of any potential problems or concerns you might have using/interacting with a CAV?
Effectiveness	The belief that technology is functioning as intended	Do you think that driving a CAV will make you drive differently? Will it make you a safer driver or a less safe driver?Do you think that interacting with a CAV will make you walk differently? Will it make you a safer pedestrian or a less safe pedestrian?
Affordability	An individual's willingness to use the technology, even if it comes with costs.	What would stop you to buy a CAV?What would encourage you to buy a CAV?
Social Acceptability	Social issues of technology acceptability which are considered by individuals when judging their own acceptability of the technology	How long would it take you to feel comfortable using/interacting with a CAV?How do you think private or shared CAVs could improve or worsen your experience as a car driver/pedestrian in the transport system?

the codes identified by the first author. Disagreements in coding were resolved through discussion and consensus, where both researchers reviewed differing codes together, discussed their interpretations, and reached an agreement. After coding all responses, the first author (LMB) developed themes and subthemes. Regular meetings were held to discuss and refine the themes and subthemes, ensuring that multiple perspectives were considered as a collaborative process involving all authors. This collaborative approach allowed us to develop themes closely aligned with the research objectives, providing a robust foundation for the study's outcomes. Coding, theme development, and interpretation of quotes underwent rigorous discussion with co-authors, addressing discrepancies until reaching a comprehensive and precise set of participants' comments. The average percentage agreement across all the processes was 90 %, indicating high consistency between authors.

3. Results

Our study employed a deductive thematic analysis approach aligned with a pre-established construct. Applying this method, we ensured a structured exploration of the data within the framework of the construct, facilitating a focused examination of specific areas of interest related to justice and safety. The themes were organised based on the construct used to provide insights into the challenges and opportunities associated with justice and safety as they pertain to the adoption of CAVs. The research findings are presented under five main themes: *usefulness, ease of use/usability, effectiveness, affordability, and social acceptability*. This section is a synthesis designed to help the reader better appreciate the 'big picture' of the acceptability of CAVs among car drivers and pedestrians, a new technology that can improve safety and justice in the transport system.

3.1. Theme 1: Usefulness

Usefulness describes if a system serves some goal or purpose. Across the data, we identified some similarities and differences that capture car drivers' and pedestrians' perceptions of CAVs. Most participants (n = 24, 80 %, 14 car drivers and 10 pedestrians) identified that CAVs can enhance people's lives by increasing safety, efficiency, and convenience in the transport system. Participants also stated that CAVs can contribute to reduced traffic accidents, improved traffic flow, and enhanced accessibility, ultimately making the transport system more reliable and enjoyable for road users. Furthermore, eight car drivers and five pedestrians identified that CAVs could seek to minimise human errors, distractions, and fatigue, potentially reducing crashes and improving the overall driving experience.

Nevertheless, while car drivers and pedestrians share concerns about trust, safety, and potential system failures related to CAVs,

Table 3
Quotes relevant to Theme 1: Usefulness.

Subtheme	Car drivers' quotes	Pedestrians' quotes
CAVs would improve people's life	*"Well, very useful, I think, particularly as I get older and I might not be able to drive my own car, I think it's going to be wonderful for people with disabilities or elderly people or, you know, people for driving is a difficult task. And any of us could experience a disability at any time." (F, 57)* *"Incredibly useful. Many millions of hours would free up for people to be productive." (M, 46)*	*"I think it would be useful because I think I would have to learn a lot less in terms of driving. So then I wouldn't have to learn how to parallel park, if that makes sense. So, I wouldn't have to actually invest as much time and as much skill into driving." (F, 28)* *"Personally, absolutely necessary. I don't like to drive. I do not like to try." (F, 29)*
CAVs would improve road safety	*"Maybe they might be able to help with congestion because I think some congestion problems are because of driver behaviour, thinking about like highway driving when is just like a really long stretch of road." (F, 53)* *"If they were running at 100 %, and they've done all the alphas and the betas, and they're tested for years, and everything was running fine. I think, in theory, it could contribute to road safety." (F, 37)*	*"If they are well designed, I think they will be a real game changer. I think they could save a lot of lives. I think they could make transport a lot easier for people as well." (M, 35)*
CAVs would reduce human factors while driving	*"Probably very useful. It would take away a lot of road rage." (F, 58)*	*"If I have to drive, I'm a cautious driver. I know it's not about me but more about what other cars are doing and anticipating what they do. Avoiding the errors affecting me, then I guess I would feel safer." (F, 54)*
Perceived barriers to CAV usefulness	*"Ohh not useful. I wouldn't use them. I wouldn't trust it with my safety or the safety of others, to be honest." (NB, 25)* *"Not very useful. I just, I think, creeps me out. I don't think we're at the point where we take the human factor out of driving completely. So I think accidents are still going to happen, and you know, and that's like, a whole legal side, I don't know who's to blame them if you're not the one that is driving the car." (F, 26)*	*"Fully automated. I couldn't find them useful at all. I know that there is always system failure. I don't think the automated vehicle is smarter than the car with the driver." (M, 53)* *"I don't know if will they yield to pedestrians. Well, maybe they can be useful. I don't know. But how do you how can you tell if the car is automated or not? Yeah, it can be risky in that way because you maybe you assume the car is automated and that it will yield to you, but perhaps you shouldn't have assumed, and you're hit, I don't know." (F, 38)*

their perspectives on usefulness, impact on congestion, concerns about human factors, and legal considerations differ based on their roles and experiences in the transport system. We grouped these perceptions into four subthemes: (1) CAVs would improve people's lives, (2) CAVs would improve road safety, (3) CAVs would reduce human factors while driving, and (4) Perceived barriers to CAV usefulness. Table 3 presents quotes relating to the sub-themes for car drivers' and pedestrians' perceptions of the usefulness of the technology.

3.2. *Theme 2: Ease of use/usability*

Perceived ease of use can be defined as the degree to which a person believes using a particular system would be free of effort. This theme illustrated mixed perceptions. While car drivers expressed positive attitudes toward the ease of use of CAVs, with seven participants describing enjoyable experiences with semi-automated features, by contrast, eight pedestrians highlighted initial scepticism and concerns about understanding and adjusting to the technology, indicating potential barriers to widespread acceptance and adoption of CAVs. Over half of the participants (n = 16, 53.33 %, nine car drivers and seven pedestrians) expressed concerns about AI reliability in CAVs, fearing technological limitations and susceptibility to cyber-attacks, potentially compromising safety. Additionally, five participants (two car drivers and three pedestrians) raised concerns about the credibility of CAV systems, questioning claims from

Table 4
Quotes relevant to Theme 2: Ease of use/usability.

Subtheme	Car drivers' quotes	Pedestrians' quotes
CAVs would be easy to use	*"I've also driven a Tesla that has certain self-driving capabilities on the highway, and I, you know, I really enjoyed that." (F, 57)* *"Yeah, I think it could be quite nice. I think I'd be more relaxed and at ease if I could just hand the controls over, but I wouldn't be paying attention. I'd be doing something else and just –Take Me Home-" (F, 60)*	*"I think it would be nice in terms of, it would take a lot less effort, and it would take away distress." (F, 18)* *"I think [CAVs] will make things potentially easier or more uniform." (F, 32)*
CAVs would not be easy to use	*"It would be a difficult adjustment to make and more difficult for my generation. So far, people who have been driving for 40 years have full control and probably have less understanding of electronics and technology." (M, 61)*	*" I have a lack of understanding of them. For sure. I don't know how they operate." (F, 32)* *"I think that at the beginning, I'm sure that it would feel strange to use because you don't know what is expected." (F, 38)*
Reliability of AI as a significant concern of usability of CAVs	*"I am threatened for a number of reasons, I have worked with AI and computer programs quite a lot, and while they can be really powerful tools, they are entirely limited by the people programming them in the data sets that are training them." (NB, 25)* *"I'm sceptical that an AI could be as flexible as a person." (F, 26)* *"I dislike the possibility that the technology could be interfered with by hacking." (F, 57)*	*"I always think about all these cyber-attacks that have been able to destroy Big castles. How can we also think about some attacks, terrorist attacks that have taken place in the past using a vehicle as a medium? How can we make sure that the system is as protective as it should be, that the system is ruling that cars cannot be converted into a weapon? I don't know, that is very concerning." (F, 38)*
Credibility of the system as a concern of CAVs usability	*"I feel very conflicted. Like, I could see it being amazing, but it's also, I'm 100 % not like a conspiracy theorist, but I think it would be insane to completely trust a government at any point in time." (F, 34)*	*"I feel like if a company is making statements, but there's no actual data to support it, then I don't understand why they can say that because a lot of people won't research, and they won't. I feel like it's really unfair that they're making all these like claims and everything when if you look like a little bit throughout that, then you can see that it's not true because I feel like, yeah, a lot of people will just believe everything that they hear." (F, 18)*
	"I think money-hungry corporations will sell it as something that's cool and convenient for abled people, rich and abled people. So we know that these companies don't actually care about safety. They only care about the numbers at the end of the day." (NB, 25)	*"Companies will advocate for this type of car, and they will always be speaking good things, but because it is their business to sell you a car so we should be careful with that." (F, 38)*
Concerns about social justice problems related to CAVs	*"I don't understand how an autonomous vehicle can make a decision, an ethical and moral decision based on like, do I run over that pedestrian that's on the road, or do I drive off the Cliff?" (F, 53)* *"They're also a bit negative to society, you know. These cars can take Uber drivers' or Taxis' jobs away from them because the car is driving themselves and there will be no Uber drivers to fill up the position or whatnot." (M, 20)*	*"I guess my question then is like, are we pushing so heavily for driverless vehicles? Is it convenient? Is it a money-making thing for manufacturers? Is it safety behind it?" (F, 32)* *"Well, my feelings are. I don't know. Will they increase Inequalities in the system? Who will be able to pay for this? Will the system be safer or not? And well, I don't know, is someone thinking of all the pedestrians when these vehicles become a reality? I don't know. More questions than anything." (F, 38)*
	"What I dislike about the car is the ethical dilemma. What are we gonna do? How do we program the car? Do we rather crash into 2–10-year-old kids? Or do we rather crash into an 80-year-old person? What is the decision matrix?" (M, 46)	*"It's a little bit like the trolley car problem, right? Like, if you're gonna kill five people or one. Which one do you kill? And for me, I suppose, no matter how aggressive a driver may be on the road, no matter how much priority, how much priority they think they have assigned to them. At the end of the day, I'm pretty confident that they don't want to kill me." (M, 35)*

governments and car manufacturers and the need for clear supporting evidence. Similarly, five car drivers and four pedestrians expressed worries about CAV ethics, particularly in relation to pedestrian safety and job displacement, highlighting concerns about fairness and ethical decision-making algorithms in critical scenarios. Five subthemes were identified across the data and are presented in Table 4: (1) CAVs would be easy to use, (2) CAVs would not be easy to use, (3) Reliability of AI as a significant concern of usability of CAVs, (4) Credibility of the system as a concern of CAVs usability and (5) Concerns about social justice problems related to CAVs.

3.3. Theme 3: Effectiveness

Effectiveness relates to the perception that the technology performs as expected. Regarding the application's effectiveness, participants were questioned about their belief in whether CAVs would bring about any changes in driving/walking behaviour. More than half of the participants (n = 16, 53.33 %, ten car drivers and six pedestrians) shared perspectives on the potential impact of CAVs on safety. Car drivers believe CAVs would improve safety by providing warnings, removing erratic behaviours, and enhancing road safety. Similarly, pedestrians anticipate becoming safer due to increased alertness and reduced distractions, especially when crossing roads. However, three car drivers expressed concerns that introducing CAVs might encourage laziness among drivers, leading to potentially dangerous situations. Similarly, two pedestrians expressed that they are cautious about the unpredictability of CAVs, expressing a preference for maintaining some level of driver control. Three themes were identified across the data: (1) CAVs would increase safety, (2) CAVs would not increase safety and (3) Other barriers to CAV effectiveness (see Table 5).

3.4. Theme 4: Affordability

Regan et al. (2002) define affordability as the individual's inclination to invest in any new technology and the amount of money they are prepared to allocate. Participants were asked about what would stop/encourage them from buying the technology. Both car drivers and pedestrians expressed concerns about the cost of adopting CAVs. A total of 12 car drivers considered the initial cost and ongoing expenses a concern, including potential fuel or electricity costs. Meanwhile, seven pedestrians focused on the importance of

Table 5
Quotes relevant to Theme 3: Effectiveness.

Subtheme	Car drivers' quotes	Pedestrians' quotes
CAVs would improve safety	*"I suppose it gives you warnings. Yeah, it might be like when you're tired, and you know you're not concentrating or you're looking somewhere else. It's quite possible. Yes, it would help." (F, 60)* *"Well. If it is a fully automated vehicle, whatever level that is, Doesn't involve any involvement of myself anymore unless it breaks down or whatever. Then I'm pretty sure it'll make it. Assuming that they're heaps of those cars on the road, and they are all communicating with each other. I would expect that it makes it way safer, but also hopefully way faster because drive closer to each other, they know which route to take to avoid traffic jams and so forth." (M, 46)* *"I think it takes out some of the erratic behaviours of both yourself and the things that can distract you." (F, 70)*	*"Probably a more a safer pedestrian. More alert. Like I probably wouldn't be on my phone and step into a crosswalk." (F, 32)* *"If it's very programmed to go on a certain way in a certain line, it could be safer because that might not go above a certain speed than it." (F, 28)*
CAVs would not improve safety	*"I'd like to think it'll make me a safer driver. But again, it gets back to this idea. Is there a fail-safe in there, and what happens if something goes wrong? What can I do about it? Do I have any sort of controls, or am I totally reliant on technology, I guess? The question would be, I don't feel comfortable relying totally on technology." (M, 79)* *"It's unlikely that I would drive one, actually, because I think I am a safe driver and I'm also a courteous driver, and I like to have control over that myself." (F, 53)*	*"I think it makes me a less safe pedestrian because I'm not sure what the cars will do." (F, 61)* *"It really depends on how they're designed. I remember reading an article about the Turkey Paralympics. The Special Olympics and there was, I think, about like an automated bus that there were trialling and using around like the Olympics, and a vision impaired person crossed a crossing, and the bus didn't stop. And so in my mind, I'm like that could very easily be me." (M, 35)*
Other barriers to CAV effectiveness	*"Like I said, there's a whole bunch of reasons traffic accidents happen, and if the car, like, just has a thing that, for example, just like stops, if there's a person or something, I think that would probably add to safety in the long term. My concern is all the exceptions because even sudden breaking can be really dangerous. I think it could encourage others to be very lazy." (NB, 25)* *"I think particularly as each new generation comes through, we get further and further away from how hard it is to learn to drive. I think the more time you have on the road, like the more experience you gain and the better driver you are, the more safe you are, the more safe you can be, whereas the less we contribute to the operation of the vehicle, if we're ever required to, people aren't going to know what to do." (F, 34)*	*"If something wrong happens, there's a massive problem because you don't have anyone to complain. And just because it's a machine or technology, you can blame that car. So, it will be difficult to modify and solve the problems." (F, 37)* *"Depending maybe depend on the time period. If it's in the early stages of exploration, research, and testing, maybe I would be very cautious, or I should not cross the street or whatever. But if it's already proven and integrated into society already, then no problem." (M, 23)*

Table 6
Quotes relevant to Theme 5: Affordability.

Subtheme	Car drivers' quotes	Pedestrians' quotes
Cost and financial benefits as a barrier to buying a CAV	*"So pricing, because I have my preferred brands of car, which I lean towards, and they are probably the European model cars, and here in Australia, those cars are really expensive. So, price point would be one thing." (F, 35)* *"I think the cost is going to be a big thing, not just the initial cost, the ongoing cost gonna be high." (M, 79)*	*"That also depends on the financial ability. If they offer any reasonable price or tax reduction on some things, that might encourage me." (F, 37)* *What will discourage me would probably be the cost. For sure, this would be expensive, and would this also take up more gasoline or electricity? Yeah. So, the cost might be a factor." (M, 23)*
Safety technology as a barrier to buying a CAV	*"It would have to be the reliability of the intent of the artificial intelligence beyond it. Yeah, it would have to be spot on for me to have confidence in it." (F, 58)* *"It would discourage me is multiple reports of cars monthly crashing into walls." (M, 46)* *"I think a big thing for me will be who is making the call. What is their safety record? What are the values of that company? Is it Being created by a Research Institute and my government to help prevent traffic incidences and stuff? I will trust it a lot more than some, playboy billionaire, who has been proven to blow things up and kill hundreds of thousands of people in sweatshops because he doesn't give a crap. So, who is making it will be really important about whether or not I feel like I can trust it? And yeah, I guess I'm a scientist. So, a lot of evidence-based demonstrations and how safe it actually is." (NB, 25)*	*"Increasing the scientific backing data would really encourage me to buy that car." (M, 23)* *"Make me want to, but not making me want to buy these. If there wasn't much testing and stuff like that. If they were just OK, tomorrow would make me not very confident. But if there's a little bit more testing, maybe." (F, 28)*
Perceived benefits and enjoyment of CAV technology	*"Brands that I would find trustworthy or also if other people have used it and just like good reviews and that everyone seems to feel safe in it." (F, 20)*	*"I think it would the thing that would encourage me is probably that it would take a lot less effort than driving." (F, 18)* *"If I get into an emergency at any point, maybe even at night when I'll feel sick and have to access my medical services, at least I can board the vehicle, and it takes me to my destination." (M, 24)*

reasonable pricing, tax reductions, and financial incentives to encourage the adoption of CAVs. Safety technology concerns that deter CAV adoption, including AI reliability, testing adequacy, and manufacturer credibility, were expressed by 20 participants (66.67 %, 14 car drivers and six pedestrians). Conversely, perceived benefits like trust in the brand and enhanced emergency access drove interest in CAVs for three car drivers and two pedestrians. Table 6 presents quotes relating to the sub-themes identified: (1) Cost and financial benefits as a barrier to buying a CAV, (2) Safety technology as a barrier to buying a CAV, and (3) Perceived benefits and enjoyment of CAV technology.

3.5. Theme 5: Social acceptability

Social acceptability refers to the social factors individuals consider when evaluating their willingness to embrace a particular technology. In total, 20 participants (66.67 %, 11 car drivers and nine pedestrians) expressed needing more evidence to be convinced to adopt CAVs in their lives. However, only one car driver and one pedestrian commented that others' experience or perception about CAVs would influence their willingness to embrace this technology. The car driver expressed: *"I'd have to wait till other people bought it before I could justify buying one." (F, 68)*. Similarly, one pedestrian said: *"I think for me I would want to have a friend or a family member or someone I know who has used them and I had good experiences with them, be able to ask them questions about their experience with them and possibly even go with them to test their vehicle." (F, 35)*. These results suggest that both participants seek credible, research-based evidence.

3.6. A thematic roadmap conceptualising the acceptability of CAVs

The findings from our interviews with car drivers and pedestrians highlighted five key themes aligned with a pre-established construct: usefulness, ease of use/usability, effectiveness, affordability, and social acceptability. These themes are likely to influence people's response to adopting CAVs to enhance safety and justice in the transport system. The results highlighted the various benefits CAVs can bring, but they also shed light on the significant sustainability, justice, and safety challenges that their adoption may pose. To ensure the successful integration of CAVs into our transport system, governments, car manufacturers, and other stakeholders must address these issues proactively. Fig. 1 provides a thematic framework to represent these themes, sub-themes and their interrelationships visually indicating the positive (+) or negative perception (−) among car drivers and pedestrians. D stands for driver, and P stands for pedestrian in this framework. By conceptualising this information, Fig. 1 outlines the opportunities and challenges in deploying CAVs to enhance safety and justice in the transport system, focusing on the necessities of each road user. Additionally, it serves as a valuable tool for understanding the factors that will determine the overall acceptability of this emerging technology.

According to the results presented in Fig. 1, a holistic approach is needed to enhance CAV acceptability and improve justice within

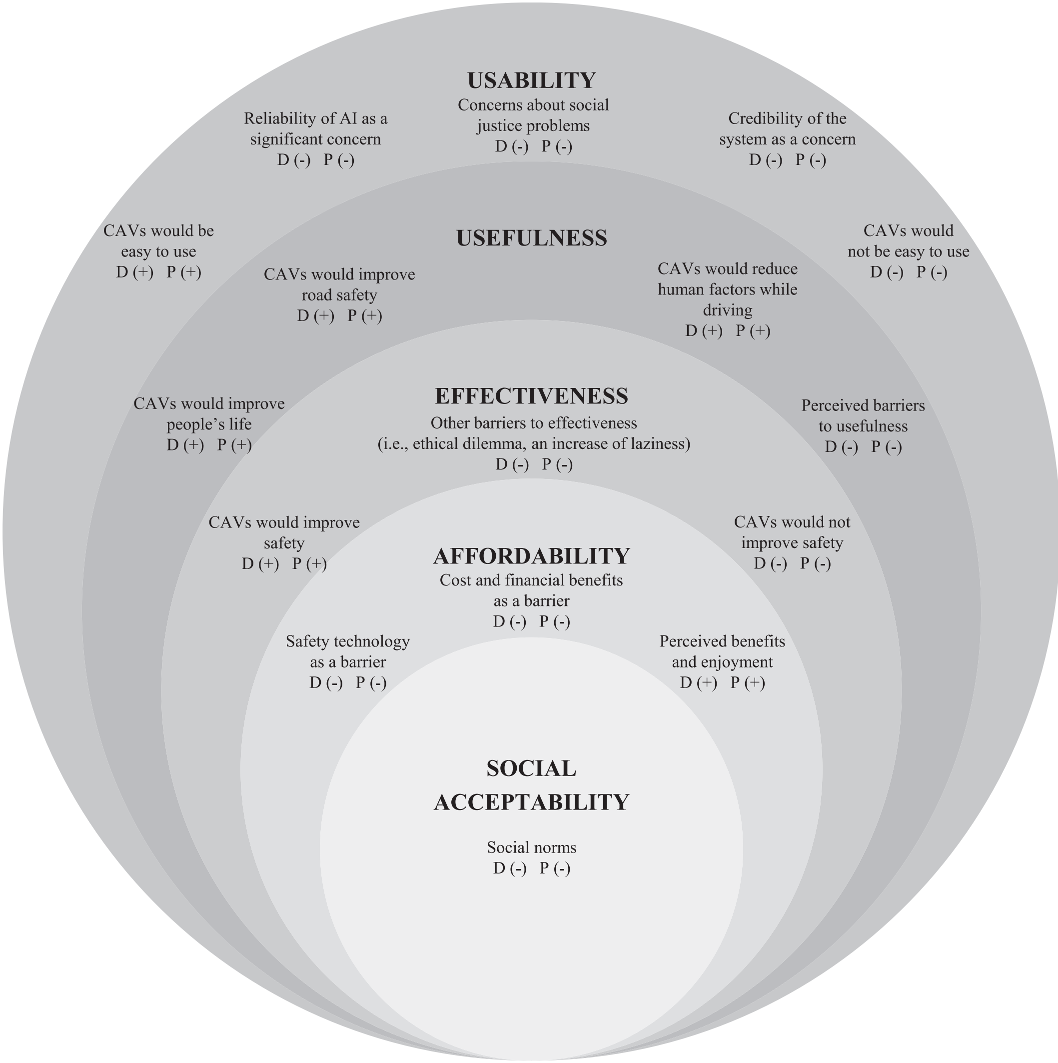

Fig. 1. A thematic conceptualisation of CAVs' acceptability.

the transport system. Public awareness campaigns should educate car drivers and pedestrians about the benefits of CAVs, addressing concerns such as the safety, efficiency, and convenience of this new technology. Transparency in communication is crucial, providing clear information about CAV safety features for the decision-making processes to build trust in both road users. Designing user-friendly CAV interfaces will alleviate worries about usability, ensuring a seamless experience for drivers and pedestrians. Establishing and communicating clear regulations and safety standards will address legal concerns and create a consistent and secure environment for CAV adoption. Emphasising the collaborative nature of human-AI driving and introducing CAVs gradually will help users adapt over time. Financial incentives, including tax reductions and reasonable pricing, should be implemented to mitigate concerns about the cost of adopting CAVs. Finally, backed by successful case studies and data, evidence-based communication will help convince sceptical users.

4. Discussion

The discussion analysis involves 'reading across' the themes presented to highlight the interactions and relationships between them, considering their role as part of the whole system and the experience of VRUs with CAVs deployment. Although governments and industry sectors have made significant investments in CAV development and display great enthusiasm, CAVs also raise numerous concerns.

Regarding our results about the usefulness of CAVs, car drivers and pedestrians underscored several times that CAVs would be a convenient new transport mode that could improve people's lives and productivity and enhance the freedom to enjoy other hobbies while in the car. These perceived benefits are consistent with the literature in which CAVs are presented as a way to alleviate mobility barriers for people with disabilities (Sundararajan et al., 2019), older people (Faber & Van Lierop, 2020) and people who are not fit to drive (Sohrabi et al., 2020). Additionally, our results are consistent with previous research where CAVs are considered to have the potential to generate induced demand, meaning that the time spent in cars becomes more valuable. In this case, individuals may become more willing to travel longer distances for commuting, daily errands, business, or leisure trips, incentivising people to relocate their homes to remote areas, attracted by lower land prices (Bansal, Kockelman & Singh, 2016).

As could be expected, car drivers expressed the belief that CAVs could contribute to easing traffic congestion. These concerns align with previous research highlighting the potential benefits of CAVs in reducing traffic congestion and air pollution. For example, Li & Wagner (2019) performed simulations to examine how traffic flow would be affected by a 70 % automated vehicle (AV) presence on motorways. Their study revealed that even with a portion of vehicles being automated, motorway traffic could experience improved flow, given the ability of CAVs to maintain a reduced following distance, adhere to speed limits, and exhibit cooperative behaviour during lane changes. Nevertheless, several other studies have highlighted numerous uncertainties concerning the future of CAVs and their interaction with manually operated cars (Li, Oviedo-Trespalacios, Afghari, Kaye, & Yan, 2023). The challenge lies in the need for conventional vehicle drivers to anticipate and respond to CAVs, while CAVs must also adapt to the behaviour of human drivers (Nyholm & Smids, 2020; Van Loon & Martens, 2015; Li, Oviedo-Trespalacios, Afghari, Kaye, & Yan, 2023).

Related to the belief of removing humans from driving tasks, car drivers and pedestrians expressed positive feelings that this would improve road safety and give more confidence when interacting with other road users in the transport system. However, both participants identified barriers to CAVs' usefulness, given that no technology is foolproof. According to Fagnant & Kockelman (2015), CAVs have the potential to reduce injuries by 75 % since they can anticipate and respond to oncoming dangers beyond human drivers' capabilities. Conversely, Papadoulis et al. (2019) have argued that this claim is overly optimistic and lacks empirical evidence. Other studies take a more balanced stance, suggesting that although road crashes may decline with CAV introduction, complete elimination is unlikely as no automated system is entirely trustworthy (Sepehri Rad, Memarmontazerin & Saffarzadeh, 2021; Ward, 2019). Indeed, research has found that drivers and other road users maintain a sceptical outlook regarding the functionality of automated vehicles, especially in scenarios where human control is minimised or eliminated (König & Neumayr, 2017; Lijarcio et al., 2019).

A critical concern for pedestrians is that deploying CAVs on the road will increase the disadvantages of VRUs. This suggests that although governments and industry sectors have made significant investments in CAV development, interactions between CAVs and VRUs need to be better understood. For example, Martínez-Buelvas et al. (2022) provided a transport justice framework that can help to structure the potential problems associated with adopting CAVs concerning their interactions with VRUs. The research established that there are injustices, including the perpetuation of current road trauma risks for VRUs with the deployment of CAVs, such as a rise in pollution, increased traffic injuries, issues related to road responsibility, and the loss of space. Understanding these tensions is crucial for illuminating the impact of technology, which could lead to its rejection or unexpected consequences. Reyes-Muñoz & Guerrero-Ibáñez (2022) reviewed the interaction process between CAVs-VRUs, analysing the road traffic ecosystem and identifying the evolution of the environment and the new elements that are being integrated. The authors expressed that CAVs-VRU interaction should be designed to guarantee the inclusion of the different requirements of all kinds of VRUs. Similarly, Li et al. (2023) cautioned against undesirable behavioural adaptations, such as cyclists reducing their self-protective behaviours around CAVs due to overtrust. Another study evaluated pedestrians' behaviour toward fully automated vehicles by proposing a novel beta hurdle regression model to assess the fine for intentionally blocking their path and its monetary value. Factors like age, gender, education, experience, attitudes, behaviours, violations, and perceived ease influence this perception (Afghari et al., 2021).

Balancing the advantages and disadvantages of CAVs in justice, safety, and their relationship with VRUs involves addressing technological, ethical, and socioeconomic challenges to increase public acceptance of this technology. Our participants acknowledged that implementing CAVs should not exclusively emphasise technological progress but also guarantee road safety and sustainability and that individuals have equitable access to the advantages offered by these vehicles. This highlights the need for policies prioritising community well-being and fair access to ensure CAVs remain relevant, beneficial, and sustainable within a dynamically changing societal context.

Car drivers and pedestrians expressed concerns that the interests and agendas of the industry, private sector, and government predominate in shaping the ongoing development and deployment of CAVs. Participants expressed concern that these interests might diverge from the overarching goals of sustainable development, prioritising commercial gains over public welfare. They emphasised the need to evaluate CAV integration into transport systems, focusing on technical, economic, and social feasibility. Notably, both driver and pedestrian participants frequently mentioned concerns about AI-related cybersecurity and reliability. This scepticism primarily stems from apprehensions regarding CAVs' safety and practical functionality. Participants suggested that this distrust is rooted in the industry's unethical practices, which have misled the public about the automated capabilities of current market vehicles (Dixon, 2020) and significant safety–critical incidents involving VRUs (Chu & Liu, 2023). Previous research has acknowledged that CAVs are indeed more vulnerable to cyber-attacks than conventional vehicles. In their research, Liu, Nikitas & Parkinson (2020) explored the perspectives of experts on the cybersecurity and privacy dimensions of CAVs, given that these factors not only have a detrimental impact on the public acceptance of CAVs but also contribute to a negative reputation during this early stage of development. Ultimately, the findings of this research emphasised that effectively mitigating these concerns requires collaboration among all key stakeholders, including CAV manufacturers, policymakers, and end-users.

Participants' perceptions substantiate that acceptance of CAVs is not solely contingent on direct consequences but is also significantly influenced by indirect consequences. For example, car drivers found one social injustice with CAV deployment: job loss. With the introduction of CAVs to the market, there is considerable concern in the literature about not only job gains (for example, improvements in mobility for people with disabilities resulting in increased access to employment opportunities) but also job losses (for example, people who work in driving jobs and people who work in vehicle-related service jobs) (Owens et al., 2019; Pettigrew et al., 2018). This is consistent with previous research in artificial intelligence (AI) (Kelly et al., 2023), which highlighted the importance of considering the potential conflicts of new technologies with social tensions. Analogously, new technology may pose risks to people who are less able to adapt to new ways of doing things (e.g., older workers or those with less education) and accelerate job loss in specific at-risk communities (e.g., rural communities) (Owens et al., 2019). This revelation underscores the need for a more comprehensive framework to understand and address the multifaceted factors shaping the acceptance of this new technology. Consequently, our findings call for an update in current perspectives and strategies, acknowledging the intricate interplay between direct and indirect consequences after CAV deployment.

Regarding our results about the effectiveness of CAVs, most participants (car drivers and pedestrians) believe that CAVs would decrease driver distraction, reduce crashes, and help monitor speed limits. However, given limited real-world data on CAVs, most studies showing that CAVs can improve the safety of roads and reduce crashes utilise simulation to investigate their safety effects (Morando et al., 2018). Car drivers and pedestrians are concerned about CAVs' effectiveness because they would not have control of the driving task; they think CAVs would increase laziness, the ethical dilemmas are unclear, and they are uncertain about how CAVs will interact and operate around VRUs. These concerns are supported in the literature; from the ethical dilemma point of view, Gill (2021) concluded that people associated ethical dilemmas with the highest risk of CAV acceptance and considered this issue the most important to address compared to the other technical, legal and ethical issues facing CAVs. On the other hand, little is known about road users' willingness to give vehicle control to an automated system and how this technology will operate when interacting with pedestrians, cyclists, or conventional vehicles (Pyrialakou et al., 2020; Martínez-Buelvas et al., 2022; Martínez-Buelvas et al., 2024). Additionally, there is a lack of research concerning the impact of the regular use of CAVs on driving skills. According to Trösterer et al. (2016), individuals tend to believe they cannot forget how to drive; however, conducting additional research, mainly through simulator studies, would be valuable in assessing this concern.

Our findings call for positive safety outcomes that may influence the acceptance of CAVs among all road users. It is imperative to carefully navigate the transition from simulation studies to real-world implementation, emphasising the significance of ongoing research and data collection as CAVs progressively integrate into road environments. Proactively addressing concerns and challenges linked to the practical deployment of CAVs becomes pivotal, shaping the pathway towards widespread acceptance and building trust in this advancing technology. Finally, the prevalent scepticism surrounding the safety advantages of CAVs underscores the need for a more transparent and ethically designed implementation of CAVs, supporting safety assertions with thorough research and compelling evidence.

The main factor behind the introduction of CAVs is the public's willingness to buy highly automated vehicles (Xu & Fan, 2019; Li et al., 2022). In our study, both car drivers and pedestrians agreed that the cost and economic benefits are the principal barriers to accepting CAVs. Related to this, participants expressed their willingness to acquire a CAV if they felt confident about all the features to improve safety and if the technology was working correctly. Similarly, Asgari & Jin (2019) found that people are willing to pay for self-driving cars if they result in cost and time savings, but those who enjoy driving are less likely to embrace or invest in CAVs. Tech-savvy individuals, on the other hand, are more open to adopting CAV technology. Chee et al. (2020) also explored willingness-to-pay for automated vehicle services, finding that users are willing to pay more for personalised services if they are safe, comfortable, and competitively priced compared to metro and train services. In contrast, Useche et al. (2021) highlighted that drivers' demographic factors and evaluations of CAV features, such as connectivity and safety, influence their intention to use the technology. Gender differences were notable, with males prioritising connectivity and fuel efficiency while females focused more on driving demands and safety.

A critical difference between drivers and pedestrians is related to the manufacturer's reputation and user experiences. Car drivers emphasised considerations such as the manufacturer's safety record and company values. In contrast, pedestrians focused on trustworthy brands and positive reviews from other users, highlighting a user-centric perspective rather than the manufacturer's background. Similarly, both participants expressed significant concerns about their lack of knowledge regarding how CAV technology operates, stressing the need for more evidence endorsed by the government or recognised universities to build trust in these vehicles. Research has shown that a firm's brand reputation is a significant antecedent in users' trust, strongly influencing their willingness to adopt innovative technology (Kim, Shin, & Lee, 2009).

Trust-building should become a top priority for car manufacturers when adopting CAVs. The lack of knowledge about the technology can lower consumers' willingness to buy CAVs. Therefore, car manufacturers need to showcase the features and benefits of CAVs at auto shows, provide reliable information, and utilise advertising to foster favourable perceptions. This approach aims to build a strong reputation and help car drivers and pedestrians understand how this new technology will operate and interact with the transport system.

Lastly, several studies support our findings about users' likelihood of adopting a CAV based on social influence. Leicht, Chtourou & Youssef (2018) analysed the effects of consumer innovativeness on the relationships between different hypothetical predictors of product adoption and purchase intentions, showing that performance expectancy, effort expectancy and social influence are positively related to purchasing a CAV. Similarly, Sharma & Mishra (2020) employed an integrated choice and latent variable model, using institutional survey data to gauge individuals' likelihood to adopt level 4 CAVs based on social values within their peer network. This research indicates a higher likelihood of adoption among high-income and frequent car-buying households.

Overall, our study underscored the necessity of prioritising justice and safety as pivotal determinants for adopting CAVs. Acceptance of CAVs hinges on usefulness, ease of use, effectiveness, affordability, and social acceptability, all closely tied to justice and safety concerns. An equitable integration of CAVs into transport systems involves understanding the unique needs and concerns of VRUs to enhance CAV adoption. Ensuring that CAV technology does not disproportionately disadvantage marginalised communities, such as those with lower income, vulnerable road users, or residents of rural areas, is critical. Policymakers and industry leaders must actively work to mitigate potential inequalities by incorporating diverse perspectives in the development and deployment of CAVs, ensuring affordability, accessibility, and inclusivity. By prioritising both priority and road safety, we can create a transport system future where the advantages of CAVs are shared broadly, fostering greater acceptance and trust in this transformative technology.

5. Implications and future research

The novelty of this research was to investigate the acceptability of CAVs designed to enhance safety and justice in the transport system, offering insights into how road users perceive these crucial aspects amid the emergence of automated technologies. This study also contributes significantly to developing a safe and equitable transport system. Furthermore, the research adopts a comprehensive approach by examining the viewpoints of both car drivers and pedestrians, providing a comprehensive understanding of the potential impacts of CAVs across various road user groups. Nonetheless, to successfully integrate CAVs worldwide, collaborative efforts between policymakers and car manufacturers are imperative.

Establishing consistent global standards for CAVs is crucial, as well as streamlining regulatory processes and ensuring a unified approach to safety, cybersecurity, and communication protocols. Policymakers need to prioritise substantial investments in infrastructure to accommodate CAVs effectively without exacerbating the inequities for vulnerable road users. Moreover, justice is critical in CAV integration, emphasising equitable access to automated transport solutions for everyone. Policymakers and car manufacturers must proactively address potential disparities, ensuring that the benefits of CAVs, such as improved safety and accessibility, are distributed fairly across diverse socioeconomic groups.

6. Limitations

This study has several limitations that may open new insight for further research. First of all, while examining acceptance before the technology reaches commercial availability holds significance, the participants in this study did not have the opportunity to observe a CAV Level 4 or Level 5 physically or have prior experience with vehicle automation, introducing a potential bias in the results. Car drivers and pedestrians may harbour overly positive or negative attitudes, potentially influenced by their previous knowledge or the media's information on automated vehicles. Future research could benefit from including research participants with prior experience in vehicle automation to provide more context on participants' familiarity with vehicle automation technologies and the impact of this on sentiments.

Second, the study has the standard limitation of all qualitative studies regarding sample size. As we explained previously, a convenience sample was employed, and data saturation was considered an appropriate criterion for determining the final sample size based on the perceived quality of the collected data (Creswell, 1988; Qu & Dumay, 2011). However, we emphasise that the results presented in this study are descriptive, local, and limited in scope. The sample size remains a small representation of Australian, specifically Brisbane, road users. Therefore, readers are encouraged to be cautious in interpreting or generalising these results. The contextual nature of qualitative research means that these findings are intended to be only partially applicable but serve as a starting point for further engagement (Leung, 2015).

Finally, while transparency in qualitative research is essential, tying it strictly to replication can be problematic (Pratt et al., 2020). Our study has demonstrated methodological rigour and thorough analysis to meet the transparency requirement. Its primary contribution lies in providing insights into the perspectives of both car drivers and pedestrians regarding accepting CAVs through the justice lens. Policymakers can use these insights to engage with their specific constituencies, exploring whether the identified concerns, challenges, and benefits resonate with broader experiences. Future research could extend these findings by replicating the study in different contexts, such as more car-reliant regional locations like Cairns or Townsville, to explore if similar patterns emerge in areas with less public transport.

7. Conclusions

As automated vehicles approach deployment on our roads, comprehending the factors influencing public acceptance becomes essential for developing a practical and inclusive standard. This study explored these factors among various road users to inform practical and equitable automated transport solutions. Conducting 30 in-depth interviews with drivers and pedestrians, the research provided insights into justice and safety in adopting CAVs. Five core themes emerged—usefulness, ease of use, effectiveness, affordability, and social acceptability—impacting CAV acceptance. Safety was identified as the most crucial benefit and concern. Participants addressed the benefits of easing congestion/traffic flow and reducing injuries/crashes while eradicating human factors from driving. However, concerns over technology reliability and impacts on vulnerable road users were noted.

The study underscores the need for comprehensive discussions on CAV benefits, incorporating diverse perspectives to ensure a safer, fairer transport system. Governments and stakeholders must address challenges to mitigate climate, health, safety, and justice impacts, ensuring responsible CAV integration.

CRediT authorship contribution statement

Laura Martínez-Buelvas: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Andry Rakotonirainy:** Writing – review & editing, Supervision, Formal analysis. **Deanna Grant-Smith:** Writing – review & editing, Supervision, Formal analysis. **Oscar Oviedo-Trespalacios:** Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The authors do not have permission to share data.

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