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Designing accessible autonomous vehicles: Insights from people with disabilities on challenges, preferences, and policy implications

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1 Introduction

One in six people globally live with a disability, and this number is projected to rise with population ageing and chronic health conditions (WHO, 2023). In Australia, nearly one in five people identify as living with disability (AIHW, 2024). Despite this prevalence, people with disabilities (PwDs) continue to face persistent transport barriers, including overcrowded buses, inaccessible ramps and handholds, and reliance on driver assistance. These issues reduce independence and social participation, with PwDs undertaking up to 30% fewer trips than non-disabled peers (Park et al., 2023).

Autonomous Vehicles (AVs) are widely discussed as a disruptive technology capable of reducing transport inequities. By removing the driver, offering flexible operations, and embedding accessibility features at design stage, AVs could enhance travel opportunities for PwDs by an estimated 14% (Harper et al., 2016). Yet, most AV research focuses on safety, efficiency, and environmental benefits rather than accessibility and universal design (Fagnant & Kockelman, 2015). Aftermarket modifications remain prohibitively expensive, whereas integrating inclusive features at the design phase could both reduce costs and improve usability.

Research on PwDs' perceptions of AVs is still sparse, with existing studies largely centred on the United States and often focused on physical disabilities alone (Bennett et al., 2019; Cordts et al., 2021). Broader disability categories—including cognitive, sensory, and psychosocial impairments—remain underexplored. Moreover, evidence suggests that PwDs express both optimism and concern: AVs are viewed as potential enablers of mobility, but worries persist around safety, emergency management, and interface complexity (Hwang et al., 2021).

This study addresses these gaps by surveying 343 Australians with diverse disabilities to examine their current transport barriers, perceptions of AVs, and preferences for AV design features. The research is guided by universal design principles (Story, 2001) and contributes by:

1. Identifying accessibility shortcomings in existing transport systems.

2. Examining PwDs' awareness, concerns, and willingness to adopt AVs.

3. Providing evidence-based recommendations for universal AV design to inform policy and industry practice.

2 Methodology

2.1 Survey and Recruitment

Data were collected in 2022 through an online panel survey administered by Pure Profile. A total of 343 responses were received, including PwDs and caregivers. Recruitment focused on inclusivity: survey questions were accompanied by audio and text descriptions, and

participants could seek assistance from family members. Ethics approval was secured, and informed consent was obtained.

2.2 Questionnaire structure

The 50-item survey covered:

- Demographics & disability type – age, gender, impairment type, mobility aid usage.
- Transport usage & challenges – barriers in public, community, and private/shared transport.
- Perceptions of AVs – familiarity, safety, emergency concerns, willingness to adopt.
- Design preferences – evaluation of four hypothetical AV design across four different vehicle types as showed in Figure 1, with questions on boarding method, seating, floor space, interior features, and accessibility.

Figure 1: Four different autonomous vehicle designs.

2.3 Data analysis

Descriptive statistics were used to capture travel behaviours and perceptions. To assess determinants of AV acceptance, a Multinomial Logit (MNL) model was applied. Response categories captured feelings toward AVs (supportive, neutral, against). The model considered more than 150 variables, including transport mode usage, disability type, privacy perceptions, and preferences for design elements such as boarding orientation and wheelchair restraints.

3 Main findings

3.1 Transport barriers

Private vehicles dominated current travel (80%), with public transport (68%) and ride-hail (36%) also common. Barriers were widespread:

- Public transport: 35% reported overcrowding; 25% faced boarding/disembarking difficulties; 38% cited problems with ramps, handholds, securing mobility devices, and driver assistance.
- Ride-hailing/taxis: 45% considered cost prohibitive; 15% struggled with app-based booking; 13% faced boarding challenges.
- Community transport: difficulties included coordinating pick-up times and using ramps/chair lifts (27%).

3.2 AV awareness and perceptions

- Familiarity: 59% reported unfamiliarity with AVs, highlighting the need for education.
- Attitudes: 46% were supportive or very supportive, 32% neutral, and 22% opposed.

- Safety: 62% expressed concern about AV safety in emergencies or system faults.

- Attendants: Strong demand existed among PwDs with cognitive, intellectual, and invisible conditions for trained attendants on board.

3.3 Design preferences

Among the four vehicle designs presented, Vehicle C was most preferred overall (43%), especially for floor space, handholds, and interior colours. Vehicle A was most favoured for boarding and seating design. Side entry was the most popular boarding option (47%), particularly among wheelchair users.

Differences emerged by disability type:

- Physical impairments – strong preference for side entry and secure wheelchair tie-downs.

- Visual impairments – higher support for AV introduction, with emphasis on audio-tactile communication.

- Cognitive/intellectual disabilities – neutrality toward AV adoption but strong support for vehicle attendants.

3.4 Multinomial logit model

Key predictors of AV support included:

- Positive predictors: ride-hail users, valuing privacy, familiarity with AVs, low safety concerns, openness to shared AVs, and preference for inclusive design features.

- Negative predictors: dissatisfaction with space in ride-hail/taxis, preference for rear-entry boarding, and opposition to certain interior designs.

4 Discussion

Discuss This study advances understanding of AV inclusivity by showing that PwDs' adoption depends not only on technical design but also on trust, safety, and flexibility. The findings reinforce the importance of universal design principles (Story, 2001).

Table 1: Key design recommendations for accessible AVs

Universal Design Principle	Practical Application in AVs
Equitable Use	Ensure wheelchair and non-wheelchair passengers can use vehicles without retrofits; avoid segregation of users.
Flexibility in Use	Provide both side- and rear-entry options; offer adjustable seating and multiple wheelchair restraint systems.
Simple & Intuitive Operation	Use clear, standardized controls with large icons; integrate voice commands and simplified navigation for cognitive accessibility.
Perceptible Information	Deliver multimodal communication (visual, auditory, tactile cues) for boarding, seating, and alerts.
Tolerance for Error	Incorporate robust emergency systems: manual override, easy access to attendants, and medical alert connectivity.
Low Physical Effort	Install powered doors, ramps, and automatic tie-downs to reduce strain on users and caregivers.
Size & Space for Approach and Use	Design spacious interiors with smooth flooring, strong handrails, and turning radii that accommodate diverse mobility devices.

4.1 Policy implications

- Governments should mandate universal design in AV regulations, preventing costly retrofits.
- Incentives (e.g., subsidies) could encourage manufacturers to integrate accessibility early.
- Educational campaigns are crucial to reduce unfamiliarity and build trust among PwDs.

4.2 Limitations

The online sample may underrepresent PwDs without internet access. Self-reported perceptions may diverge from real-world AV use. The 3-point Likert scale simplified analysis but limited nuance.

4.3 Future research

- Mixed-methods approaches (surveys + interviews) to deepen insights.
- Real-world AV trials with PwDs to validate findings.
- Longitudinal tracking of changing perceptions as AVs become mainstream.

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