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Older people's perceptions of emerging transport technologies and intentions to use them: Are mobility innovations like AVs and MaaS ageing-friendly?

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ABSTRACT

This study explores how older people perceive emerging transport technologies, designed to reform the future of mobility. With older populations rising dramatically and being on the one hand the age group most vulnerable to social exclusion and on the other hand increasingly influential in societal structures, the transport sector is under pressure to adapt to their diverse and sometimes specialised mobility needs. In this context, the study explores older people's perceptions of Autonomous Vehicles (AVs), Mobility-as-a-Service (MaaS), assistive technologies, real-time information systems and travel apps, focusing on their potential to enhance autonomy, accessibility, and mobility. In particular, we study older people's self-reported intention to use them. Data were collected via a face-to-face quantitative survey targeting residents aged 60 and over living in North England; a rare and laborious data collection approach in a dynamic UK region, fit for people often underrepresented in digital mobility research. We used descriptive statistics, ANOVA tests and ordinal regression to study their technology adoption decision-making. Findings reveal mixed attitudes: while older people recognise the benefits of increased independence and tailored mobility, concerns about affordability, ease of use, and digital literacy also emerge. ANOVA tests demonstrate that socio-economic characteristics like the educational background, driving license holding, internet usage and income are major factors underpinning older people's perceptions of emerging transport technologies. Moreover, the intention to use these initiatives is statistically associated with the importance a participant ascribed to their own transport accessibility, experience with technology, concerns of safety, cost savings, access to training and driving license holding. Our study ultimately voices the importance of inclusive design and policymaking to prevent the digital marginalisation of older people and calls for targeted older age-specific educational and awareness-raising initiatives to build trust and engagement with a future mobility paradigm that seems inevitable.

1. Introduction

Nowadays humans live longer and improved lives (Musselwhite and Haddad, 2018), resulting in an increasing share of older people in the human population (Körber et al., 2016). Recent predictions suggest that until 2060, around 30% of the population will be people aged 65 over in a world where more than 70% is expected to live in urban areas (Murray, 2014). This means that the core fabric of the urban society is greying (Nikitas et al., 2018) resulting in deep-layered revolutions in consumption patterns (Peine et al., 2014) which in turn demand rigorous

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analysis and planning.

Growing old is a distinctive process and people experiencing it may, more often than not, share some common characteristics to each other. Older people, for instance, might in some cases experience challenges of reduced mobility, oversee health problems throughout extended time frames and being often less familiar with the digital space (Gkouskos and Burgos, 2017). Some of them live in lower incomes and could be vulnerable but others have significant political power and have accumulated wealth over time (Nikitas et al., 2011). Older people also usually become, gradually more mindful to safety, cost, quality, and sustainability, for both services and infrastructure (Signoretti et al., 2015). On the other hand, especially when retired, they are more likely to have time flexibility and sometimes reduced day-to-day commitments and make more often use of concessions – i.e., in the UK, which is our case study, when people reach state pension age qualify for a free, national concessionary bus pass (Nikitas et al., 2018).

At the same time, the use of digital technology and internet has become prevalent throughout every sphere of life (Mitzner et al., 2010) and is set to have an impact on the demand for transport (Hubers and Lyons, 2013). With society progressively becoming more and more technology-centric, older generations will need to be acclimatised to massive technological interventions and an AI-based urban landscape. More specifically, the accessibility and life quality of older adults whose mobility can decrease due to age-related challenges and life events (Alousi-Jones et al., 2025; Alsnih and Hensher, 2003), may start depending on emerging transport technologies such as Autonomous Vehicles (AVs) and Connected and Autonomous Vehicles (CAVs), Mobility as a Service (MaaS), real-time information systems, travel apps and assistive tools; technologies that may completely redefine access for senior citizens.

In an ideal world, such interventions could play a leading role in promoting societal integration and safeguarding accessibility if they are designed to target older people's unique set of needs, expand and ease the use of services available to them (Schehl et al., 2019). However, the threat of these interventions causing the exact opposite of social inclusion cannot be disregarded (Sochor and Nikitas, 2016). When older people would need to use unknown and over-complicated digital, virtual and automated services replacing some of their de facto travel choices they might feel troubled, threatened and possibly excluded (Luiu et al., 2017).

For ensuring that older people are fully engaged with the digital mobility paradigm shift we are witnessing, their views about these emerging transport technologies need to receive more consideration and be put into a clearer perspective (Pandyaswargo et al., 2023). This paper is one of the very few to investigate the older people's willingness to accept and intentions to use emerging transport technologies, and ultimately, how these might be able to enrich their experiences and not be a disruption to their travel expectations and needs.

Hence, this study aspires to identify and decode older people's travel requirements, technology fears, accessibility concerns and possible supporting mechanisms that need to be in place around the introduction of emerging transport technologies such as AVs, MaaS, assistive technologies, real-time information systems, and travel apps. These five technologies were chosen so that the attitude object is more specific without being narrowed down to a single specific technology that may not be genuinely representative of transport futures; the first two represent powerful and possibly disruptive future mobility options while the two latter discuss high-tech transport realities of today. Assistive technologies are senior-related technologies in many ways, so they were assessed too. Hence, this paper intends to highlight older people's perceptions behind the adoption of such technologies.

Specifically, the research aims to: a) examine how older people currently see these five emerging transport technologies; b) determine the opportunities older people might see and concerns they might have from these emerging transport technologies as a whole; and c) identify the main factors influencing older people's intentions to use these technologies.

The paper is structured as follows; the second section outlines the literature that was used to set the background of our study, while the third section describes the research method employed and the fourth section presents the results of our analysis. The fifth section discusses the key findings and their matching policy recommendations along with the work's main contributions, limitations and pathways for further research. Finally, the last section concludes the paper by presenting how this work adds value to the state of the art and could guide those responsible for the introduction and governance of these technologies to make them more accessible to older people.

2. Transport technologies and older people: a snapshot of the state of the art

2.1. Transport technology: a facilitator or disruptor?

In a society that is aspired to be accessible, inclusive and fair for all, transport disadvantage generated by old age and ageing-related disability should be thoroughly understood so that is avoided or mitigated adequately (Musselwhite, 2021; Nikitas et al., 2018). This is not only because the population of older adults grows exponentially (Deutsch et al., 2019) meaning that in the near future it will possibly account for 30% of the passenger transport users (McLoughlin et al., 2018). It is also because transport can mitigate or worsen inequalities, can contribute enormously to life quality and welfare and encourage (or not) citizens and older people, in particular, to take active roles in the community (Baster, 2012) and shape up their travel behaviour, the choice of where they live and their social networks (Banister and Bowling, 2004). In other words, any type of trip deprivation or unmet mobility adversely affects older adults' objective and subjective well-being (Deka and Wang, 2024).

Transport technologies offering automated, connected, shared and digital mobility services have the power, if properly designed, to facilitate outdoor activities, increase convenience and foster independence for older people. Equally though, if not compliant with their needs, capabilities and even preferences, could instead become an architect of disruption, confusion, reluctance and insecurity (Mitzner et al., 2010). What is to be gained from a new robust layer of innovative transport technologies like AVs, MaaS, real-time information systems, assistive tools and travel apps may compete tightly with potential exclusion-generating challenges if older people are incapable, afraid, hesitant or unwilling to use them (Ryan et al., 2019).

These transport technologies, on a theoretical level, can improve the daily lives of older generations (Deutsch et al., 2019). For instance, in Australia, older adults are the fastest growing group of people to use ride-sharing platforms and facilities since these allow them to be more mobile and autonomous (Petrović et al., 2022). Also, Li's (2023) results show that ICT usage and daily travel for shopping, social, recreational, and healthcare purposes among older Americans are positively related. However, older people may also lack access or knowledge to use some other transport innovations, being the group most likely to be digitally illiterate, and this could lead to exclusion (Deutsch et al., 2019).

The problem of technology and ageing, as addressed by Pelizäus-Hoffmeister (2016), is that technological evolution is more frequently focused on innovation, instead of being focused on user requirements. Whereas the technological feasibility is strongly emphasised, user perceptions receive less attention, which is why various older age-targeted products tend to be rejected by these cohorts (Sochor and Nikitas, 2016). According to Peine et al. (2014), the logic behind innovative solutions directed towards older people tends to be limited because they often focus on them as a broader group and define senior technology users as inactive technology beneficiaries. Under this assumption, the authors argue that contemporary design procedures tend to produce unappealing technologies for older people.

2.2. State of the art

There is a small but emerging body of literature that is critically reporting the attitudes and potential adoption of emerging transport technologies and services from older people. For instance, Musselwhite (2019) examined how emerging transport technologies and user-centred innovations can address the mobility challenges of older people. The author emphasises the importance of involving older people in the design and development of those to ensure that these solutions are both accessible and acceptable for seniors; involving older people in the design process can lead to more effective and inclusive transport systems that are tailored to their specific needs. Similarly, Harvey et al. (2019) explored how older people can increase their mobility through the use of technology by identifying the potential of real-time information, route planning and ride-hailing services to reduce barriers. However, they also highlight the obstacles arising from a lack of digital literacy and the need for user-friendly interfaces to ensure inclusion. Metz (2017) examined the relationship between the introduction of future transport technologies and the needs of an ageing population and argues for a policy shift that considers the mobility needs of older people. He emphasises that policy must focus not only on the development of advanced transport systems, but also on ensuring that these systems remain usable for older people with declining cognitive and physical abilities.

Souders and Charness (2016) looked at the specific challenges older people face with the introduction of advanced driver assistance systems (ADAS) and AVs. Their study shows that while these technologies can improve mobility for older people, there are still significant concerns around confidence, ease of use and adaptability. Many older drivers struggle to learn new systems or are reluctant to adopt technologies that they perceive as too complex or unnecessary; so, it is no surprise that Charness et al. (2018) reported that older people are the ones most concerned with and less likely to accept AVs. On that matter while AVs are expected to bring 1.2 million people aged 75 and over back on the UK freeways, allowing these groups to win back significant levels of autonomy (Bridge, 2017), some hold the belief that, in fact, the obstacles that some older people face today and are restricting them from driving may turn out to be the same barriers that may also prevent them from travelling independently in the future (Coughlin, 2017).

Cirella et al. (2019) examined the impact of transport innovations that specifically target older populations. They identified several technological and policy innovations that have the potential to improve mobility for older adults, including ride-sharing services, public transport improvements, and pedestrian-friendly infrastructure. Their findings suggest that a multi-faceted approach combining both technological advances and urban design is necessary to meet the diverse mobility needs of older people. Shirgaokar (2020) shows how mobile phone applications can expand transport options for older people. They specifically discussed the potential role of the private and public sectors in developing and promoting apps that facilitate travel for older people. The study concludes that while these apps have significant potential to improve mobility for older people, their success depends on overcoming barriers such as digital literacy and ease of use and ensuring that they are developed with older users in mind. Payyanadan and Lee (2018) suggested that while older adults appreciate the autonomy offered by innovative transport tools like ride-sharing, barriers such as cost, privacy concerns, and technological challenges remain significant. Last, according to Vij et al. (2020), older retired people are lacking interest in MaaS; this is for them a difficult, complex and disruptive system that challenges what they know as mainstream in travel eco-systems for years. This perhaps highlights awareness-related barriers and concerns about a radically changing future for which genuine support might be needed for older people (Oxley et al., 2022).

3. Research methodology

3.1. Survey design

The paper presents a quantitative survey (attached in full as supplementary material) capturing older people's perceptions about emerging transport technologies, their merits and their potential risks. Surveys are widely utilised in transport research due to their effectiveness in establishing causal relationships, thereby enhancing understanding of attitudinal and behavioural phenomena (van de Coevering et al., 2015). When systematically designed, conducted, and reported, surveys can yield reliable and generalisable findings (Heale and Twycross, 2015).

Our survey contained 34 close-ended questions, and the average completion time was around 20 min. Five-point Likert-scales with a neutral mid-point ranging from "strongly agree" to "strongly disagree" or from "daily" to "never" or from "extremely important" to "extremely unimportant" were used for consistency reasons. Employing an ordinal scale broadened the range of statistical methods applicable to the data (Nikitas, 2018). The questions were organised in six thematic sections namely: a) daily travel, b) physical and social health implications, c) technological awareness and inferences, d) resistance to technology adoption, e) technology approval parameters and f) socio-demographics.

As is common practice, the survey entailed an introductory message designed to encourage participation. This message clearly set out the purpose of the study, its ambition to support the development of tailor-made policy recommendations for future transport interventions, and assured participants that their input would be handled confidentially, anonymously, and responsibly. The survey solely targeted people aged 60 and over; this is a common threshold for identifying older age groups used by academic literature (e.g., Musselwhite, 2021; Nikitas et al., 2011; Shergold and Parkhurst, 2012) and the World Health Organisation.

The survey was piloted before its launch. We used the feedback of five academics and 10 older people to ensure that the survey's final form was fit for purpose containing meaningful questions, user-friendly structure and comprehensible language.

3.2. Sampling and recruitment

The survey was physically distributed in hard copies. Since this was a study where digital awareness (i.e., accessing and completing an online survey is a proxy for that) would possibly introduce bias by creating an over-representation of digitally literal individuals, we decided not to conduct an e-survey. This was a bias-reducing, but at the same time very labour-intensive choice, that led us to assume field researcher roles. For collecting our sample face-to-face, we have visited older people associations after prior communication with them but also recruited participants in parks, rail stations and shopping malls. At least two of us (from the four authors involved in the field data collection) were present when each respondent completed the survey to assist them in any questions they had trying to have minimum interference in their answers per se. Our data collection took place in towns and cities in North England and specifically in Huddersfield, Leeds and Manchester in late 2024. The finalised sample included 200 fully useable responses and the response split per locality for the three localities above was 80/65/55.

Sometimes directly recruited participants from our purposive sampling recommended other people who could be potentially interested to participate, thus a level of snowball sampling existed; the non-random purposive and snowball sampling response split was 165/35. Since the study concentrated its interest on the UK the work represents a developed economy perspective. Our sample of 200 fully completed responses is sufficient considering: a) the level of difficulty in attracting a purely older adult sample tasked to fill in, with the support of field researchers, a long survey about a set of atypical attitude objects for them, and b) the alignment with the sample size of other leading survey-based transport studies with older participants (e.g., Appiah et al., 2020; Burton et al., 2011; He et al., 2020; Olawole and Aloba, 2014).

Monetary incentives to attract participation were not used to keep the data collection process purely voluntary and avoid biases. We did not record how many participation declines occurred per se when we approached possible respondents, but the response rate was likely close to 5%. Willing respondents younger than 60 were turned down through a qualifier question. Only 20 people started the survey and gave up before finishing the task; these responses were deemed unusable since full completion was set as an eligibility criterion for qualifying for the sample.

3.3. Analysis methods

The R statistical programme was used for our analysis and in particular, version 4.3.0. Descriptive analysis was conducted to provide an overview of older people's socio-demographic characteristics, travel habits and perceptions of emerging transport technologies. One-way Analysis of Variance (ANOVA) and Welch ANOVA tests (when conditions for regular ANOVA were not met indicated by a Levene's test) were selected to examine whether perceptions and familiarity levels differed significantly across socio-demographic groups; these methods are well-suited for comparing mean responses across multiple categories (Delacre et al., 2017). When group differences were detected, appropriate post-hoc tests, such as Tukey's Honestly Significant Difference (HSD) test and Games-Howell test were applied to identify which specific groups differed from each other (as per Birago et al., 2017; Guzman et al., 2021). Finally, an ordinal regression modelling was employed for our data explanation and interpretation (in line with Bruwer et al., 2022; Nikitas et al., 2021; Scott and Tulloch, 2021). Ordinal regression modelling proved useful in estimating cumulative odds across different variable groups (Hershberger, 2014). It fostered the prediction of dependency levels among key variables while clarifying and validating the relationships based on specific assumptions (Liu et al., 2017; Miller et al., 1991). The underpinning hypothesis tested here, is that older people's propensity to use innovative transport solutions is influenced by their experiences and familiarity with emerging transport technologies, their perceptions about their likely benefits and challenges and their individual background characteristics.

For the ordinal regression modelling, diagnostic procedures included checks for multicollinearity using Generalised Variance Inflation Factors (GVIF), evaluation of model fit using McFadden and Nagelkerke pseudo-R^2 indices as well as the Akaike Information Criterion (AIC) and verification of the proportional odds assumption via the Parallel Lines test. These confirmed that our model assumptions are met and that the model exhibits good fit and stability.

More specifically, the process for building the ordinal model included a broad range of candidate predictors; these were evaluated in terms of theoretical relevance, statistical significance and contribution to overall model performance. Apparently, variables that demonstrated limited variance, conceptual ambiguity or high multicollinearity with others (GVIF >5) were excluded from the final specification to preserve model stability and robustness. On the other hand, the dependent variable for the ordinal regression, i.e., intended frequency of use of emerging transport technologies, was selected based on prior research illustrating that intention to use is a strong behavioural indicator of technology adoption (Anwer et al., 2024). Such a model would provide meaningful insights that could support an inclusive transport policy strategy. The aforementioned model fit indices were assessed to compare alternative model outputs, ensuring robustness. In this context, variables that improved model fit, demonstrated statistical associations with the dependent variable, while remaining interpretable were retained. This iterative process resulted in a robust final output.

Last, all key predictors were measured using Likert-type scales, which are inherently ordinal and do not assume equal distances between response options. For this reason and in line with previous studies (Nikitas et al., 2021) as well as the conventions of ordinal regression implementation in R, these variables were treated as categorical rather than continuous. In cases where categories illustrated sparse responses, adjacent levels were merged into conceptually coherent groups (e.g., low/moderate/high) to improve model stability and interpretability.

4. Results

The outcomes are structured in line with the six thematic sections of the survey. Namely, the socio-demographic characteristics of the participants, their daily travel habits, their physical and social health implications as well as the technological awareness and inferences, the potential resistance to technology adoption and the key parameters for approving new and emerging technologies in transport.

4.1. Sample demographics

Fig. 1 presents the sample's socio-demographics.

The gender distribution of the survey participants shows an even split between men and women. This even gender split ensures that the results of this study reflect a wide range of experiences and preferences. No participants identified with the “prefer to self-describe” category. In terms of age, the majority (24.5%) of participants belong to the 75-79 age group, followed by the 65-69 age group (19.0%) and the 60-64 age group (19.0%). Also, 14.5% of respondents are between 80 and 84 years old and 14.0% are aged 70-74. A smaller percentage (9.0%) of participants are over 85 years old.

The education levels among respondents varied. The majority of respondents (39%) have completed high school. A considerable share, i.e., 26%, have a Bachelor's degree, while 8.5% and 6% have achieved a Master's degree and a Doctorate, respectively. On the other end, 20.5% of respondents have only completed primary school, indicating a substantial portion of the sample with lower educational attainment. Marital status unveils that over half (53%) of the participants are married or in a partnership. Other noticeable groups include widowed individuals, who are 17.5%, as well as single (11%) and divorced (10.5%) participants. A much smaller share (8%) is living with children or grandchildren, which may underpin direct availability for caregiving roles.

Income levels are concentrated in the middle-income brackets, with 33.5% of the participants earning between £15,000 to £29,999 annually, and 27.5% earning between £30,000 to £49,999. Higher-income brackets, such as £50,000–£69,999 (12%) and £70,000 or more (8.5%), represent a smaller share. Meanwhile, 10.5% of respondents earn less than £14,999 annually, and 8% chose not to disclose their income.

4.2. Physical and social health implications

Fig. 2 displays the physical and social health implications of the participants.

When it comes to health conditions, many respondents (29.0%) described their health as “good”, closely followed by 28.0% who described their health as “very good” Meanwhile, 21.5% of participants rated their health as “fair” and 13.0% as “excellent”. A much smaller share, 8.5%, stated that they were in “poor” health. This distribution suggests that the majority of older people participating in the study perceive their health positively, which could influence their attitude towards the introduction and use of emerging transport technologies, especially when it comes to mobility and accessibility.

An overwhelming 84.1% of respondents self-reported that they have no mobility difficulties, whereas 15.9% said that they experience mobility challenges. Finally, when looking into the importance of transport accessibility, 42.5% of the respondents’ rated transport accessibility as “extremely important” while an additional 29.5%

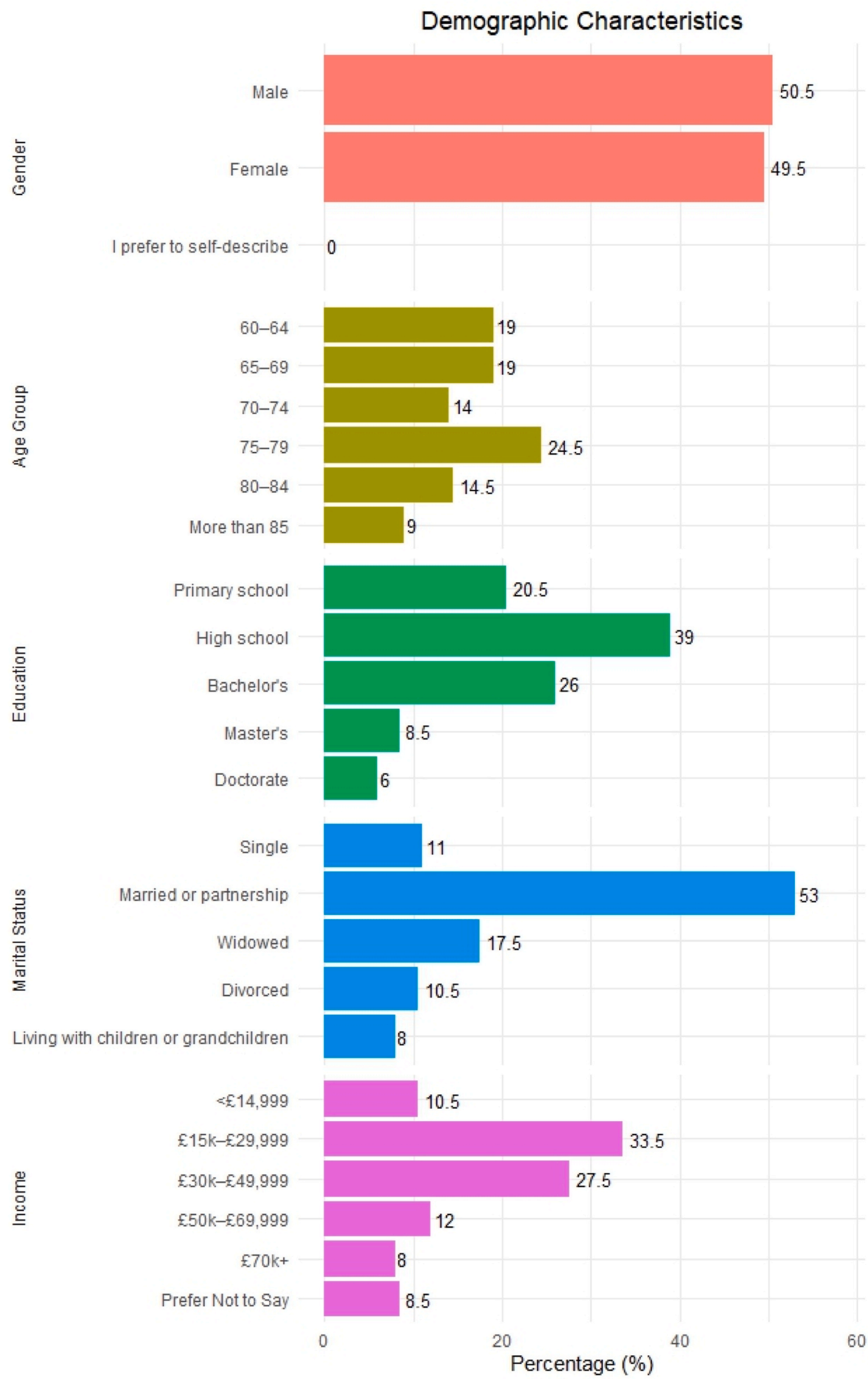

Fig. 1. Sample's demographic profile.

considered it "important." None used "extremely unimportant" as their answer and only 14.5% as "unimportant". These outcomes highlight the critical role of accessible transport in the daily life of older people.

4.3. *Daily (travel) habits*

The majority (58.0%) of respondents currently have a driver's licence, indicating that a significant portion of them may still rely on personal vehicle transport. On the other hand, 24.5% of respondents said they had never held a driver's licence, while 17.5% said they had

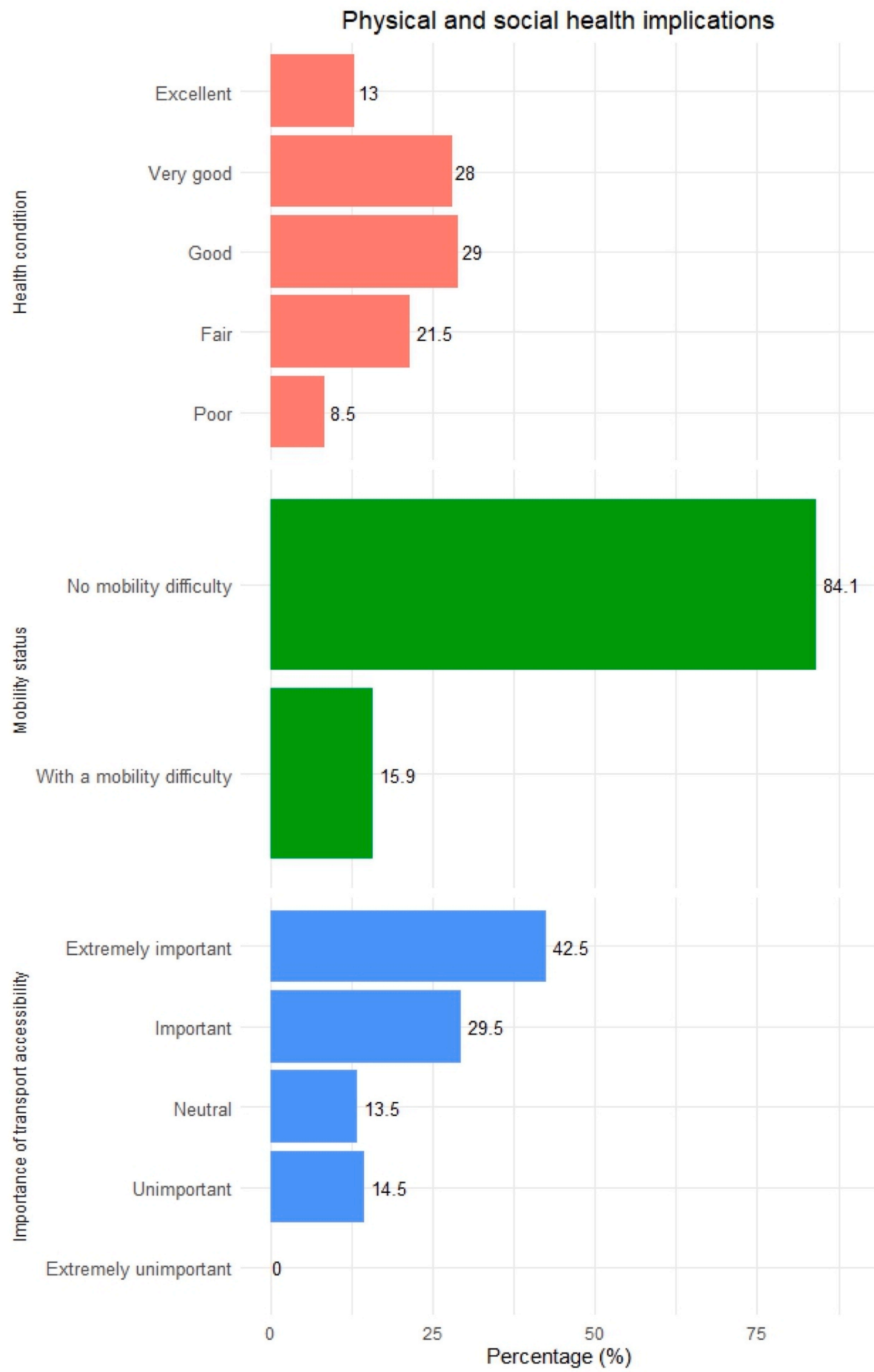

Fig. 2. Physical and social health implications.

given up driving. The relatively high percentage of people without a driver's licence, either because they never had one or had given up driving, underscores their reliance on alternative transport modes to maintain accessibility and mobility. When it comes to their daily travel habits, Fig. 3 shows the frequency of use of every transport mode (walking, uber, taxi, ridesharing, rail, car, bus and bicycle) by the survey participants.

Walking is the most frequently used transport mode, with 60.0% of respondents walking every day and 31.0% walking a few times a week, underlining its importance for seniors. In contrast, ride-hailing services such as Uber and general ride-sharing services are never used by their vast majority (i.e., 89.5% and 88.5% of respondents respectively). Taxi services are only used moderately: 33.0% of respondents rarely use them, but 14.0% said they use a taxi weekly or daily. Rail-based services and private vehicles are in most cases used occasionally, with around half of our respondents using these modes weekly or less frequently. The bus system is used more evenly, with 28.0% of respondents using it weekly and 7.5% daily. Bicycles are unpopular with 82.0% of respondents never using them. These results highlight the dependence of older people on pedestrian and bus systems, while newer transport technologies, such as ride-hailing and ride-sharing, are underutilised, indicating potential barriers to accessibility or acceptance.

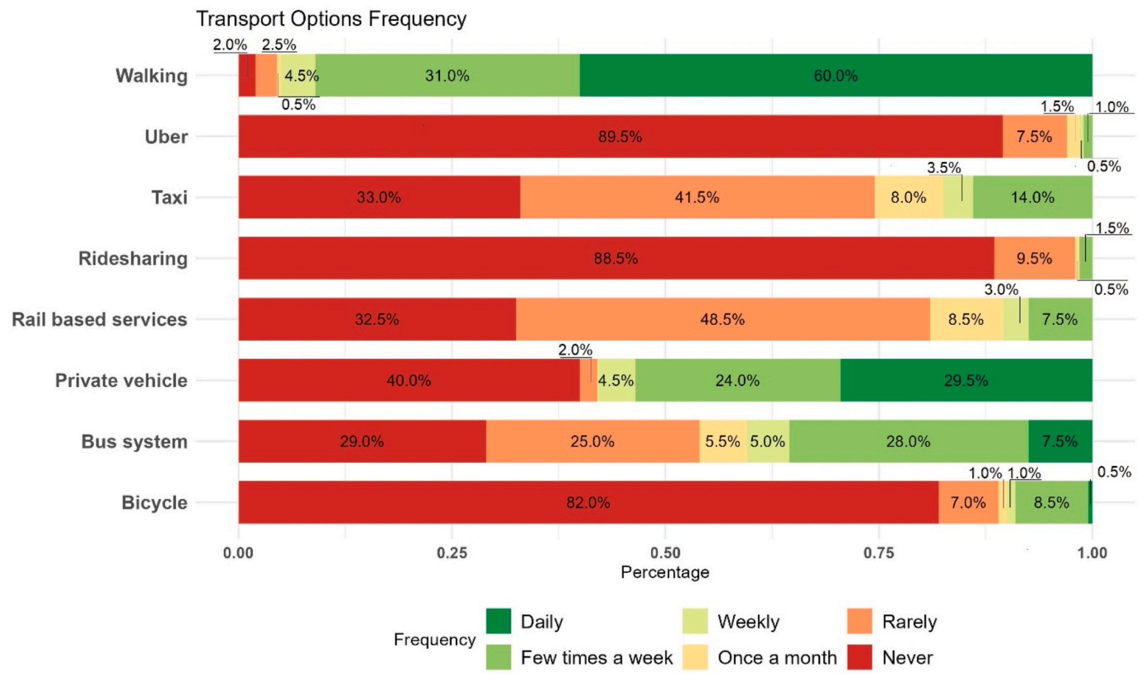

Fig. 3. Transport options frequency of use.

When it comes to the most common travel reasons, work or voluntary work appears to be the most common, accounting for 32.5% of trips. This is followed by trips to buy food and other goods (20.5%), leisure or sports activity-related trips (15.5%), trips for visiting family (12.5%) and trips for meeting friends (8.5%). Trips to the General Practitioner (GP) and the bank are less common at 5.5% and 5.0% respectively. The data suggests that both work-related and leisure activities play an important role in older people's daily mobility, in addition to shopping and social interaction trips.

4.4. Technological awareness and inferences

Nearly half of the respondents (49.5%) are internet users, while the rest never used (42.5%) or abandoned using the internet recently (8%). Fig. 4 shows how familiar older people are with various transport technologies. The levels of familiarity range from “extremely unfamiliar” to “extremely familiar” revealing considerable disparities in awareness across technologies. The most familiar technologies include assistive technologies, which 59% of respondents are familiar with, and real-time information systems, which 56% of respondents claim they are

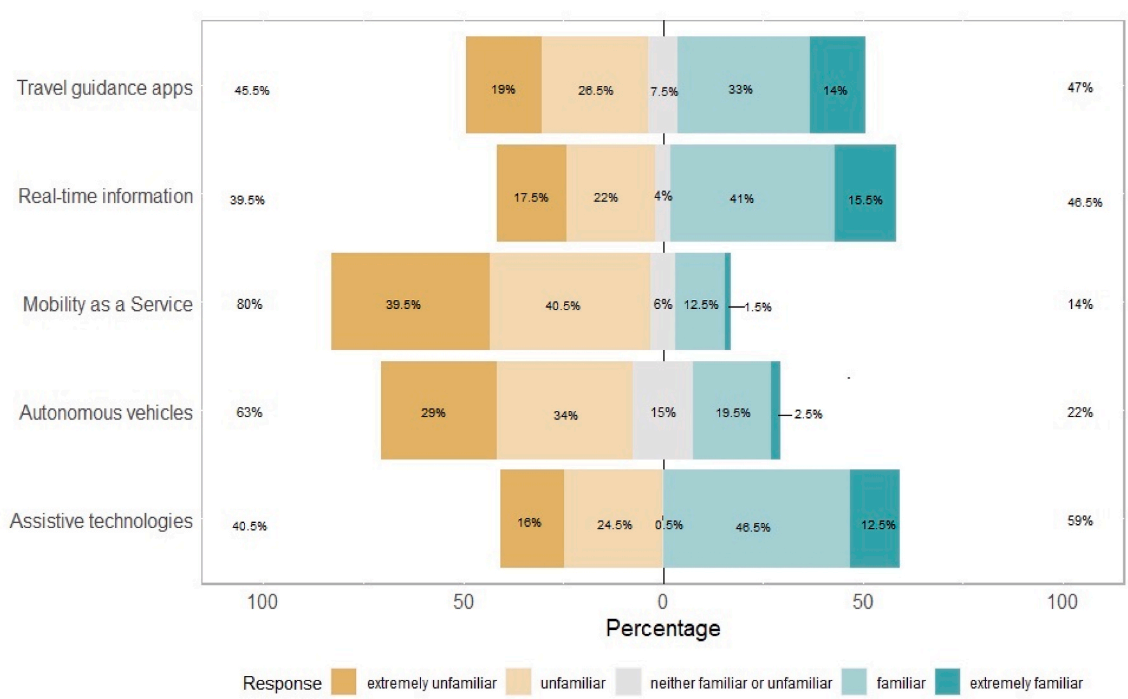

Fig. 4. Familiarity with emerging transport technologies.

familiar with. Travel guidance apps also show a balanced distribution, with 47% of respondents being aware of them and 46% not aware of them at all, thus indicating a gap in awareness. In contrast, AVs and especially MaaS are largely unknown. Apparently, 63% of respondents are not at all familiar with AVs and 80% are not at all familiar with MaaS, unveiling a general lack of knowledge around these new and even more radical technologies.

Statistical analyses revealed that familiarity with transport technologies is significantly influenced by key socio-demographic factors, especially internet usage, education, and income. For assistive technologies, internet usage (ANOVA: $F(2,197) = 74.8$, $p < 0.001$) and education (Welch ANOVA: $F(4,53.01) = 18.57$, $p < 0.001$) emerged as major predictors. Notably, individuals with mobility difficulties reported lower familiarity (Tukey HSD: mean diff $= -0.79$, $p = 0.001$), as did those no longer using the internet (mean diff $= -1.69$, $p < 0.001$). Familiarity with real-time information was also significantly associated with education ($F(4,52.33) = 22.94$, $p < 0.001$), income ($F(5,58.11) = 29.38$, $p < 0.001$), and internet usage ($F(2,197) = 5.53$, $p < 0.005$). Internet users demonstrated notably higher awareness (Tukey HSD: mean diff $= 2.00$, $p < 0.001$).

For AVs, driving license status (Welch ANOVA: $F(2,93.67) = 14.02$, $p < 0.001$) and education ($F(4,195) = 6.79$, $p < 0.001$) were key factors, with higher educational attainment linked to greater familiarity. In the case of MaaS, internet usage (Welch ANOVA: $F(2,42.70) = 18.84$, $p < 0.001$) and income ($F(5,58.36) = 9.99$, $p < 0.001$) stood out, while married individuals showed slightly higher familiarity (Tukey HSD: $p \approx 0.04$). Lastly, awareness of travel guidance apps was most strongly associated with internet usage (ANOVA: $F(2,197) = 102$, $p < 0.001$), with internet users consistently reporting higher familiarity (Tukey HSD: mean diff $= 2.06$, $p < 0.001$). These findings pinpoint the critical role of digital access, education, and income in shaping older adults' awareness of emerging transport technologies.

In terms of older people's perceptions of the potential benefits of these technologies, the responses show a split of opinion (see Fig. 5). There is a strong agreement for benefits such as personalised mobility options (84%), more accessibility (86%), and increased autonomy (86%), stressing that respondents highly value the potential of these technologies to offer tailored and accessible solutions. These categories have minimal disagreement, reflecting a broad consensus on their positive impact. On the contrary, while there is notable agreement on higher efficiency (48%) and cheaper travel (54%), these categories have more mixed responses, with higher levels of neutrality or disagreement compared to the others. Better quality of life also receives significant agreement (56%) but still 26% of respondents strongly disagree or disagree with the statement assessed. These results mean that while the potential for accessibility and personalisation is widely recognised, the economic and broader quality-of-life impacts may require further demonstration to convince older people about their positive potential.

ANOVA and Welch ANOVA tests revealed that perceptions of benefits from emerging transport technologies are significantly associated with several demographic variables. Increased autonomy was most strongly related to driving license status (Welch ANOVA: $F(2,98.51) = 13.87$, $p < 0.001$), income ($F(5,194) = 6.82$, $p < 0.001$), and education ($F(4,195) = 3.84$, $p = 0.005$). Notably, individuals with mobility difficulties (Tukey HSD: diff $= 0.38$, $p = 0.04$) and higher education (Bachelor vs Primary: diff $= -0.65$, $p = 0.01$) perceived greater autonomy benefits. Quality of life and accessibility were also significantly associated with driving license status (Welch ANOVA: $F = 10.07$ and 12.34, both $p < 0.001$), education, and income, with lower-income and mobility-impaired individuals valuing these benefits more. For personalised mobility options, gender ($F(1,198) = 6.44$, $p = 0.01$) and education ($F(4,195) = 3.53$, $p = 0.008$) were influential; men valued this benefit more strongly (Tukey HSD: diff $= 0.32$, $p = 0.01$). Finally, driving license status negatively affected perceptions of cheaper travel and efficiency, while higher income generally correlated with stronger perceived benefits across several dimensions.

However, the use of emerging transport technologies is not only associated with benefits, but also with critical risks (see Fig. 6). Interestingly, the most profound concerns entail "loss of jobs" and "loss of driving skills" with a significant share of respondents (47% and 46%, respectively) agreeing or strongly agreeing that these risks are the most likely to materialise. On the other hand, other potential risks like "not elderly focused", "increased usage difficulty" and "increased safety concerns" do emerge as less likely risks.

Statistical analysis revealed that education and income are key predictors of perceived risks related to emerging transport technologies. Safety concerns were significantly associated with education ($F(4,195) = 8.41$, $p < 0.001$) and income ($F(5,194) = 5.06$, $p < 0.001$), with

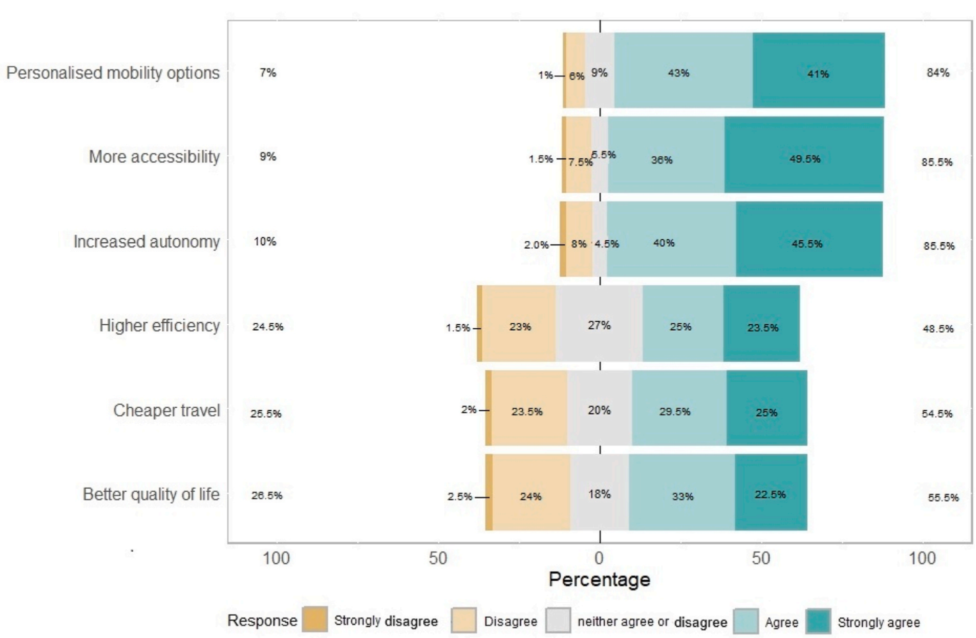

Fig. 5. The (perceived) benefits of emerging transport technologies.

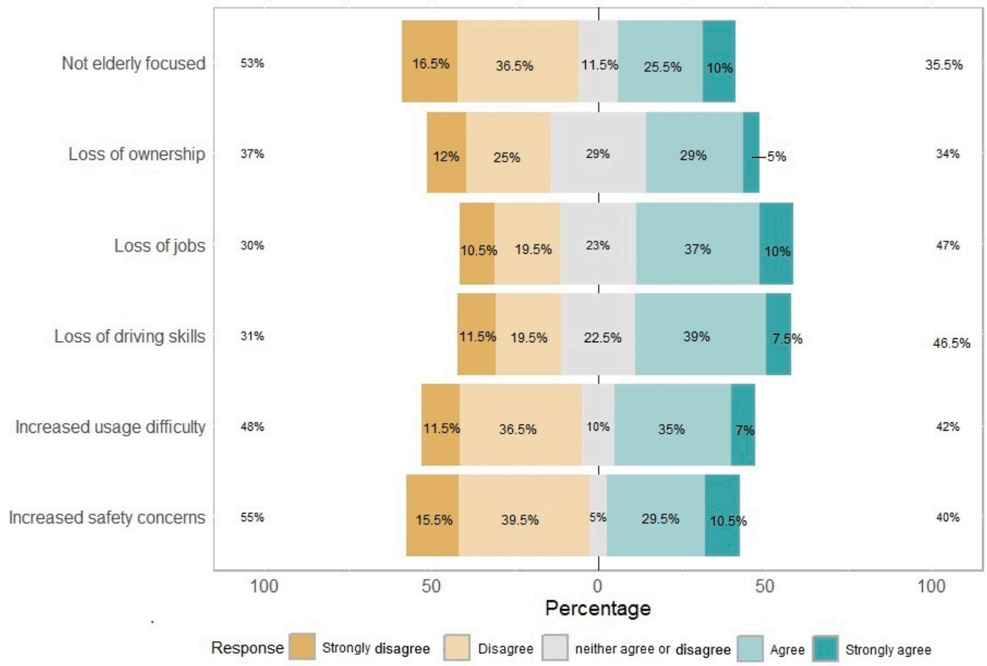

Fig. 6. The (perceived) risks of emerging transport technologies.

lower-educated and lower-income individuals expressing greater concern (Tukey HSD: $p < 0.01$). Usage difficulty was also influenced by education ($F (4,195) = 11.98$, $p < 0.001$), income ($F (5,194) = 5.63$, $p < 0.001$), and internet usage ($F (2,197) = 7.16$, $p < 0.001$). Non-internet users expected greater difficulties (Tukey HSD: $diff = -0.63$, $p < 0.001$).

The risk of technologies being "not elderly-focused" showed broad demographic associations, including education (Welch ANOVA: $F (4,50.73) = 6.64$, $p < 0.001$), internet usage ($F (2,197) = 6.31$, $p = 0.002$), and income (Welch ANOVA: $F (5,62.07) = 14.52$, $p < 0.001$). Tellingly, non-internet users were particularly concerned (Tukey HSD: $diff = -0.62$, $p = 0.02$). Finally, gender was a key factor in concerns about loss of driving skills, ownership, and jobs (F values = 6.38–9.83, all $p \leq 0.01$), with men expressing higher concern (Tukey HSD: diffs = 0.41–0.51, $p \leq 0.01$).

Looking into the intention to use emerging transport technologies, most respondents indicate willingness for occasional use, with 27% reporting weekly use and 19.5% monthly use. Meanwhile, 23.5% claimed that they would rarely use these technologies and 17% noted that they would never use them, showing firm disengagement from these emerging transport technologies. On the other hand, 13% reported a daily usage intention, demonstrating clear "commitment" to these technologies. Preliminary statistical analysis indicated that the intention to use is strongly influenced by driving license possession (ANOVA: $F (2, 197) = 34$, $p < 0.001$). Tellingly, people without driving license would be more open to use such services (Negative Tukey HSD difference and $p < 0.001$). More on the intention to use these technologies will be addressed in subsection 4.7.

Fig. 7 records issues in perceived access and usability opportunities. A majority (67%) disagree or strongly disagree that older people have adequate access to help with transport apps and technologies, and 52% feel that older people struggle to easily understand and use these tools. However, there is notable agreement (83%) on the need for more tailored training opportunities to assist older people in using transport technologies. Only 14% agree that such training is currently accessible, marking an urgent need for targeted interventions to enhance inclusivity and ease of adoption.

Based on the statistical tests, we may confirm strong associations between perceptions of older adults' access to help and key demographic factors. The belief that older people have adequate access to help was significantly influenced by driving license holding ($F (2,197) = 14.7$, p

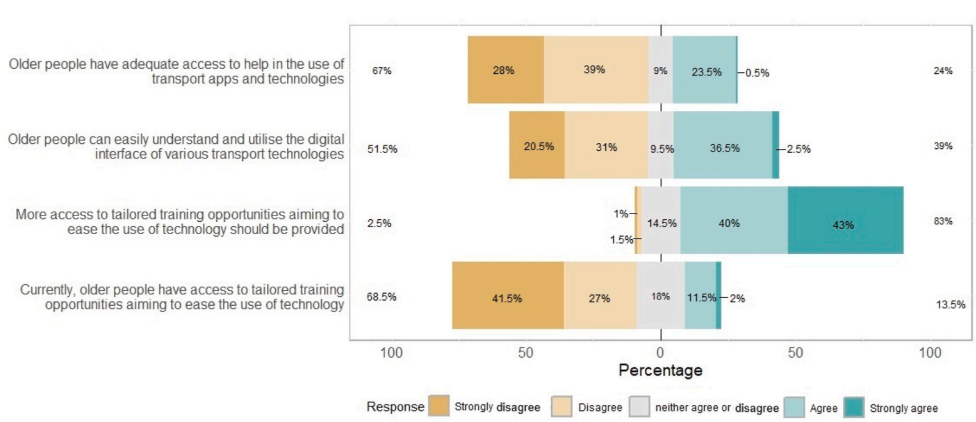

Fig. 7. The 'access to help' issues of emerging transport technologies.

< 0.001), internet usage (F (2,197) = 36.9, p < 0.001), and education (F (4,195) = 15.0, p < 0.001). Internet users and those with higher education were more likely to perceive greater access (Tukey HSD: internet user vs non-user = 1.33, p < 0.001). Comparable patterns emerged for the belief that older people can easily use digital interfaces, with Welch ANOVA confirming significant effects for internet usage (F (2,40.98) = 31.32, p < 0.001), education (F (4,48.41) = 8.19, p < 0.001), and income (F (5,59.07) = 8.88, p < 0.001). The perception that more access to training is essential was also shaped by internet usage (Welch ANOVA: F (2,42.58) = 12.26, p < 0.001) and driving license holding (F (2,87.04) = 4.96, p = 0.009). Finally, views on today's training access were also linked to driving license holding (F (2,197) = 7.38, p < 0.001) and internet usage (F (2,197) = 4.03, p = 0.02), with non-drivers and non-internet users more likely (surprisingly) to perceive current training as adequate.

According to Fig. 8, most respondents rated safety, reliability, availability, and accessibility as crucial, with over 97% considering them “Important” or “Extremely Important”. On the other hand, environmental protection, cost, and travel support received slightly lower ratings when it comes to the “Important” and “Extremely Important” categories (80-85%). Moreover, a substantial percentage of respondents (7-10%) classified them as “Unimportant” or “Extremely Unimportant”. The results indicate that operational factors (accessibility or availability) are critical determinants in the acceptance of these new technologies, while cost and environmental concerns although still clearly critical, do not get the same attention.

Welch ANOVA results show that safety perceptions are significantly influenced by driving license status (F (2,87.92) = 6.58, p = 0.002). Driving license affects accessibility as well (F (2,95.36) = 10.58, p < 0.001) together with internet usage (F (2,50.67) = 6.96, p = 0.002), and income (F (5,59.61) = 6.18, p < 0.001). Similarly, availability is associated with these same key factors, along with mobility status (F (1,75.78) = 8.86, p = 0.004). Cost is the most broadly influenced factor, showing significant associations with driving license status (F (2,86.17) = 7.52, p < 0.001), mobility status (F (1,75.66) = 8.90, p = 0.004), internet usage (F (2,197) = 4.68, p = 0.01), and income (F (5,194) = 3.08, p = 0.01). Tukey HSD tests reveal that internet users (diff = −0.42, p = 0.007) and higher-income participants (diff = 0.90, p = 0.04) are less concerned about cost. Lastly, environmental protection concerns are linked to mobility status (F (1,61.05) = 5.23, p = 0.026), education (F (4,52.06) = 3.81, p = 0.009), and income (F (5,57.17) = 4.99, p < 0.001).

4.5. Resistance to technology adoption

As any technological advance, the adoption of emerging transport technologies might face resistance (Zhang and Kamargianni, 2023). In terms of the perceptions around the existing dedication that technology companies and governments are showing to address product-related issues and technological transition risks and challenges, the following should be underlined. A substantial majority disagreed that enough resources or effort are being allocated to this, with 72% strongly disagreeing or disagreeing for governments and 62% for tech companies. Only, the 20% and 22.5% of the respondents respectively were found to share a positive attitude towards governments and tech companies.

Perceptions about whether technology companies are dedicating enough resources were significantly associated with nearly all sociodemographic factors. Similarly, belief in government efforts was linked to internet usage (Welch ANOVA: F (2,41.69) = 12.43, p < 0.001), driving license status (F (2,83.22) = 7.01, p = 0.002), and gender (Welch ANOVA: F (1194.75) = 5.61, p = 0.002). Tukey HSD results unveil that internet users (diff = 0.94, p < 0.001) and married participants (diff = 0.63, p = 0.02) were more likely to view both tech companies and governments as sufficiently investing in older people's mobility.

Regarding the rising concerns of sharing personal information while using an emerging transport solution, our results were mixed. A notable share (43%) reported low levels of concern, with 12.5% being extremely unconcerned and 30.5% unconcerned. On the contrary, 37% expressed higher levels of concern, with 27% reporting being concerned and 10% being extremely concerned. Last, 20% of respondents were neither concerned nor unconcerned. It seems that most of the respondents are relatively at ease with sharing their personal information. Concerns about data mishandling are most strongly influenced by internet usage (F (2,197) = 19.3, p < 0.001), education (F (4,195) = 11.4, p < 0.001), and income (F (5,194) = 8.37, p < 0.001). Tukey HSD tests demonstrate that internet users (diff = 1.02, p < 0.01), those with higher education (e.g., primary vs master's: diff = −1.35, p < 0.01), and higher-income individuals were more concerned about personal data risks.

Next, we looked into the importance of potential barriers that might be proven critical in preventing the use of emerging transport technologies from older people.

According to Fig. 9, the highest concern is for online fraud/scam, where 28% express high or very high levels of concern. Cybersecurity crimes follow with 25% of the respondents reporting high or very high levels of concern. On the contrary, only 13% have high or very high levels of concern, when it comes to extremist groups using digital platforms, making it the least of the concerns of older people related to

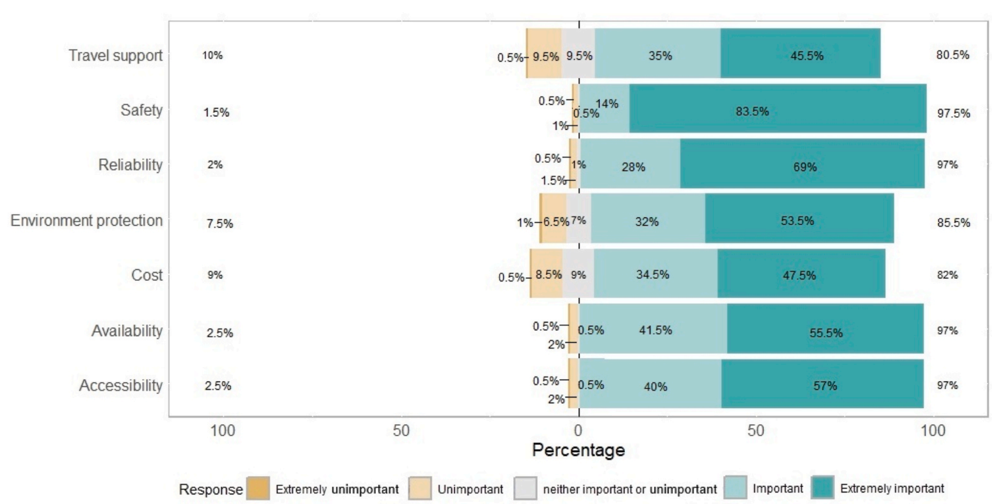

Fig. 8. Importance of parameters influencing the acceptance of emerging transport technologies.

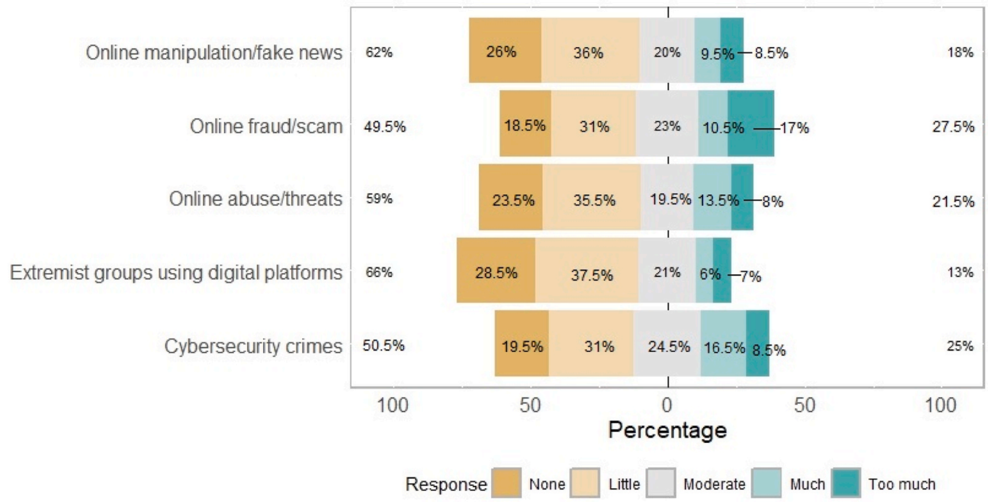

Fig. 9. Importance of barriers preventing the use of emerging transport technologies.

barriers. Concern about online fraud/scams is most strongly associated with internet usage (F (2,197) = 12.8, p < 0.001) and income (F (5,194) = 8.52, p < 0.001). Internet users (Tukey HSD: diff = 0.94, p < 0.01) and higher-income individuals (e.g., £15k–£29,999 vs >£70k: diff = −1.1, p < 0.01) are more likely to view this as a major barrier. Likewise, cybersecurity crime concern is significantly linked to internet usage (F (2,197) = 15.9, p < 0.001) and income (F (5,194) = 9.67, p < 0.001). Internet users again reported higher concern (Tukey HSD: diff = 0.94, p < 0.01). The threat from extremist groups was solely associated with income (F (5,194) = 12.6, p < 0.001), with higher-income participants showing greater concern.

4.6. Technology approval parameters

Attitudes about factors that may play a decisive role for older people in adopting emerging transport technologies were also captured as illustrated in Fig. 10. There is broad agreement (83.5%) that emerging transport technologies could enhance older peoples' lives by strengthening their social inclusion, with minimal disagreement (10%). This view was influenced by driving license holding (F (2,197) = 7.03, p = 0.001), mobility status (F (1,198) = 6.83, p = 0.01), education (Welch ANOVA: F (4,51.67) = 7.05, p < 0.001), and income (F (5,61.04) = 5.99, p < 0.001). People without a license and those with mobility difficulties were more supportive (Tukey HSD: diff = 0.47, p = 0.01). Similarly, 88% agreed that such technologies help reduce stress for older road users, while only 5% of the respondents disagreed. This perception was associated with driving license (F (2,197) = 4.47, p = 0.01), education (F (4,195) = 3.43, p = 0.001), and income (F (5,194) = 4.15, p = 0.001). Support was stronger among non-drivers (diff = −0.38, p = 0.02) and those with higher education (e.g., primary vs master's: diff = 0.70, p = 0.03).

In contrast, perceptions about the safety of having an autopilot system are mixed: 41.5% feel more secure, while 33% disagree and 25.5% are neutral. This view is significantly associated with internet usage (Welch ANOVA: F (2,51.52) = 5.41, p = 0.007), education (F (4,50.69) = 9.52, p < 0.001), and income (F (5,194) = 3.31, p = 0.007). Tukey HSD tests show that non-drivers (diff = 0.56, p = 0.04) and those with higher income (e.g., £15k–£29,999 vs >£70k: diff = −1.07, p = 0.01) are more likely to feel secure with autopilot technology.

4.7. Modelling results

A statistical model (reported in Table 1) was also formulated to quantify the relationship between the participants' intended usage of emerging transport technologies and some critical survey variables referring to perceptions and socio-demographic characteristics. Thus, the dependent variable examined relates to the question "how often would you use these emerging transport technologies?" as a proxy for intention to use. Ordinal regression was used, as it is suitable for the empirical analysis of any ordered, categorical dependent variable.

Various elements have been tested and modelled either as dependent or independent variables as well; nevertheless, the model described in Table 1 was found to be the most relevant, reliable and robust model in statistical significance and predictive terms. To improve model stability and interpretability, we collapsed the original five-category 'transport technology usage' variable into four categories by combining "weekly" and "daily" use into "weekly or more", as these two represented similar high-frequency behaviours. This adjustment resulted in improved model

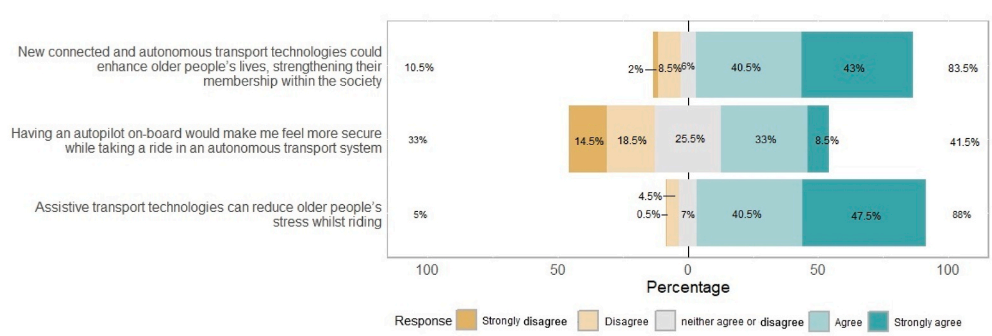

Fig. 10. Technology approval indicators for emerging transport technologies.

Table 1
Ordinal regression model analysing perceptions of the frequency to use emerging transport technologies.

Parameter estimates		Estimate	Std. error	Wald	df	Sig.	ExpB	95% confidence interval	
								Lower bound	Upper bound
Threshold	How often would you use these emerging transport technologies? = 1	−0.537	0.776	0.478	1	0.489	0.585	0.128	2.677
	How often would you use these emerging transport technologies? = 2	1.572	0.797	3.885	1	0.048	4.815	1.009	22.982
	How often would you use these emerging transport technologies? = 3	3.072	0.822	13.981	1	0	21.586	4.313	108.023
Location	Driving license? Yes	−2.162	0.476	20.619	1	0	0.115	0.045	0.293
	Driving license? No	0[a]			0		0		
	Transport accessibility importance = High	2.147	0.542	15.715	1	0	8.562	2.961	24.755
	Transport accessibility importance = Moderate	1.377	0.410	11.27	1	0.001	3.962	1.774	8.851
	Transport accessibility importance = Low	0[a]			0		0		
	Experience with technology = Very Good	2.396	0.543	19.493	1	0	10.978	3.79	31.802
	Experience with technology = Good	0.958	0.504	3.619	1	0.057	2.607	0.971	6.998
	Experience with technology = Fair	0.651	0.448	2.112	1	0.146	1.918	0.797	4.618
	Experience with technology = Poor	0[a]			0		0		
	Cheaper travel as a benefit = Agree	1.386	0.515	7.231	1	0.007	4.000	1.456	10.986
	Cheaper travel as a benefit = Slightly agree	0.518	0.440	1.383	1	0.240	1.678	0.708	3.975
	Cheaper travel as a benefit = Neutral	0.094	0.443	0.045	1	0.833	1.098	0.461	2.618
	Cheaper travel as a benefit = Disagree	0[a]			0		0		
	More access to training should be provided = Agree	0.151	0.434	0.121	1	0.728	1.163	0.497	2.723
	More access to training should be provided = Neutral	0.842	0.429	3.855	1	0.050	2.321	1.001	5.381
	More access to training should be provided = Disagree	0[a]			0		0		
	Increased safety concerns as a risk = Strongly agree	−1.302	0.632	4.252	1	0.039	0.272	0.079	0.938
	Increased safety concerns as a risk = Agree	0.341	0.452	0.569	1	0.451	1.407	0.58	3.414
	Increased safety concerns as a risk = Neutral	−0.467	0.732	0.407	1	0.523	0.627	0.149	2.63
	Increased safety concerns as a risk = Disagree	0.738	0.44	2.816	1	0.093	2.093	0.883	4.957
	Increased safety concerns as a risk = Strongly disagree	0[a]			0		0		

N = 200, Model chi-square = 146.904, $p < 0.001$, − 2log likelihood = 383.834, Nagelkerke Pseudo R^2 = 0.560. [a] This parameter is set to zero because it is the base category (the reference for comparisons).

fit, evidenced by higher McFadden R^2, lower odds ratios (Exp(B)), and narrower confidence intervals (as per Steiner et al., 2016).

The final model included six independent variables, namely: a) driving license possession, b) transport accessibility importance, c) experience with technology (as a proxy of familiarity or awareness), d) agreement with the statement that emerging transport technologies would produce cheaper travel as a benefit, e) agreement with the statement about the need for more access to tailored training opportunities aiming to ease the use of technology and f) agreement with the statement that emerging transport technologies would produce increased safety concerns as a risk. The first independent variable had a socio-demographic nature, while the rest assessed views. In all our independent variables, the first response was the base category for the ordinal model, as per the default properties of statistical programming language R.

Notably, the ordinal regression analysis reveals significant insights about the factors influencing the intention to use emerging transport technologies. In general, the model is statistically significant (χ^2 = 146.904, $p < 0.001$), with a Nagelkerke pseudo R^2 value of 0.560. Furthermore, the model has an acceptable value of McFadden R^2 (0.28), since it falls within the range of 0.20-0.40 and therefore indicates a very good fit (Theofilatos et al., 2016). Also, the AIC value is generally moderate to low, demonstrating a good-fit model (419.834). Similarly, the Parallel Lines test showed that the parallel regression assumption holds ($p > 0.05$) illustrating no violation of proportional odds. None of the independent variables are characterised by multicollinearity since the GVIF test showed that all GVIF values are below 5 (Asare and Mensah, 2020). The highest GVIF value refers to driving (2.14), while the lowest to "more access to training" (1.29). Therefore, all predictors could be retained in the final model. The model's thresholds are progressively increasing reflecting greater inclination to adopt these technologies. For instance, the third threshold (3.072) corresponds to the highest level of usage frequency and proclaims a marked shift in intention among respondents.

The first independent variable referred to the driving license possession. Apparently, this variable emerged as a significant predictor. Individuals who still have a driving license exhibit a negative association with the intention to use emerging transport technologies (estimate = −2.162, $p < 0.001$), indicating that this group may perceive less utility or have greater barriers to adoption compared to respondents with no license. As a result, current driving license status influences, possibly adversely, openness to emerging transport technologies.

Next, transport accessibility importance is another key predictor, with respondents who perceive their own transport accessibility as of "moderate importance" (estimate = 1.377, p = 0.001) or "high importance" (estimate = 2.147, $p < 0.001$) being significantly more likely to adopt these technologies. The associated odds ratios (ExpB = 3.962 and 8.562, respectively) highlight an increase in the likelihood of intended adoption as the perceived importance of transport accessibility rises. Hence, enhancing accessibility features and as a whole the perceived accessibility value of these technologies might be proven critical for their uptake by seniors.

Experience with technology also manifests a profound positive nature in its influence. Respondents with "very good" experience (estimate = 2.396, $p < 0.001$, ExpB = 10.978) demonstrate the highest propensity to use emerging transport technologies frequently, with increasing familiarity correlating considerably with adoption likelihood. Interestingly, those with "good" experience (estimate = 0.057, $p < 0.001$, ExpB = 2.607) have a quite notable propensity to adopt new transport options as well. These outcomes indicate that those more familiar with technology feel more prepared to use emerging transport technologies and solutions; this emphasises the importance of increasing technology awareness and providing custom-tailored opportunities for seniors to test and get to know these technologies.

Moving on the fourth independent variable, the belief that cheaper travel would be a benefit appears to influence emerging transport technology adoption by older people, but only for those who agree with this statement. These respondents exhibit a statistically significant increase in the likelihood of higher adoption (Estimate = 1.386, p = 0.007, ExpB = 4.000), meaning they are four times more likely to use these technologies frequently compared to those who "disagree" (reference group). However, for respondents considering cheaper travel differently there is no statistically significant association with adoption. This outcome suggests that while cost savings can be a very strong motivator, its effect is most pronounced when users have a high level of agreement about this being a potentially genuine benefit.

Moreover, the perception that more training should be provided for these technologies is linked to a moderate increase in likelihood of adoption, but the results are somehow “puzzling”. Respondents who are “neutral” about the need for training show a significant increase in adoption likelihood (Estimate = 0.842, p = 0.050, ExpB = 2.321), demonstrating they are twice as likely to use the technology compared to the reference group. Notwithstanding, those who “agree” with the need for more training show no statistically significant effect (p = 0.728). This might imply that those who strongly believe in training, actually perceive to date these emerging transport technologies complex or inaccessible, which prevents them from adopting them without a future training or educative intervention.

Last but not least, concerns about safety risks associated with emerging transport technologies present a complex relationship with their adoption likelihood. Those who “disagree” with the statement show a marginally significant increase in adoption (Estimate = 0.738, p = 0.093, ExpB = 2.093), implying that lower concern about safety correlates with higher intended usage. Interestingly, those who “strongly agree” that increased safety risks are a major issue are significantly less likely to adopt these technologies (Estimate = −1.302, p = 0.039, ExpB = 0.272), meaning they experience a 73% reduction in the odds of higher usage. This clearly indicates that strong safety concerns act as a major deterrent to adoption.

Our analysis, also involves how the probability to use the emerging transport technologies along with the frequency (weekly or more, monthly, rarely, never) changes in regard to gender, mobility difficulty, familiarity with technology and annual household income.

Fig. 11 examines the relationship between gender, mobility difficulty, familiarity with technology and the intended frequency of use divided into five categories (i.e., never, rarely, monthly and weekly or more). The patterns show nuanced variations in the interplay between these factors, emphasising their great influence on technology engagement.

Firstly, among individuals without mobility difficulty, gender-specific trends are evident. For females, the transitions in frequency of use probabilities are “fluid”, though smoother, across varying levels of familiarity, suggesting a more gradual adoption or increase in usage with improved familiarity. “Weekly or more” use tends to increase gradually as familiarity improves, whereas the probability to never use such emerging transport technologies experiences a steady decline. On the other hand, males without mobility difficulties exhibit more pronounced variations, singling out distinct shifts in intended usage patterns at specific familiarity levels. Specifically, the probability of never using new transport solutions starts relatively high but declines as familiarity improves, while “weekly or more” users exhibit a noticeable rise at the highest familiarity level. This suggests that males with no mobility difficulties may need a higher level of familiarity before committing to frequent usage. In general, it is determined that “weekly or more” users consistently dominate among individuals with the highest familiarity, indicating once again the noticeable link between advanced technological competence and frequent use across genders.

Secondly, when it comes to individuals with mobility difficulties, the

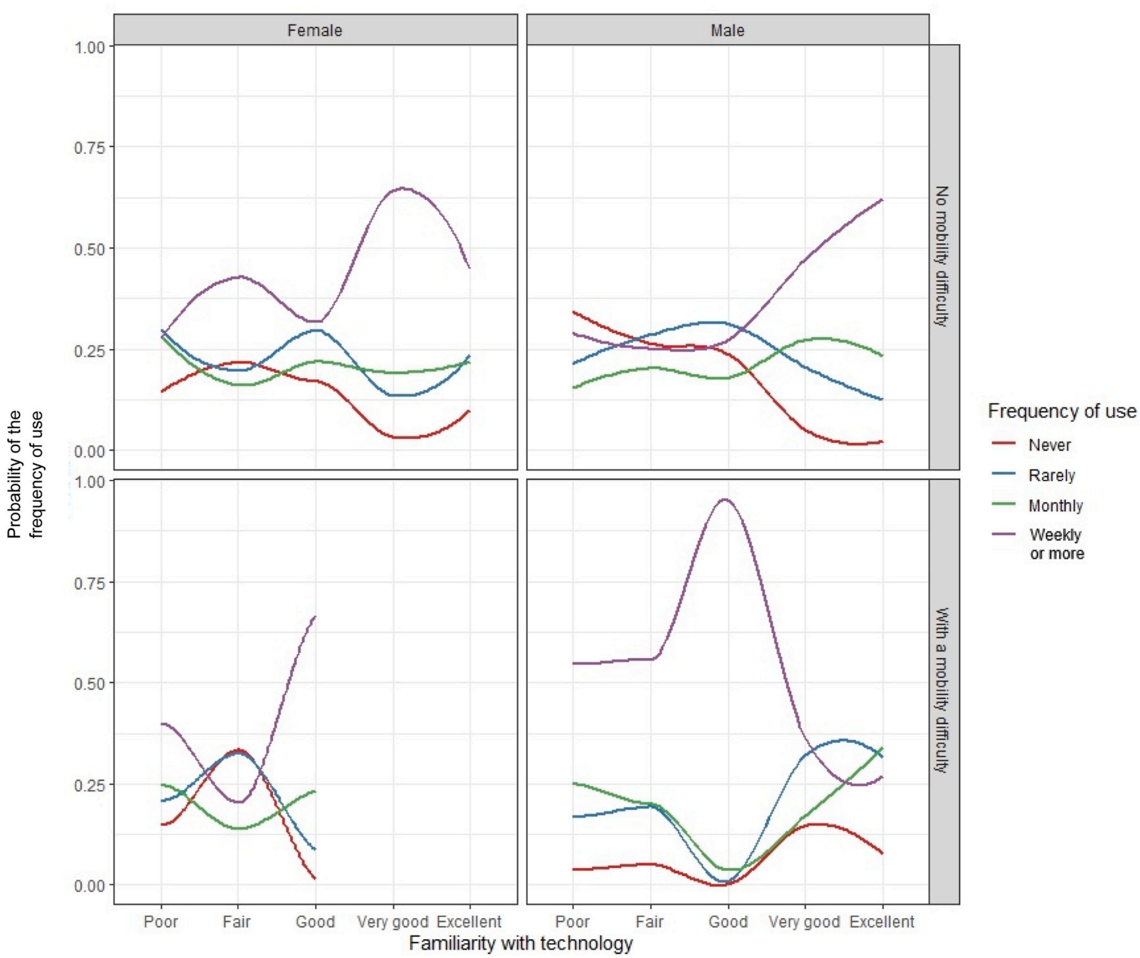

Fig. 11. Ordinal regression outcomes: Gender, mobility difficulty and familiarity with technology.

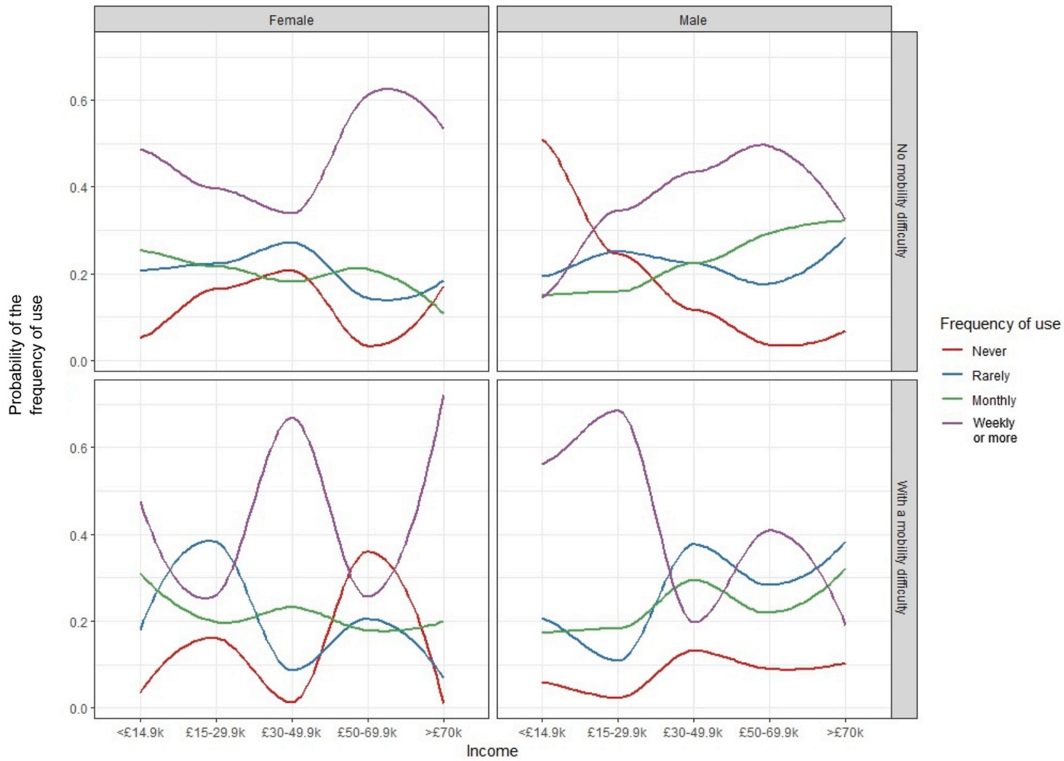

Fig. 12. Ordinal regression outcomes: Gender, mobility difficulty and income.

situation slightly changes, with “weekly or more” users showing a substantial increase in probability at higher familiarity levels in case of females. On the other hand, males experience higher probabilities in rarely or monthly frequency at higher levels of familiarity. The broader implications of these findings suggest that while gender and mobility status introduce critical variability in usage patterns, high familiarity with technology consistently corresponds with mainly monthly or " weekly or more” use. Therefore, familiarity emerges as an important feature that might influence older people to adopt new transport options.

Fig. 12 reflects the relation between gender, mobility difficulty, income levels and the probability of the use frequency divided into five categories (i.e., never, rarely, monthly and weekly or more). The trends observed reveal how income interacts with gender and mobility status to shape the adoption of new transport options.

First, when looking into individuals without mobility difficulties, distinct gender-based differences emerge. Among females, “weekly or more” users show gradual increases in probability as income rises, particularly at higher income levels (≥£70k), whereas while the probability of never using these technologies declines. Males without mobility difficulties, in contrast, exhibit more pronounced fluctuations across income categories. Interestingly, lower-income males (<£14.99k) have a higher probability of never using emerging transport technologies, whereas higher-income males experience a rise in intended frequent use. This outcome indicates that income plays a more complex role in influencing the adoption of new transport technologies among males without mobility difficulties compared to females.

Secondly, for individuals with mobility difficulties, gender plays a critical role in shaping different trends in terms of usage intention. Females tend to be characterised by higher probabilities in “weekly or more” usage in moderate income levels, whereas lower-income women exhibit a more varied distribution of use. For males, “weekly or more” use is particularly prominent in the lower-income categories (<£14.99k and £15-29.99k), revealing a stronger reliance on transport technologies despite their financial constraints. The probability of never using these technologies remains relatively low across most income levels for both genders (except £50-69.99k in women). These findings highlight the importance of income levels and demonstrate the higher propensity to use such services for older adults with lower income; perhaps these technologies may be an intervention with pro-poor character indicating that if they are affordable, they could become attractive for some less well-off people.

5. Discussion

5.1. *Key findings*

Our research explored how older people in North England might view five emerging transport technologies, with the potential to redefine transport access for them. These were namely AVs, MaaS, assistive technologies, travel apps and real-time information systems. Our main research goal was to evaluate older people's intention to use them and understand factors that could potentially affect these intentions. Our results indicate that while older adults are aware of mobile applications, real-time information provision mechanisms and driving assistance tools (interventions that are high-tech but are yet currently in use), they lack substantial familiarity with more futuristic, and possibly disruptive, solutions such as AVs and MaaS (confirmed by Vij et al., 2020). This manifests a critical gap in knowledge and lack of exposure to advanced transport technologies, which will be agents of transformational change for future mobility (Nikitas et al., 2017). Thus, awareness campaigns should be promoted with the aim to familiarise older people with the new transport options as suggested by other relevant studies (e.g., Oxley et al., 2022) since older people, in principle tend to be more reluctant and negative to attitude objects they do not understand (Nikitas et al., 2018).

Despite this lack of awareness though, respondents are generally positive, recognising potential benefits such as enhanced accessibility, personalised options, and increased autonomy. However, they are still concerned in terms of affordability, privacy, ease of use, and potential risks, including fraud and cybersecurity issues. So, there needs to be design-specific work aimed at addressing pro-actively these concerns and foster broader acceptance. This approach is in line with the policy recommendations of Mitzner et al. (2010), Payyanadan and Lee (2018) and Souders and Charness (2016) that also suggest the need for user-centric planning and design of interventions that fit the diverse needs of seniors.

Our work looked thoroughly on describing the critical role of socio-demographics in influencing perceptions and intended use. Key factors include income, marital status, educational background, mobility/health status, internet usage and driving license possession, all of which seem to significantly influence some of the attitudes toward emerging transport technologies. Signoretti et al. (2015) who focused on older people and Golbabaei et al. (2023) that investigated the general population also signify the importance of these socio-demographic variables in shaping up attitudes towards transport technologies.

When it comes to the intention to use these solutions, our results reveal that apart from socio-demographic factors (and especially the procession of the driving license that we tested in our ordinal regression model), familiarity with technology, own perceived accessibility importance, cost, training opportunities and concerns referring to safety issues are all key predictors of both intention and anticipated frequency of use. Some current literature also studied a few of these relationships (e.g., Harvey et al., 2019; Shirgaokar, 2020; Bokolo, 2023; Payyanadan and Lee, 2018) pronouncing the critical importance of some of these factors, for older audiences at least, in the way intentional and actual travel behaviour can be crafted. It is important to note that the respondents see "reasonable cost" and "affordability" as a prerequisite for a technology that is genuinely fair and pro-social much like they did in the work of Zandieh and Acheampong (2021). This is implied by the fact that acknowledging in them the benefit of cheaper travel may be a facilitator for the frequent use of the tested technologies. Therefore, ensuring emerging transport technologies that do not add extra costs on travel and potentially can compete with conventional car usage expenses is a key for designing technologies acceptable by and attractive to use for older people. Also, when income levels are low, then the self-reported probability to potentially use new transport technologies is higher. This is important because it could indicate a potential for these technologies to be regarded as a pro-poor and social exclusion-alleviating intervention especially if the services are offered in affordable prices.

Driving license possession is negatively associated with intention to use emerging transport technologies. Hence, people already driving, persist to choose what they habitually use and stay in their comfort zone, instead of adopting emerging transport technologies. People with mobility difficulties might choose these new emerging services more often than others, especially for technologies like AVs that disengage "driving" from physical disabilities. This disagrees with the study of Kassens-Noor et al. (2021) - under the note that their study participants had to compare solely between public transport and automated public transport which is a restriction - but is line with other studies such as Petrović et al. (2022).

We also found that users who are more familiar with digital tools tend to exhibit greater openness to transport innovation. Therefore, boosting the digital skills (via training and education initiatives) of older people may help them to trust more these technologies and eventually be able to use them. This agrees with relevant past research (e.g., Sochor and Nikitas, 2016). Additionally, perceived accessibility, encompassing the ease of reaching desired destinations using these technologies, further increases adoption likelihood; accessibility is known to be a powerful enabler of modal shift (Musselwhite et al., 2015) and transport technology embracement (Pangbourne, 2018). Nonetheless, concerns about sharing personal information remain a barrier for some respondents, demonstrating the importance of addressing privacy-and cybersecurity-related fears (as also discussed by elite participants looking to demystify the general population expectations of connected AVs (CAVs) in Liu et al., 2020).

Interestingly, the findings we report suggest that older people view, in general, emerging transport technologies favourably, with an optimistic stance around their potential benefits. This optimism, coupled with a recognition of the transformative possibilities these innovations may offer, indicates a sincere willingness among older populations to explore and adopt advanced transport solutions, provided that their concerns (cost, safety, ease of use, packaging with training support) are adequately addressed and the advanced technologies negotiated herewith have been designed in an ageing-friendly way. Also, their main fears seem mostly society-oriented and not self-oriented since they indicated job losses and skill losses as the two most likely detrimental side-effects of these emerging technologies.

5.2. Contribution

This paper makes a significant contribution by explicitly contextualising the opportunities and challenges older people see for themselves when coming across emerging transport technologies. This is an area that has received limited attention in prior research but decoding it might be critical for the creation of equitable urban mobility futures, where older age and ageing are not agents of disruption and sources of social exclusion.

Our key findings provide valuable insights for policymakers and academia, shedding light to the benefits, externalities and side-effects these technologies might (or might not) present for older populations. The paper highlights the threats of exacerbating inequalities in a digital age, where younger individuals may disproportionately benefit from transport technologies, while older people risk being marginalised and suggests specific evidence-based ageing-friendly policy measures addressing all the barriers we identified.

It is one of the first papers assessing within a single and well-defined comparative framework an array of different emerging transport technologies and also a study whose data were collected in a labour-intensive way (a full face-to-face field-based survey collection) that reduces the under-representation of populations that could be unable to answer an e-survey.

5.3. Limitations and further research

Despite its meaningful contribution in a still under-studied area, as any social science research study that analysed self-reported data on attitude objects that may be hypothetical or considered "futuristic", our work might suffer, to some degree, from limitations including the existence of social desirability, self-selection, acquiescence and response biases. We followed a structured approach informed by best practice to make sure that these issues were of non-critical nature. Despite our laborious face-to-face data collection in the field that overcame the possible bias of digital literacy we recognise that the survey underpinning the research findings is still based on a convenience (i.e., non-random purposive and snowballing) sample. This, we acknowledge, might affect the generalisability of some of our results.

We need to also recognise, that the research data collection was administrated exclusively within the UK (and specifically in North England's Huddersfield, Leeds and Manchester), so our results are representative of this context, and can be generalisable to similar socio-economic or cultural environments with some cautiousness. To this end, we believe our work provides an accurate regional snapshot intended to highlight contextual attitude-shaping mechanisms rather than to generalise across the UK.

Equally important is that despite the fact that the research obtained a large and coherent sample, missing perceptions of minorities might still exist. For instance, this sample may exclude older individuals with less social interaction (i.e., home-based older people that we could not have accessed through our field recruitment), who might be unfamiliar with emerging transport technologies. The statistical models developed were quite robust (using ANOVA and ordinal regression), but not the only suitable analytical methods. Moreover, the cross-sectional design allows the identification of associations between perceptions, socio-demographic factors and intended technology use, but does not permit causal inference. Longitudinal or experimental designs would be required to determine causality more robustly.

To this end, further research is essential for opening new pathways and gaining better understanding of this complex subject. This study can be reproduced to a different geographical and socio-economical setting; we intend to do that in the near future. One promising area for further research is the examination of future scenarios, which could simulate varying socio-economic and technological conditions to assess how different populations (e.g., older adults or people with disabilities) may respond to emerging transport technologies under diverse contexts. Tellingly, such scenario analysis would help researchers and policy-makers anticipate behavioural shifts and prepare for potential challenges in the implementation of these technologies. Future studies could also involve qualitative research (for building depth) and a longitudinal study so that we can evaluate how with time passing attitudes to transport technologies might change.

6. Conclusion

Benefiting from a paradigm-resetting transport technology toolbox including AVs, MaaS, assistive technologies, real-time information systems, and travel guidance apps, among others, requires specific capabilities and willingness to assume a new role as an energetic participant of an emerging travel eco-system built around AI. To avoid creating unprecedented layers of social inequity and transport disadvantage, research is needed in terms of understanding better older people who might have problems comprehending, accessing and embracing these technologies. This will allow building a new transport landscape and ethos designed in a way that will allow them to be part of this on-going transition and not left behind. This is valuable, not only on transport justice and social inclusion terms, but because older people are a population that is metamorphosing into a significant source of spending in the economy, characterised by increased downtime and a thirst for travelling (Signoretti et al., 2015). Thus, mobility operators and policymakers should start looking at them as agents of change and their diverse and particular needs as the baseline for what acceptable transport planning needs to be.

This paper supports this cause by studying how older people view and could be using emerging transport technologies. Referring to our first objective, our key findings demonstrate that older people currently recognise and value the potential of mobile applications and driving assistance tools, however, they are still not familiar with more future-oriented and ground-breaking interventions like AVs and MaaS. Responding to the second research objective, they somewhat surprisingly self-reported to be keen into adopting such solutions, as they recognise several benefits like accessibility, personalised options, autonomy, yet, they remain sceptical in terms of affordability, government support, privacy, ease of use and potential risks including fraud and cybersecurity crimes. Finally, with reference to the third research objective, we found, socio-demographic characteristics and especially, driving license possession, internet usage, educational background and income, play a major role in influencing attitudes towards emerging transport technologies. When it comes to the intention and the likely frequency to use such solutions, driving license possession, experience with technology, own perceived accessibility importance, access to training initiatives, travel cost reduction and safety concerns emerge as key predictors of behavioural response. The first and the last are negative factors, while all the others increase the likelihood of adoption.

Older people can win much from the emerging transport technologies we studied, as long as these interventions address the evidence-based priorities outlined herein. There is a need for targeted awareness-raising and trust-building efforts, custom tailored to their needs, focused on the provision of training, lifelong education, helplines and market campaigns. Additionally, and perhaps even more importantly, ageing-friendly design of affordable, inclusive, safe, cyber-secure and easy to use products and services should be prioritised, over quick fixes or more complex alternatives, to create technology engagement. Integrating innovative solutions into social settings must happen incrementally and strategically; consultation and two-way co-creation exercises would be necessary for crafting genuinely pro-social transport goods and services, and acceptable pathways to full-scale technology launches. We believe that the transport industry, by embracing the findings of ageing-focused research like ours, could become one of the architects of an accessible AI-centric built environment, which will assign more value to social inclusion, autonomy and accessibility for all.

CRediT authorship contribution statement

Alexandros Nikitas: Writing – review & editing, Writing – original draft, Supervision, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Stefanos Tsigdinos:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis. **Christos Karolemeas:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis. **Alexandra-Elena Vitel:** Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization. **Corneliu Cotet:** Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization. **Kalliopi Michalakopoulou:** Writing – review & editing, Writing – original draft, Formal analysis, Data curation. **Georgios Nikitas:** Writing – review & editing, Writing – original draft, Visualization, Formal analysis. **Athanasios Angelis-Dimakis:** Writing – review & editing, Writing – original draft, Validation, Funding acquisition, Conceptualization. **Grigoris Antoniou:** Writing – review & editing, Writing – original draft, Validation, Funding acquisition, Conceptualization. **Efthimios Bakogiannis:** Writing – review & editing, Writing – original draft, Validation, Supervision.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.tranpol.2026.104156.

Data availability

The data that has been used is confidential.

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