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Vulnerable users' perceptions of transport technologies

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Abstract

As the global population continues to grow, age and urbanize, it is vital to provide accessible transport so that neither ageing nor disability constitute barriers to social inclusion. While technology can enhance urban access, there is a need to study the ways by which transport technologies - real-time information, pedestrian navigation, surveillance, and road pricing - could be more effectively adopted by users. The reason for this is that some people, and particularly vulnerable populations, are still likely to reluctantly use (or even avoid using) technologies perceived as 'unknown' and 'complicated'. Based on evidence from British and Swedish case studies on older people's perceptions of the aforementioned transport technologies, as well as on a Swedish case study of visually impaired people's perceptions, this article makes the case that technology is only one tool in a complex socio-technical system, and one which brings challenges. The authors also suggest that although vulnerable populations are not homogeneous when expressing attitudes towards transport technologies, their assessment criteria tend to be 'pro-social' as they usually consider that the societal benefits outweigh the personal benefits. Emphasising aspects linked to the technologies' pro-social potential or relevance to the individual user could increase acceptance.

Keywords

Transport planning; Information technology; Public policy

1. Introduction

Many nations are facing challenges in providing quality transportation infrastructure and services to an increasingly ageing and vulnerable population. In this digital age, 'technology' (defined by Arthur (2009) as 'a means to fulfil a human purpose') could be a way to ease the transition to more socially inclusive urban environments. Many, for instance, are enthusiastic about the opportunities offered by new advances in transport technologies in terms of safety, efficiency, environment, but also in terms of enhancing the mobility of various vulnerable groups (defined by Hine and Mitchell (2003) as older or disabled persons, ethnic minorities, women, unemployed, children and youth). Examples include technologies such as navigation, real time information, pre- and on-trip travel planning, personal alarms, cashless payments, and electronic road pricing. Such technologies may also address subtle factors affecting mobility choices such as perceptions of access, safety and security, communication and access to help, and lack of knowledge and information, which affect one's sense of assurance, which is a broader concept than personal safety or security that also encompasses connotations of comfort and confidence (Sochor, 2013).

Despite the various opportunities transport technologies present, they bring challenges as well. The fact that they are often state-of-the-art technologies means that no matter how simple the technologies are to use, vulnerable populations could perceive them as incomprehensible, or even unnecessary. Older persons, for example, have managed their mobility their entire lives without these 'modern', 'different' or 'complicated' technologies. Older persons are also most likely to express concerns about new technology, worrying about how complex future technology might be to use (Pragnell *et al*., 2000) or even voluntarily excluding themselves from using it (Selwyn, 2004). This means that in practice older cohorts of people tend to be less involved with technology due to (perceptions of) lack of skills, motivation, opportunity to start, money, physical ability and fear of the unknown, of their ability, of appearing foolish (Nikitas, 2010a). Furthermore, there is a lack of participation by (or perhaps opportunity for) older and vulnerable groups in shaping technological development, and a lack of gender-related research in the area of ageing and technology, which is relevant given that older women often outlive men and age differently than men (Xie, 2003). In the short term, there are also questions over whether vulnerable persons would be able to afford the technologies, be interested in them or be able to use them to the same extent as the rest of the population. And in addition to these technology adoption-related barriers, older people and other vulnerable populations also have more complex travel needs than the average traveller (Alsnih and Hensher, 2003; Rosenbloom, 2001) due to mobility or cognitive limitations that need to be catered to possibly via technology design. As a matter of fact, for older and disabled travellers, the main mobility barrier can 'simply' be a lack of information (Waara, 2013). And last but not least, these transport technologies generate and use personal data and allow for increasingly precise and continual monitoring and tracking of the locations and movements of individuals and objects over time; an on-going issue of societal debate (Sochor, 2013).

As illustrated above, and as analysed and discussed below, using technology to meet exclusion-related challenges is rarely so straightforward as introducing the technology into the market for it to be adopted by those who could most benefit from it. On the contrary, the reality is that there is still a need to develop a thorough understanding of the ways with which technologies can be introduced and adopted by transport users so that the technologies are transformed from perceived barriers to decisive facilitators. Furthermore, the need to renew our understanding will persist due to the dynamic relationship between technological development, user requirements, and societal values. In order to contribute to such an understanding, one must first explore different vulnerable user groups' perceptions of the various technologies in question.

The paper will employ 'urban access' as the focus of its attention, as a means of expressing with a single term paradigms of transport-oriented social inclusion. More specifically, urban access is the right of every member of an urban society to have access to those locations, services and resources one needs to achieve a sustainable standard of living and productivity that serves the needs of one's human nature, irrespective of age or disability barriers and without limiting other people's rights of access (Nikitas *et al*., 2013).

Furthermore, the authors wish to emphasise that technologies are more than physical devices. Arthur (2009) defines technology as 'a means to fulfil a human purpose' while Rhodes' (2000) definition refers to technology as 'the current state of humanity's knowledge of how to combine resources to produce desired products, to solve problems, fulfil needs, or 'satisfy wants' '. According to Heidegger (1954), technology includes not only the technological instruments per se, but also the development and use of technology, as well as the needs and ends the technology serves. For the purpose of this article, technologies are measures that have a potential to facilitate and sometimes radically improve the provision of adequate transport services that could surpass mobility barriers, i.e. transport technologies can be physical devices such as smartphones, information services such as navigation and real-time information, policies such as road pricing, physical services such as Special Transport Services (STS), etc.

Although this paper will explore perceptions of technologies from British and Swedish studies (road pricing, pedestrian navigation, real-time information and video surveillance) in order to draw more general conclusions, the authors do not seek to assess the validity of attitudes for or against specific technologies, nor to present in-depth perception studies on the special technological needs of vulnerable populations. Instead the paper aims to highlight the importance of taking into account the attitudes that older and visually impaired people have towards different transport-related technologies so that those designing the cities of tomorrow could provide optimum levels of urban access irrespective of age or disability barriers. Henceforth, the paper provides a presentation of the contextual background behind the different

studies discussed herein, a description of the research methodologies employed, a synthesis of the most relevant results and a thorough discussion of the main findings.

2. Background

Mobility is closely linked with people's ability to reach desired destinations so that they can undertake activities referring to human requirements as necessary as food, clothing, education and work. It may also play an important role in helping to satisfy psycho-social needs, which are deemed necessary for well-being, such as relating well with others, feelings of competence and mastery, and heightened autonomy (Ellaway *et al.*, 2003; Musselwhite and Haddad, 2010; Vella-Brodrick and Stanley, 2013). Increasingly though, as Shergold and Parkhurst (2012) point out, it is not just mobility itself, which is seen as instrumental as an enabling factor, but the 'accessibility' of the locations, services and facilities that people may need to reach or engage with to avoid exclusion; described as 'opportunities' by Moseley (1979) and as 'routine journeys' that are essential for a 'normal standard of living' by Nutley (2003). This means that social exclusion, defined by Kenyon *et al*. (2002) as 'the unique interplay of a number of factors, whose consequence is the denial of access, to an individual or group, to the opportunity to participate in the social and political life of the community, resulting not only in diminished material and non-material quality of life, but also in tempered life chances, choices and reduced citizenship' is a phenomenon with substantial transport-related dimensions. This focus on the (in)ability of individuals to 'participate' distinguishes the concept of social exclusion from income-related theories (Lucas, 2011) and is behind 'the emergence of transport disadvantage as a focus of contemporary research and policy' (Church *et al*., 2000).

Transport disadvantage is generally recognised to be a multi-dimensional construct with characteristics associated with location, access to mobility and limitations on personal access associated with the physical, social and psychological characteristics of individuals (Delbosc and Currie, 2011). The groups most likely to have a transport disadvantage and therefore to be more vulnerable to mobility-related social exclusion are variously identified by Hine and Mitchell (2003) as: older people, people with disabilities, parents travelling with young children, people from an ethnic minority background, younger people (16-24), unemployed people and women. The research presented henceforward will be looking on the two former categories of people. Conventionally, the group of 'older people' has been defined by a chronological age of 60 or more years old, while disability is an umbrella term, covering impairments, activity limitations, and participation restrictions (WHO, 2015). The term 'vulnerable populations' that is adopted by the authors will be restricted however to 'older' and 'visually impaired' persons in order to be entirely in line with the special characteristics of the study participants.

This paper is based on a versatile set of seemingly different research studies conducted in Bristol, UK and Stockholm, Sweden. These studies, nonetheless, share the same focus; the

development of an understanding of how older people, and in one study visually impaired people, view particular applications of transport technologies (as defined above) that could enhance or minimise their urban access potential. The authors strongly believe that this 'versatility' of the studies and samples adds to the value of the paper; it enables this work to draw more generic conclusions about vulnerable populations' perceptions towards a wider range of barriers to technology that could, to some degree, go beyond specific local applications that strictly refer to single local samples and to a single type of technology. This indicates that the findings reported could be more easily generalisable to a wider context, at least for similar cities.

Bristol, located in the South-West of England, has a population of 437,500 people. Among those, 74,375 residents are aged 60 and over (BCC Bristol City Council, 2014). In terms of travel, Bristol suffers from high levels of congestion, which could cost the local economy around £600 million annually by 2016 (BCC, 2013). Bristol's bus services carry only 13% of work-related trips, versus 56% for private cars, of which ownership increased 13% from 2001 to 2011 (BCC, 2013). Although Bristol has been in the forefront of UK cities planning a charging scheme, fears of adverse public acceptability and the potential political backlash of such an introduction, especially from vulnerable populations, have ruled out any process to materialise these plans so far.

Stockholm is the capital of Sweden with a 2013 municipal population of 897,700 and a county population of 2,163,042 (SCB, 2014). In 2013, there were 69,919 holders of Special Transportation Services (STS) permits in the county, of which 76.3% were over 65 years of age, and of those, 68.9% were women. Over the year, 3,167,000 one-way STS trips cost 1.005 billion Swedish kronor (gross), offset by 0.145 billion in revenue (as of June 2015, 1 SEK ≈ 0.11 EUR) (Trafikanalys, 2014). Although STS is a legislatively protected service (see Swedish law 1997:736), it is also increasingly expensive given the ageing population. Thus, it is becoming increasingly important to support independent mobility in other ways, such as accessibility of public transportation and the built environment (e.g. Stockholm's decade-long 'Easy Access Project') and technological aids (a navigation aid for the visually impaired alone could reduce the STS cost for Stockholm by 10%, see Karlsson, 2008).

3. Method and Material

The transport technologies addressed in this paper are briefly introduced here:

- Road pricing covers a range of policy measures which involve payment for road access in direct relation to usage criteria, rather than paying a fixed network access fee unrelated to use, or paying proxy charges such as road fuel duty (Nikitas *et al*., 2011). In terms of operational complexity, road pricing ranges from a one-point entry tollbooth to a fully automated electronic road pricing system for a whole city centre (British study).

- An example of pedestrian navigation is the Swedish e-Adept (Electronic Assistance for Disabled and Elderly Pedestrians and Travellers) system, which is based on a GPS-enabled smartphone (with buttons) and an inertial navigation system connected to an integrated database containing pedestrian, bicycle, and road networks, as well as information about the built environment. Users can receive audio feedback and step-by-step instructions along the pedestrian network (both Swedish studies).
- Real-time information refers to the direct and timely dissemination of transportation information, e.g. up-to-date information regarding disruptions and arrival/departure times (one Swedish study).
- Surveillance generally refers to the use of e.g. video, RFID Radio Frequency Identification cards (e.g. travel cards), mobile phones, etc. to monitor or track the locations and movements of individuals and objects over time. In the one Swedish study, the surveillance scenario focuses on video surveillance.

The Bristol study employed a mixed method approach consisting of a questionnaire followed by focus groups. The first part of the study was based on a primarily quantitative questionnaire (principally using five-point Likert scale) aimed towards testing the hypothesis that older people's attitudes to road pricing differ from those of other age groups. The questionnaire included items covering public attitudes, social norms and pro-social values referring to road pricing and the synergies between them. The questionnaires were distributed by post to 2025 homes randomly chosen from a de-personalised Bristol City Council list and to 275 members of Bristol's Older People's Forum. There were 491 useable post-back responses referring to 184 participants aged 60 and over; 48 of them aged 75 and over; and to 307 individuals younger than 60 years of age. Older people and retirees were intentionally over-represented in the survey to allow the results of age-specific comparisons to be statistically significant. The sample was split into four main age groups for analysis: young younger people (16 to 34), old younger people (35 to 59), young older people (60 to 74) and old older people (75 and over).

A series of focus groups followed to allow an in-depth investigation of some of the reasons behind the age-specific differences and particularly the way in which older people's attitudes could be affected by their particular social norms and pro-social value orientations in comparison with those of younger people. Thirty participants - 19 older people and 11 younger people – took part in three, 90-minute focus groups consisting of 10 people. Two of the groups were intergenerational while the third focus group consisted solely of pre-older (aged 55 to 60) and older people aiming to allow the examination of older people's attitudinal dependence on age-related issues such as retirement, pensions, age-induced mobility/cognitive difficulties and free bus passes. The focus groups employed a scenario-type approach where the participants were introduced to a specific hypothetical road pricing scheme to ensure that the 'attitude object' of the study would be understood in more homogeneous terms.

The two Swedish studies, one with visually impaired persons and one with older persons, were planned as interview and questionnaire studies, respectively. The aim of both studies was to investigate user perceptions of using technology to enhance mobility, including items covering perceived (personal and social) benefits and risks, and impacts on privacy and assurance in various scenarios. In both studies, due to the ordinal nature of the rating questions (five-point Likert scale where scores over 3 are positive unless otherwise indicated), non-parametric statistical tests were employed (α=5%). Where appropriate, post hoc tests were performed with a Bonferroni adjustment to minimize Type I error.

The semi-structured interview study with visually impaired persons consisted of a sample of 23 participants, from 23 to 92 years of age (four 60 to 69 years old and three over age 70) and the technology scenario focused on a tailored pedestrian navigation system. The potential influence of previous experience or exposure to the e-Adept pedestrian navigation system under development in Stockholm was controlled for and was found to have little or no influence on responses (Sochor, 2015). The questionnaire study with older persons consisted of a sample of 252 participants, from 65 to 99 years of age, and the technology scenarios included the aforementioned pedestrian navigation system, as well as real-time information, and video surveillance. As the increasingly older, but healthier population is not homogeneous and can be subdivided (Levin *et al*., 2007; Nikitas, 2010a; 2010b), a hypothesis was tested; namely that respondents 73 years and older (33.7% of the sample), who are less likely to be actively driving (Bauer, 2003) and more likely to have a disability affecting their mobility, would hold more favourable perceptions towards using technology to enhance mobility. Although the older group had a significantly higher rate of disability compared to the younger group (20.5% versus 6.6%, $U = 5779.5$, $p = 0.001$), there were no other statistically significant differences among the socio-demographic characteristics. Furthermore, only one difference was found among the general or scenario-related perceptions for the item regarding one's willingness to ask someone nearby for help when one is lost or needs information, where the older group was significantly less willing (2.81 versus 3.41, $U = 4596.5$, $p = 0.004$). Thus, this study's hypothesis that younger and older groups of older adults would have differing perceptions of using technology to enhance mobility is rejected in the Stockholm case.

4. Results and Discussion

In the British study on road pricing, young older people (60 to 74) held the most negative attitudes of the four age groups towards the acceptability of this technology. This group was also the one most likely to express disagreement (and in particular strong disagreement) with the notion of 'road pricing being a good idea'. Old older people (75 and over), on the other hand, were more likely to be sympathetic and far more likely to be neutrally oriented to this notion than any the other age group. These age-specific differences were statistically significant ($\chi^2 = 39.188$; $df = 12$; $p < 0.01$). It should be noted that in this particular study it was

hypothesised that the answers to a question specifically set to frame the 'perceived goodness' of road pricing would be the strongest and most direct indicator reflecting acceptability of the concept.

The study also examined the respondents' pro-social values and social norms referring to road pricing. Nikitas *et al.* (2011) defines pro-social value orientation as 'the process of favouring what is positively valued by society', while social norms can be described (Horne, 2001) as 'standards based on widely shared beliefs about how individual group members ought to behave in a given situation'. Young older people (60 to 74) were the individuals most likely to *not* recognise the pro-social character of road pricing, while old older people (75 and over) were those most likely to recognise the pro-social character of road pricing. More specifically, young older people (60 to 74) were those least likely to self-declare that they would accept road pricing even if this would be 'helping future generations', 'easing people's journeys', 'improving local transport alternatives' or 'reducing the environmental damage', which were the four specific attitude objects meaning to frame pro-sociality. This was because many of these particular participants did not trust that road pricing could actually benefit society; they thought that it was an excuse for introducing a new tax-collecting mechanism, which would harm their freedom and hurt the least affluent members of society. Still almost half of them, the ones willing to trust the motives behind such an introduction, gave a positive or strongly positive response to these four statements. In contrast, older old people (75 and over) were more likely than any other age group to respond in a positive sense to these four pro-sociality indicators, and significantly more so compared to the young older people: 'helping future generations' ($\chi^2 = 34.174$; df =12; $p < 0.01$), 'easing people's journeys' ($\chi^2 = 28.367$; df =12; $p < 0.01$), 'improving local transport alternatives' ($\chi^2 = 23.402$; df =12; $p < 0.01$) and 'reducing the environmental damage' ($\chi^2 = 20.366$; df =12; $p < 0.05$). Young older people (60 to 74) were also the age group least likely to think that their significant others perceived 'road pricing as a good idea'; 17.4% of them agreed or strongly agreed with the notion. For older old people (75 and over), this share was significantly larger (23.3%) while 46.5% of them were neutrally oriented to the idea that their significant others thought that road pricing is a good idea. These age-specific differences were statistically significant ($\chi^2 = 22.695$; df =12; $p < 0.01$).

Older people in general and especially people aged 75 and over, were more influenced by social norms than younger people were. When asked to assess a rating statement that 'they would accept road pricing if their significant others agreed that this was a good idea', 50.9% of people aged 60 and over disagreed, 16.5% were neutral and 33.7% agreed, while the shares for people aged 59 and below were 57.2%, 20.6% and 22.3% respectively. Particularly, the share of people aged 75 and over that chose the option 'agree' for this item was 44% compared with the second highest respective share (25%) for people aged 60 to 74. These age-specific differences were statistically significant ($\chi^2 = 27.702\ 5$; df =12; $p < 0.01$). Gender differences were not found to be of statistical significance in any of these findings.

The analysis of the focus group outcomes further strengthens the conclusion that pro-social values and social norms have an important role in how older people shape attitudes towards road pricing. Pro-social values seemed to influence young older people primarily in a negative sense since 'pro-sociality' for them was an equity attribute reflecting the monetary barrier introduced by road pricing to people with lower incomes. Old older people were more likely to see 'pro-sociality' as a commitment to what is necessary for providing future generations with a better chance to enjoy a liveable city. Older focus group participants were very likely to be influenced to some degree by social norms (both those associated with family and friends but also those associated with society as a whole), but very unlikely to recognise the influence of others on their decision-making process when evaluating road pricing. Lack of trust about the motives behind road pricing's introduction, its eventual efficiency, ease of use and administration, and about the way that the collected revenue would be spent for the benefit of their local society constituted major drivers of opposition to the idea of road pricing - especially for people aged 60 to 74.

Looking to Sweden, in the studies with visually impaired (VI) and older persons, respondents felt that technology in general benefits individuals and society, and they expressed a personal interest in new technology. Note that the average response ratings for these two questions were consistently higher from the visually impaired group than from the group of older persons (technology beneficial 4.13 versus 3.92, and personal interest in technology 4.17 versus 3.64, respectively). However, this is not necessarily surprising considering the interview results revealed that these visually impaired persons generally looked to technology to facilitate daily activities. During the open response question, VI Respondent 13 commented 'I had not thought about how much one could benefit from technology', while VI Respondent 2 pointed out the potential downside: 'Good technology benefits individuals and society, but bad technology hurts them…It's discrimination if there isn't any technology that disabled people can use.'

The study with visually impaired persons also revealed other types of concerns regarding technology development projects. First, general concern for the continued support for projects targeting vulnerable groups, e.g. 'nothing usually happens with disability-related projects after they are finished. The technology isn't updated' (VI Respondent 2). Second, concern for the nature of the pedestrian navigation project specifically, e.g. questioning if it is the smartest use of resources to develop yet another system and how to maintain stakeholder interests and balance in the ownership of the product. And the third type of concern emphasizes the need for a continued focus on the accessibility of the built environment and improved organisational efficiency. VI Respondent 17 felt that '[public transportation] accessibility has a greater effect than technology', and VI Respondent 18 commented: 'What is needed is faster communication to the responsible parties and faster measures to fix problems'. Additional comments included continued problems with illegal placement of signs on sidewalks and conflicts with bicyclists.

These comments illustrate that technology is not a 'magic bullet', but must be viewed as part of the overall concerted endeavour to enhance mobility together with other technological, physical, organisational, and individual efforts.

Both Swedish respondent groups perceived a personal benefit of a pedestrian navigation system, although the average rating was much higher for visually impaired persons (4.35 versus 3.12). Visually impaired persons in particular felt that the system would greatly increase their independence (4.26) and open responses illustrate how such a navigation system (and technology in general) can benefit users in different ways depending on their level of need. On one hand, VI Participant 15 framed the benefits in terms of facilitation and convenience: 'Visually impaired people who are independent get around anyway'. It's more about being able to save energy, time, or effort by using the navigation system, so that one feels better.' On the other hand, VI Participant 1 described more fundamental benefits, with technology playing a crucial role in the ability to live independently and maintain mental health: 'I'm very positive to technological development. The development goes quickly, but that's good because I need it. Technology helps me and gives me hope to be able to live independently. I would get depressed from being shut away at home. I get depressed at the thought of needing a personal guide in order to be able to go anywhere, or needing to decide when to go out in advance. I want to be able to get around by myself. I'm dependent on my daily walks. I think that technology can help me as long as I have partial vision. I want to be independent and try to live like everyone else.' This illustrates the integrity and mobility enhancing possibilities of technology-based assistance, which will be increasingly important as the population continues to age.

Even though these Swedish user perspectives indicate favourable perceptions of the technologies' impacts on one's sense of assurance (one type of personal benefit), the users were generally consistent in rating the social benefits as higher than the personal benefits. The ratings of assurance were generally higher for video surveillance (than for real-time information or pedestrian navigation) and in situations likely perceived as more vulnerable, such as using the subway and traveling alone or in an unfamiliar setting. But despite this, it was also perceived to have greater social than personal benefit, perhaps due to its targeting the crowd and optimistic bias related to general versus personal risk, where others are deemed to be at greater risk than oneself (Sjöberg, 2000). The greatest perceived personal benefit came from real-time information in public transportation, although it still did not exceed the ratings of social benefit. For the pedestrian navigation system with public transportation information, effects on assurance were generally ranked lower, although the pattern was broken for car and walking modes, perhaps as the individual may have greater control over the route and timing of such trips compared to public transportation trips.

In considering gender differences, results from the Swedish study with older persons indicate that female respondents used public transportation more (and had less access to a car), but felt

relatively less assured when traveling. They also rated the technological applications' effects on their assurance more highly than men, particularly in the case of video surveillance and real-time information, which are both used extensively in public transportation and targeted to all travellers. Male and female respondents perceived similar ratings of general benefit of technology for society; however, men expressed a greater personal interest in new technology. Men also perceived higher personal benefit of navigation (a technology targeted for individual use) and, on average, were interested in purchasing it (see Sochor, 2014 for the tables of statistics). Although one might think that the female respondents could more greatly benefit from such a personal system, given that they rated feeling relatively more assured when in possession of detailed directions, expressed a greater willingness to ask for help, travelled alone more often, etc., they were not, on average, interested in purchase. This calls into question the possibilities of effectively addressing user needs or concerns, particularly via technologies intended for individual use, if those who potentially serve to gain more by them are not being reached or are not as interested in such 'solutions'.

Regarding the explored technologies' impacts on privacy and assurance, the respondents in both Swedish studies generally perceived the technologies as relatively beneficial and felt more reassured due to them. Given that effects on assurance and privacy were often rated as positive and neutral, respectively, the hypothesis of a perceived trade-off between assurance and privacy was not supported. Despite this, ratings for perceived trust for the actors (data collectors) and risk for data misuse were not particularly favourable in an absolute sense. For example, in interviews, one not uncommon side comment to the question regarding level of trust for data collectors was of the type 'I have to trust them' or 'I hope I can trust them'. Privacy and trust are highly contextual, as illustrated by VI Respondent 9's comment: 'I can feel that a navigation system improves my sense of personal integrity because of increased independence, but that does not mean I am not concerned about a surveillance society', which illustrates the need to engaged in a more nuanced debate about technology, mobility, privacy, and personal integrity, including the differences between perceived individual and societal benefits.

5. Conclusions and recommendations

Despite the fact that over the last two decades we have seen the development of a greater understanding of the concept of 'social exclusion' and of the relationship between exclusion, mobility and accessibility, as Shergold and Parkhurst (2012) suggest, there are still contextual gaps in identifying and understanding how the groups particularly susceptible to exclusionary processes are being challenged by technology. Designing cities able to provide optimum urban access is a prerequisite for any society that means to craft inclusive pathways to prosperity. This paper was set to add a step in the process of developing an understanding of the ways with which technologies can be introduced and adopted by transport users so that their potential is more greatly fulfilled. It does so by discussing how vulnerable populations perceive a number

of mobility mechanisms that were described with the umbrella term of 'transport technologies', based on results from studies in Bristol and Stockholm. Bringing together findings from three different studies referring to two different regions of Europe by revealing synergies and exposing dissimilarities provides this work with significant generalisation merit; more than what a singular local study could ever provide on its own.

The first key conclusion is that mobility-challenged road users, such as older and visually impaired people, are not a homogeneous group in terms of expressing attitudes towards transport technologies. The results presented in this paper confirm what Gilleard and Higgs (2005) and Daatland and Biggs (2006) suggested about older people being a highly diverse group; there are different ages of growing older, different minority groups, different lifestyles and beliefs, and different attitudes and approaches to and because of old age. This paper is expanding this 'diversity' concept beyond older age suggesting that the extended group the authors defined as 'vulnerable populations' is clearly less cohesive in their perceptions of transport technologies than what they are generally presumed to be. Therefore using much-debated terms as 'older age' or 'disability', as clear indicators of potential acceptance of 'new' technologies is not unproblematic.

Nevertheless, there was one theme that came up consistently in all three studies reflecting the vulnerable populations' attitudes that were set to frame 'pro-sociality' or 'perceived social benefit' (although the authors acknowledge that differences in the measures may somewhat limit the generalisation of this finding). Thus, the second key conclusion that can be drawn is that vulnerable people are very likely to assess transportation technologies based on how they feel these could impact not only themselves but society as a whole. Vulnerable people are also inclined to think that the societal benefits of these measures' introduction usually outweigh their personal ones. As a result, different strategies may be useful when developing and introducing different types of transport technologies. For example, for 'non-optional' transport technologies that one cannot avoid due to accessing the transport system (such as surveillance or road pricing), emphasising aspects of 'social benefit' could have greater impact. On the other hand, for 'optional' transport technologies that the individual must actively choose to use (such as information and navigation services), the emphasis must be placed on making the technologies as relevant as possible for the individual users. If the gap between personal and social benefit is not closed (or at least narrowed), how can user needs or concerns effectively be addressed via technologies if those who potentially serve to gain more by the technologies are not being reached or are not interested in such 'solutions'? One way of increasing technologies' relevance is to take a more user-centred design approach by giving increased attention at each stage of the design process to the special needs, wants, and limitations of the end users of these technologies. Furthermore, one must keep in mind that a more 'pro-social' attitude does not mean lack of concern or criticism. In both Bristol and Stockholm, study participants expressed clear concern for 'bad' technologies, (lack of) trust, and (im)proper use of resources

and revenue. Such concerns need to be acknowledged and addressed in order to better develop and introduce these technologies.

A third conclusion, of which there are several aspects to consider, is that despite its potential, technology is only one tool in the toolbox, and one which brings its own challenges. One aspect is replacing the regime of technology from an instrument-based perspective to a complex socio-technical system perspective in which the human factor is just as or even more important than the instrument per se. Related to this is that these technologies alone cannot improve urban access for vulnerable groups if the built environment, transportation system and authorities, and local economies and policies, continue to present physical accessibility, organisational, economic, or legislative barriers. And a fourth and final aspect is that the various forms of transport technologies discussed here can potentially lead to increased independence and autonomy, or to further exclusion and powerlessness. As such, it is important for technology developers and policy makers to remember that so-called smart technology, although exciting and certainly offering opportunities for many, does not automatically imply ethically sound technology, for example, technology that is universally accessible, affordable, or integrity enhancing.

As a concluding remark, the authors submit that accessibility, privacy/integrity, and user perspectives in general should be addressed more closely in the technological design and development processes associated with the delivery of technologies. If the different and more specialised needs of diverse vulnerable groups, who are already underrepresented in the development process, are not attended, the result can mean new layers of vulnerability and exclusion. Although government initiatives and the legal system are certainly important tools in promoting urban access, they tend to be reactive and lie off the pace of technological development. As such, these studies serve to remind us that a continual and coordinated effort on multiple fronts is vital in addressing users' needs and meeting broader social goals of mobility and urban access.

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