The case of Mobility as a Service: how the challenges of shared mobility shape its adoption by women

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This paper explores issues of inclusiveness and safety that women encounter when using Mobility as a Service (MaaS), a transport offering which enables users to book, manage and pay diverse modes of transport through smartphone apps. Personal mobility modes may include public transport, car, bicycle sharing, automated vehicles and more. The adoption of MaaS by women may contribute to decarbonisation of personal mobility and yet it suffers from implementation gap. The study draws on *Practice Theory (PT)*, a theory which focused on social practices and *Consumer Culture Theory (CCT),* which focused on the interaction between consumers' identities and their behaviour.

Despite benefits, participants associate using MaaS with meanings of unsafety and apps with intrusiveness. Women seem disadvantaged compared to men when using MaaS. Suggested solutions include rigorous vetting of service personnel and whenever possible, recruit female personnel such as drivers. On board cameras, recording devices and safety features of apps may help women feel safe. MaaS providers could encourage the formation of communities around MaaS brands. Geography affects MaaS use as coverage of rural areas is poor, whilst women are more likely to use MaaS when on holiday. Changes are needed to the socio-technical landscape, including to social practices and infrastructure and this requires changes in policy, investment and governance.

1 Introduction

This paper explores issues of inclusiveness and safety that women encounter when using Mobility as a Service (MaaS), a "user-centric, intelligent mobility management and distribution system, in which an integrator brings together offerings of multiple mobility service providers, and provides end-users access to them through a digital interface, allowing them to seamlessly plan and pay for mobility" (Kamargianni et al., 2018). In this way, the paper joins the recent debates about mobility diversity and equity (Sopjani, 2021). MaaS offers opportunities to reduce the number of private cars in circulation and therefore the environmental impact of transport (Jittrapirom et al., 2017). This is important, because transport, especially by private cars, represents a considerable proportion of the impact of human activities on the environment (Whittle et al., 2019), even if private cars are powered by electric motors or other low carbon technologies. The lower or zero emissions of such vehicles are offset by the dispersal of brake and tires' rubber particles in the atmosphere and in the water cycle (Fuller, 2016).

Indeed, Government policy in Western countries encourages funding of research in shared mobility such as MaaS (Transport Government Scotland, 2018). Unfortunately, MaaS is meeting implementation challenges beyond small scale demonstrator projects which mostly did not scale up outside a "living lab" (Hensher et al., 2020). Catulli et al. (2021b) suggest that product-service hybrids such as MaaS find it difficult to scale up outside "protected niches", because of unwillingness of providers to take risks and create the necessary supporting networks. The implementation issues of MaaS apply especially to women, therefore approximately 50% of mobility users might resist MaaS adoption.

Women consider personal cars damaging to the environment more than men by a scale of 107% in Sweden (Weinreich et al., 2021). Women are more likely to embrace sustainable consumption than men (Bardhi and Eckhardt, 2012) and to use sustainability criteria to select means of transport (Duchène, 2011). Therefore, women should be more inclined than men to adopt transport offerings which promise environmental benefits, such as MaaS, which would be beneficial to the sustainability of transport. MaaS adoption would also benefit women because often they have less access to private cars than men (Ibid.) and MaaS could offer additional options for their mobility. However, hesitancy to adopt MaaS and poor access to private cars might make of women "transport captives" (Gekoski et al., 2017: ,3). This, for women on low incomes, results in disadvantage when accessing employment, education and healthcare opportunities. Indeed, policy makers encourage research in the inclusivity of transport, see for example europa.eu (2021). From a design perspective, women and excluded groups are not represented in the design process (Sopjani, 2021; Heiskanen et al., 2005), therefore their needs can be overlooked when designing MaaS offerings, so women can actually be "excluded by design" from MaaS (Sopjani, 2021). This paper explores these issues. The point of departure of the research is that women encounter challenges when using public transport and shared mobility, therefore the question the paper addresses is,

> *How do the challenges women encounter when using MaaS shape their adoption of MaaS and other shared mobility offerings?*

The contribution to knowledge is to shed light on how the mobility practices of women might change to incorporate MaaS, map the challenges represented by its inclusivity and implications for its adoption by women and responses by policy makers and MaaS providers. In this, we answer Giorgi et al. (2021)'s call for research in the needs of vulnerable and excluded users and the challenges that MaaS developers, operators and policy makers face.

2 Literature review

Transport offerings can and do exclude individuals and groups with diverse characteristics such as ethnic and socio-economic background, location, age and gender (Giorgi et al., 2021). Women encounter different challenges than men when they go about traveling between locations of work, shopping or leisure, indeed access to mobility is inequitable (Sopjani, 2021). For example, in most countries, fewer women than men have access to cars (Duchène, 2011) and use public transport more than men (Weinreich et al., 2021). MaaS could be an alternative but presents women with challenges of its own.

In some western countries, usage of MaaS offerings is 40% vs 49% for men but women's share of use of elements of MaaS are of 29% for car sharing and 15% for e-scooters versus 71% and 69% respectively for men (Weinreich et al., 2021). Reasons for this include women's carrying loads such as shopping in sequential shorter trips (Ibid.), for example from shopping venues to the gym, children and healthcare. Women on lower incomes might not access MaaS, because they may not own smartphones (Choudrie et al., 2018) or may not be capable to use MaaS smartphone apps (Durand et al., 2018).

Safety is one of four key priorities underpinning transport decisions, the others being convenience, cost and comfort (Bizgan et al., 2020). However, women are more concerned than men about personal safety when using public and shared transport (Weinreich et al., 2021; Matyas, 2020). Whilst for men safety from aggression is a secondary consideration, for women is a key concern and they would exclude MaaS from their choice if the issue were not addressed (Ibid.). When associated with bicycles, this includes risk of accidents as well as aggression. This is a real barrier to adoption of MaaS by women (McDonald, 2020). Adoption is defined as an individual process detailing the series of stages one undergoes from first hearing about a product to finally adopting it (Rogers, 1995).

Furthermore, literature on shared mobility suggests additional effects that can affect adoption of MaaS by women, such as fear of contagion, where women might be discouraged more than men (Hensher, 2020; Weinreich et al., 2021), not only by risks of infection from disease (e.g. covid-19), but even traces of previous users of a vehicle (Bardhi and Eckhardt, 2012) and concern that vehicles might not be available when needed (Firnkorn and Müller, 2012).

2.1 Unsafe aspects of travel

Switching between vehicles, from a means of transport such as a shared car to another such as a train service, is risky, particularly at night (Weinreich et al., 2021). Time of traveling is a challenge, women may feel isolated, such as when being in an empty bus of even when a vehicle is too crowded (Ibid.), especially recently because of covid (Hensher, 2020). When car sharing, women may feel unsafe if traveling with strangers (Weinreich et al., 2021; Bizgan et al., 2020), in particular with ride sharing, where direct threats from strangers are complicated by concerns about their driving skills and behaviour (Bizgan et al., 2020). Women, disproportionately from men, transport children and accompany people who need assistance, which is not accommodated by the design of transport routes (Ibid.), which makes travel more difficult for women.

Different modes of transport are perceived as more or less safe. For example, taxis are perceived as safer, because of the presence of a licensed driver (Bizgan et al., 2020). To generate trust in MaaS, trained human service staff has a significant role, as it can reassure users (Giorgi et al., 2021). In turn, bicycles are perceived as safe as women can just "pedal away" in case of unwanted attention by other users (Weinreich et al., 2021), although there is risk of being ran over by other vehicles (Ibid.). In contrast, women perceive busses and trains (Ibid.) and car and ride sharing as more concerning, because they could involve sharing rides with people they do not know (Bizgan et al., 2020). On public services such as trains, women feel 'stuck' with whoever enters the train.

People who never used MaaS have different attitudes to it than those who have, who have far less concerns than the former (Ibid.). However, real incidents do happen. When on public transport or using shared mobility, women may incur actual harassment and aggression in far greater measure than men (Weinreich et al., 2021), for example in overcrowded buses and minibuses (Duchène, 2011). in the UK, 37% of women reported having experienced specific incidents when using public transport (McDonald, 2020) and 15% reported sexual harassment from men when using shared transport (Gekoski et al., 2017).

These issues shape the transport practices women perform. Women have a range of strategies to deal with safety concerns, from avoiding perceived risky areas (Duchène, 2011) and not staying out late, to wearing shoes they can run with and carrying their keys in between their fingers in their pocket as a potential weapon (Weinreich et al., 2021). Women are reported not to carry cash, cards or other valuables with them as most purchases can be made with a mobile phone (Ibid.). Women may ask their friends to track them via apps or share their location, especially in the evening, they refrain from listening to music and try to sit close to other women (Ibid.) and the driver in a bus (Ibid.).

2.2   The role of geography

Criado Perez (2019) asserts that transport routes are designed to be less inclusive of women, who have dissimilar needs from men because of multi-stop journeys as mentioned earlier. MaaS may help overcome those limitations, but women may be more drawn to private cars than to MaaS. Safety issues are relevant to all countries and locations but with significant differences, for example when comparing India with EU countries (Weinreich et al., 2021). Women are concerned by specific locations perceived as unsafe (Duchène, 2011), "space" in Giorgi et al. (2021:267)'s terminology, including isolated, neglected areas (Ibid.) and lack of policing and company staff that could protect them, especially on public transport (Bizgan et al., 2020). Rural areas are difficult to service by MaaS offerings because they offer fewer transport options and women would be feel isolated (Kubitz, 2020). Places without access to broadband internet, such as rural areas, affect the relationship of every type of user with MaaS, however women are more concerned about being stranded in isolated areas without connection to book services (Giorgi et al., 2021). Mobility apps may fail to match real geography (Ibid.), for example a service seen as available on an app may not actually be available, or roads might not even be reported on electronic maps (Ibid.). Finally, in some countries it is the" social" aspect of the socio-technical landscape which is exclusive, such as cultural barriers and a hostile atmosphere in Arab countries. In summary, because of the risks of using MaaS and public transport women prefer private cars as they consider them safer (Weinreich et al., 2021; Duchène, 2011) and comfortable "cocoons" (Pudāne et al., 2019: 17) compared with shared mobility.

3   Perspectives and methods

The study draws on the perspective of *Practice Theory (PT)*, a cultural theory (Reckwitz, 2002) in which social practices form the main unit of analysis (Shove et al., 2012). A practice is *"a routinized type of behaviour which consists of several elements, interconnected to one another: forms of bodily and mental activities, "things" and their use, a background knowledge in the form of understanding, know how, states of emotions and emotional knowledge"* (Reckwitz, 2002). Shove et al. (2012) simplified the constituent elements of practices as:

- *Materials*, the things people use when performing their practices, e.g., vehicles and smartphones when using MaaS. This category includes elements that are virtual but are used instrumentally to perform MaaS mobility, e.g., smartphone software apps.
- *Competences*, the performative skills people need to perform practices, in the case of MaaS these are ability to use apps, riding bicycles and even institutionalized competences guaranteed by driving licences.

- *Meanings*, associations users make between a practice or its components with values and feelings, and the social conventions shaping users' practices.

Practices are the result of the integration of these elements by practitioners and are connected and dependent on each other. For example, work practices are linked to mobility practices as people need to travel to work. In turn, mobility practices are linked to other practices such as shopping or traveling to leisure places (Watson, 2012). Indeed, practices are interconnected in practice constellations (Schatzki, 2003). This interconnection of practices makes practices obdurate and resistant to change. PT was selected for the analysis because it enables researchers to study the daily routines human subjects, including users and providers of MaaS, perform in their lives (Shove et al., 2012), including traveling through MaaS. This enables understanding of challenges people encounter when using MaaS and how these challenges shape users' practices.

Whilst PT is a suitable perspective, understanding of the interplay of consumer identities with their mobility practices is needed, to explain also how and why travel practices performed by women differ from those performed by men. To do this, the research partly draws on *Consumer Culture Theory (CCT),* a multidisciplinary approach founded in anthropological research (Douglas and Isherwood, 1996), which studies the dynamic relationships between consumer actions, the marketplace, experiential aspects of consumption and cultural meanings (Arnould and Thompson, 2005:868). CCT offers insights into how women's identities shape their use of MaaS (cf. Joy and Li, 2012). PT and CCT are distinct but comparable cultural theories, which this research draws on as separate lenses to respect their diversity (Stirling, 2011) to investigate how users' identities shape their use of MaaS offerings.

Informed by the theoretical frameworks of PT and CCT, the research team conducted 24 qualitative interviews of female users of mobility offerings and five men for comparison, adding up to 29. Participants were selected by convenience sampling amongst students and staff at a university and recruited through an advertisement on the university *Managed Learning Environment*. Several participants were recruited amongst parents of members of a scout club. Participants from both groups were encouraged to introduce additional participants to complement the sample with a snowball sampling strategy. The interviews were conducted on MS Teams and videorecorded. Recordings were then transcribed by a professional transcription agency, the analysts watched the video recordings whilst coding the transcriptions in NVivo, a qualitative analysis software package (Silver and Levins, 2014), using a flexible template approach (Miles and Huberman, 1994) to integrate existing themes identified through literature search with novel themes emerging from the analysis.

4   Findings

4.1   Introduction

When conducting the initial pilot of the interview guide (IG), little awareness of MaaS was observed as could be expected from the limited diffusion of MaaS explained in section 1. The research team modified the IG to use proxies of MaaS, such as *Citymapper*, *Google Maps* and transport modes such as car clubs, *Über* services and bicycle sharing offerings. These examples helped researchers and participants to explore the relationship of women with MaaS as reported below.

4.2   Geography and landscapes

Apps help users map the landscape, including stops and direction of travel. Participants narrate that they use apps to see what areas they travel through and whether these are dangerous areas. Deserted, neglected areas are not reassuring. Participants state that apps can help reassure them by enabling knowledge of the provision available and landscape, and the identity or professional details of the drivers of vehicles when these are staffed. On the other hand, apps can be also misleading, because they might be giving users the shortest

route, which would go through a dark alley or a park instead of a well-lit road, so local authorities and providers need to invest in infrastructure. Apps are useful to plan journeys and manage their costs. A participant says, "…e*ven Google Maps now flashes how much an Uber would be, not that I trust the price, (…) I'd always go and double-check, but in terms of usability.*"

Most participants said that they prefer traveling where there are other people. If multiple people are sharing services, they know each other and have common purpose or destination, this helps reassuring users. People rely on other people for safety, as this citation illustrates, "*she goes home after darkness, she usually calls her mom. And so, she's on the call with her mom or at least sometimes she might pretend that (…) she is*." However, crowded vehicles and sharing space with the wrong type of people do not spell safety. Indeed, all participants cited proximity with people affected by physical or mental health, drunkenness, fighting or use of drugs as alarming situations. The ratio of female to male driver is important. If there were more female drivers on shared vehicles, women could decide to share with other females. Participants said that they would feel better being driven around by a woman, as this statement illustrates, "*I'd much prefer a woman driver to pick up my daughters than a man driver."* Another safety feature in a shared vehicle could be a free call service - where users could push an alarm button to put them in touch with professional assistance.

The support of communities with a shared purpose makes the service trustworthy. Examples of these communities are workplaces, e.g., the NHS, schools or other employers. Although this reassurance is not always manageable by MaaS providers, they may still benefit from efforts to aggregate users around communities. When someone has specific problems, e.g., a girl in a wheelchair, people as a community might be protective. Some participants talk about "do it yourself safety" when familiar people (boyfriends, parents) support each other for safety. Providers' apps may help because they enable other people keep track of where their friends are. Car sharing is better shared with friends or people users know. A participant stated that she prefers using shared mobility when she is on holiday rather than in her everyday life.

4.3   Identities

Identities shape practices. The analysis through CCT reveals the interplay between the identity the participants embody as women and their shared mobility practices. The men we interviewed said that they feel confident when travelling. However, men are concerned about family female dependants using MaaS, indeed they feel that they should protect women and avoid alarming women they do not know by keeping their distance.

Participants observe that they may be self-conscious and attract attention to themselves because of complaining, which they say is part of the vulnerability of being a woman. This makes women feel powerless and overwhelmed by men. Women state that they are aware and afraid of crime. Two participants narrate how gender and ethnic identity combined affect them. For example, an Asian woman felt threatened by other travellers, who were hostile because they associated their Asian appearance with the Covid-19 pandemic. Participants stated that as women, they feel threatened by men, e.g., "*… where I felt uncomfortable, it has been a male to make me feel uncomfortable.*"

Liminality - being in a transition in life - shapes practices, e.g., transgender identities, a result of identity transition, exemplify differences between genders. A participant who transitioned to a woman reports how she was "…*always a little worried occasionally walking around at night, but (…), now [that I have transitioned to a woman], it just takes someone who decides that I don't look quite right to (cause) an issue, (…) and so I'm much more careful than I ever used to be"*. Students, who are also going through a change, might be more likely to try novel offerings. A participant claims that "*as a student you're probably more carefree and you just want to save money*" and therefore they may be more likely to try innovations.

4.4 Links between practices

From a PT perspective, women are engaged in constellations of interlinked practices. In comparison with men, women perform more activities, such as shopping, infant caring and looking after older relatives. This includes visits to medical appointments which cannot be missed. Combined with travel to gyms and other exercise classes, these practices make women travel on multiple stop journeys. Women tend to transport more artefacts, e.g., baby car seats, shopping, prams and more, which makes switching vehicles through MaaS problematic, as these citations illustrate, "*the reason why I use my private car is for convenience because it's quicker, because you don't have to carry the bags, you just put everything you need in the car"*. Accompanying children is problematic and limits the ability to use public transport, "...*when you travel in the rush hour, sometimes you'd struggle with a number of children on the train because there will be queues next to the doors." With a private car* "*…I go, drop off the boys at school (…) and I collect them."* With elderly relatives, a private car is preferable because it takes the user door to door. When journeys are urgent, such as to medical appointments, users are more likely to use their private car. MaaS can enable these practices, but participants might not be familiar with it.

Women may modify and vary activities they get involved with during the day based on the availability of shared transport, i.e., whether other people are driving in a certain direction so they can share with them. This availability may shape the user's travel plan. The following sections describe the constituting elements of women shared mobility practices.

4.5 Materials

MaaS elements include a range of vehicles, including private cars, public transport and shared cars, bicycles and scooters. The personal car is still dominant, because participants say they consider it safer, independent, dependable and it delivers door-to-door service. As this statement illustrates *"…there are no other people around you… (…). It takes less time to get to [your] point of destination, you don't have to stand at the bus stop, or the tube stop and wait, and you know, you can just, jump into the car, and go where you need to."*

Shared vehicles might be dirty and therefore discourage people from using them, *"I've seen (that they can) be quite rickety (…), even by the look of them."* Hygiene and cleanliness are key assurance of vehicles. Cameras and other security hardware can be placed in the vehicles and the landscape, for example inside and around trains and docking stations. Participants consider some vehicles, such as taxis, reassuring, because they can be locked, "*nobody can get in*". On the downside, materials can include fake number plates and certificates, which mislead users.

The use of artifacts in women's consumption defines their identities (Richins, 1994) and shapes their practices. The attire women wear shapes their mobility practice. They could wear a business suit but also skirts and high heels. This makes use of scooters and bicycles difficult. Therefore, identity-specific artefacts women use deter them from using MaaS. As shown in section 4.4, prams and car seats that women take with them to transport infants limit their freedom. Helmets make it safe to use bicycles and scooters but of course make travel harder for users because they are incompatible with smart clothes and must carry them.

Women might carry devices to protect them, e.g., "...*they've got rape alarms, as in where they pull the thing out and it's a really high-pitched sound*". Further, specialist apps help, a participant states that she has "*Find my Friend on my phone*". Apps are virtual, but they are manufactured artefacts and therefore "material" women use for their mobility. One participant mentioned a "help app", Angela, a personal alarm device (heresangela.com) which can be used when users feel unsafe. As illustrated, *"…where if you're out (…), you can just ask for Angela."* Users find these devices helpful.

Apps help reassure users through information and feelings of control. Participants claim that Ùber is an app and a taxi service, and it has generally a good reputation. Means such as car clubs and other sharing offerings are perceived as complicated, because of the membership, *"…I just think that car clubs are a lot of faff in my head, I think there's a load of admin that comes with it and a lot of associated cost."*

One participant says that the quality of information accessible through apps is good and yet she needs to buy tickets separately. This clashes with users' practices. With personal cars, users might travel on a whim. In contrast, they may just turn up at a bus stop or a train station and their service is gone. This says what even when information is good, people do not use it. Finally, users think apps cannot replace human service staff.

4.6   Competences

Generally, apps give confidence in traveling as this citation illustrates, "*…can just pull out my phone and get Google Maps up or TfL (Transport for London) to see when the next or the last bus or train (…) is going to take me home*". Participants report how they learnt to use apps to be tracked by friends and track other people, as this citation illustrates, "*Danielle's on my app, […] she will follow me, and I'll follow her. (…) she'll say to me "well where are you?" I'll say, "just check on the app""*.
However, smartphone apps required by MaaS can overwhelm users and induce apps fatigue, as they suffer from "overapp". MaaS apps need to interface with bank details, and this can cause glitches. As the citation illustrates, "*…there was a situation where It would connect to the app, but for some reason my bank details wouldn't go through and (…), I could (…) get on the train and potentially get fined for not having a ticket."* Apps are downloaded in smartphones, which can run out of charge and women said they had "battery charge anxiety."

The cumulative work to learn the skills required to manage mobility apps is challenging as this citation illustrates, *"…how many apps have I got? I got to download another app. So, you tend to kind of go back to the apps you've already got and then make it work rather than (download another app…)",* they would worry about *"how big it will be and how much more new registration information (you need) to put in there (…) to make it work."* It is difficult to manage all the available (and possibly competing) apps. The entry of additional personal information in various databases is a deterrent because of privacy and long-term commitment concerns.

Complexity is a deterrent, "*The only thing that would put me off is if, it was too complicated, (…) a mishmash of train booking and scheduling, club cars*" and other, a sequential booking of different modes. Participants say that they would be deterred by the need to plan their journey. Using apps, for example to book a bicycle, takes precious attention away from surroundings and jeopardizes safety. Users may even be distracted by reading a book or listening to music. They also say that booking through apps would box them on a specific travel mode, therefore they prefer paying in person. Some participants claim that they would rather walk.

Women narrate that they need to rely on their "street smart" skills to be safe. This suggests that they see a gap in the provider's provision of safety. They say that they make themselves visible, to make it difficult for would be harassers to isolate them. They deploy their own landscape knowledge, such as where the most isolated stations are. They avoid traveling when dark and therefore at night. Many participants also report "self-made" self-defence practices such as carrying bunches of keys in their hand and wedge keys between their knuckles as weapons.

4.7   Meanings

Participants somewhat associated shared mobility managed via apps with environmental protection. In this respect, the perception of the concept of MaaS is positive. However, sharing with other people is a two-way street. If these people are strangers, then lack of *trust* is a constraint. Users can be wary that other people may share information on them. Similarly, a

busy area - such as London - might come across as safe but also as risky as public transport is crowded.

Apps are associated with *safety* by most participants, "…*you know that the app will at least give you a route or a way to kind of I(…) get home and as a woman that's (…) comforting, it gives you a sense of freedom to go out as much and as long as you want (…) without […] worry about, oh God, (…) I have no idea how I'm going to get home*". Participants also associate cameras with safety; however, they associate darkness, night travel and deserted, isolated locations with meanings of *danger* and *unsafety*. Most participants cited connections between modes, such as switching from a train to a bicycle as the least safe legs of their journey.

Women's travel practices are shaped by the *social convention* that women face more risks than men. Participants claim that women are somewhat "socialized to be afraid," concerned about safety and to see transport as a possible danger, and this can be a defining feature of women's identities. As this citation illustrates, "…*every woman I know has this, and it might just be ingrained in us from young ages, which I didn't get, (…), but I'm getting it from my friends now.*" Media communications contribute to diffuse these meanings. Participants all cited the Sarah Everard case, where a woman was kidnapped and killed by a police officer whilst she was traveling between locations (Topping, 2022). One participant states that most people traveling are fine and have no problems, but the news "...*only report the bad things (…), 99.9% of people traveling are fine, you just hear about (…) the really bad things so that (…) stays on my mind.*"

A male participant, who is father to two young women, claimed that he too could see how women could feel threatened when walking alone near a male. Women may consider any connection between transport modes which involves walking or standing isolated where males are in sight unsafe. Men therefore should change their traveling practices to give women space. Users explain that some of the services such as bicycle share are associated with getting "*sweaty*" and require equipment such as helmets - which makes it harder to switch between modes. Users also claim that MaaS requires *extra work* to become a member.

Use of specific types of materials, such as vehicles and smartphones, is associated with a user's *social position.* For example, a participant explains that in her country, use of busses is associated with *lower social groups*. Therefore, when using MaaS, some users would feel less likely to book a bus than a share car. Apps and the supporting smartphones occasionally project meanings of *intrusiveness* and create concerns for privacy, *"I do have a massive suspicion about (…) some of the smaller (MaaS) startups. (…). What are they using the data for? (…) I (…) quite often (…) turn them off completely (…) make sure that they're not (…) tracking me when I'm not using the app.*"

4.8 Summary

The identities of women shape their mobility practices, and the practices constellations and geographies they are immerse in shape their ability and feelings of safety when using MaaS. Apps are virtual, but they are part of the "materials" women use to navigate the landscape. Apps empower female users by enabling them to track and to be tracked by associates, check where vehicles are and how crowded they are, and access other key information that makes them feel safe. Women can manage less means of transport through apps than men. Although apps are useful, they challenge users to learn to plan and create app fatigue. Despite benefits, participants associate using shared mobility with meanings of unsafety and apps with intrusiveness.

Table 1 Summary of safety concerns

• Battery anxiety • Suitable attire needed

- ICT (e.g., cameras) and human (e.g., transport officers and police) vigilance
- Too many people / wrong people / not enough people
- Risks from criminal activity
- Having to rely on other people
- Privacy concerns
- Hard work and planning are a necessity of MaaS

5   Discussion

The point of departure of the research was that the challenges women encounter when using shared mobility shape their practices. One insight of the research is that users are not aware of MaaS in the real world, but they do use a range of smartphone apps to navigate the landscape. Findings show that women do encounter challenges when using MaaS offerings and this shapes their mobility practices. The institutionalized roles of women, such as child rearing and homemaking (Weinreich et al., 2021) limit their freedom to switch between modes of transport when using MaaS. Geographies shape perception of safety of MaaS, as Kubitz (2020) explains how problematic delivering service in rural areas.

Social changes may mean that differences in mobility practices between women and men will reduce, however this change may affect a minority of women. One crucial insight informed by PT is that social conventions around the danger of traveling shape women's travel practices. This suggests that women may overestimate the risks of using MaaS but the facts on the ground, e.g., the Sarah Everard and similar cases, suggest that this social convention is rooted. These conventions are not specific only to MaaS. They are challenges that, from a CCT perspective, affect and constrain the identifies and practices of women in all facets of life. As Criado Perez (2019) reports, women are banned from some spaces, denied their own spaces, and held responsible for their own safety. These challenges need to be addressed on a social level.

In the specific of MaaS, it is alarming that women perceive a lack of safety provision in shared mobility offerings, as exemplified by the adoption of "self-made" safety measures such as being prepared to use keys as a weapon. The fact that these concerns (and perhaps resignation) are ingrained in social conventions is deeply troubling. One strategy to enhance safety may be to enable women to share mobility spaces with other women, although exclusion of user groups from travel on certain services may even be illegal as discriminatory (Dindar and Parkinson). From the PT perspective, technological and management responses such security innovations and staff training must be complemented by radical change in social practices (Shove and Walker, 2010), which need to be "shaped" by governance (Giddens, 1984; Geels, 2012).

Women that tried MaaS are more confident and enabling people to try new practice facilitates recruitment of new practitioners (Watson, 2012). Tourism can help women to adopt MaaS as they are more likely to try it when on holiday (Chen et al., 2023) and then adopt it at home. The usefulness of supporting communities to anchor shared mobility confirms research by Catulli et al. (2021a) and Bardhi and Eckhardt (2012) and suggests that MaaS providers could contribute to fostering communities around their services and perhaps even attempt to establish *brand communities* linked to their offerings (cf. Catulli et al., 2021a). A brand community is a "*specialised, non-geographically bound community, based on a structured set of social relationships among admirers of a brand*" (Muniz and O'Guinn, 2001: 412), such as those aggregated around Harley Davidson motorcycles (Schouten and McAlexander, 1995), Alfa Romeo (Cova, 2012) and Hummer vehicles (Schulz, 2006). However, reassurance is not enough to improve the inclusivity of MaaS, practical changes are necessary to enhance its safety and inclusiveness.

6 Conclusions

MaaS challenges to women indeed shape practices so that they are not fully compatible with its adoption. Suggested solutions include rigorous vetting of any people who participate in service delivery and whenever possible, recruit female personnel such as drivers. The reassuring effect of the licensed status of the service staff suggests that an important intervention would be a quality certificate or other information vouching for the trustworthiness of the driver or other service staff, underpinned by control and enforcement by the provider. Suggested reassurance includes safety staff and technology devices such as alarm and recording but this has the potential to be intrusive.

MaaS providers could encourage the formation of brand communities around MaaS brands, perhaps with women chapters to reassure women with fostered familiarity. It is evident, however, that significant changes are needed to the socio-technical landscape including practices and infrastructure and this requires considerable investment and governance. The tourism specific market for MaaS may help spearhead the adoption by women.

Investigation is needed into what MaaS providers are doing now to assure safety and what actions they could consider when presented the findings of this research. Further research is needed in the relationship of MaaS with other disadvantaged groups, including ethnic and gender minorities. One suggestion is that this research could draw on the theory of governance of just transitions.

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