



# Mobility as a service and sustainable travel behaviour: A thematic analysis study

Elena Alyavina, Alexandros Nikitas\*, Eric Tchouamou Njoya

Department of Logistics, Marketing, Hospitality and Analytics, Huddersfield Business School, University of Huddersfield, HD1 3DH Huddersfield, UK

## ARTICLE INFO

### Article history:

Received 10 February 2020

Received in revised form 2 July 2020

Accepted 5 July 2020

Available online 29 July 2020

### Keywords:

Mobility as a Service

Travel behaviour

Sustainable mobility

Qualitative study

Thematic analysis

## ABSTRACT

Mobility as a Service (MaaS) is a novel brand of transport that promises to replace private cars with multimodal personalised mobility packages enabled by a digital platform capable of integrating travel planning, booking and ticketing, and real-time information services. It is an intervention that through its digitisation, connectivity, information and sharing merits intends to inspire and support the transition to a more sustainable mobility paradigm. Recent research suggests, however, that the potential uptake of MaaS might not be overwhelming; current car drivers could face considerable difficulties in bypassing their personal car for it and, more worryingly, future MaaS users may substitute not only personal car trips but also public transport journeys with car-sharing and ride-sharing services. This means that MaaS might not be able to create travel behaviour change, and even if it does, the changes may not be always towards the right direction. Through conducting 40 semi-structured interviews in three different UK cities, namely London, Birmingham and Huddersfield, and employing a robust Thematic Analysis approach, this study explores the factors underpinning the uptake and potential success of MaaS as a sustainable travel mechanism. The challenges and opportunities reflecting and affecting potential for responsible MaaS usage refer to five core themes Car Dependence; Trust; Human Element Externalities; Value; and Cost, each of them with distinctive and diverse dimensions. Policy-makers and mobility providers should realise that MaaS success relies on changing people's attitudes to private cars (something very challenging) and thus they should incentivise responsible MaaS use, promote public transport as its backbone, use public engagement exercises and trials to expose people to the concept and somewhat demonise private car ownership and car use.

© 2020 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

A car-centric transport paradigm has been the foundation of urban growth on a worldwide scale for decades now, which, despite its 'user convenience' merits, has been associated with severely adverse effects on the grounds of social, environmental and economic sustainability (Nikitas, 2018). Hence, planning bodies are embracing innovative ways for enabling people to travel more responsibly. Mobility as a Service (MaaS) is a novel concept that could facilitate a shift in individuals' travel behaviour away from private car dependence. According to the MaaS paradigm, privately owned vehicles will be replaced by personalised multimodal mobility service packages on a contract or 'pay-as-you-go' basis (Kamargianni & Matyas, 2017;

\* Corresponding author.

E-mail address: [a.nikitas@hud.ac.uk](mailto:a.nikitas@hud.ac.uk) (A. Nikitas).

Nikitas, Kougias, Alyavina, & Njoya Tchouamou, 2017). MaaS is predicted to contribute to sustainability by increased sharing of mobility resources, reducing the number of vehicles needed as well as simplifying multimodality through integration (Strömberg, Karlsson, & Sochor, 2018). MaaS allows access to transport services (which themselves could be new) via mobile apps and represents a window of opportunity to establish the age of sharing economies in transport (Bardhi & Eckhardt, 2012). To enhance the reaches of public transport, MaaS relies on shared use alternatives to private car, such as taxi, car-sharing, ride-sharing, ride-hailing and bike-sharing (Jittrapirom et al., 2017). Recent research suggests, however, that the potential uptake of MaaS might not be overwhelming (Ho, Hensher, Mulley, & Wong, 2018); current car drivers could face considerable difficulties in bypassing their attachment to personal car (Storme, De Vos, De Paepe, & Witlox, 2020), and future MaaS users may substitute not only personal car trips but also public transport journeys with car-sharing and ride-sharing services (Hensher, 2017) – a phenomenon called “Uberisation” of MaaS. This means that MaaS penetration, contrary to expectations, may lead in numerous cases to unsustainable travel practices among its users and to limited results in terms of modal shift and car ownership reduction. At present, there is a scarcity of research trying to understand the drivers of the observed behavioural (or in most cases intentional behavioural) patterns with MaaS. Therefore, this study makes its purpose to:

- (1) Explore the factors underpinning the potential uptake of MaaS and its pathway for being established as a mainstream travel mechanism;
- (2) Identify challenges and opportunities in creating genuinely sustainable travel behaviour with MaaS.

The next section of this study provides a more detailed background justifying the need for this study. This is followed by a detailed description of the methodology used. Then, this study's key findings are presented. Finally, the paper provides a discussion section that integrates the key messages of this study and initial policy recommendations that would be necessary for those with the task to build effective and widely acceptable MaaS schemes that create more sustainable and liveable futures.

## 2. Literature review

This section aims to provide a background for the primary findings of this study. Relevant points from an emerging, yet underdeveloped, literature are identified and synthesised to support the study's primary research contributions.

### 2.1. Introducing MaaS trends

Mobility as a Service (MaaS) is a concept still in its infancy that aims to integrate multimodal transportation options into a single on-demand mobility service accessible via a single digital interface. Propelled by global trends such as digitalisation and servitisation, MaaS has rapidly grown in popularity and hype but, due to its novelty, large-scale scope, unprecedented coordination and collaboration needs and disruptive nature, represents a challenging transition (Smith, Sochor, & Karlsson, 2019). MaaS is a natural fit with a lifestyle emerging among younger generations, who nowadays drive less, are more enthused about the latest technological products and alternative forms of mobility and are less likely to learn to drive or own a car (Lyons, Hammond, & Mackay, 2020; Mulley, 2017). Wireless connectivity, technology savviness but also, as Lee, Circella, Mokhtarian, and Guhathakurta (2019) suggested, the impact of the economic crisis and fundamentally different travel preferences from those of older birth cohorts led the younger traveller to open up to digitally enabled multimodal mobility. Yet, those transport services are unimodal in their nature, and create barriers to older users and others discouraged by the complexities (and uncertainties) associated with such procedures (Kamargianni, Li, Matyas, & Schäfer, 2016), and to those still resistant to abandon the era of the privately owned vehicle (Nikitas, Njoya, & Dani, 2019).

### 2.2. MaaS uptake

One of the most prominent examples of operational MaaS platforms is Whim, developed by Finnish start-up MaaS Global and introduced in Helsinki in 2016. The Whim user can combine, plan, and pay, both in pay-as-you-go or monthly subscription forms, for public transport, taxi, car rental, car-sharing and city bike trips. By July 2018, operational for over two years, Whim had been used by around 45,000 Helsinki residents, which accounts for only 7% of the city's population (House of Commons Transport Committee, 2018). Put against Uber alone, Whim appears to be falling behind. Whim is now up and running in West Midlands, UK, and despite being piloted twice since August 2017, the latest launch of the app received just around 500 downloads (House of Commons Transport Committee, 2018).

Ho et al. (2018, 2020) studied the potential uptake and willingness to pay for MaaS among 252 transport users in Sydney, Australia and 290 transport users in Tyneside, UK. The participants, who were first introduced to MaaS by viewing a video explaining the concept, were then to make a distinction between the proposed mobility packages, evolving around their demographics, personal circumstances and travel patterns, pay-as-you-go option, or no subscription. Interestingly, as many as 53% of participants in Sydney and 55% of participants in Tyneside chose not to subscribe to MaaS even on a hypothetical level.

Fioreze, de Gruijter, and Geurs (2019) looked at the willingness to use MaaS in the city of 's-Hertogenbosch, Netherlands. A survey, which introduced a concept of MaaS through MaaS app screenshots and asked a series of questions focusing on attitudes towards different transport modes and the intention to use MaaS, was completed by 568 residents of Paleiskwartier, a district of 's-Hertogenbosch. The findings indicated that only 20% of participants were, to some degree, willing to use MaaS be it available to them. As many as 60% of respondents had no interest in using MaaS, while another 20% remained neutral towards the concept. Another study (Caiati, Rasouli, & Timmermans, 2020), conducted in Netherlands, explored, through the use of a panel survey, the willingness to subscribe to MaaS among 1078 residents of Amsterdam and Eindhoven. The study revealed that only in 17% of all choices the participants demonstrated an interest in the MaaS subscription.

### 2.3. MaaS and travel behaviour

The industry and academia both express excitement about the MaaS approach, due to its promise in facilitating sustainable travel behaviour (Matyas & Kamargianni, 2019). Inappropriate consumption of MaaS and the integrated car- and ride-sharing services, can, however, aggravate transport related sustainability issues. Hensher (2017), for instance, notes that car-sharing services, rather than making car owners switch to sharing, give access to cars to those who are not in possession of one, therefore increasing car agglomeration. Rayle, Daia, Chanc, Cervero, and Shaheen (2016) revealed that many car owners became ride-hailing users simply to avoid the hassle of driving and, otherwise, would drive themselves or take a taxi, while the study by Shaheen, Cohen, and Zohdy (2016) stated that 75% of ride-sharing users were previous public transport riders. Fioreze et al. (2019) argued that the people most likely to use MaaS are not frequent car drivers, but people primarily using public transport; there is, therefore, a risk that by facilitating the use of other modes, such as car-sharing and ride-sharing, MaaS may induce an adverse effect leading road users to give up public transport, and not their cars, in favour of ride-sharing trips as it has been the case for Uber and Lyft in major cities. Any shift from public transport to car-centric solutions however is not in line with what MaaS, in theory at least, is set to achieve, in terms of sustainability gains (Nikitas, Michalakopoulou, Njoya, & Karampatzakis, 2020).

Kamargianni, Matyas, Li, and Muscat (2018) studied the attitudes of 1570 car-owning and non-car-owning Londoners towards car ownership and MaaS, and the potential of MaaS to alter their travel behaviour. The respondents did not show prominent willingness to alter their travel behaviour if equipped with MaaS. Only 33% of car owners agreed MaaS would help them depend on car less. Even when offered unlimited access to car-sharing with MaaS, 61% of the car owners remained reluctant to sell their cars, while 64% of non-car owners would not delay buying a car. As many as 22% of all respondents were willing to substitute public transport trips with taxi when equipped with MaaS. Integrated within MaaS car-sharing was an attractive public transport trips' replacement for another 11% of respondents.

Hartikainen, Pitkänen, Riihelä, Räsänen, Sacs, Sirkiä, and Uteng (2019) looked at the potential commonalities and differences in travel behaviour of an average Helsinki resident against the Whim app user. Whim users appeared to ride public transport 15% more often than an average Helsinki resident. Yet, the Whim user combined taxis with public transport three times more often and used taxi alone 2.1 times more often than a typical Helsinki resident, while also showing an increasing interest in incorporating car rentals into daily trips.

UbiGo was the MaaS web interface piloted to 195 car-owning residents of Gothenburg, Sweden between November 2013 and April 2014. The platform offered its users access to combinations of various transport modes in a form of monthly package, for a subscription fee starting at €135 per month. At the end of the pilot, 64% of all participants used private car less. Abnegating personal car use, though, was the precondition of participation in the UbiGo experiment. The reduction in private car use caused an increase in the use of bus and tram services, local railways and bike-sharing with accordingly 50%, 18% and 23% of participants using the services more often. However, non-private cars faced even greater interest: as many as 57% of participants used car-sharing services more frequently and another 20% of participants reported the increase in the use of taxi (Karlsson, Sochor, & Strömberg, 2016; Sochor et al., 2015, 2016).

Another pilot study (Storme et al., 2020) took place in Ghent, Belgium with 73 car owners using a MaaS application for two and a half months. Study participants were given free access to MaaS packages of value varying between €150 and €350 and were asked to minimise their car use to the largest possible extent, with it being penalised at €0.50/km and deducted from the value of their MaaS package. Despite the strict rules, participants demonstrated rather unsustainable behaviours: a third of all MaaS budget offered to participants was spent on the use of personal cars whilst another third was used to access car-sharing services. Over the study period participants purchased a total of 545 bus and tram tickets and 162 train tickets, which refer roughly to just four public transport trips per participant per month.

### 2.4. Research gaps

While the number of studies on the potential uptake of MaaS and its impacts on travel behaviour is slowly developing, there is little research examining the reasons behind such low rates of MaaS acceptance and shift to public and active transport. Some of the recognised-to-date underpinnings of MaaS acceptance on user level include: added value (Fioreze et al., 2019); car convenience and the associated comfort, ease of planning, and the need to chauffeur dependants (Fioreze et al., 2019; Polydoropoulou, Pagoni, & Tsirimpa, 2018; Storme et al., 2020); perceived usefulness and ease of use of MaaS platform, the hedonic motives, previous experiences, and the motivation to achieve autonomy, competence and relatedness to like-minded people (Schikofsky, Dannewald, & Kowald, 2020); social influences (Caiati et al., 2020); digitalisation in the popula-

tion, reliance on internet and mobile devices, integration, personalisation, compatibility and trust in monetary transactions (Polydoropoulou et al., 2018); and cost (Caiati et al., 2020; Ho et al., 2020; Karlsson et al., 2020). Our study will focus on generating more insights about the expected consequences MaaS may have on the ability to travel more sustainably, exploring the determinants of sustainable MaaS uptake on user level that the existing literature has not yet identified or paid enough attention to, and offer recommendations on how to promote sustainable travel through MaaS.

### 3. Research methodology

#### 3.1. The choice of semi-structured interviews

This study aims to explore the barriers and facilitators of MaaS acceptance and uptake on the user level and to generate insights about the expected consequences MaaS may have on the ability to travel more sustainably, which implies the use of a qualitative approach. Qualitative methods have been scarcely used in the MaaS literature despite the important role these can play in travel behaviour analysis grounds (Matyas, 2020). Individual semi-structured interviews, based on an interview guide but at the same time allowing some flexibility in the questioning approach, were chosen over other qualitative methods as they, although laborious, allow researchers to get rich data (Walle, 2015) and understand the reasons for the decisions individuals make by capturing their attitudes and opinions (Saunders, Lewis, & Thornhill, 2016, p. 394). The interview guide, a data collection instrument designed to improve consistency between different interview sessions, had six parts: introduction; individual demographics; current travel practices and attitudes towards different transport modes; familiarising with MaaS through an infographic; attitudes towards MaaS; and summing up. The interview guide is available in the [Appendix A](#). The interviews were fully recorded and transcribed solely by the authors to ensure accuracy of the insights given by each participant.

#### 3.2. The use of infographic

In order to explain the concept of MaaS to our study participants and aid the interviewing process, a literature-infused infographic ([Fig. 1](#)) was developed adopting key MaaS characteristics as presented in [Jittrapirom et al. \(2017\)](#) and [Mulley \(2017\)](#). Infographics provide an engaging visual display communication tool that offers to researchers the ability to present intense and sophisticated information on a certain subject in a more comprehensible manner ([Dur, 2014](#)). The infographic contains the textual conceptual description of MaaS as well as some graphic MaaS elements, such as a hypothetical app mock-up. Similar methods aiding data elicitation were previously applied in MaaS related research. For example, [Schikofsky et al. \(2020\)](#) used a conceptual description of MaaS to make focus groups participants aware of MaaS and its functionalities. The authors then enhanced conceptual description with MaaS app mock-ups to aid the data collection through a survey. Similarly, [Fioreze et al. \(2019\)](#) used conceptual description and MaaS app mock-ups to explain the concept to their survey participants.

We aimed to be value-neutral in the way we presented MaaS features in our infographic. MaaS as a concept was explained using four conceptual features, each supplied with a brief description in the infographic: consolidated transport offering; all-in-one digital platform; payment options; and effective cooperation. We then also described the MaaS experience as a five-step process of: creating account; planning the journey; booking and paying for travel; accessing transport modes; and resolving on-route issues. During the interview, participants were given an opportunity to ask questions in case something in the infographic appeared ambiguous to them.

#### 3.3. Study locations

This study focuses on three geographical areas in the UK, namely London, Birmingham and Huddersfield (see [Fig. 2](#)). With its population being close to 9 million in 2019 ([ONS, 2019](#)) London is the largest city in the UK. Despite the highly developed transportation system in place and the introduction of congestion charging and Ultra Low Emission zone, London remains the most congested city in the UK with 227 h lost in congestion per capita on annual basis ([INRIX, 2018](#)), and also one of the most car-centric cities with 2.66 million privately owned cars registered to its residents ([Statista, 2020](#)). Birmingham is the second largest British city by population with over a million inhabitants ([ONS, 2019](#)), and the 12th most congested city in the country with 134 h lost in congestion per capita in 2017 ([INRIX, 2018](#)). Birmingham is of particular interest to this study because it currently serves as a pilot ground for Whim app, the most well-known active MaaS scheme. Huddersfield is Kirklees' biggest town in West Yorkshire, with close to 150,000 inhabitants ([Kirklees Council, 2019](#)) and is home to the fourth most congested transport corridor in the UK outside London, the Huddersfield Road ([INRIX, 2018](#)). So, located in the South, the Midlands and the North of England, these geographical locations differ significantly in size and transportation, offering a study cohort that includes a metropolis, a city and a town, all suffering from high levels of congestion, largely influenced by residents' car-centric behaviours. This choice facilitates capturing a diversity of views on MaaS and how these potentially align with key built environment specifics and urban planning considerations.



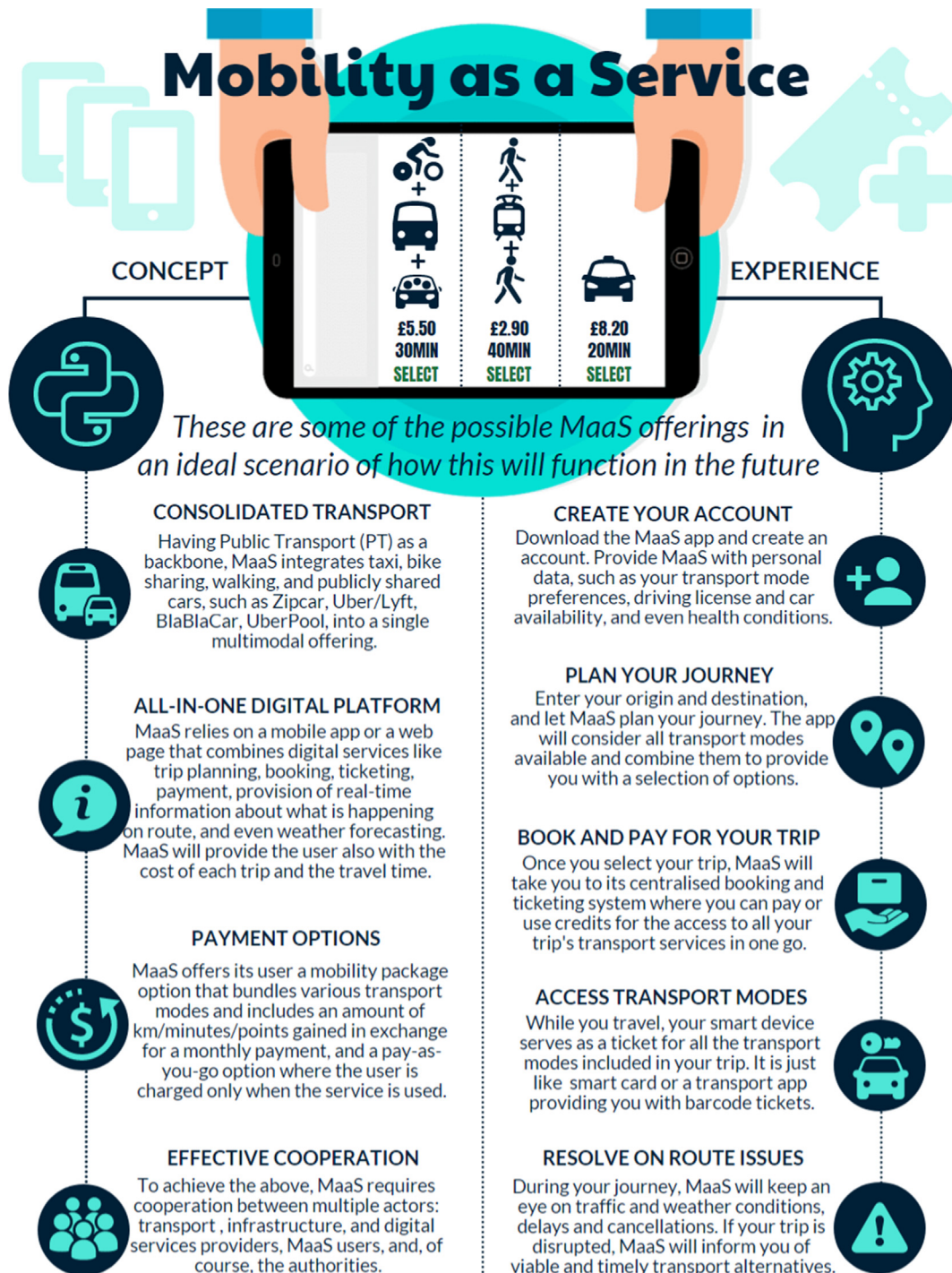


Fig. 1. Infographic explaining MaaS.

### 3.4. Sampling approach and recruitment

Given the explorative nature of this study and, thus, needlessness of statistical inferences about the characteristics of studied population (Saunders et al., 2016, p. 276), non-probability sampling was used. The participants were not incentivised in any way to take part in this study. The prerequisite for participant selection included the residency in one of the chosen study locations and daily travel activity. Achieving a diverse sample in age, gender, family status, educational background,

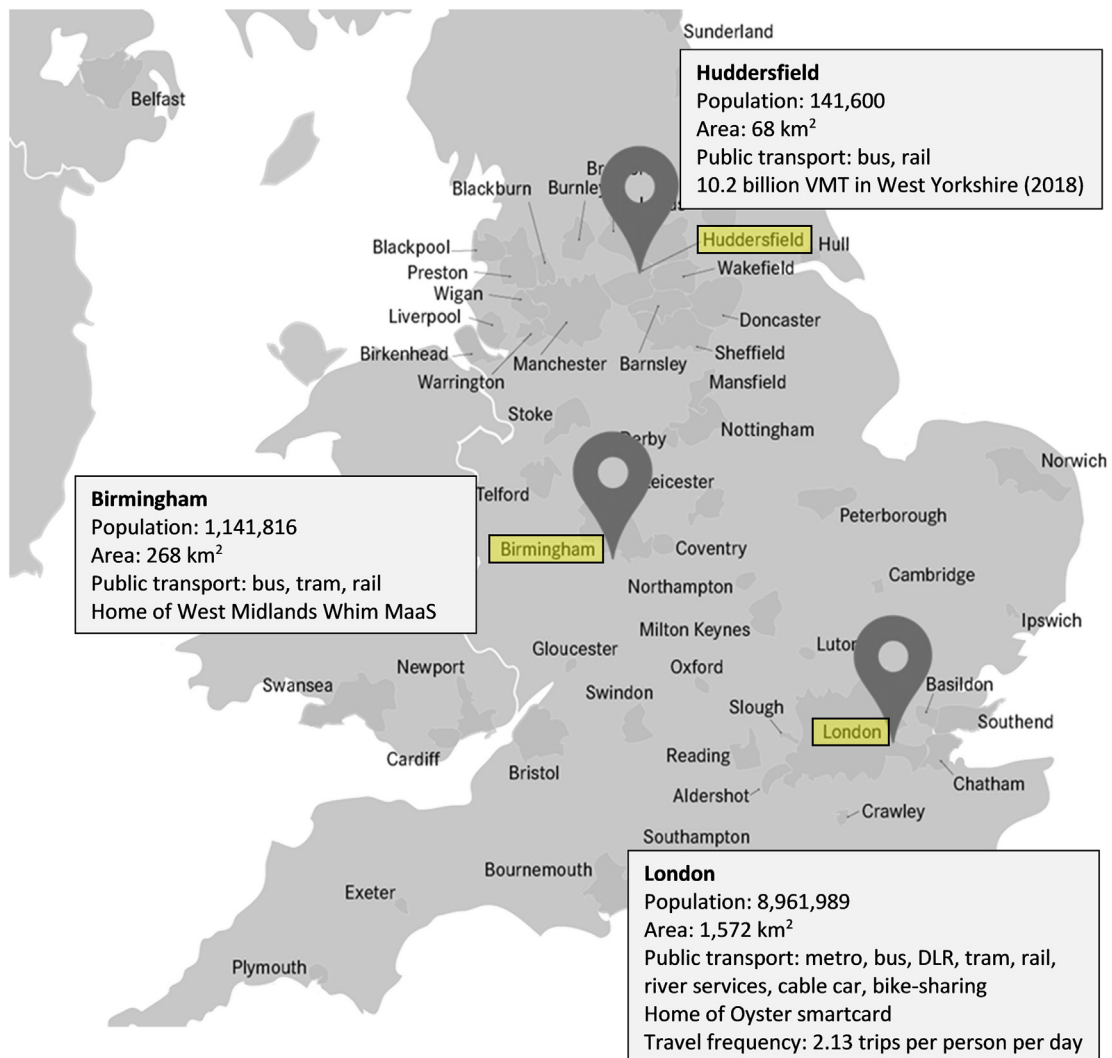


Fig. 2. Study locations.

employment types, levels of income and, obviously, household car ownership was also a consideration. Self-selection technique, where individuals chose to take part in the study on their own accord once the latter was advertised to them via social media platforms and e-mail distribution lists, was used to recruit 21 of the participants. The other 19 participants were recruited through a snowballing technique: the already recruited participants suggested future participants from among their acquaintances. Saunders et al. (2016, p. 297) suggest that the minimum non-probability sample size for semi-structured interviews should be between 5 and 25, which this study has significantly exceeded. It is important to note, though, that it was not the number of participants the interviewing process focused on but rather reaching the point of saturation where the collected data began to provide little, if any, new information. Prior the interview, study participants were contacted via e-mail and were provided with a participant information sheet explaining the nature of the study, a consent form that would allow us to record, store, transcribe and use the interview output solely for academic and research purposes, and the MaaS infographic. In this pre-interview correspondence, our participants were also given an opportunity to select the convenient date and time for the interview as well their preferred means of communication: face-to-face, skype or phone.

Table 1 lists the key characteristics of the participants providing their demographic information, and the presence of car within household. Participant ID consists of the location identifier (L for London, B for Birmingham, and H for Huddersfield) and the associated participant number. Thereby, this qualitative study is based on interviews with 40 road users living in the UK, 14 from London, 12 from Birmingham, and 14 from Huddersfield. The study largely focuses on car-owners, though, non-car-owners also took part for enabling a better identification of possible unsustainable side-effects referring to people that may actually see MaaS as an opportunity to access cars on a more frequent basis.

**Table 1**

Sample characteristics of study participants.

ID	Gender	Age	Marital Status	Children	Driving License	Household Car	Education	Employment Status	Household Income (Monthly Estimate)
L01	Male	28	Single	None	Yes	None	Master's	Employed FT	£3,200
L02	Male	50	Married	2	Yes	1	Bachelor's	Employed FT	£5,500
L03	Male	48	Domestic Partnership	5	Yes	4	Secondary Education	Employed FT	£4,600
L04	Male	35	Domestic Partnership	None	Yes	1	Bachelor's	Employed FT	£6,500
L05	Female	39	Domestic Partnership	1	Yes	2	Master's	Employed FT	£6,500
L06	Female	36	Married	None	No	1	Secondary Education	Employed FT	£4,600
L07	Female	28	Single	None	Yes	None	Master's	Employed FT	£1,800
L08	Male	53	Single	None	Yes	1	Bachelor's	Employed FT	£3,600
L09	Male	31	Domestic Partnership	None	Yes	1	Master's	Employed FT	£3,200
L10	Female	34	Married	None	Yes	2	Secondary Education	Employed FT	£6,500
L11	Male	35	Married	2	Yes	1	Master's	Employed FT	£5,000
L12	Male	48	Married	2	Yes	1	Secondary Education	Employed FT	£5,500
L13	Male	27	Domestic Partnership	None	Yes	None	Master's	Employed FT	£6,500
L14	Male	28	Single	None	Yes	1	Master's	Employed FT	£3,200
B01	Female	27	Domestic Partnership	None	Yes	1	Secondary Education	Employed FT	£1,500
B02	Male	64	Married	2	Yes	1	Secondary Education	Employed FT	£1,300
B03	Male	32	Single	None	Yes	None	Doctorate	Employed PT	£2,000
B04	Male	29	Single	None	Yes	None	Doctorate	Employed FT	£2,300
B05	Male	27	Single	None	Yes	1	Secondary Education	Employed FT	£3,800
B06	Female	24	Single	None	Yes	1	Master's	Employed FT	£2,000
B07	Female	29	Domestic Partnership	None	Yes	1	Bachelor's	Employed FT	£3,400
B08	Male	36	Married	2	Yes	1	Doctorate	Employed FT	£2,600
B09	Male	39	Single	None	Yes	None	Master's	Employed FT	£2,600
B10	Female	34	Married	3	Yes	2	Master's	Student	£5,000
B11	Male	36	Married	3	Yes	1	Bachelor's	Employed FT	£2,600
B12	Male	20	Single	None	Yes	1	Secondary Education	Student	£1,000
H01	Female	26	Married	1	No	1	Master's	Student	£1,900
H02	Female	36	Married	2	No	1	Doctorate	Employed FT	£3,000
H03	Female	51	Married	2	Yes	2	Master's	Employed FT	£3,000
H04	Female	53	Domestic Partnership	None	Yes	2	Doctorate	Employed FT	£3,000
H05	Male	24	Single	None	Yes	1	Secondary Education	Student	£1,000
H06	Male	29	Single	None	Yes	3	Master's	Employed FT	£8,000
H07	Male	56	Single	5	Yes	1	Secondary Education	Student	£1,000
H08	Male	41	Married	1	Yes	1	Master's	Employed PT	£2,000
H09	Male	28	Married	None	Yes	1	Master's	Employed FT	£2,000
H10	Male	25	Married	1	Yes	1	Master's	Employed FT	£1,900
H11	Female	25	Domestic Partnership	None	Yes	1	Bachelor's	Employed PT	£1,000
H12	Male	19	Single	None	Yes	1	Secondary Education	Student	£1,000
H13	Male	24	Domestic Partnership	1	Yes	1	Master's	Student	£1,500
H14	Male	36	Married	2	Yes	1	Doctorate	Employed FT	£3,000

### 3.5. Method of analysis

Inspired by the six-step Thematic Analysis approach proposed by [Braun and Clarke \(2006\)](#) this work adopts the systematic line of work of [Nikitas et al. \(2018, 2019\)](#). Thematic Analysis is a method for identifying, organising, and offering insights into patterns of themes across several items of qualitative data. It provides the mechanics of systematically coding and analysing data and linking it to broader theoretical concepts.

The interviews were conducted, transcribed and analysed by the authors. The analysis procedure included: fully transcribing the interviews; familiarising with written data and identifying codes; searching, reviewing and defining themes; and, ultimately, generating findings. The coding and theme identification processes in this analysis were data-driven to lessen analyst-oriented biases. The identified key themes and their sub-themes were linked to the theoretical literature upon completion of the analysis and not prior. The coding process was performed manually through repeated reading of and making notes on interview transcripts. Therefore, every one of the 40 transcripts were fully coded, with some data extracts, or quotes, falling under more than one code. Next, an Excel spreadsheet was created for organising the codes and matching data extracts, with surrounding data kept in order to maintain the context, into a manageable format for theme identification. The codes, and the related extracts, were then scrutinised, and combined to form overarching themes repeatedly to ensure that the final thematic map thoroughly meets the research aims of the study. It is important to note that the themes were not built by looking for the wealth of textual evidence but, as also approached by Nikitas, Wang, and Knamiller (2019), by identifying structures within the data that have an explanatory capacity. To ensure reliability and avoid bias, the three authors analysed the data independently for the coding stage and then compared and synthesised their independent coding analyses to create a single “bigger-picture” narrative. During the synthesis procedure we reached a 90% consensus on the codes that were eventually the building blocks of our themes; this very high intercoder reliability helped us triangulate and validate our work.

During the theme identification process, it became obvious that, although some extracts belong to the same theme, they interpret different, at times contradicting, theme dimensions. Moreover, as on occasion the extracts matched more than one theme, some of the themes also appear logically interlinked. There were also a few cases where two different sub-themes both discussed a specific agenda from an entirely different angle like, for example, capacity and user behaviour risks, using quotes that might represent two entirely different viewpoints. Braun and Clarke (2006) suggest that the themes and relationships among them do not have to smooth out or ignore but instead retain the tensions and inconsistencies within and across data, which our study has conformed to.

When writing up, the main considerations were to provide “a concise, coherent, logical, non-repetitive and interesting account of the story the data tell” (Braun & Clarke, 2006) and to demonstrate prevalence of the themes by selecting the most characteristic and convincing individual responses (Nikitas et al., 2018; Vaismoradi et al., 2013). Therefore, the findings of this study, presented in the following section, will take a form of a narrative with Themes and sub-themes signposted in bold and bold italics accordingly and followed by raw data extracts which capture the essence of the point demonstrated in the narrative. These selected participant quotes are presented in italics so that they can be easily separated by our analysis commentary. The findings will then be linked to theoretical literature in the Discussion section.

## 4. Findings

There were five core themes that our analysis identified as critical determinants underpinning MaaS acceptance and success: **Car Dependence**; **Trust**; **Human Element Externalities**; **Value**; and **Cost**. Each of them has distinctive dimensions, expressed as their sub-themes, that affect and reflect user intention to commit to sustainable travel with MaaS.

### 4.1. Overview of findings

None of the study participants had previous knowledge about MaaS, yet, the majority had used various travel apps, and therefore, when reading through the speculative infographic, easily comprehended the nature of the concept. Attitudes towards MaaS were largely positive with study participants demonstrating willingness to accept, or at least to consider using MaaS for travel once it is available to them.

*B06: “I think it’s a good idea, and I would use it.”*

*L09: “I like the concept of it, though. I think it’s a good idea.”*

The acceptance and potential application of MaaS, however, came in many different forms, influenced by a variety of factors emerging from car ownership and use, technology intricacies and the nitty-gritty of non-car travel.

### 4.2. Car Dependence

The theme of **Car Dependence** in this analysis reveals the effects of MaaS on participants’ bonds with cars and car related travel decisions. MaaS was viewed for many through the lens of owning a car:

*B05: “I like my car, and it is fun. Would you give up your shoes if you were offered a pair of sandals?”*

*B01: “I think a lot of people get used to the comfort of cars, and it is very difficult to change this. Now that I don’t have a car, I would absolutely use MaaS.”*

Indisputably, MaaS showed the potential to induce **modal shift** considerations. Some participants, after familiarising with possible features that MaaS has to offer, assumed they could cease car use:

*L02: “If MaaS is as good as it says and my personal time isn’t impacted greatly, then it makes sense and I don’t really need a car.”*



L14: "I would consider giving up my car, that's for sure. MaaS could eliminate the need for car."

Others, although accepting the possibility to change the way they travel and to reduce car use, pulled out quasi-sustainable behaviours:

L03: "I would definitely try and use MaaS more. I guess I'd use more taxis and possibly car-sharing. I never used car-sharing before, but I would try that. Ride-sharing maybe not as much!"

L07: "To be honest, if I could use those ZipCars, for example, I would much rather do that than have a car myself."

Some participants took a stance where their decision to own and use a car could not be influenced altogether:

B11: "All things being equal, if my health is okay, and I am not banned from driving, for me MaaS would be a no."

B04: "I and a lot of people would not hold back from buying a car, no matter what alternative is presented."

Yet, while MaaS did not seem to be able to fully substitute car use for every individual, partial substitution was thought of:

B07: "I would be interested in using this as well as having my own car."

H07: "I would probably reduce the amount of times I use my own car."

It was practically unanimous that MaaS could not replicate the **convenience** of a private car:

B03: "MaaS might affect the frequency of my driving. Yet, it will not change my mind from driving because it doesn't resolve all the issues that push me to drive."

The convenience of car was particularly valued in terms of control over the journey, independence from timetable, and privacy the car allows its owner to have as well as for family travel, travel with luggage, and cases of emergency:

H10: "I don't have to wait around for other transport means. If I go shopping, I have the entire boot to put everything in it. I can plan my own trip when I want it, so I don't depend on any other time constraints from other transport means."

B12: "If you are in your car, even with friends, you are not sharing with other people, with strangers."

L09: "If there was an emergency, whatever that might be, a trip to a hospital or going to see someone quickly, you've got your own car, you can drop everything and go, whereas with MaaS there is always going to be a lag."

B08: "I think the convenience and the comfort for my family is more important. For that, I would not want to swap my personal car for MaaS."

The car came across as a preferred transport option not only because of the convenience but also because of the general **enjoyment** of its "personal space" aspect as well as of ownership and use:

L13: "I generally enjoy cars. From a linear point of view, you can view cars plainly as transport, but they can be for enjoyment, they can be for general social aspects. They are a trend."

B06: "I just got my car in January, so it's like my little baby at the moment, and I love it."

H08: "It is also self-esteem to some extent because if you're driving a car, if you are satisfied with the car, if you drive the car you really like, that becomes the point of it. That's what we are looking for in our life. It's a way of treating ourselves."

The context of **morality** came up too. Sustainability indifference and misinterpretation of the impacts of car use on society and environment were yet another explanation to the pursuit of driving habits:

L10: "Whilst I am very aware that there is a problem, it's not a big enough problem for me to say that I'm not going to use my car anymore."

B11: "If everyone uses a car that is environmentally safe in terms of emissions it produces, like I do, then we would have a safer environment. So, on my part I know that I use something environmentally friendly."

Car-related sustainability concerns, however, resulted not only in cognitive dissonance in individuals when deciding to drive but also a change in travel practices:

H08: "Recently the British government announced that diesel cars are rather dangerous, and because I've got one, that makes me a bit uncomfortable."

H03: "I'm challenged quite often because I do have an interest in sustainability, but I also like to drive."

B10: "Whenever I go to university, I would call a colleague of mine and tell her in advance that I'm going, say, tomorrow and ask whether she would like to join. She doesn't pay me for it, by the way, but I feel good doing it."

H05: "Cars are noisy, and pollutants are smelly. It's not ideal. I try to cycle in cities, or walk, or use public transport."

Therefore, concerns around diverse sustainability implications were likely to have a positive influence on the uptake of MaaS as users saw it as a tool that would help them travel in a more sustainable manner:

L05: "It would be interesting to actually put something there [in MaaS] that would tell you about the carbon footprint of each travel mode. I think that would be a bit of an eye-opener for some people and maybe influence their decision."

H03: "Going back to the sustainability thing, using MaaS would make me feel like I was contributing more to maintaining sustainability."

B09: “If there was a proper service like this [MaaS], which could locate other users at the same area where I am and match the destinations, I would rather do that for all the environmental and social reasons.”

#### 4.3. Trust

**Trust** in this analysis developed as a factor explaining how perceptions of MaaS’ functionality influence its acceptance and viability as a travel mechanism. While on a theoretical level MaaS generated a great deal of enthusiasm among study participants, many of them did not trust that the concept could actually work as advertised:

L13: “It’s the release of a new service, and then how much trust would you have in it to deliver? If it had any sort of issues, then you’d be left to your old ways of doing things.”

B01: “If I could just get to work in the morning by, say, Uber, after work take a bus to the train station, get down to London by train and then travel around there, and it all would be for that one fixed monthly price, it would be great, but I find it hard to believe. I don’t believe it’s possible.”

To make sure that the “impossible” is achieved and MaaS delivers on its promise some participants demonstrated the need for **travelling** the tool:

B04: “I can actually use this service to test the accuracy in the city I live, with travel routes that I’m confident of, and if I see it is very accurate, then I could travel from Birmingham to, say, Leeds, and I’d want to use MaaS.”

Many interviewees doubted the **efficiency** of MaaS. Some participants, certain of their transport knowledge and planning capabilities, demonstrated a strong sense of self-efficacy and, thus, did not believe that MaaS could do better than them:

L04: “I can probably work out all my alternative routes quicker in my head than this app can.”

L12: “The only thing I find with using apps is when you’ve got an idea of a system, and you go on the app, and you go “how am I getting from A to B?” and the app tells you to go there, and you go there. And I think, well, actually, if I go that way it’s better because it’s cheaper, but because it’s a minute longer than the other way, the app will tend to give you the quickest time, and it’s not necessarily as flexible and giving you as many options.”

The above partially occurred as participants doubted MaaS information would be always accurate:

L09: “I think with the on-route issues often the information that comes through is poor, and that’s exactly the reason why, if something happens, no one quite knows what’s gone wrong and why. And then you almost end up making that decision yourself.”

Participants expressed **capacity** concerns suggesting that MaaS may offer limited alternatives, or reduced capacity in them:

H08: “If we imagine that everyone uses MaaS, we then need more public transport in terms of numbers; we need more taxis, buses, because everyone would use it. I’m thinking about peak times. If you want to book a taxi around school time in the morning, you won’t be able to do it because it’s so busy. If many people abandoned their cars, such things could become more frequent.”

H11: “On the bus or on the train, you’d have to worry if you’d get a seat or not, if it’s a long journey.”

It was acknowledged by participants that trusting the **technology** could become yet another challenge when travelling with MaaS. Participants thought of MaaS as an app-based tool, which induced concerns about simple practicalities like mobile phone battery life, network coverage, and inclusion of all modes under the MaaS umbrella:

H05: “If your phone is not charged, you can’t get access to it [MaaS], and then you’re lost. You can’t just rely on it.”

H02: “The only thing is Wi-Fi, the internet connection.”

B12: “You expect everything to be seamless, but then you turn up on a bus and they say they don’t accept MaaS.”

Some also demonstrated their concerns about possible **cybersecurity** threats that could affect MaaS systems:

L06: “It’s asking for payment through the app, and I would want some kind of reassurance that this is fine.”

L07: “If something goes wrong with it, if payments are charged when they shouldn’t be or if there is overpayment or anything like that, people might not want to rely on it.”

H07: “It could endanger lives one way or another if the hackers, terrorists break into this system [MaaS].”

The trust in MaaS and its capabilities were also largely influenced by the individual state of **digital readiness**, which appeared to be shaped by one’s age and innovativeness:

H12: “I suppose people who are a little bit older would probably struggle with the concept of using a mobile phone app to access different transport modes.”

B05: “I don’t think my brother has ever even used Uber. He calls taxis because he is not very good with phones.”

#### 4.4. Human element externalities

The participants worried that MaaS would be operating in a framework defined by negative aspects of human behaviour that can be traced in the user and provider levels including **negligence**, **discourtesy** and **disobedience**. These issues come under the umbrella term **Human Element Externalities**. This is a theme that highlights some of the grey areas for the transition to a MaaS-based transport paradigm that relate to social environment barriers.

B01: *"The problem is not with the transport itself. The problem is with people."*

Participants worried about receiving honest, safe and reliable service due to having already experienced the **negligence** of those who cater for them, which is not guaranteed to be battled through MaaS:

L13: *"Will those offering driving services be malicious and want to go via routes that take longer and cost you more purposely to get more money?"*

B07: *"The reason I would still use a car over this would be independence. With MaaS you're still reliant on people, you're still reliant on someone for a taxi, a bus, a train, and anything can happen."*

L04: *"They [drivers] don't really care. They, most of the time, just fly about, and not safely, to get you there as quickly as possible. I think they can cancel on you quite easily, there is no repercussions. You're completely in their hands. I've been in some pretty scary journeys in different parts of the world, where I wasn't sure if I was going to live or die because drivers were mental."*

Participants also discussed the negative impact **discourtesy** of other transport users has on their transport related experiences. A few talked about fellow travellers being inconsiderate of others' personal space, privacy and the need for peace and quiet:

H01: *"And then, there are other people on the bus: some are considerate and think about the fact that they are not alone, and then others can listen to loud music or talk as if they were on their own on that bus, and everyone has to listen to their plans or whatever they did."*

H04: *"If the train was nice and quiet, it would be great. But you know, if it's really busy, you can't get a seat, and that's a pain, and then obviously if it's full of noisy people you can't concentrate on reading."*

People abusing the rules and the infrastructure put in place for everyone's good, thus demonstrating **abuse** and **disobedience**, could also become an issue even in the MaaS era:

B07: *"For me buses are just not well looked after, you've got a lot of abusive people on there, you've got some people smoking in the back though smoking is clearly not allowed. There are also regular attacks on the bus against women."*

B05: *"Public transport is usually full of young people coming from parties, and they like to swear and smash stuff."*

B12: *"It's all about the way people behave. People should understand rules, otherwise they will make things inefficient."*

B02: *"A lot of people cannot even drive their own cars, so they are not going to drive nicely somebody else's car that's not their property."*

Consequently, many **anticipated** that travelling by non-private transport could impose **danger** to their health and well-being, and even life, which makes them reluctant to sharing the travel with others:

H11: *"At the train station, you get all these drugged, drunk people late at night, and if you're arriving late and waiting for your taxi there, then you're susceptible to harm. Not that you would definitely get harmed, but it puts that fear in your head, that it's really dark, the train station staff are not there, and you might have your possessions with you, like laptops, so you might feel more susceptible to harm."*

L10: *"I'm not very good with the sole security element, with not knowing who I'm with. I don't know how I feel about sharing."*

B05: *"The area of my work is not nice, and you wouldn't want to be on a bus there, unfortunately, unless you've got a stab-proof vest on."*

#### 4.5. Value

This theme discusses what users would **Value** when shifting to a MaaS-dictated travel paradigm; the things that make a difference and the benefits those could bring to the logistics of their trips.

Whilst being challenging for a few, the **appification** of travel planning with MaaS was what excited many participants and was even referred to as a major selling point as it was something they were already accustomed to:

L08: *"MaaS being an app is one of its major selling points I would have thought."*

H02: *"It's easy enough. Anyone these days has a phone that can support it. I already have a few apps on my phone."*

The **integration** of a variety of transport options with information, booking and payment services in MaaS was perceived as another value-adding opportunity, making travel easier and more accessible even to those who are older and not technologically enthused:

B03: "It makes things much more convenient because you are able to get everything in one particular point. You are able to get information, you are able to get payments, and you are able to get tickets for the different services that you might be using."  
 L12: "Trying to find out the local bus operator, you might need to find their app, or use Google, so that takes time. If there was an app that gave you the opportunity to easily search for any location, without having to resort to different operators and stuff, that would be of interest to use. [...] Someone who's older or not so strong with IT, might struggle with MaaS. But then they would also struggle to find a local bus operator in a different town."

The integration feature tempted participants to consider a change in their travel routine, thus showing potential to **break habits**:

H05: "It might encourage people, if it's aimed that way, to walk or cycle more, if it could take them through routes which are more walking- and cycling- friendly."

L02: "If you go shopping on a Saturday, instead of parking the car, if you book a taxi normally you would wait for it 10–15 min, do your shopping, book another taxi, wait another 10–15 min, whereas using this, you could walk a bit to the bus, get a bus, do the shopping, and then get a taxi because you have stuff to carry potentially. Or by the sounds of it, you could actually have it saying "well, you can get a bus now instead of a taxi". So, I think it might make a more engaged experience, the fact that you can go "let's try that or that or that"."

B05: "If I had MaaS and I could find a ride share that goes to my work, I would never drive. I could completely stop driving and find an easy way to get there cheaper and simpler."

Much thought was given to the **analytics** behind MaaS systems. Participants speculated that the data MaaS gathers from its users could be employed, one way or another, in improving travel experience. A few spoke about the ability of MaaS to manage capacity:

L05: "I think, in terms of trains, they could do some research and actually let you know on what train you are likely to get a seat, or at what time it is going to be less busy. That would probably be quite beneficial because that could influence your decision positively if you knew the train that has actually got seats."

L14: "It could be useful if this system had all this data about all the individual journeys taking place at the same time, so they could all be interrelated to each other depending on where everybody is going and where from. Say, there could be a hundred people trying to get from A to B. It could then start making decisions for everyone, so that not everyone goes from A to B the same way as that would cause problems. So, by understanding what journeys people are trying to make, this system could eliminate bottlenecks potentially."

Participants also speculated that MaaS could, at least to some extent, eliminate the risks associated with service and other users by allowing to **create accounts and give feedback**:

B09: "It's the safety the application provides. All the accounts are connected to the user, so there is transparency. If something happens, you are able to identify and locate the person who was responsible for the issue occurred."

B04: "Another positive is that you can use feedback systems to rate your experience with every driver: it is an incentive for the drivers to be well-behaved because they know that the negative feedback will affect their own service."

H10: "I think they should cover everything, not just the car, but also the people you share that car with. You may feel a bit safer that way."

Ultimately, by rationally processing user data, MaaS could become a socially inclusive transport tool and create a more enjoyable travel experience:

L04: "MaaS might make transportation become more social, which at the moment is not. So, you end up on trains where everyone is very passive aggressive, or just aggressive, people don't really talk to each other. You might end up with more people who travel together and enjoy their journey a little bit more."

It was for the purpose of **leisure and tourism** MaaS was found most useful as it would allow to easily get around unfamiliar places and do long-distance trips:

L06: "This sort of app would be really helpful for me, going to places and destinations I'm not really familiar with."

H02: "For a long-distance trip, though, I would use it, and that would be interesting."

H05: "If it had points of interest or something like that, the things you could do when you get off that transport. It's like when you go into a new city, it could offer you bus tours and include that. Rather than just having transport offering across the city, you can go here and then see something."

All of the above, however would mean nothing, as stated by participants, if the **level of service provision**, for public transport in particular, remains as it is at present:

H13: "I get where other people come from, like they live in the middle of the town and they could get the bus quite easily, but I come from quite a rural area, so I am dependant on that car."

B07: "If I'd like to get in the centre of Birmingham, I would usually go on a train, not drive, whereas if I was going to the Isle of Skye in Scotland, I'd drive instead of getting a train if you know what I mean."

B09: “At times I would so much rather use the car if I had one, but this thought is highly connected to the quality of public transport service.”

Thus, the true value of MaaS is in providing users with a robust transportation network that encourages public transport and meets their everyday needs:

H14: “On a Sunday there is a bus only every 30 min, so of course I usually use my car. If MaaS offered me the flexibility of the public transport and a better frequency, then I might use that instead. If on a Sunday it is still difficult to do that, then MaaS makes no sense. I would want that to be 24/7 the same. Public transport is not the same 24/7. That guarantee that I would have the opportunity to use public transport whenever I want, that would be something.”

L09: “Encourage public transport networks that work with each other, that serve what people actually want, that run late in the night, that run at weekends, a bus that departs 5 min after a train arrives. You can't do this anymore in this country. We have lost that ability of actually getting everything to interwork with each other but that would actually make a big difference in choices people make.”

#### 4.6. Cost

The **Cost** of MaaS was projected to be perhaps the most critical factor for its uptake. Although there was a specific cost related question within the interview guide, cost as an influencing factor appeared in the responses long before the question was asked. So, the following were some of the responses to the question on whether the participants were willing to use MaaS at the start of the interview:

H01: “My decision would probably depend on price.”

L11: “It depends on the cost.”

H14: “If MaaS was more expensive than what I am doing, I don't think I would even try it.”

The ways participants expressed their views on what the cost of MaaS should be took many different directions. One of the ways to express the acceptable cost of MaaS was to do **benchmarking against status quo**. Some participants wanted to see the cost of their travel reduced:

H13: “I would use it if it worked out cheaper than going individually, like if I took a taxi to Huddersfield centre, it would be one price, but if it was a taxi and a bus ride it would be cheaper. Then I'd be more inclined to use it.”

L01: “I am topping up my Oyster card £30 a week and that's to cover all my transport. So, I would want to see that reduced.”

Though it was noted that fixed costs of car ownership and use were often neglected when choosing to drive, car users specifically noted that travelling with MaaS should work out cheaper than using their own car:

H03: “If MaaS didn't make my trip more cost-effective, then I would question why I am using it really. So, I would expect it to be less expensive than using my own car. But then, if you were to weigh up all the fixed costs of having your own car, then I think it will be cheaper because you don't have to pay for all the outlay of the car, the insurance, and everything that goes with it.”

L03: “MaaS would need to work out cheaper than the car.”

H12: “It is like £25 for me to get home on a train. If it was the same with MaaS, I would probably just get in my car.”

Some participants appreciated the fact that MaaS was providing them not only with transportation, but also the bundling, payment and guidance services, for which they were ready to pay:

L10: “I think I'd be willing to pay a little bit extra to get the full service.”

B06: “I think people would pay that little bit more because it does more, and I'd be ready to pay a little bit more.”

Many discussed the importance of **time** against the cost and would like to see that factored in:

L08: “Comparing the costs would certainly be interesting as well as comparing the journey times.”

L11: “Say, I'm going from A to B, and it normally takes me an hour. I can go with MaaS if it takes me an hour and 10 min. I wouldn't mind the 10 min as long as it's cheaper.”

B02: “If a trip was going to cost me less and take roughly the same amount of time, I would use MaaS.”

While some study participants were ready to pay for the digital services MaaS provided, others considered it unjust and developed a “**Why to pay? Can do myself**” attitude:

B04: “If I see that in the end this works out, say, £10 more expensive than just using Google maps and doing it yourself, like dealing with Virgin trains and so on, me and other people will just go for a cheaper option, because the more travel is done by a more cost-effective option, the more you would end up saving as well.”

H04: “If that was a journey that I could easily do myself and that journey was going to be a lot more expensive through MaaS, then I perhaps would be inclined to just do it myself.”

A number of proposals to provide MaaS users with financial **incentives, reliefs and motives** within the pricing structure in order to influence their travel behaviour occurred. Some spoke about incentivising users through the app:



L05: “If you were to pick one way, and you had a train, for example, would you get a discount for using the train through the app because you are choosing to do that over taking your own car? I think that would influence people.”

B05: “You could give people bonuses, something like reward points every now and then: a free trip after 10 trips done with MaaS, or a free mile after every 100 miles travelled. Give people an incentive to use it. Bribe them. Freebies usually work.”

L08: “If you wanted this to take off in any sort of big numbers, then you have to be very careful of what you offer because a lot of people only want things that are free.”

The government interference, with both “push” and “pull” pricing measures, was also considered a mechanism to influence participants’ decision to use MaaS:

L02: “The government should offer credits, where you get your money back, or you’re not taxed as much because you don’t have a personal car. If you pay £100 for your car emissions, then you’re not paying it, but maybe you should get a flipside where they say “ok, because you use MaaS you get some return as an incentive.”

H09: “If they would make travelling by my own car, like through taxes, extremely, unbearably expensive, then I would be forced to use public transport, but I wouldn’t like to see that. But it can be an option the government could look at, increasing the cost of owning a car, and that could push people to use MaaS.”

## 5. Discussion

Our study identifies and analyses the five key themes that underpin MaaS and its potential to inspire (or not) travel behavioural change. **Car dependence**, **Trust**, **Human Element Externalities**, **Value** and **Cost**, each with a number of distinctive dimensions expressed as their sub-themes, shown on Fig. 3, in cases interlinked and difficult to isolate *per se*, underpin people’s acceptance and potential uptake of MaaS.

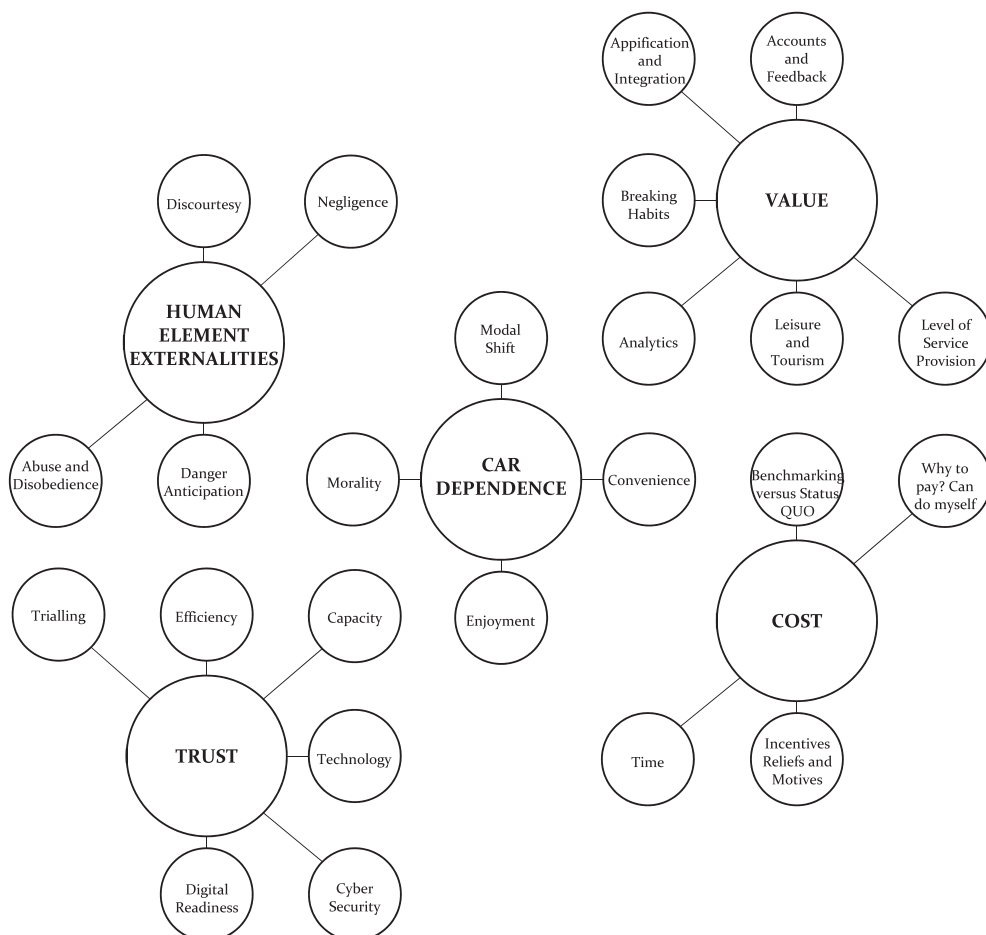


Fig. 3. Factors affecting acceptance and uptake of MaaS as a sustainable travel mechanism.

While the idea of MaaS received generally positive commentary, with participants willing to see the system in action, many still looked at MaaS through the lens of **Car Dependence**. So, the potential **modal shift** was not radical: the majority of participants were inclined to still depend on car by giving preference to modes like car-sharing, ride-sharing and ride-hailing and/or using their own car as well as using MaaS. All in all, at this point in time MaaS is viewed as a complement to personal car rather than a substitute for it, which is in line with Storme et al. (2020). Much like Fioreze et al. (2019) and Ho et al. (2020) suggested, our study revealed that potential users remain dependant on cars due to perceiving MaaS as unable to beat private car **convenience**. It has been long recognised, however, that car is more than just a convenient mode of transport (Steg, 2005). The findings of our study suggest that cars to this day are viewed as the most **enjoyable** transport mode; owning and using the car stimulates self-esteem, serves as a means of representing self and provides a sense of freedom, independence and joy on top of removing the complexities and uncertainties of relying on others and on a digital-based system to travel. These are sensations that MaaS cannot replicate. Sustainability attitudes have been found to have an influence on driving habits and modal choice (Bamberg & Schmidt, 2003; Gardner, 2009) and the decision to use multimodal travel applications (Dastjerdi, Kaplan, Silva, Nielsen, & Pereira, 2019a, 2019b). Similarly, our study suggests that people with limited **moral considerations** or, in other words, people with the mindset that their unsustainable driving habits are “a drop in the ocean” appear the least likely to travel with MaaS sustainably, if at all. Those who voiced concerns about the environment were more likely to look for ways to reduce their dependence on cars and see MaaS as a means for identifying more sustainable travel options, at least for some of their trips, and as a way of contributing to maintaining sustainability.

The affection for privately owned cars and personal driving was not however the only reason study participants did not show much enthusiasm about extensively relying on MaaS. There were a number of **Trust** issues underpinning incidents of MaaS disapproval. According to Rogers (2005) Diffusion of Innovations Theory, an individual often expresses the need to trial an innovation before its full adoption in order to give meaning to an innovation, to eliminate uncertainty and to find out how it functions in real terms. Similarly, our study participants demonstrated the desire of **trialling** MaaS to test its **efficiency** in providing timely and reliable information, reasonable itineraries, and alternative routes in cases of disruption. MaaS could only be as good as the transportation network behind it, thus participants demonstrated their concerns with the potential MaaS **capacity**; when today at peak hours, the demand for public transport and shared use mobility can severely outweigh the system's capacity, what would happen on the much larger scale of a MaaS paradigm, when most users will abandon their cars? The latter is closely related to the notion of crowding (Li & Hensher, 2013), associated with a high density of passengers on vehicles, access ways and stations, which has a significant influence on modal choice (Tirachini, Hensher, & Rose, 2013; Vedel, Bredahl Jacobsen, & Skov-Petersen, 2017; Wardman & Whelan, 2011). When travelling with MaaS, users would have to rely on **technology** and often worry whether the battery of their mobile device is sufficiently charged, whether they would have appropriate mobile network coverage where they are travelling, or whether the device would be accepted as a means of access to the many transport modes MaaS promises to integrate, an issue previously highlighted by Giesecke, Surakka, and Hakonen (2016). This means that any MaaS system should also work offline and offer back-up access options if it is to be embraced as also suggested by Polydoropoulou et al. (2018). Moreover, the mobile app form of MaaS could be a major barrier to its uptake as not every potential MaaS user at present is at the desired level of **digital readiness** (Polydoropoulou et al., 2018), and older people specifically, as noted by Pangbourne, Mladenović, Stead, and Milakis (2020), seem to be left out. While individual data privacy and protection, and safety around monetary transactions within MaaS have been considered in recent research (Cottrill, 2020), little attention has been paid to the possible **cybersecurity** vulnerabilities of MaaS and their mitigation, although cybersecurity and resilience planning have been signposted as areas of priority for years now for the broader context of public transport (Beecroft & Pangbourne, 2015a). The frequency of fraud and cyberattacks, often severe, in contemporary times caused our participants to fear relying on not just MaaS but any digital system. In the MaaS era cyber-attacks may impose a great amount of risk as they could spread over, and endanger, an entire MaaS coverage area in a very short time.

Reliability, safety on board, and privacy, associated with vehicle occupancy, are the known attributes influencing user perceptions of and satisfaction with transport service quality (Beirão & Sarsfield Cabral, 2007; Garvill, Marell, & Nordlund, 2003; Prioni & Hensher, 2000; Spears, Houston, & Boarnet, 2013) and affecting travel behaviour and modal choice (De Vos & Witlox, 2017). In our study, similar attributes developed for the context of MaaS and, as they appeared to be largely of human nature, were defined as the **Human Element Externalities**. Social environments, perceived by some participants as psychologically and physically hazardous, negatively affected the potential acceptance and uptake of MaaS. Study participants reflected on their previous experiences and, realising the service in MaaS was still dependant on the responsibility of its providers, were troubled by the possibility of transport provider staff deceiving them, getting them to their destination with little consideration for their health and safety, and simply not providing the service at the required time, thus demonstrating **negligence** in relation to users. The **discourtesy** of fellow travellers was yet another worry: inappropriateness of some conversations, profanity of the language, and the inability of other transport users to keep noise to a minimum was what made the experiences of sharing transport even with MaaS a non-ideal scenario for some people. Another barrier identified was the possible **disobedience** of safety rules, the misuse of dedicated transportation infrastructure for irrelevant purposes, and the **abuse** on shared means of transport. Thus, some participants **anticipated danger** and expected harm when sharing with others, and, ultimately, generated negative perceptions of travelling with MaaS. The above is in line with Gardner and Abraham (2007), who argued that the provision of personal space and security pose real challenges to car reduction schemes, and Beecroft and Pangbourne (2015b) who concluded that personal security considerations tacitly influ-

ence passenger choice. For the MaaS context this agenda is barely touched, with a few exceptions perhaps (e.g. [Jittrapirom, Marchau, van der Heijden, & Meurs, 2018](#)).

While [Fioreze et al. \(2019\)](#) uncovered that the low potential uptake of MaaS was the result of survey participants not recognising the added value of the service, our study offers an insight on what users consider things of **Value** when travelling with MaaS. Although digital illiteracy of some potential users could complicate the realisation of MaaS as a web- or app-based product, the **appification** was still regarded as a valuable feature as it was something the majority of participants already had experience with, which goes along with the findings of [Schikofsky et al. \(2020\)](#). The travel choice making qualities and **integration** capacity of MaaS were also highlighted by some of our participants, which is in line with the results of [Polydoropoulou et al. \(2018\)](#). With MaaS, individuals will not have to deal with a variety of apps and webpages but do everything from a single app. Furthermore, the all-in-one service could help **breaking** existing travel **habits** by offering the user more sustainable travel modes. MaaS was found to be a valuable tool for organising short- and long-distance trips with the purpose of **leisure and tourism**, confirming the hypothesis of [Ho et al. \(2020\)](#) that tourists may represent the largest market group for MaaS and be its first adopters. Our study suggests that a MaaS feature for creating **accounts** and giving **feedback** about drivers delivering the service and fellow travellers, could make sharing, at least car-based ([Casprini, Di Minin, & Paraboschi, 2019](#)), more transparent and easier to get used to. The sensation of knowing that everyone is registered and can be easily identified in case a situation occurs might make sharing public and shared means of transport more pleasant and trustworthy. Our study participants also recognised that MaaS, having access to individual trip and user data, could use **analytics** to help eliminating traffic bottlenecks. This supports the findings of [Milne and Watling \(2019\)](#). Yet, the transportation network itself, as it is as present, is far from being able to seamlessly serve user needs and offers no resilience when dealing with disruption. Significant improvements in the **level of service provision**, however, are of paramount value to users and tend to induce a positive change in travel behaviour ([Redman, Friman, Gärling, & Hartig, 2013](#)).

Our participants considerations about MaaS' **Cost** made it clear that travel by alternatives is still considered inferior to car use. Although valuing some of the features MaaS may potentially offer, only a few, as also recognised by [Ho et al. \(2020\)](#), wished to pay extra for the MaaS service. Many demonstrated a “**Why to pay? Can do myself**” attitude and took a stance where they would rather plan the trips themselves than pay MaaS for creating an integrated offer as there were already free of charge apps and services in place that they could easily use instead. Some participants were ready to accept a slight increase in travel **time** provided the cost of travel with MaaS was lower than what they paid previously, in a way **benchmarking against status quo**. Others wished to be **incentivised** to use MaaS by getting, through the MaaS platform, **motives** such as bonus points and discounts for every trip. The latter reward instruments could be successful in promoting sustainable multimodal options ([Dastjerdi et al., 2019b](#); [Tsirimpa, Polydoropoulou, Pagoni, & Tsouros, 2019](#)) and thereby facilitating a positive change in individual travel behaviour ([Poslad, Ma, Wang, & Mei, 2015](#)). Some car users mentioned, rather reluctantly, that the only way out of driving for them would be the policy makers putting in place environmental laws and excessive charges for personal car use and ownership. Indeed, road pricing schemes, although often challenged by public resistance, grant more significant reduction in emissions as opposed to, for example, shared use mobility schemes ([Cavallaro, Giaretta, & Nocera, 2018](#)), which could be a consequence of reduced car use. Car users were more open to “pull” measures such as being offered tax **reliefs** for switching from their car to more sustainable alternatives. Such policy, also referred to as tax break or tax exemption, has been successfully utilised to promote the use of electric and more fuel-efficient cars ([Bjerkkan, Nørbech, & Nordtømme, 2016](#); [Orlov & Kallbekken, 2019](#)) and appears to also have potential to reduce overall car use ([Gardner & Abraham, 2007](#)).

## 6. Limitations and future work

The present work responds to a significant literature gap and helps addressing the lack of qualitative research studies in the topic of MaaS and travel behaviour. We need to acknowledge that the qualitative nature of our study might not have the same potential to offer generalisable results for broader contexts, than the UK cases we studied herein, when compared with quantitative studies that perform statistical analysis in big datasets. We also recognise that although Birmingham is the home of the first English MaaS pilot and London is a city with one of Europe's biggest and most versatile and integrated public transport networks our study was not about capturing real-life experience from MaaS use since very few of our interviewees had ever heard before about MaaS; however capturing attitudes and intentional travel behaviour is of crucial importance too. Studies experimenting with actual MaaS-related travel behaviour although advantageous are very rare because MaaS is in an embryonic stage of its development; furthermore, the systems tested might not even be full scale MaaS systems but MaaS-lite. The next phase of our research will be based on an online quantitative survey and the statistical analysis of its results. This follow-up study will aim to triangulate, complement and extend our present findings.

## 7. Conclusions and recommendations

MaaS as a whole seems to be portrayed as an attractive mechanism, yet it does not guarantee the desired behavioural change, to the extent, where transport-caused sustainability challenges could be overcome. Car remains the convenient but also enjoyable option for transport users, who at present also have little consideration for sustainability and, if not forced, are bound to stick to their existing driving habits. Acceptance and intended usage of public transport services, even

enhanced by shared use mobility modes, is falling well behind the private automobile, meaning that a major reform of these services and their overall design should happen coupled with travel demand measures designed to push people out of their cars. Therefore, all MaaS can offer to the potential user at present is the comfort and ease of “appified” access which may reduce the cognitive load for preparing and undertaking a journey, in line with [Lyons et al. \(2020\)](#). The ease of access, though, is not something transport users are willing to pay for as it only allows them to easily access services that do not work up to the required standards and, consequently, do not meet their needs.

Moreover, transport users do not trust that MaaS could make the access truly easy and see many issues that could hinder the provision of transport services via a digital interface. It is also due to the contemporary social environment that the MaaS paradigm may not develop sustainably: both transport staff and users, according to some of our participants, show little respect to rules, transport infrastructure, and even each other, which could make the use of shared transport means inefficient, unpleasant and at times dangerous. It appears that the society, although perceiving MaaS positively, is not yet ready to change their existing travel practices ([Ho et al., 2020](#); [Karlsson et al., 2020](#)). Hence, policy makers and transport providers need to think very carefully of what they offer through a MaaS platform.

The value of MaaS is not in beating the convenience of the private car, which is rather unrealistic, but in creating a multimodal travel option that offers the opportunity to people to be part of an initiative designed to create more liveable, socially inclusive and sustainable futures. Thus, transport users should be incentivised to travel responsibly with MaaS through bonuses and tax reliefs, and be persuaded to think ‘big’ and ‘out of the box’, possibly via dedicated awareness, information provision and social engagement exercises designed to make the concept more familiar to them and highlight its importance in sustainability terms if used responsibly. Transport providers and policy-makers need to test out and work on improving MaaS through the use of pilots, trials and living labs; this will give a window of opportunity to users to familiarise with change and abort negative (usually unsustained) perceptions about risks that a real-life scheme application would make apparent that they should not exist. Their next and more important step however should be to make public transport the backbone of any MaaS system by putting major efforts into encouraging integrated, demand-responsive, timely and inexpensive public transit networks where many modes, enhanced with well-timed, reliable and honest information provision, work together to satisfy the very diverse user needs. Car- and ride-sharing should be less accessible in contrast (via monetary disincentives within the MaaS pricing framework or car-free and parking-free zones) and perhaps provided primarily for emergencies and as neighbourhood feeders to mass-transit systems. But this marginalisation of car solutions embedded in this sustainability-enhancing approach might go against the usual MaaS rhetoric of “individual unfettered freedom” (as covered by [Pangbourne et al., 2020](#)). So, the society of the future, and the research community, should be facing a dilemma: “do we want a genuinely sustainable MaaS?” or “one that is more easily accepted but might be uberised?”

## CRediT authorship contribution statement

**Elena Alyavina:** Conceptualization, Methodology, Data curation, Formal analysis, Writing - original draft, Writing - review & editing. **Alexandros Nikitas:** Conceptualization, Methodology, Formal analysis, Writing - original draft, Writing - review & editing. **Eric Tchouamou Njoya:** Formal analysis, Writing - review & editing.

## Appendix A. Interview guide

### BACKGROUND INFORMATION

- (1) What is your date of birth?
- (2) What is your marital status? Are you single/in domestic partnership/married/divorced/etc.? How many children are in your household?
- (3) What is the highest degree or level of school you have completed? If currently enrolled, highest degree received. What is your current status of employment (employed/self-employed/unemployed/student/retired/etc.)? What is your job title?
- (4) What is your personal/household income?
- (5) Do you have a driving license?
- (6) Do you have your personal car (household car)?

### TRAVEL BY PERSONAL CAR

- (7) How often do you use your own car (either as a driver or as a passenger)?
- (8) Every time you make a decision to travel by car, do you compare it to other available options?
- (9) What is usually the purpose of the trips that you use your own car for?
- (10) Would it be difficult for you not to use your car for those trips?
- (11) What benefits of travelling by car do you consider when making your travel decisions?
- (12) Are there any drawbacks of the use of your own car which you consider when making your travel decisions?

- (13) Many people think that cars and their excessive use generate problems for society, the environment and even the economy. What do you think about that?
- (14) Do you feel responsible for the above? What actions are you taking to change that?

#### TRAVEL BY PUBLIC TRANSPORT

- (15) How often do you use public transport as a travel mode?
- (16) What is the purpose of the trips you use public transport for?
- (17) What do you consider beneficial about travelling by public transport when making your travel decisions?
- (18) Are there any public transport drawbacks you consider when making your travel decisions?

#### TRAVEL BY OTHER MODES

- (19) How often do you use Taxi or Uber as a travel mode? Why do/don't you use it?
- (20) What is the purpose of the trips you use Taxi or Uber for?
- (21) Do you usually use those transport modes as substitute for or in combination with other transport options?
- (22) What are the benefits of taxi travel, in your opinion? What are the drawbacks?
- (23) How do you feel about the smartphone app experience that services like Uber offer? How easy/how difficult do you find to use those?
- (24) What is your opinion on the use of active transportation, such as walking and cycling?
- (25) What do you think of sharing a ride with a friend/a stranger?
- (26) What is your opinion on car-sharing schemes? Do you see any benefits/drawbacks in using those?

#### TRAVEL BEHAVIOUR GENERAL

- (27) What circumstances make it easy for you to travel the way you do at present?
- (28) What circumstances make it difficult for you to travel the way you do at present?
- (29) Are there any particular individuals or groups of people who influence your decisions regarding transport and traveling? In what way?

#### INTRODUCING THE CONCEPT OF MAAS

Infographic exercise: go through definitions of MaaS, highlight its features and their functions, and describe the experience it offers to its users in detail.

#### MAAS ATTITUDES

- (30) Would you be willing to use MaaS for your everyday travel? Why? Why not?
- (31) What are the opportunities of using MaaS for travel? What are the barriers to using MaaS, in your opinion?
- (32) What do you think about the technological aspects of MaaS, to wit the provision of travel related services and information through a single smartphone application? What are the benefits to you? What are the barriers?
- (33) To what extent your decision to use MaaS would depend on the cost of the service?
- (34) Could MaaS change the way you travel right now?
- (35) If people most important to you were in favour of using MaaS, would you be in favour of using MaaS yourself? What about the influences of general public?
- (36) Having MaaS, would you be willing to give up your personal car? Why do you feel so?
- (37) Is there anything transport providers and policy makers could add to MaaS that would help you switch from your car to other transport modes and help you depend on car less?

## References

- Bamberg, S., & Schmidt, P. (2003). Incentives, morality or habit? Predicting Students' Car Use for University Routes with the Models of Ajzen, Schwartz, and Triandis. *Environment and Behaviour*, 35(2), 264–285. <https://doi.org/10.1177/0013916502250134>.
- Bardhi, F., & Eckhardt, G. M. (2012). Access-based consumption: The case of car sharing. *Journal of Consumer Research*, 39(4), 881–898.
- Beecroft, M., & Pangbourne, K. (2015a). Future prospects for personal security in travel by public transport. *Transportation Planning and Technology*, 38(1), 131–148.
- Beecroft, M., & Pangbourne, K. (2015b). Personal security in travel by public transport: The role of traveller information and associated technologies. *IET Intelligent Transport Systems*, 9(2), 167–174.
- Beirão, G., & Sarsfield Cabral, J. A. (2007). Understanding attitudes towards public transport and private car: A qualitative study. *Transport Policy*, 14(6), 478–489. <https://doi.org/10.1016/j.tranpol.2007.04.009>.
- Bjerkkan, K. Y., Nørbech, T. E., & Nordtømme, M. E. (2016). Incentives for promoting Battery Electric Vehicle (BEV) adoption in Norway. *Transportation Research Part D: Transport and Environment*, 43, 169–180. <https://doi.org/10.1016/j.trd.2015.12.002>.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp0630a>.



- Caiati, V., Rasouli, S., & Timmermans, H. (2020). Bundling, pricing schemes and extra features preferences for mobility as a service: Sequential portfolio choice experiment. *Transportation Research Part A: Policy and Practice*, 131, 123–148. <https://doi.org/10.1016/j.tra.2019.09.029>.
- Casprini, E., Di Minin, A., & Paraboschi, A. (2019). How do companies organize nascent markets? The BlaBlaCar case in the inter-city shared mobility market. *Technological Forecasting and Social Change*, 144, 270–281. <https://doi.org/10.1016/j.techfore.2018.01.012>.
- Cavallaro, F., Giaretta, F., & Nocera, S. (2018). The potential of road pricing schemes to reduce carbon emissions. *Transport Policy*, 67, 85–92. <https://doi.org/10.1016/j.tranpol.2017.03.006>.
- Cottrill, C. D. (2020). MaaS surveillance: Privacy considerations in mobility as a service. *Transportation Research Part A: Policy and Practice*, 131, 50–70. <https://doi.org/10.1016/j.tra.2019.09.026>.
- Dastjerdi, A. M., Kaplan, S., Silva, J. A., Nielsen, O. A., & Pereira, F. C. (2019a). Participating in environmental loyalty program with a real-time multimodal travel app: User needs, environmental and privacy motivators. *Transportation Research Part D: Transport and Environment*, 67, 223–243. <https://doi.org/10.1016/j.trd.2018.11.013>.
- Dastjerdi, A. M., Kaplan, S., Silva, J. A., Nielsen, O. A., & Pereira, F. C. (2019b). Use intention of mobility-management travel apps: The role of users' goals, technophile attitude and community trust. *Transportation Research Part A: Policy and Practice*, 126, 114–135. <https://doi.org/10.1016/j.tra.2019.06.001>.
- De Vos, J., & Witlox, F. (2017). Travel satisfaction revisited. On the pivotal role of travel satisfaction in conceptualising a travel behaviour process. *Transportation Research Part A: Policy and Practice*, 106, 364–373. <https://doi.org/10.1016/j.tra.2017.10.009>.
- Dur, B. I. U. (2014). Data visualization and infographics in visual communication design education at the age of information. *Journal of Arts and Humanities*, 3 (5), 39–50.
- Fioreze, T., de Gruijter, M., & Geurs, K. (2019). On the likelihood of using Mobility-as-a-Service: A case study on innovative mobility services among residents in the Netherlands. *Case Studies on Transport Policy*, 7(4), 790–801. <https://doi.org/10.1016/j.cstp.2019.08.002>.
- Gardner, B. (2009). Modelling motivation and habit in stable travel mode contexts. *Transportation Research Part F: Traffic Psychology and Behaviour*, 12(1), 68–76. <https://doi.org/10.1016/j.trf.2008.08.001>.
- Gardner, B., & Abraham, C. (2007). What drives car use? A grounded theory analysis of commuters' reasons for driving. *Transportation Research Part F: Traffic Psychology and Behaviour*, 10(3), 187–200. <https://doi.org/10.1016/j.trf.2006.09.004>.
- Garvill, J., Marell, A., & Nordlund, A. (2003). Effects of increased awareness on choice of travel mode. *Transportation*, 30(63), 63–79. <https://doi.org/10.1023/A:1021286608889>.
- Giesecke, R., Surakka, T., & Hakonen, M. (2016). Conceptualising Mobility as a Service: A User Centric View on Key Issues of Mobility Services. In Paper presented at Eleventh International Conference on Ecological Vehicles and Renewable Energies (EVER), Monte Carlo, Monaco.
- Hartikainen, A., Pitkanen, J. P., Riihelä, A., Räsänen, J., Sacs, I., Sirkä, A., & Uteng, A. (2019). WHIMPACT Insights from the world's first Mobility-as-a-Service (MaaS) system. Ramboll. Available at: [https://ramboll.com/-/media/files/rfi/publications/Ramboll\\_whimpact-2019.pdf](https://ramboll.com/-/media/files/rfi/publications/Ramboll_whimpact-2019.pdf).
- Hensher, D. A. (2017). Future bus transport contracts under a mobility as a service (MaaS) regime in the digital age: Are they likely to change?. *Transportation Research Part A: Policy and Practice*, 98, 86–96. <https://doi.org/10.1016/j.tra.2017.02.006>.
- Ho, C. Q., Hensher, D. A., Mulley, C., & Wong, Y. Z. (2018). Potential uptake and willingness to-pay for Mobility as a Service (MaaS): A stated choice study. *Transportation Research Part A: Policy and Practice*, 117, 302–318. <https://doi.org/10.1016/j.tra.2018.08.025>.
- Ho, C. Q., Mulley, C., & Hensher, D. A. (2020). Public preferences for mobility as a service: Insights from stated preference surveys. *Transportation Research Part A: Policy and Practice*, 131, 70–90. <https://doi.org/10.1016/j.tra.2019.09.031>.
- House of Commons Transport Committee (2018). Mobility as a Service: Eighth Report of Session 2017–19. Available at: <https://publications.parliament.uk/pa/cm201719/cmselect/cmtrans/590/590.pdf>.
- INRIX (2018). Global Traffic Scorecard. INRIX Research. Available at: <http://inrix.com/scorecard/>.
- Jittrapirom, P., Caiati, V., Feneri, A. M., Ebrahimigharehbaghi, S., Alonso-González, M. J., & Narayan, J. (2017). Mobility as a Service: A critical review of definitions, assessments of schemes, and key challenges. *Urban Planning*, 2(2), 13–25. <https://doi.org/10.17645/up.v2i2.931>.
- Jittrapirom, P., Marchau, V., van der Heijden, R., & Meurs, H. (2018). Future implementation of Mobility as a Service (MaaS): Results of an international Delphi study (In press). *Travel Behaviour and Society*. <https://doi.org/10.1016/j.tbs.2018.12.004>.
- Kamargianni, M., & Matyas, M. (2017). The Business Ecosystem of Mobility as a Service. In Paper presented at 96th Transportation Research Board (TRB) Annual Meeting, Washington DC.
- Kamargianni, M., Matyas, M., Li, W., & Muscat, J. (2018). Londoners' attitudes towards car-ownership and Mobility-as-a-Service: Impact assessment and opportunities that lie ahead. MaaS Lab – UCL Energy Institute Report. Available at: [https://28716f27-42ea-4260-ac26-48e00a153449.filesusr.com/ugd/16813a\\_67c78a2209954ccdaf1cc5b5a0d8836c.pdf](https://28716f27-42ea-4260-ac26-48e00a153449.filesusr.com/ugd/16813a_67c78a2209954ccdaf1cc5b5a0d8836c.pdf).
- Kamargianni, M., Li, W., Matyas, M., & Schäfer, A. (2016). A critical review of new mobility services for urban transport. *Transportation Research Procedia*, 14, 3294–3303. <https://doi.org/10.1016/j.trpro.2016.05.277>.
- Karlsson, I. C. M., Mukhtar-Landgren, D., Smith, G., Koglin, C., Kronsell, A., Lund, E., ... Sochor, J. (2020). Development and implementation of Mobility-as-a-Service – A qualitative study of barriers and enabling factors. *Transportation Research Part A: Policy and Practice*, 131, 283–295. <https://doi.org/10.1016/j.tra.2019.09.028>.
- Karlsson, I. C. M., Sochor, J., & Strömberg, H. (2016). Developing the 'Service' in Mobility as a Service experiences from a field trial of an innovative travel brokerage. *Transportation Research Procedia*, 14, 265–273. <https://doi.org/10.1016/j.trpro.2016.05.273>.
- Kirklees Council (2019). Kirklees Factsheet 2018: Intelligence and Performance. Available at: <https://www.kirklees.gov.uk/beta/information-and-data/pdf/fact-2018.pdf>.
- Lee, Y., Circella, G., Mokhtarian, P. L., & Guhathakurta, S. (2019). Are millennials more multimodal? A latent-class cluster analysis with attitudes and preferences among millennial and Generation X commuters in California. *Transportation*, 1–24. <https://doi.org/10.1007/s11116-019-10026-6>.
- Li, Z., & Hensher, D. A. (2013). Crowding in Public Transport: A Review of Objective and Subjective Measures. *Journal of Public Transportation*, 16(2), 107–134. <https://doi.org/10.5038/2375-0901.16.2.6>.
- Lyons, G., Hammond, P., & Mackay, K. (2020). Reprint of: The importance of user perspective in the evolution of MaaS. *Transportation Research Part A: Policy and Practice*, 131, 20–34. <https://doi.org/10.1016/j.tra.2018.12.010>.
- Matyas, M. (2020). Opportunities and barriers to multimodal cities: Lessons learned from in-depth interviews about attitudes towards mobility as a service. *European Transport Research Review*, 12(1), 7.
- Matyas, M., & Kamargianni, M. (2019). The potential of mobility as a service bundles as a mobility management tool. *Transportation*, 46(5), 1951–1958. <https://doi.org/10.1007/s11116-018-9913-4>.
- Milne, D., & Watling, D. (2019). Big data and understanding change in the context of planning transport systems. *Journal of Transport Geography*, 76, 235–244. <https://doi.org/10.1016/j.jtrangeo.2017.11.004>.
- Mulley, C. (2017). Mobility as a Services (MaaS) – does it have critical mass?. *Transport Reviews*, 37(3), 247–251. <https://doi.org/10.1080/01441647.2017.1280932>.
- Nikitas, A. (2018). Understanding bike-sharing acceptability and expected usage patterns in the context of a small city novel to the concept: A story of 'Greek Drama'. *Transportation Research Part F: Traffic Psychology and Behaviour*, 56, 306–321. <https://doi.org/10.1016/j.trf.2018.04.022>.
- Nikitas, A., Avineri, E., & Parkhurst, G. (2018). Understanding the public acceptability of road pricing and the roles of older age, social norms, pro-social values and trust for urban policy-making: The case of Bristol. *Cities*, 79, 78–91. <https://doi.org/10.1016/j.cities.2018.02.024>.
- Nikitas, A., Kougias, I., Alyavina, E., & Njoya Tchouamou, E. (2017). How can autonomous and connected vehicles, electromobility, BRT, hyperloop, shared use mobility and mobility-As-A-service shape transport futures for the context of smart cities?. *Urban Science*, 1(36), 1–21. <https://doi.org/10.3390/urbansci1040036>.
- Nikitas, A., Michalakopoulou, K., Njoya, E. T., & Karampatzakis, D. (2020). Artificial intelligence, transport and the smart city: Definitions and dimensions of a New Mobility Era. *Sustainability*, 12(7), 2789.

- Nikitas, A., Njoya, E. T., & Dani, S. (2019). Examining the myths of connected and autonomous vehicles: Analysing the pathway to a driverless mobility paradigm. *International Journal of Automotive Technology and Management*, 19(1–2), 10–30.
- Nikitas, A., Wang, J. Y. T., & Knamiller, C. (2019). Exploring parental perceptions about school travel and walking school buses: A thematic analysis approach. *Transportation Research Part A: Policy and Practice*, 124, 468–487. <https://doi.org/10.1016/j.tra.2019.04.011>.
- Office for National Statistics (2019). Estimates of the population for the UK, England and Wales, Scotland and Northern Ireland Available at: <https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationestimates/datasets/populationestimatesforukenglandandwalesscotlandandnorthernireland>.
- Orlov, A., & Kallbekken, S. (2019). The impact of consumer attitudes towards energy efficiency on car choice: Survey results from Norway. *Journal of Cleaner Production*, 214, 816–822. <https://doi.org/10.1016/j.jclepro.2018.12.326>.
- Pangbourne, K., Mladenović, M. N., Stead, D., & Milakis, D. (2020). Questioning mobility as a service: Unanticipated implications for society and governance. *Transportation Research Part A: Policy and Practice*, 131, 35–49. <https://doi.org/10.1016/j.tra.2019.09.033>.
- Polydoropoulou, A., Pagoni, I., & Tsimpa, A. (2018). Ready for Mobility as a Service? Insights from stakeholders and end-users (In press). *Travel Behaviour and Society*. <https://doi.org/10.1016/j.tbs.2018.11.003>.
- Poslad, S., Ma, A., Wang, Z., & Mei, H. (2015). Using a smart city IoT to incentivise and target shifts in mobility behaviour—is it a piece of pie?. *Sensors*, 15, 13069–13096. <https://doi.org/10.3390/s150613069>.
- Prioni, P., & Hensher, D. A. (2000). Measuring service quality in scheduled bus services. *Journal of Public Transportation*, 3(2), 51–74. <https://doi.org/10.5038/2375-0901.3.2.4>.
- Rayle, L., Daia, D., Chanc, N., Cervero, R., & Shaheen, S. (2016). Just a better taxi? A survey based comparison of taxis, transit, and ride sourcing services in San Francisco. *Transport Policy*, 45, 168–178. <https://doi.org/10.1016/j.tranpol.2015.10.004>.
- Redman, L., Friman, M., Gärling, T., & Hartig, T. (2013). Quality attributes of public transport that attract car users: A research review. *Transport Policy*, 25, 119–127. <https://doi.org/10.1016/j.tranpol.2012.11.005>.
- Rogers, E. M. (2005). *Diffusion of Innovations* (5th ed.). London: Free Press.
- Saunders, M., Lewis, P., & Thornhill, A. (2016). *Research methods for business students* (7th ed.). Harlow, England: Pearson Education Limited.
- Schikofsky, J., Dannewald, T., & Kowald, M. (2020). Exploring motivational mechanisms behind the intention to adopt mobility as a service (MaaS): Insights from Germany. *Transportation Research Part A: Policy and Practice*, 131, 269–312. <https://doi.org/10.1016/j.tra.2019.09.022>.
- Shaheen, S. A., Cohen, A., & Zohdy, I. (2016). Shared Mobility: Current Practices and Guiding Principles. (FHWA-HOP-16-022). Retrieved from: <https://ops.fhwa.dot.gov/publications/fhwahop16022/fhwahop16022.pdf>.
- Smith, G., Sochor, J., & Karlsson, I. M. (2019). Public-private innovation: Barriers in the case of mobility as a service in West Sweden. *Public Management Review*, 21(1), 116–137. <https://doi.org/10.1080/14719037.2018.1462399>.
- Sochor, J., Karlsson, I. C. M., & Strömberg, H. (2016). Trying out Mobility as a service: Experiences from a Field Trial and Implications for Understanding Demand. *Transportation Research Record: Journal of the Transportation Research Board*, 2542, 57–64. <https://doi.org/10.3141/2542-07>.
- Sochor, J., Strömberg, H., & Karlsson, I. C. M. (2015). Implementing Mobility as a service: Challenges in Integrating User, Commercial, and Societal Perspectives. *Transportation Research Record: Journal of the Transportation Research Board*, 2536, 1–9. <https://doi.org/10.3141/2536-01>.
- Spears, S., Houston, D., & Boarnet, M. G. (2013). Illuminating the unseen in transit use: A framework for examining the effect of attitudes and perceptions on travel behaviour. *Transportation Research Part A: Policy and Practice*, 58, 40–53. <https://doi.org/10.1016/j.tra.2013.10.011>.
- Statista (2020). Number of licensed cars in London, England from 1995 to 2018. Available at <https://www.statista.com/statistics/314980/licensed-cars-in-london-england-united-kingdom/>.
- Steg, L. (2005). Car use: Lust and must. Instrumental, symbolic and affective motives for car use. *Transportation Research Part A: Policy and Practice*, 39(2–3), 147–162. <https://doi.org/10.1016/j.tra.2004.07.001>.
- Storme, T., De Vos, J., De Paepe, L., & Witlox, F. (2020). Limitations to the car-substitution effect of MaaS. Findings from a Belgian pilot study. *Transportation Research Part A: Policy and Practice*, 131, 196–205. <https://doi.org/10.1016/j.tra.2019.09.032>.
- Strömberg, H., Karlsson, I. M., & Sochor, J. (2018). Inviting travelers to the smorgasbord of sustainable urban transport: Evidence from a MaaS field trial. *Transportation*, 45(6), 1655–1670. <https://doi.org/10.1007/s11116-018-9946-8>.
- Tirachini, A., Hensher, D. A., & Rose, J. M. (2013). Crowding in public transport systems: Effects on users, operation and implications for the estimation of demand. *Transportation Research Part A: Policy and Practice*, 53, 36–52. <https://doi.org/10.1016/j.tra.2013.06.005>.
- Tsimpa, A., Polydoropoulou, A., Pagoni, I., & Tsouros, I. (2019). A reward-based instrument for promoting multimodality. *Transportation Research Part F: Traffic Psychology and Behaviour*, 65, 121–140. <https://doi.org/10.1016/j.trf.2019.07.002>.
- Vedel, S. E., Bredahl Jacobsen, J., & Skov-Petersen, H. (2017). Bicyclists' preferences for route characteristics and crowding in Copenhagen – A choice experiment study of commuters. *Transportation Research Part A: Policy and Practice*, 100, 53–64. <https://doi.org/10.1016/j.tra.2017.04.006>.
- Vaismoradi, M., Turunen, H., & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing & health sciences*, 15(3), 398–405.
- Walle, A. H. (2015). *Qualitative Research in Business: A Practical Review* (p. 69). Newcastle-upon-Tyne, UK: Cambridge Scholars Publishing.
- Wardman, M., & Whelan, G. (2011). Twenty years of rail crowding valuation studies: Evidence and lessons from british experience. *Transport Reviews*, 31(3), 379–398. <https://doi.org/10.1080/01441647.2010.519127>.