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Mobility as a Service: Exploring Young People's Mobility Demands and Travel Behavior

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Abstract

Increasing vehicular travel and environmental issues are trends increasing the pressure on urban transport systems. The new concept Mobility as a Service (MaaS) is one approach to tackle these challenges. The aim of MaaS is to reduce the need of the private car and increase the use of shared resources by providing one single application that integrates all transport modes, payment, and services. Several ongoing societal trends such as urbanization, technologic development, and sharing economy are examples of reasons for the emergence of MaaS. Young people are often leading the development and are early adopters of new technologies. The mobility demands of young people today and in the future will therefore play an important role in the implementations of MaaS.

This qualitative study uses focus groups to explore mobility demands today and in the envisioned future of young people (aged 15-23) living in Stockholm. Our understanding of travel behaviour and mobility demands among young people is limited, and this study also aims to get deeper understanding of the underlying values and attitudes towards mobility that influence those demands and behaviours. This study aims to answer how young people's mobility demands look like and if they correspond to the visions of MaaS as stated by developers and experts of the concept.

Findings indicate that mobility demands and behaviour are strongly influenced by parents, and underlying values such as 'Freedom' and 'Comfortable life' affect mobility more than factors such as availability and travel time. There is little need for increased accessibility to transport today and in the envisioned future. Findings also indicate a relatively widespread environmental awareness, but an unwillingness to convert awareness to change of behaviour. The demands of young people correspond to some extent with the visions of MaaS, and the probability of young people to adopt MaaS and to choose environmentally friendly journey is high if demands for convenience and comfort are fulfilled.

Sammanfattning

Fler bilresor och miljöproblem är trender som ökar trycket på transportsystemen i världens städer. Det nya konceptet Mobilitet som tjänst (MaaS) är en potentiell lösning på dessa problem. Syftet med MaaS är att minska behovet av den privata bilen och att öka användandet av gemensamma resurser genom att erbjuda en mobilapplikation som integrerar alla typer av transpormedel, betalningar och tjänster. Pågående samhällstrender likt urbanisering, teknisk utveckling och delningsekonomi främjar den pågående utvecklingen av MaaS. Unga människor har ofta en ledande roll i dessa trender och är tidiga att anpassa sig till nya tekniska lösningar. Deras mobilitetsbehov och beteende idag och i framtiden är av de anledningarna viktiga för implementering av MaaS.

Den här kvalitativa studien använder fokusgrupper som metod för att undersöka unga människor (15-23 år) i Stockholm och deras mobilitetsbehov och resebeteende idag och i framtiden. Vår förståelse för unga människors mobilitetsbehov och resebeteende är idag begränsat och studien syftar även att öka förståelsen för underliggande värderingar och attityder som påverkar dessa behov och beteenden. Vidare syftar studien att jämföra dessa behov och beteenden med visionerna för MaaS och hur väl de överensstämmer.

Resultaten visar att unga människors behov och beteende är starkt påverkat av föräldrar, och att underliggande värderingar som ”frihet” och ”bekvämlighet” påverkar behoven mer än traditionella aspekter som tillgänglighet och restid. Resultaten visar också att unga människors i Stockholm inte har behov av mer mobilitet idag eller den uppmålade framtiden. Miljömedvetenheten är relativt utbredd bland unga människor samtidigt som medvetenheten inte påverkar behov och beteende i någon större utsträckning. Visionerna för MaaS överensstämmer relativt bra med unga människors behov. MaaS bör inte erbjuda mer möjligheter till ökad mobilitet men om tjänsten erbjuder bekväma och smidiga resor så är chanserna att unga människor väljer mer miljövänliga alternativ goda.

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Contents

1. Introduction & Aim

Nearly all predictions of future mobility on a global level assume that both overall vehicular travel and car ownership will continue to rise. Research also increasingly acknowledges the environmental and resource problems facing transport in a future where urbanization and densification of our cities are continuing trends (Moriarty & Honnery, 2008). To tackle the challenge of increasing pressure on urban transport systems and the environment one approach has been a shift towards shared mobility services, such as car sharing and bike sharing, with the aim to reduce the need of a private car. Autonomous vehicles (AVs) have also the potential to reduce the need of private cars and will play a big part of future transport system (McCluskey, 2016). However, the complexity today of using a variety of transport modes, different payment methods, different mobile applications for each operator, and a lack of integrated information discourages many people to use those services. As a response to these complexities the development of mobility services go faster than maybe ever before (Bern *et al*, 2016), and in the forefront of delivering individualized and integrated mobility services is what we today call Mobility as a Service (MaaS) (Hensher, 2017). The aim of MaaS as a concept is to integrate all those elements of future transport system and provide one single mobile application that provides its users with seamless and accessible mobility (Kamargianni *et al*, 2016).

This study has its foundation in several societal trends that occur in parts of the world today, which have the potential to facilitate adoption of MaaS. This study explores the role of young people in this development, which is the population group that in many cases is leading the development of these trends in society. Firstly, young people of today show different attitudes and behaviours towards car ownership and driving. Despite the increasing global trend of both overall vehicular travel and car ownership young people tend to drive less and do not have same intention to own their car as earlier generations, which will probably increase their demand for alternative mobility solutions such as MaaS. Secondly, young people are the first to adopt new technologies (Blumenberg *et al*, 2012) and are the first generation that has not experienced a life without the mobile phone. Their lifestyle, where the mobile phone is often constantly present, has both reduced the demand for some kind of trips, due to a shift in how they socialize, but also increased the demand for a transport system where you can work, text or talk on the phone while travelling (Davis *et al*, 2012; Transport Systems Catapult, 2016). The travel behaviour of young people today will persist when they move into adulthood (Line *et al*, 2010; Blumenberg *et al*, 2012; Smart & Klein, 2017), and therefore development of MaaS according to demands and visions of young people could have the potential to increase long-term usage and adoption of such mobility services. Also, today most of existing research on mobility and travel behaviour has been conducted on adult populations and our knowledge of young people's travel behaviour is surprisingly limited (Blumenberg *et al*, 2012; Skrbis *et al*, 2013).

This qualitative study uses focus groups as method to explore mobility demands of today and in the envisioned future of young people (age 15-23) in Stockholm. It also aims to gain deeper understanding of the underlying patterns of values

and attitudes that influence those demands and visions. Further it aims to put those findings in the context of MaaS and explore if mobility needs and visions of young people correspond to the visions of MaaS as stated by experts and developers.

The study aims to answer the following research questions:

- How do the mobility demands of young people look like today and in the envisioned future?

- Do the visions of MaaS correspond to the mobility demands and visions of young people?

1.1 Scope & Limitations

The study was conducted between March 2017 and September 2017 and equals 20 weeks of fulltime work. The study uses focus groups to explore mobility demands and travel behavior of 22 young people (15-23 years of age) in Stockholm County, all with generally good access to public transport and other transport modes. The results are limited to be valid only for young people living in an urban environment with good availability of mobility, and the results cannot be generalized and valid for other population groups or young people living in cities with less developed public transport system.

1.2 Structure of the Report

The structure of this report includes five main sections. The first one is the introduction and the aim of the study. The second one is the literature review and earlier research on MaaS, mobility and travel behaviour. The third section describes the methodology and the methods used to collect data. The fourth section is a combined section of the findings and discussion. In the last section the conclusions drawn from this study are presented which also contains suggestions for implementation of MaaS based on the findings of this study as well as suggestions for further research

2. Literature Review

This section introduces and defines the concept of MaaS. It also describes the different components that together form the concept and what services it aims to deliver. This section also describes the emergence, potentials, visions and risks with the concept. Further this section gives a brief overview of young people's mobility needs and patterns today, attitudes and behaviour theory among young people, and describes other aspects that influence travel behaviour. Lastly this section introduces attitudes towards private cars and towards autonomous vehicles (AVs).

2.1 Introduction and Definition of Maas

MaaS is a relatively new concept and does not have a commonly agreed definition (Holmberg *et al*, 2016). This study will neither attempt to give a strict definition of the concept. However, this section will introduce the concept and present the interpretation of the concept as used in this study.

MaaS is today a broad concept that could theoretically refer to all kinds of mobility services, even occasionally single-mode services such as Uber or car sharing (Mukhtar-Landgren *et al*, 2016). Also terms like *multimodal mobility*, as described by Spickermann *et al* (2014), combines different travel modes and is similar to MaaS. However, the concept lacks the service component that is regarded as an important aspect of MaaS (Karlsson *et al*, 2016). Another related concept is *Shared mobility* that refers to different transport modes shared between users. This concept lacks the integration of different modes to be fully considered as a MaaS (Mukhtar-Landgren *et al*, 2016).

In broad terms MaaS refers to a co-operative and interconnected transport system where services, infrastructure, information, and payment are all important aspects of the concept. The idea is also to blur the boundaries between transport modes and between private and public operators (Karlsson *et al*, 2016). McCluskey (2016, p. 40) summarize the idea of MaaS by stating: "Instead of locating, booking and paying for trains, buses and taxis separately, multimodal platforms let travellers plan and book door-to-door journeys from a single app, providing real-time journey information at the touch of a button".

MaaS will mostly be developed as an application (used on phones or tablets), and the concept involves buying mobility services as packages based on users needs instead of buying the means of transport (Karlsson *et al*, 2016). However, as the concept is relatively new there are varying definitions and varying starting points for the purpose of MaaS. For example, the Swedish Knowledge Centre for Public Transport (K2) sees MaaS as a tool to make private car ownership less attractive, whereas the Transport Systems Catapult (2016) and MaaS-Alliance (n.d) focus on users and their expectations for a well functioning transport service. Kamargianni *et al* (2016) highlights the needs and demands of users, but focus on the growing pressure on the personal transport system of cities as a starting point, and see MaaS as a solution to insufficient capacity within that system.

This study adopts MaaS as defined by Sochor *et al* (2015, cited in Mukhtar-Landgren *et al*, 2016, p. 8):

> A service that not only integrates a range of mobility services, both public and private, but also provides one-stop access to all services through a common interface (hence creating a seamless customer experience, i.e. the service). The service component could be more or less developed, ranging from simply the possibility to find travel information and pay for different mobility services within one technical system, to providing more far-reaching mobility service offers such as subscriptions to different mobility packages, perhaps also involving other service components such as goods delivery or bicycle repair services.

The main difference to other concepts, like *multimodal mobility* and *shared mobility* is the integration of all kinds of travel modes, integration of payment, and the potential of involving other service components.

Even if the starting points and aim of the service differ among developers there are more definitions that describe MaaS similar to the interpretation used in this study. MaaS Alliance (n.d.) defines it as: "MaaS fulfils users' needs for mobility with a wide range of transport services for both travellers and goods, offering tailor-made transport on demand. To meet a customer's needs, a MaaS service provider arranges the most suitable transport means, be it public transport, taxi or car rental, or even ride-, car- or bike-sharing". This definition adds to the former one the dimension of "suitable transport means". Even if the overall aim of MaaS is to reduce the number of trips by private cars, this definition indicates that no travel mode is favoured over others, and that the term "suitable" varies from each individual trip.

The above definitions of MaaS suggest that single-mode services (such as Uber or car sharing) should not be regarded as MaaS but rather as components of MaaS. The same can be said for route planners and booking systems that are an important part of a complete MaaS platform.

2.2 The Emergence and Visions of MaaS

Holmberg *et al* (2016) and Burrows *et al* (2015) argue there are several reasons for the emergence of MaaS. On a societal level there is an ongoing trend of urbanization and densification of our cities and the need to tackle climate change. There is also an emerging trend of the sharing economy, and the young people of today are a generation characterized by for example declining consumption patterns and a higher demand for personalized and on-demand services. Further, we also experience some economical changes in society that drives the development of MaaS. The first and main one is the excess capacity and idle transport assets, which allows profitable markets in the forms of for example car sharing, which is one part of MaaS, and the most developed of shared mobility services in Sweden today. The second economic driver is the increased financial flexibility that allows start-ups as well as various digital payments solutions. According to Felländer *et al* (2015) another driver entails technical development. The increased usage of smartphone's and access to Internet is the main enabler of the transformation of the transport sector

towards mobility services such as MaaS and a sharing economy within it. The UK's Technology and Innovation Centre for Intelligent Mobility also highlights technical development as a driving force and states: "the opening up of transport datasets has already added significant value to travellers in terms of new applications. As a result of the Internet of Things, transport data will become more pervasive. Combining big data with new autonomous transport systems will enable opportunities to innovate and refine MaaS offerings" (Transport System Catapult, 2016, p. 31). Lastly, the increased usage of social networks facilitates new MaaS services by offering for example different ways of marketing that could intensify the development (Holmberg *et al*, 2016).

The transport sector is traditionally conservative and has historically avoided major change up to now (Holmberg *et al*, 2016). This is due to a several set of circumstances in the transport sector, which according to Burrows *et al* (2016, p. 2) are: "the cost and time to develop transport infrastructure, the cost and complexity of entry into the market, the regulatory environment and difficulty of taking on relatively large and (usually) well-established businesses". But MaaS and new technologies now have the potential to break down such barriers by innovative solutions, which for example require less investment in infrastructure (for example by integration of travel modes and mobility operators), and new companies who finds new ways to enter the market of mobility and transport (for example Uber)(ibid.).

Public transport routes have also traditionally been fixed, the stops have been fixed and run on a fixed timetable. Fixed transport services mean that passengers have to organize their door-to-door journey with the 'last mile' element always being outside the system, requiring separate planning and information. Traditionally there has also been a clear and established range of transport modes (Burrows *et al*, 2015), and users are locked in to a single mode of transport when they buy a car or a public transport pass (Sochor *et al*, 2016). The vision of MaaS is to change this structure of mobility and the transport sector and turn it in to a more customer-centric sector, and to help them choose the most suitable travel mode for each individual trip (ibid.), and by so blur the boundaries between different transport modes (Burrows *et al*, 2016). The overall vision and aim of MaaS could also be argued to be to decrease private car ownership and increase the use of shared resources (Sochor *et al*, 2015; Kerttu *et al*, 2017). The vision of the first MaaS company in the world (MaaS Ltd) is divided into four main objectives; the first is to give back 90 minutes of the day to the users by reducing daily travelling time, maintain the freedom of movement, take away the pain of "how do I get there?" and to make sure the user is not a polluter (Hietanen, 2014). MaaS has the potential to change attitudes and behaviours, as well as the norms to both private and public transportation (Bern *et al*, 2016). However, for the visions and potentials to be fulfilled MaaS needs to be both commercially viable but also adopted by its future users (Sochor *et al*, 2015).

2.3 The Framework of MaaS

The framework of Maas contains of infrastructure, transportation providers, and the MaaS services (i.e. the application) (See **figure 1**). All these sectors will change in the future and adapt to future mobility needs.

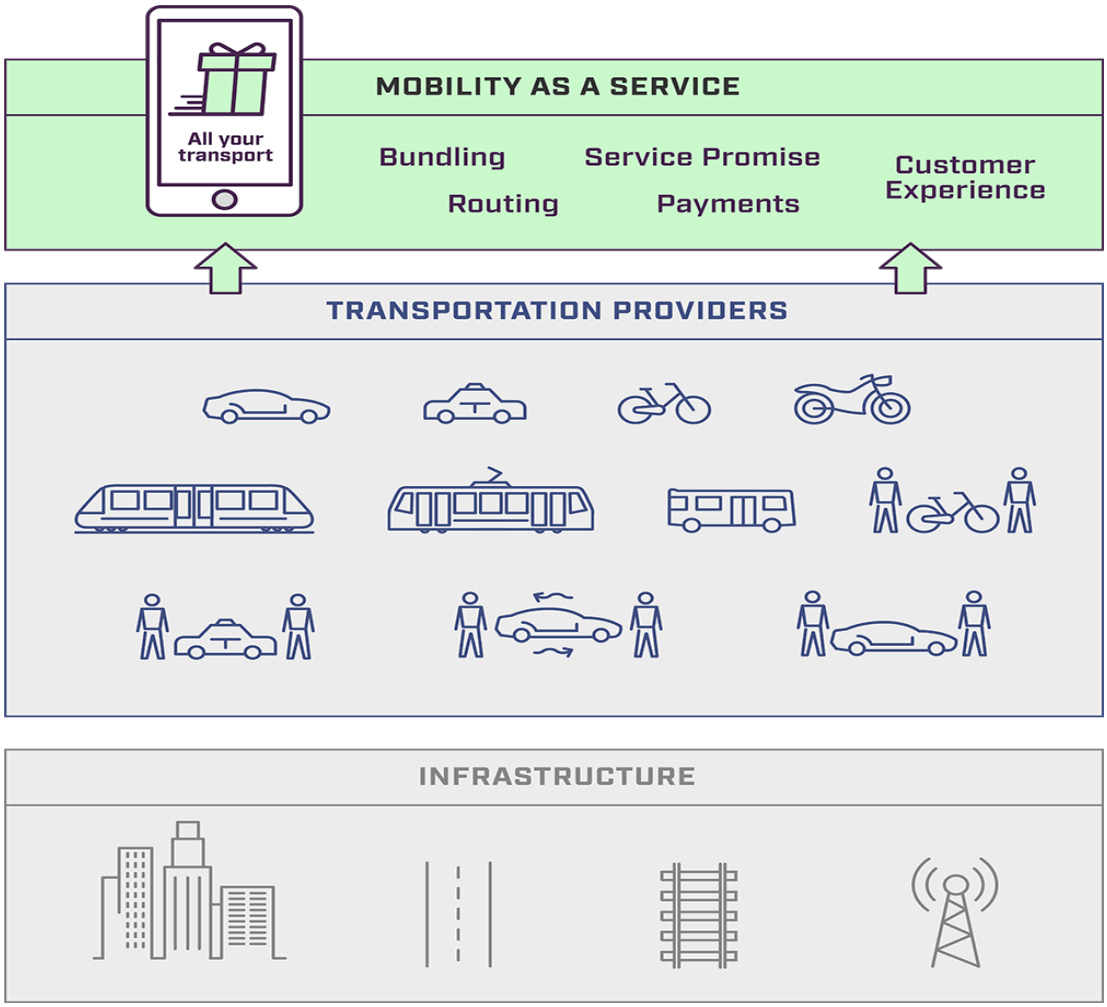

Figure 1. Conceptual visualization over the framework of MaaS (Source: MaaS Global, 2017)

The infrastructure is the most rigid part, but there will be changes even in the infrastructure in order to adapt to future mobility demands. Additions to the infrastructure could be various sensors for AVs and charging stations for future electrified vehicles. Within the sector of transportation providers a lot of changes will happen. New car sharing, bike sharing and self-services will occur as well as new services within public transport. New transport modes such as AVs will also play a big role in this sector. Within the MaaS sector all information and communication technology will occur and the software applications (See next section for examples of two existing applications) will be developed. Payment, navigation, tolls, booking, and scheduling are examples of components within that sector. (Finnish Transport Agency, 2015).

2.3.1 Design of MaaS Applications

This section is based on the assumption that a MaaS application needs to meet the commercial demands of the users in order to obtain its aims and potentials (Sochor *et al*, 2016). When later discussed, this section should be regarded as a summary of all the aspects of young people's mobility demands and visions and how these should be met in terms of services provided, design, cost and payment, and usability in form of a potential MaaS application. To increase understanding of the design of a MaaS service this section introduces two examples of existing applications and briefly describes their functions. The first one is the Finnish application *Whim*. The second one is the UbiGo service, which was a pilot project launched in Gothenburg in 2014.

Whim is currently available in the Helsinki region and gives access to buses, commuter trains, trams, metro, ferries, taxis and rental cars. Services as rental bikes and car sharing are not included yet but will be in the future. The application is free to download and service is offered with three different monthly subscriptions, while a pay per ride solution also is available. The basic package cost €89 per month and is converted to 94 Whim points. The package includes unlimited travel on public transport, which equals 55 points, and the rest of the points could be used for other modes and equals for example 2 median length taxi rides. The second package cost €149 per month and equals 179 Whim points. The package includes unlimited travel on public transport and points that cover for example 6 median length taxi rides or 4 days of car rental. There is also a business package offered with unlimited public transport and taxi rides. It is possible to change the subscription on a monthly basis and unused Whim points will be lost and not transferred to the following month (MaaS Global, 2017).

The UbiGo test project contained 83 households and 195 individuals who became test pilots for the service. They were recruited in different ways but had all already relatively good access to public transport and car sharing service. UbiGo provided a similar service as Whim even if there were several differences. The travel modes offered to the users included all the ones offered in Whim, but it also included bike- and car sharing services. The test included only one single subscription to a minimum cost of €135, which was converted to credits. In difference to Whim, the UbiGo service were adapted and personalized to the transport needs of each individual user. Also, unused credit could be transferred to next month. In the application the user could activate tickets/trips, make and check bookings, check credit balance, trip history and so forth. The service also included a customer service line and an improved so called traveller guarantee (Karlsson *et al*, 2016).

2.4 Potential Risks with MaaS

The concept of Mobility as a Service has been proposed as a feasible way to achieve more sustainable transport in terms of reduced environmental impact, mainly due to its potential to reduce the need of private cars by increasing accessibility to other transport modes (Sochor *et al*, 2016). However, predictions indicate that depending on the aim of the MaaS service the outcome might be

different. If the aim is to reduce car usage and traffic congestion, by providing alternatives to the private car, there is potential to reduce the generation of car traffic and increase the share of trips by public transport and other modes. On the other hand, if the aim of the service is to attract as many customers as possible the amount of trips might increase. Even if the trips with private car will decrease the amount of trips with other travel modes might be higher than today, and by so the possible positive environmental effects of MaaS are more unpredictable (Kerttu *et al*, 2017). Also Holmberg *et al* (2016) claims that MaaS has the potential to reduce environmental impact, but there is also a risk for induced demand and MaaS will enlarge the market for mobility providers. That means that MaaS risk to provide opportunity for a bigger market for mobility operators due to the increased accessibility to mobility given by MaaS, and if so the environmental benefits could be overstated.

The potential of MaaS to reduce emissions lies partly in the increased accessibility to different transport modes other than the private car. However, to achieve the aims there is a need for change of attitudes towards car ownership – where people choose to share cars in different ways instead of owning their own. If that is not changed the positive effects of MaaS are more unpredictable (Kerttu *et al*, 2017; Sochor *et al*, 2014). Due to the limited implementation of MaaS to date, little research has evaluated the impacts from such a service on both travel behaviour change and environmental impacts (Kamargiani *et al*, 2016).

2.5 MaaS and Young People

Exploring young people's mobility needs and visions in relation to MaaS is relevant for several reasons. Firstly, there is a gap in the research literature in investigating travel behaviour among young people, because the majority of existing research addresses adults (Blumenberg *et al*, 2012; Kamargianni *et al*, 2012; Skrbis *et al*, 2013). Young people of today are "members of the first generation to have never known a world without instantaneous and nearly ubiquitous mobile phone access" (Blumenberg *et al*, 2012, p. 12), and they tend to be the first age group to adopt new technologies (ibid.), which most likely will make adaptation to MaaS applications a relatively small step compared to the efforts required by other age groups.

Further, young people are the most likely to first adopt MaaS (Transport Systems Catapult, 2016) because they show different behaviours towards car ownership and driving than earlier generations – they tend to drive less and when they do they use more hired or shared cars (Burrows *et al*, 2016; Transport Systems Catapult, 2016). According to Davis *et al* (2012) this trend has emerged mainly due to increased environmental awareness and technical development. More young people of today consider the environmental impact from private cars and tend to choose other transport modes to a greater extent than earlier, and technological improvements make alternatives to the car more convenient to use. Ubiquitous mobile phone access has also changed the lifestyles of young people and social networking has reduced the need for some trips (they tend to socialize more online than meet in reality than earlier generations), as well as public transport is more compatible with the lifestyle where one can talk on the

phone, text or work while riding. On top of that, those who not yet drive face greater obstacles, mainly economic, to driving licence than any previous generation faced, and there is a decreasing trend, in Sweden and many other countries, in the percentage of young people with driving licence (Blumenberg *et al*, 2012).

2.6 Mobility Demands

Mobility Demands represent the core of mobility and basically includes travel patterns and choice of travel mode. In other words, this theme is about how young people travel in the city and which travel modes they use, and is important to consider since it is predicted to change in the future if MaaS applications are implemented on a broader scale (Bern *et al*, 2016). Young people "are making trips to school, after-school private tutorial lessons, sport activities, entertainment activities, visiting friends, parks and a host of other destinations" (Kamagianni *et al*, 2012, p. 3636), and there is quite obviously significant variation in mobility demands and patterns among young people. Mobility demands and patterns depend on their age, personal circumstances (such as social class and family relations), and where they live (Taylor *et al*, 2007). Regarding choice of travel mode there are relatively good statistics in Sweden to identify mobility patterns. A survey of travel habits in Stockholm County in 2015 (Stockholm County Council, 2016) shows young people (age 16-24) mostly use public transport, 80% of total share, while the car stands for only 5% of total share, for travelling to and from school. The rest 15% is distributed between travelling by foot, by bicycle, or other means of transport. When the same group travels to work the share of car use increases to 28% and public transport decreases to 55%. For commuting to school/work the distribution of travel modes is relatively similar as the older group in the survey (age 25-39), while the people aged 40-64 use the car significantly more and use public transport less than other age groups. When it comes to leisure trips the share of car use increases for young people to 30% and public transport decreases to 42%.

Explorations of young people's visions of future mobility demands are of importance for several reasons. To realize transformations (such as implementation of new mobility systems like MaaS) it is important to have a vision (Ortegon-Sanchez & Tyler, 2016), but the problem is often that there are differences in the vision of planners and developers in relation to the vision of the public (Bern *et al*, 2016), and for that reason exploring the vision of young people of today is argued to be important to obtain a broad adoption of MaaS. Also, to reach a common vision planners and developers need to understand changes in behaviours and demands that are occurring in the society (Auvinen *et al*, 2012).

2.6.1 Influences of Young People's Mobility Demands

This section is about factors that influence mobility demands and travel behaviour, and addresses aspects such as the cost, availability, frequency, travel time, and safety of different travel modes. It also addresses the influence of environmental awareness, the built environment, and earlier experiences. Each one of them is often included in different ways in research related to mobility

and travel behaviour, and were identified while reading research of for example Line *et al* (2006; 2010), Klein (2016), and Sochor *et al* (2016).

Mobility demand has traditionally been a matter of two factors. The first is the characteristics of the transport service supplied: the cost, travel time, frequency, safety, and spatial coverage. The second set of factors is related to aspects outside the control of the transport provider: the regional economy, local geography, land use near stations and so forth (Klein, 2016). However, there are also incalculable and context-specific perceptions about transport and underlying socially constructed factors that influence individuals' decisions in everyday mobility (ibid.). When young people move to a new neighbourhood their mobility patterns will be influenced by the built environment context of the new neighbourhood, the economic circumstances, their attitudes and preferences, and their past experiences (Smart & Klein, 2017). Sochor *et al* (2016) address similar thoughts and argue that in order to understand mobility needs and behaviours, one needs to address individuals in a social context and understand that for example household members influence each other and coordinate their mobility needs.

Young people are susceptible to external factors and past experiences of mobility most likely shape decisions today and in the future (Smart & Klein, 2017). For example, research by Mackay (1997, cited in Line *et al*, 2006) indicates that people 16-18 years old with unrestricted availability of a car (either if they drive themselves or are driven by someone else) use it for almost all journeys. This tendency appears to continue as they age and they are likely to continue to use cars for almost all journeys later in life. This relationship tends to be the same with public transportation. Young people exposed to a lot of public transportation during early years in life display travel behaviour later in life dominated by public transportation and less car use (Smart & Klein, 2017). How much young people are affected by exposure to public transportation has shown to differ depending on their age at the time of the exposure. The strongest effect seems to start from the early twenties and end around thirty, and for older people that age has a stronger effect on their travel behaviour than their current transportation possibilities and the built environment they are living in at the moment (ibid.).

One other aspect that influences young people's mobility choices, more than adults, is cost. Storey and Brannen (2000, cited in Line *et al*, 2006) found that the cost of public transport is a significant barrier to young people making use of it. Also Taylor *et al* (2007, p. 30) states that the costs of the journey influences travel mode choice, but also "frequency of the services, reliability, how crowded the service is, whether it arrives and leaves on time, and how many stops the service makes between an individual's starting point and their destination" influence young people's choice of public transport mode. However, young people tend to underestimate the real cost of a car in relation to public transport. This is because they might get financial support from parents to buy a car or they borrow the car from their parents (ibid.).

2.6.2 Attitudes and Behaviour of Young People

This section is about the underlying values and attitudes that influence mobility demands and travel behavior of young people today and in the future. As mobility demands are predicted to change understanding the underlying values and attitudes is important to in order to adapt mobility services and the transport system to those changes (Beirão & Cabral, 2007), and is therefore important for the developers of MaaS.

Line *et al* (2010) indicates that values such as 'A Comfortable Life', 'Freedom', and 'Pleasure' act as underlying influence on adults and young people in regards to travel behavior. Also, young people are more sensitive than adults to external factors and values such as 'Identity', 'Image', and 'Social recognition' that play a big part in their travel behavior. Even if young people understand the environmental impacts from different transport modes and the environmental awareness increases, they tend to ignore environmental aspects of mobility to a larger extent than adults. This is due to young people being concerned about issues in the present, such as exams and homework that have mental precedence to issues related to long-term environmental impacts. There are also several social factors that influence travel behavior among young people. Line *et al* (2006) argues that the perception of peer impact travel behavior and being seen as 'cool' by friends are important from the age of 11 and onwards. Even so, the conformity to peer group norms seems to decline in the later stage of adolescence when they develop their own identities (ibid.).

Even if exposure and use of a certain type of transportation mode seems to follow young people into adulthood (as described in previous section), their attitudes towards a certain transport mode does not seem to follow the same pattern. Research by Taylor *et al* (2007) indicates for example that a very positive attitude towards for example private cars does not mean a negative attitude towards public transport. On the contrary, young people with very positive attitudes towards public transport can also see the benefits of cars. In this case both female and male demonstrated similar attitudes, and gender seems to have less influence than perhaps assumed on attitudes towards different transport modes.

2.7 Attitudes Towards Car Ownership and Private Cars

This section is important for this study mainly due to the aim of many MaaS applications, which is to reduce private car ownership and the distance travelled by private cars (Sochor *et al*, 2015; Kerttu *et al*, 2017). For developers of MaaS to obtain this aim it is important to understand the attitudes the young people of today towards car ownership and private cars, but also to understand why they have those attitudes and what influence them.

Dittmar (2004, cited in Line *et al*, 2010, p. 241) argues that values and beliefs influence young people's attitude towards cars. In the study she claims: "The majority of participants associate the car with a second set of beliefs, believing it be capable of providing them with an identity of adult status, an image of success and, with respect to those already driving, a sense of purpose relating to the

roles they play as a driver in their family and peer group". Previous research has shown that there is a desire among young people to drive and own a car in the future (Line *et al*, 2010). Dittmar (2004, cited in Line *et al*, 2010, p. 241) argues this is because materialistic values, and they influence young people belief that material goods are: "a central life goal; the main route to identity, success and happiness; and the yardstick for evaluating self and other". On the other hand, the young generation of today is characterized by declining consumption patterns (Holmberg *et al*, 2016). There is also a societal trend today that supports shared resources and economy and there is a current shift in attitudes and values in a more environmentally conscious direction, which will allow for example joint and shared car ownership or no ownership at all (Sochor *et al*, 2016).

Taylor *et al* (2007) present a broad range of young people's attitudes towards private cars, even if most of them were relatively positive. The predominant benefit that young people expressed about using a private car was the perceived ability to travel to places more easily and quickly than using public transport. Other benefits expressed included being able to go to an exact destination, rather than the nearest transport link, being able to come back home at whatever time, rather than having to rely on timetabled services, and being able to easily carry things with them. It was also stated by the young people in the study that a private car gave them a sense of independence and control of their own lives and having an own private car, some argued, gave them a feeling of not being a burden to their parents and a chance to get away from their parents. Some young people with positive attitudes to cars also mentioned the physical experience of driving a car as a leisure activity in itself. Cars were also seen as a safer alternative to public transport, especially at night.

The disadvantages expressed by the young people in the research of Taylor *et al* (2007) were mostly practical ones and included problems such as limited parking space, stressed associated with congestion, not being able to drink when going out, and the costs of owning and running a car. Even if most of the young people in the study felt safer when driving themselves, some recognized the danger associated with driving. As mentioned earlier, research by Line *et al* (2010) indicates that young people show little awareness of the environmental impacts from transport, and the research by Taylor *et al* (2007) indicates similar pattern. However, there were some concerns raised about the negative environmental impacts from cars, even if most of them related to local environmental issues. Taylor *et al* (2007) sums up by stating that the attitudes towards private transport and cars showed to be less dependent on the local context than public transport and more related to the inherent benefits and disadvantages of the car.

2.7.1 Attitudes Towards Autonomous Vehicles

AVs are expected in the future to replace many of the private cars we have today and will most likely play a big part of future MaaS applications and transport system (McCluskey, 2016). However, attitudes towards AVs are an unexplored research topic and "the limited research that has been conducted in recent years is focused mostly on examining the technical aspects and feasibility of AVs, and

the impacts on safety and congestion. Little research exists to date on the potential behavioral shifts and the underlying motivations to use AVs." (Haboucha *et al*, 2017, p. 38). This study addresses AVs mainly as fully automated vehicles, which means the driver basically do not need to manoeuvre the vehicle at all. However, "since fully automated cars are not commercialized yet, it is important to examine acceptability, attitudes and drivers' intentions toward fully automated vehicles" (Payre *et al*, 2014, p. 253). Exploring the attitudes of individuals towards AVs are also important since the public controls the governing policies and future infrastructure needed for implementation of AVs (Haboucha *et al*, 2017), as in turn provides the conditions and possibilities for MaaS developers to include AVs as a service.

What we know is that there are already more or less autonomous AVs on our roads today, but they will most likely play a much bigger role in future mobility than right now, and widespread adoption of autonomous vehicles "is increasingly considered to be inevitable" (Gruel & Stanford, 2016, p. 18). Further, AVs have the potential to "fundamentally alter transportation systems by averting deadly crashes, providing critical mobility to the elderly and disabled, increasing road capacity, saving fuel, and lowering emissions" (Fagnant and Kockelman, 2015, p. 167). On the other hand, the long-term effects of AVs are more uncertain. Gruel and Stanford (2016) argues that there could be environmental positive effects of AVs if people's behavior does not change (even if amount of mobility will increase) and they continue to use AVs as they use their cars today. That will basically reduce the need of private cars and be replaced by AVs that are shared or operates as taxis. However, if behavior change and AVs increases the attractiveness to travel by car the amount of mobility might increase even more and take shares from various public transport modes and other modes of transport, and if so, the long-term positive effects are uncertain.

There are also ethical dilemmas to be explored and AVs "will sometimes have to choose between two evils, such as running over pedestrians or sacrificing themselves and their passenger to save the pedestrians" (Bonnefon *et al*, 2016, p. 1573). Defining the algorithms that will help the AV to take such decisions will be challenging. When people in one study were confronted to such scenario, they tend to accept so called utilitarian AVs, which is programmed to sacrifice their passenger for the greater good, and they would like others to buy them. On the other hand, they would themselves prefer to ride in AVs that protect their passenger at all cost (ibid.).

3. Methodology

In recent years there has been an increased interest in qualitative methods in mobility and travel behavior research (Mars *et al*, 2016), a research fields that historically have been characterized by quantitative studies (Pooley, 2012; Cass & Faulconbridge, 2016). Today, travel behavior is complex due to for example the multiple travel choices, all with different characteristics, advantages and disadvantages, and costs, which people face for each individual journey (Beirão & Cabral, 2007). To make implementation of MaaS effective, a deep understanding of people's attitudes, perceptions and behavior is needed, and to understand those mobility complexities a qualitative method is a suitable tool to use (ibid.). Mars *et al* (2016, p. 435) explains the difference between qualitative and quantitative methods in mobility research as follows: "Qualitative methods applied to travel behavior studies focus on the subjective experiences of individuals related to travel. On the other hand, quantitative approaches are more interested in knowing frequency and distributions of trips". The aim of this study is to capture the subjective experiences of young people to gain a deeper understanding of the values and attitudes that influence mobility demands and travel behavior.

3.1 Focus Groups

Focus groups were originally developed as an academic research method, but since the 1950s they have become more synonymous with market research. However, the method has in recent years regained popularity in academic research and is now widely adopted in a wide range of research fields and disciplines (Liamputtong, 2011a). The method has historically been used as a primary research method to explore participants' own views and understanding of a particular topic.

The method is a participatory method and Kitzinger and Barbour (2011, p. 5) describe the main difference to other group interviews by stating: "Focus groups are distinguished from the broader category of group interviews by the explicit use of group interaction to generate data", which means focus group researchers should aim to encourage participants to debate and talk to one another instead of asking questions to each person in turn (Bagnoli & Clark, 2010). The interactive nature of focus group discussions has the potential to generate more developed thoughts and ideas than many other interview methods, and the participants tend to elaborate more on the topic discussed compared to individual in-depth interviews or other group interviews (Wilkinson, 1998). Those characteristics of focus groups mean it has exploratory potential, which generates understanding of group reactions to a specific research topic rather than identifying individual opinions (Bagnoli & Clark, 2010). Kitzinger (1995, p. 299) states that: "The method is particularly useful for exploring people's knowledge and experiences and can be used to examine not only what people think but how they think and why they think that way".

3.2 Methods

The following sections describe how focus groups were used in this study. It describes the recruitment of participants, selection and sample of participants, how the focus groups were structured and designed as well as how they were conducted, and lastly how the focus groups were transcribed and analysed.

3.2.1 Recruitment of Participants

Schools are a suitable source to recruit young people (Line *et al*, 2006), and in the initial stage of the recruitment process emails were sent to 29 upper secondary schools in the Stockholm region. The age of students in upper secondary school is 16-20. Email was sent either to the principals of the school or directly to teachers, in some cases emails were sent simultaneously to both principals and teachers. The email contained an introduction of the study, the aim of the study, and an inquiry to the recipient of the email if they had the opportunity and will to forward the question to the students to participate in the study. According to Kitzinger and Barbour (2011) one potential risk when using gatekeepers to recruit participants is that not all relevant information is passed on, therefore the respondents of the email were encouraged to pass on the whole introduction to potential participants. In those cases where a reply was received a telephone contact was later established. Five of the schools responded to the email and sent the inquiry further to the students.

To avoid issues related to power relations, where adults or teachers control the environment of the students, it is important to give the control back to the students and let them choose to participate or not (Line *et al*, 2006). This was pointed out to the representatives of the schools and the aim was to only interview people who wanted to participate. Conducting research in schools should cause minimal disruption to teachers and class life (Rassol, 2004, cited in Line *et al*, 2006) and the aim was to conduct the interviews outside school hours. There was no compensation offered to the potential participants except from refreshments during the interviews. Two groups were recruited during the initial stage of the recruitment process.

In order to recruit more participants a second stage of the recruiting process was initiated. The range of age was broadened, to the age 15-24, and contact was established also with high schools and the researcher's personal contacts that worked within schools either as teachers or in other positions. Contact with high schools was established in the same way as in the first stage. Initial contact with personal contacts were carried out through a direct telephone call. In this stage three additional groups were recruited, one from a high school and two from the researcher's personal contacts.

During the recruitment process no personal characteristics were specifically targeted (except for age) of the potential participants. In other words, specific requirements such as gender, ethnicity, social class, mobility demand, prior knowledge on the subject, and so forth were not specified in the inquiry. However, personal characteristics like these influence mobility and a different sample within the same age group would most likely produce different findings.

3.2.2 Selection and Sample of Respondents

In total, 22 people participated in five focus groups (See **Table 1** for summary of the groups): 10 females and 12 males. According to Kitzinger (1994) four or five groups are suitable when studying a particular group of the population. The number of participants in each group ranged from three to six people. Liamputtong (2011) argues groups of six to eight people a suitable size for focus group discussion, which means some of the groups in this study could be argued as small regarding number of participants. On the other hand, Kitzinger and Barbour (2011) argues that some researchers prefer small groups with as few as three participants, and opinions among researchers in general seems to differ on what is a suitable size of a focus group. Group dynamics and interaction among participants within the different groups in this study appeared relatively similar. That indicates that a group size of only three participants, given the topic of the study and the structure of the focus groups, produced findings similar to the larger groups. The median age of the participants' was 17,5 years, ranging from 15-23 years old. Participants in all groups except one were full time students, out of them three groups contained of students from upper secondary school and one contained of students from ninth grade of high school. One group, with participants ranging from 21-23 years old, contained one full time university student, one part time employed worker and one full time employed worker.

Participants from three of the groups lived in central parts of Stockholm City – two groups of upper secondary school students and the group of people aged 21-23. The last group of secondary high school students and the group containing high school students studied and lived in an adjacent municipality in the northern part of Stockholm County. All participants lived close to where they studied or worked, except one who lived in a city about 50 km north of Stockholm. All participants, except one, from the groups containing students lived at home with their parents, the exempt lived by alone in an apartment in the city centre. The last group of participants aged 21-23 lived collectively together in a central located apartment. All participants had a monthly or a six-month pass to public transport.

Table 1: Summary of focus groups

Group	Participants	Age	School	Area
1	4 males 2 females	16-18	Upper secondary school	Central Stockholm
2	2 males 2 females	16-19	Upper secondary school	Central Stockholm
3	3 males	21-23	University/Working	Central Stockholm
4	1 male 2 females	17-19	Upper secondary school	Adjacent municipality, northern parts of Stockholm County
5	2 males 4 females	15-16	High school	Adjacent municipality, northern parts of Stockholm County

The socio-economic status and social class were more or less equivalent among participants, although questions regarding these aspects were not directed to the participants. The participants in the groups containing students were already acquainted with each other, as well as the participants from the group with slightly older people. The homogeneity among participants and the fact they already knew each other is, according to Bagnoli and Clark (2010), and Morgan and Krueger (1993), a recommendation to conduct successful focus group discussions. Also Kitzinger (1994) recommend working with clusters of people who already work, live or socialize together, and are used to naturally discuss with each other.

3.2.3 The Structure of the Focus Groups

The general structure of focus groups is less rigid and structured in academic research, and more structured in market research (Liamputtong, 2011a). The less structured approach is more likely to give the researcher a deeper understanding of the participants' meanings and interpretations and the approach encourages the participants to talk to each other rather than to the moderator (Wilkinson, 1998). The focus groups started with a short introduction of MaaS, which is a quite unknown concept for many, and an overview of the aims and objectives of the study. The last part of the introduction contained some requests and information to the participants. The participants were notified of the discussions being audio-recorded and about their anonymity in the study. They were also encouraged to talk to each other rather than to the moderator. Reducing the influence of the moderator also gives the participants more opportunity to set the research agenda, and to elaborate on questions they find most interesting to them (Wilkinson, 1998). Based on Krueger (2002) how to create a relaxed atmosphere it was also communicated that there was no right or wrong answers, that they should feel free to share all opinions even if it differed from what others said, and that both negative and positive comments on the questions were welcome. That was also communicated to reduce the risk of individuals being silenced due to the articulation of group norms that sometimes occur within focus group research (Kitzinger, 1995). The second and main part of the focus groups included the discussions (See **Appendix 1** for complete interview guide). The interview guide was used as a basis for the discussions and to keep the focus groups on track and to make sure all topics were more or less discussed. It was not followed strictly and supplementary questions differed from group to group and those are not specified in the guide. Before each topic was discussed a short explanation of the topic was given to the participants with the aim to clarify and explain the content.

The design of the questions was to a large extent inspired by Krueger (2002) on how to create suitable questions for focus group interviews. The main points stated by Krueger are for example to use open-ended questions, which is also highlighted by Kitzinger (1995). Dichotomous questions that can be answered with a "yes" or "no" were avoided as much as possible. Use of examples, choices, rating scales etc. was also useful to get participants involved and particularly useful in mobility research (Mars *et al*, 2016). The content of the questions was derived from the literature on mobility, MaaS, and attitudes and travel behavior theory. When the Swedish Transport Organisation launched an investigation about future mobility they addressed questions about attitudes and norms regarding travelling by car and the future of autonomous vehicles. They addressed this in relation to views on ownership, willingness to pay, and individual travelling in relation to public transport, and the expectations on the future transport system (Bern *et al*, 2016), and these were topics that influenced the content of the questions in this study. Auvinen *et al* (2012) describe similar questions for future mobility and MaaS and argue that concerns over privacy, security and public-private role divisions are crucial to investigate further, which also influenced the content of the questions.

3.2.4 Conducting the Focus Groups

Four of the focus groups were carried out in the schools where the participants were studying. Schools provide an easily accessible environment to carry out research (Line *et al*, 2006), and successful focus groups also rely on that the setting and environment is comfortable for the participants (Liamputtong, 2011). In order to avoid power relation issues and give control of the students it is suitable to let participants be involved in decisions such as the location for the focus groups (Line *et al*, 2006). The focus group with group 3 was conducted in their home, which was an apartment in central Stockholm were they collectively lived. The researcher was running and moderated the focus groups alone. After running the first focus group it was assessed that conducting the focus groups solely was possible and worked out fine. The focus groups were audio recorded with a voice-memo application on a mobile phone. Two phones were running voice-memo at the same time to avoid possible battery shut down or other technical issues. Few hand written notes were taken during the discussions mainly due to the risk of losing focus on and moderating the discussions. The focus groups lasted an average of 70 minutes each, ranging from 55 to 90 minutes.

3.2.5 Transcription

The focus groups were audio-recorded and transcribed. Some parts of the discussions that were considered irrelevant were left out from transcription. The conversations were in Swedish and transcribed to Swedish. The transcriptions were later translated, by the researcher, to English when it was used as the basis for the analysis. Excerpts cited in the analysis are English translations from the Swedish transcripts. Hydén and Bülow (2003) argue that Swedish speech differs from English in many ways, and these differences need to be considered. One way is to translate Swedish into English and try to retain the characteristics of the Swedish language. However, doing that could make the text difficult to read for English-speaking readers (ibid.). In this study the excerpts are translated into English to better fit the characteristics of the English language. It is a risk that small details and expressions in the conversation get lost when translation is done like that (ibid.), but it was considered to be of little importance. Also, disfluencies such as “ehhh”, “umm” and “aaah” or similar was excluded from the quotes, and was not considered to add any value to the analysis and risked to decrease the readability. Transcription of the focus groups took approximately 8 hours each, which is common for an hour-long focus group discussion (Liamputtong, 2011). The focus groups were listened through two times each in order to validate the first listening and to make sure the content of the discussions was perceived equal both times, as well as to fill in potential gaps in the transcription.

3.2.6 Analysis of the Data

This section describes and discusses the qualitative analysis of the collected data. This is done to increase consistency, clarity and congruence of the study (Mars *et al*, 2016), and it is something that is often insufficiently specified in focus group research (Wilkinson, 1998). Analyzing focus group data involves basically the same processes as any other qualitative data. However, the main thing that differentiates focus group analysis from others is that the researcher also needs

to consider group interaction (Kitzinger & Barbour, 2011). Hydén and Bülow (2003) highlights some important aspects that should be considered when analyzing focus group data. The main aspects to have in mind are to firstly consider who is speaking as what. That means basically that the question whether the participants talk and interact as a member of the group or if they talk and interact as individuals who happened to take part in a group activity. That aspect has to be considered during analysis and assessed to what extent that influences the outcome of the focus groups.

One disadvantage with data from less structured group discussions is the difficulty to compare it from group to group. This is because some topics will come up in some groups and not in others (Morgan, 1997), and given that, such comparisons are not conducted to any significant extent. However, all topics were more or less discussed during all focus groups and some comparisons of the data from the different groups are presented in the analysis.

The analysis method used in this study is the so called thematic analysis, which is the most commonly used analysis technique within focus group research, and is in general commonly used in qualitative research (Mars *et al*, 2016). The method is used to identify, analyse, and report patterns (themes) within the data (Liamputtong, 2011). The discussions all followed a similar sequence in terms of the order of the questions and the discussions that followed, which made the analysis easier. The first step was to summarize the transcriptions by each topic discussed during the focus groups and then each topic was analysed separately. Out of the summarized transcriptions themes and recurring answers and opinions were identified. The next step was to identify deviant answers and opinions among the participants. Finally all the individual opinions and answers for each topic were added together and summarized to create a common understanding of the group.

4. Findings and Discussion

This section provides a combination of the findings and the discussion of the findings. The findings are presented according to the themes of the study rather than by each focus group. As a consequence it will be hard to identify opinions by a particular group throughout the whole discussion, but the content of the analysis will be more readable and understandable. The specific questions directed to the respondents are not presented in detail (See **Appendix 1** for a complete interview guide). To make the text more vivid and compelling for the reader focus group data is best presented with illustrative excerpts from the discussions (Wilkinson, 1998), and that is done throughout the whole analysis.

4.1 Mobility Demands

Participants from the five groups followed relatively similar mobility patterns and had similar demands. A majority of the respondents walked or cycled to their daytime activities, which in this case for most of them was to school. Their mobility patterns were not affected by different weather conditions or seasons, and were described to be more or less the same all year around. However, there were a few examples of mobility patterns that differed from the others and they included travelling by bus, moped or subway. The car was entirely absent among the participants as a travel mode to and from daytime activities. This is because most of the participants did not have driving licences, and their proximity to their schools. For the participants from the group with older people, which all had driving licences, the car was absent mostly because they all lived in the city centre and they experienced no need of a car to travel to work/school or for leisure trips. This described travel pattern for commuting to school and work was expected and correspond relatively well to the pattern in the survey of Stockholm City Council (2016). However, the travel pattern most likely would be different with a different sample of participants from another city in Sweden or from other parts of the Stockholm region.

Young people today participate in many different activities after school or work and their mobility patterns change after their day activities ends (Kamargianni et al, 2012), and this was confirmed by the participants during the discussions. Some participated in different sport activities, some described they often met with friends at someone's home or in the city centre, and others participated in other kinds of cultural activities. The share of trips with a car increased significantly for participants, who still lived with their parents, as the major travel mode to and from different evening activities. Most of the participants without driving licences claimed that they got a ride from their parents or from friend's parents. The change in travel pattern during evening hours was not surprising and corresponds well to the travel pattern survey of young people in Stockholm (Stockholm City Council, 2016), where the share of car use among young people increases for leisure trips.

The group containing participants living by themselves did not change travel behavior after the end of their daytime activities. However, the same change in travel behavior was expressed even from them when they thought back on when they still lived with their parents. One of them (male, 23) thought back a few years and stated: "when I lived with my parents I use to take the bus to the

floorball practice and it worked fine, but when I got my driving licence I instead borrowed the car from my parents when going there. Even if I earned some time I think it was more a choice depending on convenience and the simple fact that I had access to a car". Another participant (male, 21) from the same group expressed similar behavior and simply stated: "When I lived with my parents and I didn't have a driving licence I used public transport for most of my trips, but when I got my licence I changed behavior and used my parents car for most of my trips". Even if few of the participants had driving licences this indicates that no matter the possibility to drive yourself or not, the importance of the car tend to increase after daytime activities.

So how come the car replaces other transport modes after daytime activities to such a significant degree? It could be assumed that one simple explanation is that the availability to a car increase when parents finish work and have the opportunity to give their children a ride, which was also stated as an explanation by several of the participants. It also corresponds to Sochor et al (2015) that argues that family members coordinate mobility needs among them. It could possibly be explained by that after school activities take place in more far distant and inaccessible locations. However, during the discussion these assumptions where somewhat rejected, and many of the participants claimed that they mostly tend to move around relatively local even during evening hours and to and from after school activities. Given that, it could be argued that there is little need for young people to change travel behavior after their daytime activities. However, some raised concerns over reduced safety during evening hours and therefore travelling by car was perceived as safer. Even so, the general opinion among the groups was not that safety concerns influenced their choice of travel mode to any significant degree. However, findings indicate there are other important aspects influencing why the role of the car change when daytime activities ends. These aspects are discussed in depth in the next section.

Few of the participants had experience of using shared mobility services, such as rental cars or a rental bikes. For example, no one had ever used a rental bike, not even in group 3 containing older people, and just a few of the participants had ever rented a car together with their families. Most car rental companies in Sweden apply more expensive insurances for young people than for adults, which could be one explanation for young people with driving license to not rent a car. However, the habit to rent transport modes seems not to be a natural element of young people's everyday mobility demands. The main reason behind not renting bicycles proved to be the restriction of that the bicycle needs to be returned at a specific location. There was a clear vision among the participants to have the opportunity to leave the bicycle wherever it was suitable for them. One participant (male, 19) from group 2 stated: "I have considered many times to use a rental bike when I am in the city but when I realize I can't leave it wherever I want I change my mind and just walk", another participant (female, 16) continued the reasoning: "I agree with you, but how should that work in practice? How can you just leave a rental bike wherever you want?" No one was able to come up with an answer to that, but it certainly questions the vision of MaaS to provide seamless mobility, as described by Mukhtar-Landgren et al (2016) and Kamargianni *et al* (2016). The 'last mile' element is also still

unsolved, which seemed to be important to the participants. It could also be assumed based on this finding that young people have less ability and willingness than adults to plan their trips in advance, and that was also the feeling experienced during the discussions. “I just want to go wherever I want, whenever I want” (male, 18), and “I don’t like to plan my trips in advance and often my plans change” (male, 19) were opinions raised during the discussion that amplifies that idea.

Price and payment method seemed not to be a main reason why they avoided rental bikes, but some participants also raised easier payment as a possible improvement to increase their potential usage of such mobility service. Taxi services like Uber and regular taxis were rarely used, even among participants from the older group. Among the younger participants the price was the main and obvious limitation to usage of such services. Among the older respondents, which had financial possibilities to use it, the reason seemed to be that they tend to stay locally. In other words, they did not travel enough long distances to make taxi services play an important role in their daily mobility pattern.

There was one major mobility service application that was used by almost every participant of the discussions – and that was the SL (Stockholm Public Transport Company) application *Res i Sthlm*. The application differs from the main SL application since it is used basically solely as a route planner, whereas in the main application you can buy tickets and gain more information than just the routes and timetables. This could be explained by that almost everyone already had some kind of pass to public transport and did not need more than the route planner. However, there seemed to be one aspect of usability that seemed to be very important when using mobility service applications. Several of the participants raised the aspect of usability and the importance of applications being simple to use, and contain no more information than needed. This will be discussed more deeply later in the section *4.7 Design of MaaS Applications*.

4.2 Attitudes and Behavior

Research by Line et al (2010) indicates that young people are more sensitive than adults to external factors and values such as ‘Identity‘, ‘Image‘, and ‘Social recognition‘ and that such values influence their travel behavior. The findings of this study somewhat contradict those statements. Most of the groups and most of the participants agreed on that those external factors did not influence their travel behavior to any larger extent, neither to their attitudes towards certain travel modes. On the other hand, it is a risk that the participants abstained to admit that those external factors influenced them due to the presence of their friends. It was possibly embarrassing to admit that their friends influenced them and that they were aware of their image when they display certain travel behavior or choose a certain travel mode. Line et al (2006) argues that the perception of peers and being seen as ‘cool’ influence travel behavior of young people, but those same perceptions might have influenced their discussions also during the focus groups. However, to what extent it was the case during the focus groups of this study is hard to detect. Nevertheless, on the question if they were influenced by each other and their friends when they chose travel mode or what

their attitudes to different travel modes are, one participant (female, 16) replied with a determined voice: “No, I don't get influenced by my friends, it is other things that influence what travel mode I use. But if my friends go by subway to the city of course I will take the subway too, and if they take the bus I take the bus too, no matter what I think about busses or the subway”. Another participant (female, 18) said: “If one of my friends buys a new moped or even a car I used to think it is pretty cool and I think that I want one myself, even if I don't really need a moped or a car right now”. These quotes are certainly not clear evidence that the participants in this study are influenced by their friends or affected of peer pressure. However these quotes indicates that at least some of the participants are influenced by their friends and adopt values and attitudes from them. It could also be assumed that young people today are unconsciously influenced by each other, even if they don't realise that or want to admit that during a focus group discussion.

Even if the level of influence from friends and values such as ‘Identity‘, ‘Image‘, and ‘Social recognition‘ was quite difficult to interpret, the influence from parents appeared to be stronger and more decisive on their behavior and attitudes. A majority stated that their parents, to various degrees, influenced their attitudes towards different travel modes, and one participant (male, 18) said: “My mum hates subway, she never travels by subway and she tells me to rather take the bus or get ride from someone, and that has for sure influenced my attitudes towards subway and I don't use it very often. I don't really know why she hates it so much, but I believe she think it’s too crowded”. Another participant (female, 19) filled in: “My parents don't like public transport either and they always use the car or bicycle, and now when I think about it my attitude towards public transport is surely influenced by their negative attitude. But maybe I use the bicycle more thanks to them, which is a good thing”. Research by Taylor et al (2007) indicates that exposure to a certain type of transportation tends to follow young people into adulthood, whilst attitudes do not follow the same pattern, which indicates that the influence on attitudes given from parents to their children do not necessarily affect their attitudes later in life. On the other hand, attitudes seems to have relatively strong influence on young people’s mobility demand today, which means that changing attitudes even for young people could be regarded as important as any other actions to obtain the potential of MaaS, which to some inherent the possibility to change travel behavior.

Even if parents seemed to influence their children, two participants talked about the reverse situation where they influenced their parents’ attitudes and behaviors. One of them (male, 18) said happily: “About two years ago my parents very rarely travelled by bus or subway, they are quite conservative and liked their cars, they had two cars at the time. I was often out with my friends and we used public transport to travel around in the city. Then I began to talk to my parents about that and I told them what I liked about public transport, and after some time they tried public transport and later they even sold one of the cars! My mum now commutes to work by bus every day, and she says that she is happy because they also save money every month”. There is potential for young people to influence adults, which the story of the participant indicates. Young

people of today have different lifestyles than earlier generations had when they grew up (Blumenberg et al, 2012) and when it comes to MaaS applications this could be relevant for a broader implementation. Older generations have not adopted the same attitudes and behaviors as young people of today towards technical gadgets, and since young people tend to be the first age group to adopt those there lies potential, especially for MaaS application developers to target young people, which in turn can influence and educate their older family member and relatives. An education latter from young to old could be a suitable tool for MaaS developers to aim for.

As discussed earlier the importance of the car as a travel mode increases after daytime activities. The most important aspect explaining that change in travel pattern, according to many of the participants, is the influence from their parents. This finding also corresponds to the research by Line et al (2010) which states that underlying values such as 'A Comfortable Life', 'Freedom', and 'Pleasure' influence both young people but also adults. One participant (female, 17), who used to cycle to school, stated: "When I get home from school and later go out again to football practice or something, I am always offered ride by my parents if they are at home. I often accept the offer, but it is like they ignore that I cycle to school every day. For them, it does not seem like an option that I should cycle to practice, even if it is about as close as school. If they would not have offered me a ride every time, then I would have cycled". This quote exemplifies a case where values such as 'A Comfortable Life' and 'Pleasure' is transferred, however, probably unconsciously, from one generation to the next. As stated by Taylor et al (2007) attitudes and values not necessarily follow young people into adulthood, but as argued by several authors (Blumenberg et al, 2012; Smart & Klein, 2017; Line et al, 2010) travel behavior tend to. Given that, it could be argued that, as in this case, when values and attitudes to travelling by car also influence the actual behavior should be paid greater attention, from for example developers of MaaS, than values and attitudes that does not. On the other hand, it is very likely that naturally safety concerns of parents over their children influence values and attitudes like this, even though safety concerns was not raised as a great influence of travel behavior among the participants.

4.3 Influences of Young People's Mobility Demands and Travel Mode Choices

4.3.1 The Cost of Mobility

Discussions on this topic differed among the groups and opinions within the groups also varied significantly. Storey and Brannen (2000, cited in Line et al, 2006) state that the cost of public transport is a significant barrier to young people making use of public transport. This statement did correspond to some extent with the discussions, and several of the participants raised the cost of public transport as a barrier. However, the opinions were strongly related to which kind of monthly or yearly pass each participant had for travelling with public transport in Stockholm County. Some had a pass that was only valid for daytime trips and during school hours, whilst others had passes valid for unlimited trips and all hours of the day. In general, those with unlimited access

to public transport experienced the cost of public transport as a less barrier than those without unlimited access. Students in Stockholm have subsidized prices for commuting passes, and only two participants paid it themselves. Since few of the participants earned their own money, the cost for mobility was obviously important, no matter if they paid themselves or if their parents paid for their passes or for trips outside the hours for which they passes were valid.

Even if most of the participants considered the cost while choosing travel mode the participants ability to value the real cost of each transport mode was limited. This is mainly due to the young age of many of the participants and to the fact that most of them did not pay for their mobility themselves. This phenomenon is also highlighted by Taylor et al (2007) who claims that young people often underestimate the real cost of a car since they often do not pay for the whole cost themselves. Therefore their ability to compare the cost between several travel modes could be limited. This statement was also validated to some extent during the discussion and opinions about the cost of owning and running a car. However, it should be stated that some of the participants were fully aware and accurate in their discussions about the cost of different travel modes. Even if most of the discussions and the opinions expressed about cost of mobility were quite expected, there were some interesting findings. Those discussions was more about how they aspired to pay for their mobility in the future and in the form of a MaaS applications, and those opinions will be presented and discussed deeper in the sections *4.6 Envisioned Mobility Demand* and *4.7 Design of MaaS Applications*.

4.3.2 Availability, Travel Time, Frequency and Safety

Mobility demand has traditionally been a matter of for example availability, travel time, frequency and safety (Klein, 2016). These factors proved to influence mobility demand among the groups and participants in very different ways. However, the general perception was that availability influenced the travel behavior more than the others. It relates to earlier findings about the increased use of the car during night-time where the availability to the car increase and by so change travel behavior. In itself it is not a remarkable finding, but one interesting thing that was found was that the values such as 'A Comfortable Life' and 'Pleasure' seems to have even greater influence on many participants than the availability. One participant (male, 21) said: "I will never choose accessibility over comfort and convenience when I choose travel mode". Another participant added (male, 22): "If I have to choose between a comfortable journey versus one more accessible with less travel time, but less comfortable, I will choose the comfortable one" When the groups were asked to choose between several travel scenarios (See **Appendix 1** for one example of such travel scenario), presented by the moderator, those scenarios that was perceived as the most comfortable and convenient was preferred most of the times. Number of travel mode transfers, travel time and accessibility seemed to be less important as the comfort and convenience (such as comfortable seats, little congestion on the travel mode, and smooth travel mode transfers). To clarify, the number of travel mode transfers or transfers in general seemed to influence less than the character of the transfer. If the participants knew the transfers were going to be

smooth and convenient it was for most participants not perceived as a significant barrier to their choice of journey route.

However, there was opposing views to this, and one female (18) stated: "I prefer accessibility over everything else, for me it is about getting to where I want as quick as possible. I don't care so much about how I travel and if it is comfortable or not". The participant who lived on the countryside (male, 17), 50 km from Stockholm did also prefer accessibility to many other aspects. However, for him frequency was the most important aspect of mobility and he said: "Where I live the bus departs every 15 minutes during some hours of the day, but mostly only every 30 minutes. If want go to town during night-time I need to plan thoroughly both my trip there and also my return trip… Where I live now I would prefer higher frequency over everything else, and maybe the application we are talking about could help improve that?" Where one lives influences travel behavior, as stated by Taylor et al (2007), and this quote indicates that attitudes are influenced by where one lives. It is assumed that this participant most likely would have different attitudes if he were living in a central part of Stockholm. However, a broader sample is needed to draw conclusions from this statement, and it emphasises the delimitations to this study to only be valid for young people with relatively good or very good access to various kinds of travel modes.

Even if availability was described important by most of the participants, most of them argued to already experience good availability to mobility options and various travel modes in their lives, and in the areas where they lived now. The opinions regarding accessibility did not differ significantly depending on if they lived in the city centre or an inner suburb. This could also be a major factor that values such as 'A Comfortable Life' and 'Pleasure' have greater influence than it would have if they were experiencing lack of availability. That also relates to the influencing factor of the regional economy, as stated by Klein (2016). The economy of the areas where the participants studied/worked and lived is all regarded as relatively wealthy, and that in itself might provide increased availability.

Even if group 3 contained of two participants who were working and lived independently, they valued comfort and convenience over less travel time and availability in a similar way that those who were studying and living at home. Availability, frequency and travel time are considered important influencing factors for choice of travel mode and journey route (Klein, 2016), and these results were somewhat unexpected. Even so, it is a possibility that these priorities and values change when these young people move into adulthood and their lifestyle and family relations change.

4.3.3 Environmental Awareness

There is an ongoing trend of increased environmental awareness among young people today (Davis *et al*, 2012), and this was also detected during the focus this study. Overall, the participants showed good ability to discuss environmental issues related to transport, and they were in general well aware of the potential impacts caused by their mobility. But did the fact that they were aware actually influence their travel behavior or mobility demands? Line *et al* (2010) and

Taylor *et al* (2007) address similar thoughts and state that young people understand the environmental impacts from transport, but they tend to ignore them to a larger extent than adults. The discussions of this study partly correspond to these statements. It corresponds in the way that young people tend to be aware of environmental impacts but at the same time tend to ignore them. However, it should be emphasized that far from everyone in this study ignored the environmental impacts and that the awareness did not influence their travel behavior. The scope of this study limits the possibility to specifically answer to what extent young people ignore the environmental aspects more than adults. However, as findings regarding attitudes and behavior in this study indicate, several participants were influenced to a large extent by their parents, which contradict that statement. Also, the older the participants were in this study, the more environmental awareness seemed to influence travel mode choices and travel behavior.

One participant from group 3 (male, 22) stated: " I am aware of the environmental aspects of transport, and my intention is to choose travel mode according to that more often… It happens that I take active choices, but to me is most often a choice between different modes of public transport and that may not matter so much. For me I think it will be more relevant if I one day buy a car." The moderator asks: "Pretend you have a fully developed MaaS application that you could use, and it provided rental bikes as a service. Would you use that service, and if yes, would it be based on environmental awareness or on other aspects?" Participant responded: "To be honest, I don't think I would use it based on environmental awareness, but if it would be convenient and smooth to use, why not? … I think most young people don't think about those issues so much, but it would be helpful if a application like MaaS could provide good options without us having to think about it." Another participant (male, 21) from the same group filled in: "I agree, I am aware of the environmental impacts but I don't want to make my environmentally friendly choices when I'm about to go out and take me somewhere. I want to make those choices before, when I vote or something like that. Or, I don't know really… Whatever, I think people want to make good choices, but they can not be bothered to do it." It was quite clear that the awareness existed, but the will to use it to change travel behavior was not. If the aim of MaaS is to reduce environmental impacts it could be argued that there is a gap for MaaS to fill here. Based on the earlier discussions there is room for change in behavior, and factors such as travel time, frequency, and availability tend to play less importance. Given that, there is potential for MaaS to provide sustainable options without the need to provide more accessibility. Basically, the services just need to be there for them to use, and if not, they might not make any greater effort to change behavior. However, based on the quotes from group 3 stated above, it is questionable if their travel demand and behavior is environmentally unsustainable. Even if they do not choose travel mode based on environmental awareness there is not legitimate to argue for change only because of that. They don't own cars and travel mostly with public transport. Nevertheless, whether their travel behavior is environmentally sustainable or not is not for this study to answer.

From some other groups more direct answers were given on the topic of influence of environmental awareness. One female (15) said: "I don't care about it at all", another participant (female, 16) said: "I know that cars are bad, but I don't really care." A third female (17) gave a bit more reflective answer: "I know that we pollute and stuff, but what can we do about it? We are in school and then we go to some activity in the night. I can't see what we should do, it should not be our responsibility." All this opinions are, I would argue, natural response to such an issue. These participants were young, and as argued by Line *et al* (2010), young people are concerned by about issues in the present and that have mental precedence to long-term environmental issues. On the other hand, the existent awareness over environmental issues related to transport and mobility in such a young age could be seen as progress in itself.

4.4 Attitudes Towards Driving and Ownership of Private Cars

4.4.1 Driving

The questions on attitudes towards driving of cars produced in general lively discussions among the participants in the groups, and it was clear that this topic was important to the participants and the interaction between participants was intense. As expected, there was no consensus reached among the participants and the opinions varied a lot. However, as in research by Taylor *et al* (2007), there was overweight in positive attitudes towards driving, and that pattern was reflected even during these discussions. Since only participants from group 3 had driving licences the discussions focused more on aspirations and desires to drive rather than on their experience of driving. However, with only two exceptions, all the participants without driving licence aimed to take it in the future. Even if they had not yet taken their driving licences it somewhat contradicts the declining trend of young people with a licence in Sweden (Blumenberg *et al*, 2012). Several of the participants had also started to practice driving with their parents.

Line *et al* (2010) states that previous research indicates that there is a common desire among young people to drive their own car in the future, and this corresponds relatively well to the findings of this study. One of the main aspirations that many participants wanted to obtain was the feeling of freedom, which again reconnects to the research by Line *et al* (2010) about underlying values such as 'Freedom' that influence travel behavior. It also relates to the perceived ability to travel to places more easily and quickly than using other transport modes, as expressed by young people in research by Taylor *et al* (2007). On the question if they aimed to drive their own car in the future most of the participants answered yes. One participant (male, 18) elaborated on the question and stated: "Yes, I think for sure I want to drive my own car in the future. It is the feeling of having the possibility to go whenever you want that is tempting… Like it is now, I'm always restricted by something if I want to go further than my own area where I live. However, I don't feel I have a great demand at the moment to travel around more but the thought is tempting". Another participant (female, 19) added: "I definitely want to drive in the future! I love the thought of just driving around with my friends and go on road trips and

so… I know it is not so good for the environment to drive cars, but I want to have that feeling of being free and not need to be dependent of parents or someone else."

These quotes amplify that the feeling of freedom is important, and maybe the strongest influence on the aspiration among many young people to drive their own car. It also relates to the influential feeling of independence among young people of driving their own car, as stated by Taylor *et al* (2007). Further, they also allude on the capability of the car to provide an identity of adult status, as argued by Dittmar (2004, cited in Line *et al*, 2010), and could be seen as a natural response by teenagers. Even if it was not stated directly that there was a will to obtain an identity of adult status, the interpretation of the discussions indicates that driving a car could play one part of that potential aspiration. It could also be assumed that the feeling wane after a couple of years of driving and when young people move away from home. One participant from group 3 (male, 23), who had been able to drive since 4 years, touched upon this and said: "I was quite keen to take my driving licence after finishing upper secondary school, because I thought I would obtain more freedom and so on… However, since I moved away from home to this place, and couldn't use my parent's car anymore, I have no aspirations to own a car. You realize now the disadvantages there is with owning a car in the city, which you didn't think of back then." On the other hand, the same participant later said: "Sure, I miss having a car sometimes, and that feeling of being able to go anywhere, whenever you want, I don't have it now in the same way like I had before."

Positive attitudes were also raised by several participants about the physical experience and leisure activity of driving a car, which was also stated by young people in the study of Taylor *et al* (2007). Participants without a driving licence talked about this topic based on either experience from practice driving with parents or just the imagination of driving. In some sense, those positive attitudes towards driving opposed that environmental awareness that also existed, and one participant (male, 17) said: "I know that driving is polluting and is not always good for the environment. But I love cars and I want to drive my own in the future. My dream car is a Tesla because it is a very nice and fast car, but it's fuelled by electricity". This quote indicates an understanding of environmental issues related to cars, but other aspects inherent of the car seem to be stronger. To solve that dilemma one solution could be to buy a car that is perceived as more environmentally friendly, which could be argued as a natural response of young people to tackle dilemmas like that.

Safety issues related to driving seemed to have little influence on the attitudes towards driving. Driving yourself was perceived as relatively safe by most. On the other hand, safety issues were perceived as important when autonomous vehicles were discussed, and are elaborated on in section *4.5 Attitudes Towards Autonomous Vehicles.* Even if the overall attitudes were positive towards driving, there were also opposing views expressed from some participants. Firstly, a few raised the economic cost of taking driving licence as a barrier to driving, which corresponds to research by Blumenberg *et al* (2012) that indicates that the obstacles young people today face to driving licensing are influencing the

decreasing trends in percentage of young people who takes it. A few participants also expressed very negative attitudes towards driving and towards cars in general. On participant (female, 16), with determined voice, said: "I hate cars, and I hope I will never need one! They are just in the way when I go into the city, and they stink and pollute." Blumenberg *et al* (2012) highlights the change in lifestyle among young people today and a will to be able to use mobile phones, text, or work while travelling. Some of those who showed scepticism towards driving also raised that argument, and one participant (female, 15) said: "I want to use my phone and check Facebook and so when I go to school. Also in the future I think it will be more pleasant to sit and use your phone instead of having to concentrate on driving… You can also relax more if you don't drive". There were also more negative attitudes towards cars expressed during the discussions. However, they relate more to visions of future mobility and will be discussed in section *4.6 Envisioned Mobility Demand.*

4.4.2 Ownership

According to Burrows *et al* (2016) young people have different attitudes towards ownership than earlier generations and, when they drive, use more hired or shared cars. To what extent this is true or not is outside the scope of this study, mainly due to the limited numbers of participants that were actually driving. However, aspirations and visions among participants towards ownership both confirmed and contradicted that statement. The questions on this topic created lively discussions and basically divided the participants in two equally large groups of different opinion – those who preferred private ownership, and those who had positive attitude towards shared ownership. Shared ownership was discussed mainly in the form of car pools and similar services.

Those attitudes expressed in favour for private ownership were closely related to the ones in favour of driving private cars, such as feeling of freedom and independence. On the other hand, Dittmar (2004, cited in Line *et al*, 2010) argues that also materialistic values are important to young people in their desire to drive and own a car. Such values seemed to have relatively little influence on those with positive attitudes towards private car ownership and few expressed materialistic values as an argument to own a car. The main argument against shared ownership was that the perceived risk of not being able to use the car whenever one wanted. One participant (female, 18) stated: "I'm not against sharing things with others, but when it comes to cars I think it will be difficult if you can't use it whenever you want." Another participant (male, 17) responded to that: "But if there is good availability to cars in the car pool, and the only thing you have to do is just some planning. Maybe decide the day before that you have to do grocery shopping instead of going every day, or something like that, wouldn't that be possible? You might save some money as well!" The female (18) were not convinced, and responded: "I understand, but I don't want to live like that. I don't want to plan my life so much! Also, if you have your own car you can leave stuff in the car and don't care about others using the car" This quote, and expressions from other participants as well, relates to the discussion on mobility demands where several participants expressed unwillingness to plan their trips. Given their unwillingness to plan their trips several participants expressed a preference to rent a car rather than share the ownership. No matter what the

actual differences are between shared ownership and renting, their will to rent rather than share symbolizes somewhat their strong desire to obtain the feeling of freedom and independence.

The overall vision of some MaaS developers is to increase the use of shared resources (Sochor *et al*, 2015), and among those with negative attitudes towards shared ownership, the sharing aspect per se, does not seemed to be the most negative aspect of shared ownership. According to Holmberg *et al* (2016) and Burrows *et al* (2015) one of the drivers to why MaaS is emerging right now is the trend towards a shared economy in society. There seemed to be little opposition among the participants that contradicts that, and the negative attitudes towards shared car ownership were expressed to relate more to planning and practical issues. It was also perceived that underlying values such as 'A Comfortable Life' and 'Pleasure' might have influence on negative attitudes, and one participant (male, 19) said: "If I would do something good for the environment think I rather change to a electric car or something instead of sharing a car. I don't mind sharing other things, but it's very convenient to have your own car".

Another aspect of owning a private car seemed to relate to safety issues and family concerns, and one participant (female, 17) stated: "What do I do if I need the a car very quickly, and there is no car available? If I will have kids and stuff in the future I think it would be more practical to have my own car. It would be nice also if something happen, if my kids get injured and I need to go to hospital." Similar thoughts as expressed in this quote were also raised by several of the participants with negative attitudes. That quote also highlights the thoughts young people have about the future and their adulthood. Consensus was almost reached among the groups that they believed that their values and priorities most likely would change when they moved into adulthood. Smart and Klein (2017) argues that past experiences in life influence mobility patterns, and Sochor *et al* (2016) states that the social context where household members coordinate mobility demands among them also influence mobility pattern. To what extent those aspects have influenced the participants in this study is difficult to evaluate, but it could be assumed that such aspects influence their reverence for their future families and therefore they value the practical and safety aspects of a privately owned car.

On the other hand, there were also positive attitudes expressed about sharing a car with others. One male (17) considered the economic aspect of sharing and stated: "I guess you will save a lot of money by sharing a car with others, I actually like the idea of sharing a car. Especially if you don't use your car so often." Another participant (male, 19) thought about the environmental aspect of sharing cars and added: "Exactly, we don't need all the cars we have and it would be good for the environment also with less cars. It's not good for the environment to produce all cars." That again highlights the environmental awareness that existed among the participants. Some participants also came up with idea of sharing a car among friends, and the fact that they would feel more comfortable sharing with people they already know. However, that sort of ownership does not completely relate to car pools, and is maybe difficult to practically apply on a large scale and in a sharing economy. On the other hand, it

tells something about several of the participants somewhat pessimistic attitude towards sharing with unknown people.

Even if most of the participants experienced sufficient availability of mobility and travel mode options it does not mean that they would accept less availability. Based on that and the attitudes expressed, the challenge for developers of MaaS could be argued to provide shared car services that fulfil the availability demands that young people aspire. Nevertheless there seems to be acceptance over the idea of sharing resources, even if it tends to have little less acceptance regarding car ownership. A shared ownership of cars, regardless of in what form it is provided, will not completely replace the freedom and availability that a private car offers, but there seems to be potential for future AVs to solve parts of this issue and this is discussed further in the next section.

4.5 Attitudes towards Autonomous Vehicles

According to Davis *et al* (2012) young people of today have a lifestyle where the mobile phone is constantly present, and there is an increased demand for mobility systems where you can work, text or talk on the phone while travelling. The future visions of AVs, where you can drive a car without manoeuvring, seem to fit well into that lifestyle. This demand was somewhat confirmed by the participants, and the idea of AVs was appealing to many of them, and they expressed mostly positive attitudes towards AVs. However, there were some concerns raised over safety and ethical aspects.

The discussions were quite intense, and many of the participants seemed to get excited over the idea of driverless cars might occupy the streets in the future. One participant (male, 17) said: "I really like the idea of autonomous vehicles, I really hope it happens soon! I think it's very cool and I will for sure use it." The moderator replied: "But can you see any negatives aspects of it, maybe safety or ethical issues?" Participant responded thoughtfully: "Well, maybe. I think the computers are safer than humans and that there will be fewer accidents… But maybe it will be difficult when the computer has to choose between two bad choices? I guess so, that's not an easy situation to handle." The immediate reactions to the idea about AVs were often very positive, and one participant (female, 18) from another group stated: "It so cool how cars can drive without a driver, and I really want to try to go with one such car!" Quotes like this, and many other expressed thoughts, indicated an immediate fascination over autonomous technology, which also was quite expected. However, even if their attitudes still remained very positive, the first and maybe a bit uncritical reactions waned somewhat when ethical and safety issues were discussed further.

Even if AVs should reduce traffic accidents there are ethical dilemmas that needs to be explored Bonnefon *et al* (2016). The groups were confronted with a similar scenario as stated by Bonnefon: "AVs will sometimes have to choose between two evils, such as running over pedestrians or sacrificing themselves and their passenger to save the pedestrians", and the reactions where similar to those expressed in the study of Bonnefon, and also quite expected. Most of the

participants said they wanted to go in AVs that protect their passengers. However, many participants thought this was a topic that they had issues to really find out for themselves what they thought. One participant (female, 19) reflected over this issue: "It is a very disturbing thought and you feel very selfish if you choose a car that saves you over others. But imagine if you go with a car that you know will save others before you, would anyone do that?" Another participant (male, 18) responded: "I know, it is very confusing to think of! … Also, what would it be like to walk on the streets if you know some cars will sacrifice you to save the passengers in the car? That would feel very uncomfortable." Discussions took similar direction in all groups about this topic, and highlight the challenging task for both users and developers to cope with such dilemmas. It is assumed that this stance not distinguishes young people from other groups, but that they are still positive might be influenced by their attraction of the technological aspects of AVs.

4.6 Envisioned Mobility Demand

The groups were asked to envision their mobility demands in the future and the responses differed. However, a general vision of the groups was that cars were pictured to occupy less space in the city than they do today. This could be seen as somewhat paradoxical given the positive attitudes towards cars and AVs that were expressed earlier in the discussions. However, it was also stated by several participants that their attitudes and behavior today did not mean that they perceived their travel behavior and the city as perfect. One participant (male, 23) from group 3 stated: " I like cars and understand that people use them and I also see myself use one in the future if I get family and so. But I also want less cars in my ideal future city, and I would sacrifice some travel time and mobility if the city became nicer without cars." Another participant (male, 22) added: "I agree, I would give up both time and mobility options for a car-free city centre as long as it don't prevent me from getting somewhere… I mean, if I can travel wherever I want in the city I don't really care if it takes a bit longer time." A third participant (female, 18) shared a similar view and stated: "That I like and can enjoy my city is more important than the possibility to travel around quickly." These quotes indicate a will to give up time for less access to cars and fewer of them in the city. Earlier discussions indicate that the participants would not give up comfort and convenience for environmental reasons, but time and availability seems to play less importance even in their envisioned future. However, given that participants in general perceived sufficient accessibility to different travel modes and that many lived in central parts of Stockholm obviously influence their envisioned future with fewer cars.

Very few of the participants aspired to increased mobility and the majority were satisfied with their possibilities to travel around in the city. However, several participants thought that MaaS could change their travel demands and behavior in the future. The moderator asked: "Imagine the future and you have access to a fully developed MaaS application, do you think your travel demand and behavior will change because of that application?" A Female (16) from group 1 responded: "I think it will, but maybe not only because of that application. Of course, if it works it will maybe make travelling easier and you can use more cycles in the

city. I want to cycle more in the future! I also think it should be more cycle routes in the city and if I could rent a bike easily through that application I would try that." Another participant (male, 19) had strong opinions about the future and travel behavior: "I picture a future where people travel around as much as they want, and such application could surely help to provide more mobility, even if I don't really know. I don't like when someone tries to change people's behavior and travelling should not be seen as anything bad!" Another participant (female, 19): "I don't think I will travel more or with other modes, but as long as it's convenient I can travel with whatever mode available. I don't really care about that." These quotes indicate change of behavior, if desirable, could be achieved in the future. However, the discussions and recurring words such as 'convenience' and 'easily' indicate it will be achieved if it requires little effort and if the level of comfort and convenience is maintained.

4.7 Design of Maas Applications

Young people of today are used to new technologies and mobile applications, which will most likely facilitate their adoption of MaaS applications. Given that, and based on the discussions in the focus groups, there were positive attitudes towards increased use of mobile applications and technology in the future. However, there are some aspects discussed that will influence their use and influence what kind of applications and services that will be adopted. When the cost and payment method were discussed several different opinions were expressed. Nevertheless, one common opinion among the participants was that a monthly subscription almost always was to prefer over a pay-per-ride solution. "It's disturbing to see the cost for each trip. Now I pay for a monthly pass and I would certainly do that for a MaaS service as well" (male, 23), and "I don't want to care about the cost for each trip" (female, 19) are examples of opinions expressed during the discussions. This is not an unexpected finding, but the willingness to pay for the convenience that a monthly pass or subscription inherent was stronger than expected. One participant (female, 18) from group 2 stated: "I rather pay more than it's worth for the convenience of not having to bother and just travel as much as I want", another participant (male, 18) from the same group added: "I would not pay more than it's worth now, but in the future when I got a job I will definitely do. I want to pay each month and then just use whatever travel mode I want. I cannot take the hassle with different tickets!" These quotes and the discussions indicate that the willingness to pay for the convenience of not having to think about the cost for each trip was high. However, the fact that all participants already had some kind of monthly pass obviously influences their opinions since they are used to having almost unlimited access to public transport.

Furthermore, the moderator asked the groups about their opinions of a scenario where different categories of journeys are included into a MaaS service and its journey planner. These could be for example; the quickest route, the most environmental friendly, the most convenient, or the most scenic route. Almost everyone was positive towards the availability of different choices, but the interesting findings occurred when these categories were compared to each other, and when the monetary value of each category was discussed. Several

participants expressed positive attitudes towards paying more for an environmental friendly journey if the comfort and convenience was maintained. As in earlier discussions comfort and convenience were expressed to influence more than travel time and availability. One participant (male, 23) stated: "It would be nice if a MaaS service could provide several categories of journeys, and would happily pay more for an environmentally friendly route if it was offered to me. Of course not always, if I'm in a hurry I would chose the quick one, but if I have time I would give up both travel time and some money for the environmental friendly route." Another participant (female, 17) stated similar thoughts: "It would be fun if you sometime could chose different routes even if you're heading to the same destination. If I have time I think will choose a scenic route or even environmental friendly sometimes." Moderator asked: "Would you pay more for a scenic route or a environmental friendly one than for the quickest one?" Participant responded: "Maybe a small sum yes, but if they are all convenient and comfortable I would choose the environmentally friendly one, even if it takes more time." However, there were also opposing opinions expressed, and one participant (male, 19) said: "When I have paid for a pass I have already done my part, and I will always choose the most convenient journey. I won't choose a more environmental friendly journey instead of a quick and comfortable one." A few participants agreed to that kind of opinions and it was perceived that they thought that it was not their responsibility to actively choose the most environmentally friendly route.

The MaaS application Whim provides different fixed monthly packages (MaaS Global, 2017), whilst the pilot project UbiGo provided more personalized monthly subscriptions (Karlsson *et al*, 2016). Personalized solutions were favoured among the participants, since they argued they had different demands from week to week. However, it depends very much of the cost, they argued. Several participants also expressed that in the future, if they will have more regular demands from week to week, they might think differently. The cost of Whim and UbiGo is converted to credits of which you can buy or use additional services to the unlimited access to public transport. Those can be a couple of taxi rides or days of car rental, or bike- and car sharing services. There were positive attitudes to those kinds of additional services and the possibility to use points to whatever one prefers.

5. Conclusions

The aim of this study has been to explore young people's mobility demands of today and in the envisioned future. The aim has also been to gain a deeper understanding of the underlying values and attitudes that influence those demands. Lastly, it has aimed to put those findings in the context of MaaS and has explored if demands of young people correspond to the visions of MaaS. Based on the findings of this study the following conclusions have been drawn.

The mobility demands of young people in Stockholm today are much influenced by a will to obtain a feeling of freedom and to travel conveniently and comfortably. There is little demand, today and in the envisioned future, for increased mobility or increased access to different travel modes. Daytime mobility patterns are characterized of travelling by public transport, by foot or by bike, whilst the travelling after daytime activities is characterized by increased use of private cars. Availability is obviously an important factor to that increase, but the fact that young people tend to travel locally even after daytime activities, reduce that influence. It proved rather that the influence from parents on their children were the most decisive aspect on the increase of car use, but even on attitudes towards cars and other transport modes.

As for all groups in society, availability to different travel modes influence young peoples' choice of travel mode and travel patterns. However, findings of this study indicate that aspects such as convenience and comfort influence travel behavior of young people even more. Travel time, frequency and safety proved to have less influence than other influential aspects. Environmental awareness had also influence on travel behavior of young people. To what degree it actually influenced behavior was difficult to evaluate even the awareness definitely were present in the mindset of many participants.

The vision of MaaS is to reduce driving and ownership of private cars, and to increase the use of shared travel modes. Values such as 'A Comfortable Life', 'Pleasure', and 'Freedom' in particular had strong influence of the positive attitudes towards driving of private cars. On the other hand, in the envisioned future, the car occupied less space in the cities, and despite the positive attitudes towards driving, there proved to be a willingness to reduce the importance of the private car in the future. The attitudes towards sharing of resources were positive, but sharing cars divided the participants in groups of both negative and positive attitudes. The private car seemed to have inherent practical and emotional attributes that had strong influence on young people.

AVs will most likely play a big part of MaaS and future transport system, and this study showed that there is great potential for AVs. Young people had positive attitudes towards new autonomous technology and they envisioned a future where such vehicles are used. Even so, the ethical dilemmas still need to be solved whilst safety issues won't become a major barrier for young people to adopt AVs.

The visions of MaaS correspond to a relatively large extent with young people's demand of today and in the envisioned future. The visions to provide seamless

mobility and maintain the freedom of movement correspond well to the demands of young people. However, to obtain the positive environmental effects there is a need for change of behavior. Change of behavior is related to attitudes, and according to the findings of this study, developers of MaaS need to also understand those attitudes and not only focus on provide increased availability to mobility and to different travel modes. Given the findings of this study there is no significant resistance to public and state intrusion, which allows for public education and other governmental incentives to obtain behavioral change. To what extent MaaS has the potential to change behavior is still unknown.

5.1. Suggestions for Implementation of MaaS

Based on the findings and conclusions of this study the following suggestions for implementation of MaaS and for developers of the concept are proposed:

- MaaS should try to capitalize on the existing environmental awareness of young people. Information and education should play part of a MaaS application in order to convert awareness to change of behavior. Promotion of young people to educate other age groups might be suitable for a broader adoption. Greatly reduced prices over a period of time, free trial-periods or similar solutions could be suitable to change behavior and make young people early adopters of MaaS applications.

- Alongside information and education a MaaS application should provide convenient and comfortable mobility. The probability of young people to choose environmentally friendly journeys is high as long as those aspects are fulfilled. Travel time and frequency proved to play less importance and a variety of journey categories might increase usage of MaaS applications.

- There is good potential for MaaS to promote use of shared mobility services as long as the feeling of freedom is maintained. AVs have potential to meet that demand in the future as well as more developed bike-rental services and car pools where the need to plan the trip in advance is reduced.

5.2. Suggested Further Research

This study has explored mobility demands in a context where accessibility to public transport and mobility is perceived as good. Further research of young people living in cities with less developed public transport system will add deeper understanding of underlying patterns of values and attitudes that influence young people.

The relationship between young people and their parents showed to influence mobility demand and travel behavior more than maybe expected. This relationship could be relevant for developers of MaaS to further explore. Examining values and attitudes of parents could also increase the understanding of which values and attitudes that are actually transferred to their children and which is not.

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Appendix 1

Interview Guide

Age? Where do you live? Do you have driving licence? Own a car, bicycle or other vehicle?

Describe how you travelled here today

Describe your mobility pattern during a regular week.

- What modes of transport do you use?
- With who do you normally travel?
- To what kind activities do you travel?
- How do you plan your trip?

Do you or your family use any mobility services today? (Like mobile phone applications (Google Maps, SL etc.), car-sharing, bike rental services, Uber etc.)

- Why or why not are you using such mobility services?

Can you discuss what factors influence your mobility patterns and travel behavior?

- Do you like or dislike the same travel modes as your friends or parents?
- Does media, advertising or something similar influence your attitude towards different travel modes?
- Is identity, social recognition or perception of peers important to you? Do you think the way you travel influence your image?

Discuss what influence your choices of mobility and what is important and not when you plan your trips?

- Consider for example influences such as the cost, travel time, frequency, convenience, availability, environmental aspects etc.
- Imagine you have to choose between two different routes for the same destination. Example of scenario: The first route includes two changes of travel mode (bus to subway to bus) and takes 40 minutes. The second one includes one change of travel (walking to bus) and takes 50 minutes. Which one would you choose, and why?

Can you describe your attitude towards cars and driving?

- Do you like or dislike cars and driving, and why?
- Why do you think you like or dislike cars?

- What are the best and worst things related to cars?
- To you intend to take driving licence and buy your own car?
- What is your attitude towards sharing a car? Car pools, rental-cars etc.
- Describe the advantages and disadvantages you see about sharing a car versus owning your own.
- Do you think you will use AVs, and do you think it will change your mobility pattern?
- Do you think you will have the same attitudes towards cars when you grow older and your lifestyle might be different?

Autonomous vehicles will most likely play a big part of future transport system, what is your immediate reaction to driverless cars?

- Do you think you will use AVs, and do you think it will change your mobility pattern?
- Security concerns?
- Ethical aspects, example of scenario: "AVs will sometimes have to choose between two evils, such as running over pedestrians or sacrificing themselves and their passenger to save the pedestrians", what is your opinion about such issues?

Design of MaaS Applications

- Payment/Willingness to pay
- What services do you want?
- What about different categories of journeys? (The quickest, the most convenient, most environmentally friendly etc…)

Can you picture your future mobility demands?

- Do you intend to travel in the same way? What would you like to change?
- Describe your visions for your future ideal city?
- How do people travel in that future?
- How do you think MaaS could influence future mobility?
- How do you think you would use a fully developed MaaS application?