Promoting Transport-Related Physical Activity through Sustainable Urban Mobility Plans

A Case Study on Copenhagen

Master Thesis

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Abstract

Sustainable Urban Mobility Plans (SUMPs) are a new planning approach introduced by the European Commission. The driving idea behind the approach is to improve the accessibility of urban spaces by providing sustainable mobility and transportation in the urban areas. Cycling and walking are sustainable means of transport, which also address physical inactivity, a leading health hazard in the 21st century. Thus, SUMPs offer the opportunity to induce infrastructural changes and policy measures to reduce emissions as well as to increase the level of physical activity in the population. Customized and designed policy measures and infrastructural changes are integrated in SUMPs that aim at changing the people's travel behaviour. The research highlights the importance of understanding human behaviour, which should serve as a basis to ensure the long-term success of policies. This thesis provides a conceptual framework to assess how the SUMP approach can eventually help to increase the level of physical activity. The following analysis is based on theoretical considerations but partially also provides initial exploratory and empirical findings to understand the challenges of SUMPs and the causality of behavioural insights and physical activity. To visualize the concept, Copenhagen was selected as a case study. The City has the vision of becoming the best bicycle city in the world and introduced a SUMP in 2013, in which a number of policy measures are apparently already taking into account behavioural insights. Society-level, city-level, route-level and individual-oriented policy measures make use of concepts as choice architecture, nudges and social motivation. Relating behavioural changes to policy measures is complex, as policy strategies are usually multifaceted, but a number of behavioural insights have already been made use of in urban and mobility planning.

Keywords: Sustainable Urban Mobility Plan, Behavioural Insights, Physical Activity, Active Travel, Copenhagen, Cycle Superhighways, Urban Planning, Mobility Management

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List of Abbreviations

CO2: Carbon dioxide
EC: European Commission
EU: European Union
GHG: Greenhouse gas
ITS: Intelligent Traffic Systems
NCD: Noncommunicable disease
NOx: Nitrogen oxides (combination of NO and/or NO2)
PA: Physical activity
PIA: Physical inactivity
RQ: Research question
SUMP: Sustainable Urban Mobility Plan
SQ: Sub question
WHO: World Health Organization

1 Introduction

Today, more than half of the world's population lives in urban areas. This number is constantly increasing in virtually all countries around the world. It is estimated that by 2050 the number will have increased to 68 per cent. In Europe, around 74 per cent of the population is living in urban areas at the moment. This ongoing trend leads to growing cities. Urbanization causes significant implications for the environment as well as the overall living conditions for people. Therefore, urban planning and well-managed growth are crucial for a successful and sustainable development, for both humans and the environment (UN, 2018). Managing how people and goods move throughout the growing and dense urban space is a key determinant for sustainable growth and societal development and social justice. Yet, while urban transportation and mobility management are essential for this development, the transport sector currently accounts for almost 25 per cent of the CO2 emissions in the European Union. Additionally, nearly "95% of the energy consumption in the transport sector derives from oil and oilbased products" (State of Green, 2016, p. 4). These numbers show that the transformation of the transport sector should be a priority for all countries in order to reduce their carbon emission and to combat climate change. As Denmark has set the ambitious goal to be independent from fossil fuels by 2050, sustainable transportation must be a key part of the country's city planning (ibid.). In its capital Copenhagen, the City Council has adopted a series of environmental and climate plans, which follow the City's goal to become carbon neutral by 2025 (City of Copenhagen, 2016a).

To promote and reinforce sustainable transport on a European level, the European Commission (EC) has developed the Urban Mobility Package, which includes the concept of Sustainable Urban Mobility Plans (hereinafter referred to as SUMPs). SUMPs present a new approach to urban mobility planning. With a focus on sustainability, accessibility, social justice and health, the SUMPs aim at contributing

to the creation of more liveable cities and thus a higher quality of life in urban spaces in Europe (Reeves, 2018; Wefering, Rupprecht, Bührmann, & Böhler-Baedeke, 2014).

Transforming the transport sector and reducing the CO2 emissions is not only contributing to a healthier environment and climate, but also helps to improve different health issues. Besides the widely discussed health impairment through the emission of the microscopic pollutants that can damage the brain, heart and lungs, the use of motorized traffic is supporting another main health issue, namely physical inactivity (PIA). PIA is one of the leading health challenges of the 21st century and is associated with noncommunicable diseases (NCDs) such as obesity, diabetes, colon and breast cancer and strokes (Bull, Milton, & Kahlmeier, 2011; WHO, n.d.-a). Therefore, increasing the level of physical activity (PA) on a population-wide level is a major issue and can help to reduce the morbidity and mortality of NCDs.

1.1 Problem Statement

Combating climate change is one of the most pressing challenges worldwide. To slow down the climate change and the build-up of greenhouse gases (GHG), the overall emissions must be reduced significantly. To achieve this, multiple solutions across all sectors are needed, which also includes changes in the current travel behaviour (de Nazelle et al., 2011). Moreover, as most of the world's population today lives in cities, climate change calls for urban solutions. SUMPs are the European Union's (EU) framework concept to increase the accessibility and safety as well as efficiency and effectiveness of urban transportation. They also approach the reduction of environmental problems such as GHG emissions, and air and noise pollution and further aim to make cities more attractive and liveable (Wefering et al., 2014). As mentioned earlier, Copenhagen has adopted a climate plan for the city, which is also linked to other urban strategies such as the city's most recent bicycle strategy and the *Action Plan for Green Mobility*. The latter is the City of Copenhagen's adoption of a SUMP (Eltis, n.d.-a). One important part of this plan is to further promote active

means of transport such as cycling and walking and to improve the public transport network, which is scheduled to be carbon neutral by 2025 (City of Copenhagen, 2012, 2016a).

Urban planning and transportation policies which promote the use of active means and public transportation address the aforementioned urban and environmental problems, as well as PIA, a pressing health challenge today. The World Health Organization (WHO) has identified PIA "as the fourth leading risk factor for global mortality" (WHO, 2010). In many countries worldwide the level of PA is decreasing, thus PIA is rising, which has major implications for the citizens health. Therefore, to analyse the influence of SUMPs on the PA level, the objective of this research is to answer the following question:

RQ: How can Sustainable Urban Mobility Plans improve the level of physical activity of adults?

To allow a deeper analysis while also complying with the limited scope of this thesis, the city Copenhagen (and to some degree the Capital Region of Denmark, in which Copenhagen is located) is selected as a single case study to advance an understanding of the possible impact of SUMPs on the adult level of PA. Copenhagen is widely seen as a forerunner to being a happy and healthy city and therefore a best practice example (Boseley, 2018). In order to analyse the RQ and to embed it into an appropriate context, two additional sub questions are posed. The aims of these questions are for the first question to gain a better understanding of SUMPs and the challenges that arise in the planning process and, conversely criteria for a successful implementation and for the second question, to investigate on a theoretical level how peoples' behaviour can be influenced in order to improve their level of PA. Thus, the two sub questions are as follows:

SQ 1: What challenges arise during the development and implementation of a SUMP?

SQ 2: How can behavioural insights promote change in the PA level of adults in Copenhagen?

While the adoption of SUMPs and an improved level of PA have many additional notable co-benefits which include a reduction in traffic injuries, pollution and congestion as well as increasing mobility and accessibility for elderly people, children and people with low income, these topics are not focused on within this thesis. Additionally, even though the promotion of PA and use and possibility of active transportation is also highly important for elderly people and children, these age groups will not be considered. Further research should focus on these topics. The focus within this work is on adult population, as they are the main decision-makers for travel choices.

1.2 Chapter Outline

In order to deepen the knowledge about SUMPs and the role of behavioural insights on the promotion of PA and later answer the questions posed in the previous section, this thesis begins with an introduction about the general idea and concept of SUMPs in the second chapter. Within this chapter, the drivers and challenges of the SUMP planning process as retrieved from the literature research are introduced, as well as information on the current uptake of SUMPs in Europe and in Denmark. The third chapter looks into the methodology and the ways of data collection of this thesis and the subsequent fourth chapter gives an overview about PA in relation to transport, again with a focus on Denmark. In the fifth chapter, urban planning is addressed with the fundamental idea of Jan Gehl's human dimension of urban planning, which is currently en vogue and a good starting point for today's mobility management. The theoretical background work on behavioural insights of the sixth chapter focuses on work by Daniel Kahneman, Amos Tversky, Richard Thaler and Cass Sunstein, as well as user experience insights of Don Norman and social motives of Robert Cialdini. Based on this prior research, the following seventh chapter presents an in-depth

review of relevant literature focusing policies and studies that can help promote an increase in the PA level, in the form of active travelling. In the eighth chapter, the selected case of Copenhagen is presented in detail, examining its SUMP and bicycle strategy and the measures that should increase the modal share of cycling in the city and thus increase the level of PA in the population. Based on this research, the sub and research questions are answered in the discussion part in the ninth chapter, followed by the research limitations in the tenth chapter and a short conclusion and outline of future research recommendations in the final eleventh chapter.

2 About SUMPs

Europe's cities are home to more than 70 per cent of the EU-population and account for around 85 per cent of the EU's GDP. The ongoing urbanization leads to a rising demand for mobility within the urban areas and contributes to an unhealthy living situation in the cities with strong environmental impacts, i.e. congestion, noise, CO2 emissions and poor air quality (European Commission, n.d.-b).

2.1 Development & Definition

To tackle these impacts, the EU aims, amongst other things, at developing a resource-efficient and competitive transport system. The EU's goals are to reduce its dependency on imported oil, create an essentially CO2-free urban mobility in the city centres by 2030 and to reduce its transport carbon emissions by 60 per cent by the year 2050 (European Commission, n.d.-b, 2011). At the moment, transportation accounts for around 25 per cent of the total GHG emissions in the EU. Within this quarter, urban mobility has made up about 40 per cent of the CO2 emissions and 70 per cent of all other pollutants that come from road transport (Interreg Europe, 2018). SUMPs are a new approach of strategic urban transport planning. The SUMP concept was adopted in 2013 and developed as part of the EC's Urban Mobility

Package. It was actively promoted by the EC in the *Action Plan on Urban Mobility* (2009) and the *Transport Whitepaper* (2011). With the implementation of SUMPs, the EU aims to promote and reach its energy and climate goals and improve health as well as social justice in European cities. While the more traditional urban transport planning approaches have primarily focused on motorized traffic flows and car friendliness, the new SUMP concept puts citizen and stakeholder involvement as well as intersectional cooperation between neighbouring authorities and authority levels in the spotlight. The ultimate goals of SUMPs are to increase accessibility, safety and security, to reduce noise and air pollution and GHG emissions as well as to improve efficiency and cost-effectiveness and thus, to contribute to the attractiveness and liveability of urban space (Wefering et al., 2014). Therefore, the SUMP concept pursues the following guiding principle:

> "A Sustainable Urban Mobility Plan has as its central goal improving accessibility of urban areas and providing high-quality and sustainable mobility and transport to, through and within the urban area. It regards the needs of the 'functioning city' and its hinterland rather than a municipal administrative region" (European Commission, 2013, p. 1).

The planning and development process of a SUMP is broken down into 11 steps, which are part of the planning cycle (Eltis, n.d.-b). The planning cycle is pictured in the following Figure 1, to visualise the SUMP planning process from the beginning to the end.

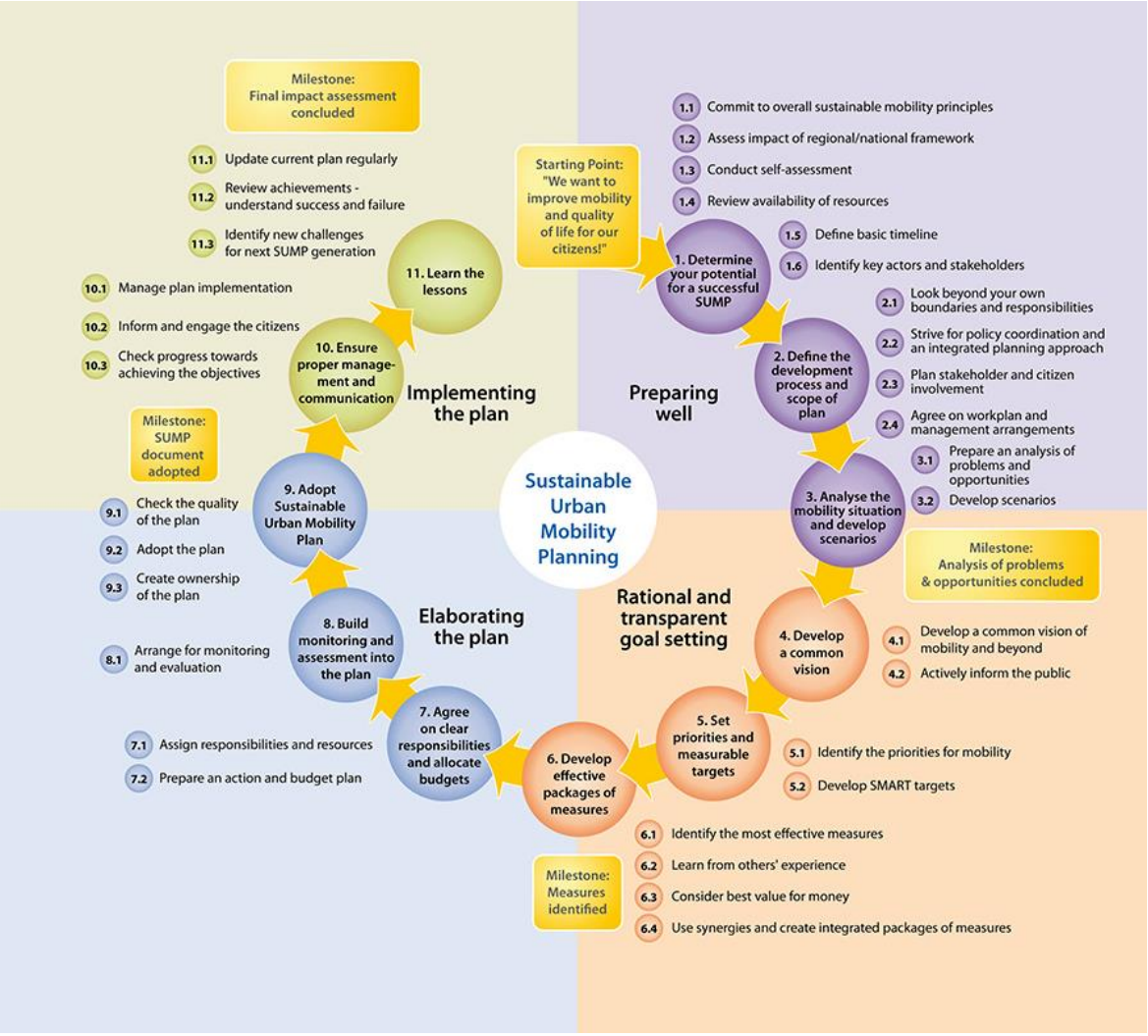

Figure 1. SUMP planning cycle (Eltis, n.d.-b)

The developed EU SUMP guidelines provide a planning framework for the development and implementation of SUMPs and support the local authority in the processes. Additionally, the EC supports SUMPs through funding and the facilitation of communication and information as well as sharing of experiences and knowledge on the funded website called the European Local Travel Information Service[1] (European Commission, n.d.-a). To sum it up, SUMPs are vision plans that are based

[1] www.eltis.org

on the current situations in cities and mostly contain concrete initiatives and projects considering the mobility needs of its citizens as well as the climate and environmental challenges (Tetraplan & Formel M, 2014). Yet, the urban transport planning processes and willingness to participate are part of the member states' national, regional or local responsibility. Therefore, the challenges of the planning and implementation processes vary locally.

2.2 Drivers & Challenges

In an EU-wide user needs analysis on the take-up of SUMPs key drivers and barriers that influence the elaboration and implementation of SUMPs were identified. Analysing the SUMP take-up drivers, the authors of the user needs analysis did not find any correlations between the city type or city characteristics and the drivers. Rather, the drivers were influenced by the countries in which the cities are located and the country-specific conditions. The main drivers that have been identified are the availability of and access to state funding, CO2 emission and air pollution reduction targets, especially when legally binding, and the political will and public support. Additional motivation for the development of SUMPs was in some cities the opinion that SUMPs are a solution to address urban transport challenges and also legal requirements in a country that require cities to develop a SUMP. Moreover, some cities highlighted the economic benefits of SUMPs as a means to make cities more attractive for citizens, businesses and tourists, which have a positive impact on the city's finances (Chinellato et al., 2017). More drivers for the SUMP take-up were identified in a national programme analysis. These include the existence of a financial framework that ensures or stimulates the SUMP development and implementation of measures, as well as a methodological framework that helps the adaption on a national level. Also, the requirement of a legal framework giving the local authorities the relevant competences as well as a governance framework that enables the cross-administrative cooperation between local, regional and national authorities were

named as supportive for the SUMP development processes (Durlin, Plevnik, Balant, & Mladenovic, 2018).

In the user needs analysis, cities, including Copenhagen, have named the following barriers or challenges that arise when developing and implementing a SUMP: The cooperation of different levels of administration is prone to challenges such as coordination issues or conflicting sets of priorities. The analysis came to the conclusion that this seems especially true in capital cities, as the interaction with the national level is more apparent there. Besides the vertical, also the horizontal integration presented a challenge when the competences were divided across different departments. However, challenges in the same department could also arise when, for example, developers and operators have different opinions about the identification of financing priorities. A lack of national support and an adequate regulatory framework as well as the political will and priorities of limited resources constitute more challenges for the SUMP development and implementation processes. Additional challenges are opposing citizens or interest groups, the pace of technological change versus the local administration capacity to implement an adequate regulatory framework for those innovations as well as the missing data and monitoring results (Chinellato et al., 2017). Furthermore, the national programme analysis identified the lack of SUMP awareness and interest as well as the lacking cooperation on a national level as challenges. Moreover, the lack of professional support and sustained funding constitute barriers. Also, the focus of the strong traditional transport planning approaches lies on the motorized traffic and therefore, other transport-related measures are often prioritized over SUMPs (Durlin et al., 2018).

2.3 Data & Overview in Europe

In 2013, when the SUMP concept was adopted EU-wide, already 800 SUMPs existed and by now around 1,000 cities across Europe have adopted SUMPs (status 2017). Of

these 1,000, 290 cities are working on second- or third-generation plans (status 2017). New take-ups came especially from Slovenia, Romania and Sweden. However, three countries, namely Belgium, France and Spain (Catalonia), have adopted half of the total number of SUMPs. These countries have made the adoption of SUMPs either mandatory or supported them with strong incentives. Also the number of SUMPs that are currently developed has increased (Durlin et al., 2018). In a report about the status of SUMPs in the EU member states, the European countries were divided into four categories regarding their SUMP maturity and experience: The first category was called "forerunners" and includes France, Lithuania, and Norway (though not an EU member), the regions Catalonia in Spain and Flanders in Belgium. These regions and countries

> "have a well-established urban transport planning framework that incorporates SUMPs (or equivalent documents), fully supported from the national/regional level with several assisting elements. Countries and regions in this group have developed a system that supports comprehensive, long-term transport planning over the longer period" (Durlin et al., 2018, p. 9).

The second category of "active" members includes Denmark, Finland, Austria, Germany, Italy, Malta, the Netherlands, Slovakia, Slovenia, Sweden, the United Kingdom and the Belgium regions of Brussels and Wallonia. What differentiates the two groups is the level of support for SUMPs. In the second group, the support is either non-schematic or only partial. Some of these countries are still developing their support system. The last two categories are "engaged" and "inactive" countries. The first of the two categories lists Bulgaria, Croatia, the Czech Republic, Greece, Hungary, Portugal, Romania and Spain (without Catalonia). These countries have developed an urban transport planning framework in recent years that includes SUMPs or equivalents, but lack the support from a national or regional level and are often implemented as a way of accessing the structural funds. The inactive group contains the countries Cyprus, Estonia, Ireland, Latvia and Poland. Here, the SUMP take-up is non-systematic and isolated and therefore low (Durlin et al., 2018). As an overview, the four levels are shown in the map of Europe in Figure 2.

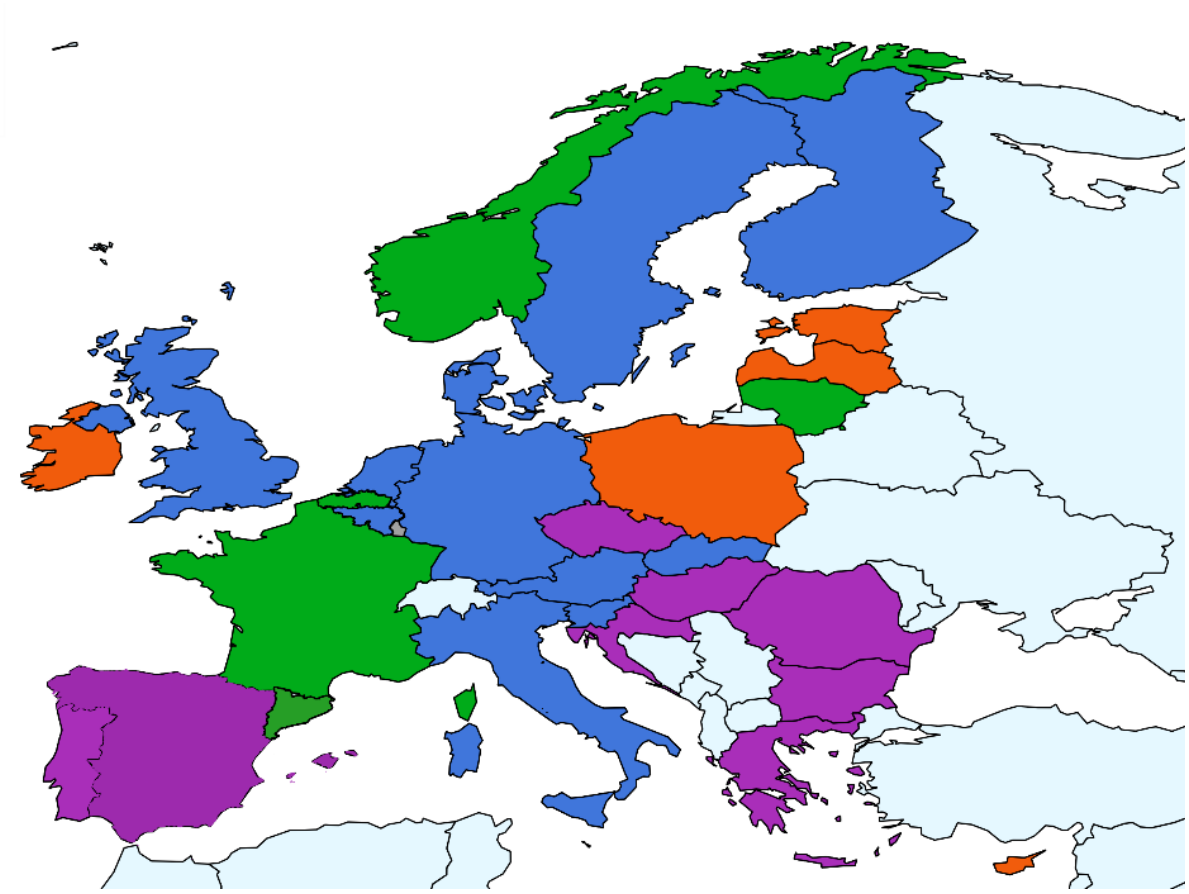

Figure 2. Overview SUMP take-up per country, status 2017(Durlin et al., 2018)
Colours and level: green – forerunner; blue – active; purple – engaged; red – inactive

2.4 SUMPs in Denmark

The concept of Sustainable Urban Mobility Plans as a new approach of mobility management to mitigate transport-related problems is relatively new in Denmark. Still, the country has a long tradition of citizen engagement in planning processes and since the 1990s its urban planning has had a strong focus on traffic and environmental issues (Enemark, n.d.). Its own Danish SUMP manual was elaborated based on the EC guidelines. The second edition of the guidelines was published in 2014 by the traffic planning firm *Tetraplan A/S* (now *MOE | Tetraplan*) and the

former *Formel M* initiative that was funded by the Danish Transport Authority and the Capital Region of Denmark (Lauritsen, 2014; Tetraplan & Formel M, 2014). While SUMPs are developed and implemented within the different cities, Denmark has also launched a national bicycle strategy called "Denmark – on your bike!" in 2014, to encourage the use of bikes. This strategy was based on three different aspects: First, the increase of everyday cycling by improving the facilities and infrastructure and encourage more people to commute by bike. Second, the strategy was promoting active holidays and recreation by making more information available. Third, improving the safety along the routes so that everyone feels safer, especially children when cycling to school (Ministry of Transport, 2014). Additionally to this national strategy, several Danish cities planned and completed their own initiatives and projects as parts of their traffic and mobility planning, which are part of their SUMPs. In general, the cities use these plans to promote their goals to become more environmentally friendly, to attract new businesses and tourists as well as to make it more attractive for people to move and live there. Moreover, the cities associate an increase of cycling and walking and reduction of motorized traffic with a healthy population, a more liveable city and an overall positive urban vision (see Aarhus Kommune, 2018a; Helsingør Kommune, 2015; Randers Kommune, 2015).

The cities in Denmark which have implemented urban mobility plans are (in order of the declining population number) Copenhagen, Aarhus, Aalborg, Odense, Esbjerg, Frederiksberg, Gladsaxe, Randers, Roskilde and Køge. The table in Appendix A provides a brief overview of the different plans in the listed municipalities to give an idea about the scope of the individual plans. Copenhagen is not included in the table as the later eighth chapter will look more closely into the details of the capitals' SUMP.

The following chapter describes the methodology and data collection that are used to answer the research questions.

3 Methodology & Data Collection

With regard to the principal aim of this thesis, the study of relevant SUMP literature outlined above identified a gap in existing research. Thus, Copenhagen was chosen to serve as an exploratory single case study. The aim of this chapter is to give an overview of the case study methodology and the processes of the selection and acquisition of interview partners, the development and conducting of the semi-structured interviews and the following analysis.

3.1 Methodology

Case studies are one of many ways of conducting social sciences research (Yin, 2003). For this thesis, doing a case study instead of using another research strategy is the appropriate method because of the three main conditions that relate to the characteristics of a case study: According to Yin (2003), case studies are the adequate research strategy when investigating a form of "why" and "how" questions of real-life context and contemporary events, while the investigator has no control over the behavioural events. Moreover, the boundaries between the investigated phenomenon and its context are not clearly recognizable. Case studies rely on multiple sources of data, can be a mix of quantitative and qualitative evidence and are supported by previously developed theoretical propositions, which guide the collection and analysis of data. Case studies do not allow what Yin (2003) refers to as "statistical generalization", meaning that the inferences that are made about a sample can be generalized. Yet, the previously developed theory can serve as a template with which the empirical results of case studies can be compared, which is what the author calls "analytic generalization" (Yin, 2003). A generalization to other cases also depends on the similarities and features shared with other examples (Denscombe, 2010).

3.2 Data Collection

To pursue the goal of this research, multiple data sources have been used. For the data collection on SUMPs, most information and data were gathered through different reports and analyses, as the concept was adopted in 2013 and is therefore comparatively new. To acquire knowledge about physical activity, urban planning, mobility management and behavioural insights as well as information about case specific data about Copenhagen and the Capital Region of Denmark, reports, books and journal articles as well as websites and studies were reviewed. Additional to this desk research, one semi-structured interview was conducted to generate knowledge about details of the Copenhagen SUMP.

3.2.1 Semi-Structured Interviews

The conducted and transcribed semi-structured interview supplements the literature review as it allows a more evaluative perspective and generates knowledge that could not be obtained solely through literature research (Meuser & Nagel, 2002).

Selection and Acquisition of Interview Partners

To obtain the information needed for answering the first sub question of this thesis and thus have a deeper understanding of the Copenhagen SUMP, which is crucial for ultimately answering the research question, interview partners with detailed knowledge about the processes and challenges that are of interest, are required. In this specific research interest, experts are employees of the public sector who work actively with the SUMP of Copenhagen. Therefore, the region Capital Region of Denmark, in which Copenhagen is located, and the municipality, City of Copenhagen, more precisely the responsible employees of the Technical and Environmental Administration and the Bicycle Programme were identified as possible interview partners. They were selected through desk research and recommendations. The

potential interview partners were contacted via email. Unfortunately, all but one of the emails led to rejections. The only contact that replied positively led to an interview on the 28th of March 2019, with the Capital Regions' senior consultant responsible for cycling and green mobility in the municipality, Mrs Helen Lundgaard. The interview took place in a co-working space in Copenhagen.

Development and Conducting of Semi-Structured Interview

In contrast to a structured interview, semi-structured interviews allow the interviewer to be more flexible regarding the topics and to pose ad hoc questions. It also enables the interviewees to express themselves and their ideas and perspectives more freely. As the aim of this interview was to discover new ideas and issues of the complex topic and not to do fact-checking, the semi-structured interview was the appropriate tool (Denscombe, 2010). The interview guide and questions were developed and sorted with regards to content, relevance and coherence (Gläser & Laudel, 2010).

The interviewee agreed to the interview on the condition that she was sent the main questions beforehand. As the goal of the interview was to gain new insights and generate knowledge, this did not compromise the quality interview, but rather ensured a higher quality of information as it allowed Mrs Lundgaard to make sure she could provide as much information as possible to each of the questions. The interview was conducted face-to-face in English which is a foreign language for both the interviewer and the interviewee. The interviews were recorded with an audio recording device after obtaining the approval of the interviewee. The recorded interviews were then transcribed and a few basic rules were set for the transcription. These included having the primary focus on the content and verbal communication, ignoring stutters, pauses, filling words, laughter and other emotions as well as intonations. The interviewees' speech flow and sentences were structured and grammar corrected according to the common practice and standard orthography, but with a focus on the spoken word, to avoid a loss of information. Small comments

from the interviewer to keep the conversation going were left out of the transcription as they are of no relevance for the obtained knowledge; the same applies for a short disruption by an employee of the co-working space. Some short paragraphs were excluded, but marked, when the interview wandered off the topic of interest. As the interviewee continuously referred to the Cycle Superhighways as "Super Cyclehighways", this was adjusted to its official name in the transcript, in order to avoid confusion. After the transcription (see Appendix C), the text document was sent to the interviewee for approval and to confirm her consent for the interview usage for this thesis. Afterwards the interview was analysed using the qualitative content analysis.

3.2.2 Interview Analysis

The content analysis is defined as "a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use" (Krippendorff, 2004, p. 18). In this thesis, the meaningful matter that is being analysed is the transcribed interview with Mrs Helen Lundgaard. The content analysis was carried out using Philipp Mayring's abstraction and inductive categorization rules. Therefore, the categories and codes were created following the authors four steps of material reduction, including paraphrasing, generalization and reduction (Mayring, 2010). The following Table 1 shows the result of the identified categories and codes, which will be further examined in the discussion part in the ninth chapter.

Category	Codes
Main drivers for SUMPs	- Financial resources - Political priorities - Human resources - Stakeholder engagement - Timing - Knowledge
Main challenges for SUMPs	- Coordination of different plans - Communication in or between departments - Political will or political changes (change of priorities) - High maintenance costs

	- Voluntariness - Impossibility to plan everything beforehand - Dependency on others - Willingness to compromise - Lack of standardized data
Inducing behavioural changes	- Infrastructural changes important, but are not sufficient - Timing - Hard and soft measures needed - Not one "game changer"
Cycle Superhighways	- Knowledge sharing and expert knowledge in the secretariat of Cycle Superhighways - Proof in numbers - Multitude of good arguments
Evaluation measurements	- Cycle account report - Not systematic yet, mostly on project level - Strong focus on cycling, neglected other means of green mobility - Holding people responsible through elections, but not personally
Benchmarks for cycling and sustainable urban mobility	- Goal to become the best cycle region in the world - International agreements - No role models - Copenhagen a role model for the rest of Denmark - Benchmark themselves with the Netherlands

Table 1. Categories and codes from the interview with Helen Lundgaard (H. Lundgaard, personal communication, March 28, 2019)

The now following fourth chapter explores physical activity in relation to transport and health and presents the first chapter of the literature review.

4 Transport-Related Physical Activity & Health

Within the transport sector, motorized urban transport is one main driver that fosters physical inactivity (Bull et al., 2011). PIA is seen as "one of the most important health challenges of the 21st century" (de Nazelle et al., 2011, p. 768). It is a proven fact that PIA can increase the risk of some NCDs such as forms of cancer, cardio-vascular diseases and diabetes as well as contribute to obesity. It is therefore a recognized risk factor for chronic disability and morbidity and causes of deaths (Bull et al., 2004; James et al., 2004). To specify what PIA or the lack of physical activity means, the WHO definition of PA is used in this context:

> "Physical activity is defined as any bodily movement produced by skeletal muscles that requires energy expenditure. Physical inactivity (lack of physical activity) has

> been identified as the fourth leading risk factor for global mortality (6% of deaths globally). Moreover, physical inactivity is estimated to be the main cause for approximately 21–25% of breast and colon cancers, 27% of diabetes and approximately 30% of ischaemic heart disease burden" (WHO, n.d.-b).

The WHO recommends at least 150 minutes of moderate-intense PA weekly for adults, but despite the widely known positive health benefits and risks related to PIA, this recommendation is often not met (Götschi, Garrard, & Giles-Corti, 2016; WHO, 2010). Data from the WHO Regional Office for Europe show that more than half of the European population does not meet the WHO recommendations and the trend suggests a continuous decrease of the level of PA (WHO Regional Office for Europe, n.d.). The challenge of PIA is also enhanced by a sedentary lifestyle. On a transportation level, the usage of cars and other motorized means of transport supports this inactive and sedentary lifestyle and also contributes to the emission of CO2 and other pollutants that are associated with climate change, which is another one of the major and pressing challenges of the 21st century (Rojas-Rueda, de Nazelle, Teixidó, & Nieuwenhuijsen, 2013).

The health benefits of PA and in this thesis especially walking and cycling as active means of transport have been documented in an increasing number of studies (de Nazelle et al., 2011; Kelly et al., 2014; Oja et al., 2011; Winters, Buehler, Götschi, & Buehler, 2017). Besides that, active transport is also widely seen as part of a solution to many different urban problems such as noise, congestion, emissions and health issues related for example to air pollution and traffic hazards (Buekers, Dons, Elen, & Int Panis, 2015; de Nazelle et al., 2011). Within this thesis, the focus will be solely on the PA perspective of active travelling, deliberately leaving out or remaining superficial when mentioning other health impacts (e.g. the reduction of severe traffic fatalities in the eighth chapter).

Walking and especially cycling as an active means of travelling is on many levels beneficial for urban and suburban transport and it allows an accessible and easily integrable way of including PA into daily routines. Unlike exercising, integrating PA through active commuting does not require spending extra time that could be used

for hobbies or social or other activities. Its cost efficiency and easiness to handle makes cycling suitable and accessible for large segments of commuters and the rest of the population. However, cycling is still only a marginal factor in transport and health policies in most countries (Götschi et al., 2016).

The shift from motorized to active transportation and therefore a higher level of PA has shown a decrease of the risk of morbidity of certain NCDs such as breast and colon cancer, diabetes and ischaemic heart disease (de Nazelle et al., 2011; Rojas-Rueda et al., 2013; WHO, n.d.-b; Winters et al., 2017). Moreover, a study conducted in Copenhagen came to the conclusion that PA significantly reduces the mortality rate, both for younger and elderly people (Andersen, Schnohr, Schroll, & Hein, 2008). To enhance the health benefits, studies have shown that the intensity is more important than the volume or duration of the PA (de Nazelle et al., 2011). Additional to the physical health benefits, also psychological health benefits can be related to PA. While PA does not prevent the onset of mental illnesses such as depression, increased exercise can help to reduce depressive symptoms. Moreover, also panic disorders and anxiety symptoms can improve with regular physical exercise (Paluska & Schwenk, 2000; Soo et al., 2012). PA also fosters the healthy development and growth of young people (Bull et al., 2011).

In order to promote the country's health, Denmark is part of the WHO European Healthy Cities Network, as well as the WHO European network for the promotion of health-enhancing physical activity (HEPA) (Euopean Commission & WHO Regional Office for Europe, 2015). The country publishes its own handbook on physical activity as prevention and treatment of illnesses (Danish Health Authority, 2018b). In 2017, around 71 per cent of the Danish population met the WHO's recommendation for the minimum of PA. While the share of people who do not meet the recommendations is the lowest for adults younger than 24 years old (around 19 per cent) it is especially high for the age group older than 75 years old (around 42 per cent). From those who do not meet the minimum level, 71 per cent indicate that they would like to be more physically active (Danish Health Authority, 2018a). Therefore,

while policy measures to increase active travelling should target the population as a whole, also more vulnerable road users such as seniors and their needs should be acknowledged.

To gain a better understanding of how the design of cities can influence the travel choices and thus, the PA level of its citizens, the following chapter presents the idea of a human dimension of urban planning and the approach of mobility management.

5 Urban Planning & Mobility Management

The Danish architect and urban planner Jan Gehl has dedicated most of his career to the human-centred urban planning, an approach which he calls the human dimension of urban planning. Gehl's human dimension planning targets cities around the world and focuses on an integrated urban policy development for sustainable, healthy, lively and safe cities. In his work, he criticises the theories and visions that city planners and architects used as starting points for their city developments in the past decades. Gehl states that in the past decades of urban growth and professional planning of city's development, "there was hardly any knowledge about how physical structures influence human behavior. The drastic consequences of this type of planning on people's use of the city were not recognized until later" (Gehl, 2010, p. X). By his definition, a city is liveable when it respects the human scale. This means that the pedestrians and cyclists determine the pace of the city and not the cars. Additionally, in a city of human dimension, people can easily meet in public places and streets. In interviews he has shared a special indicator to find out about the liveability of a city: see how many children and elderly people are in the streets and the public spaces, as only when a city is safe, more vulnerable people of society feel free to wander around the city (Willenbrock, 2014). As Gehl puts it "[a] good city is like a good party. You know it's working when people stay for much longer than really necessary, because they are enjoying themselves" (Anderson-Oliver, 2013).

In 2000, Gehl set up an architecture firm called Gehl Architects with co-founder Helle Søholt. Generally, to understand their working principles better, Gehl and his people's work approach is to first of all try to understand who the people are that are using the places, what they are doing there and how the place is set up. They analyse the behaviour of the people, examining their preferences and as a result quantify the experience and behaviour in a city or a place. Afterwards, they do not try to transform a city radically with new ideas, but rather promote smaller initiatives to encourage change, with the first priority to improve the walkability. Transforming a city is a long-term project, for example, it took Copenhagen around 50 years to become the human-focused city that it is now (Partridge, 2015).

As mentioned, Gehl has criticized the urban planning of the past five decades. In his opinion, the one-sidedness which has put too strong a focus on motorized traffic has cost thousands of lives as it kept people in a state of permanent physical inactivity. He claims that today, more than a third of all US-Americans are overweight which, together with PIA, would be a more effective killer than tobacco. In Gehl's view, it would be a cheap health policy for cities to bring people on the move as walking 10,000 steps per day or exercising in another form could prolong life for around seven years. Today, Gehl's planning approach has come into fashion. He explains that this shift comes from the fact that most countries in the Western World have got to a point where people have a safe place to live, own at least one car and have more and more leisure time. This would lead people to think about the purpose of life and what a place should be like where they would want to spend the rest of their lives. This way of thinking would also give more liveable cities a competitive advantage for businesses, major events and people in general. From his experience, Gehl has come to the realization that more and wider roads inevitable lead to more motorized traffic. Therefore, it is crucial to have less streets and parking spaces for cars, which leaves more space for pedestrians, cyclists, cafés and squares, or as Gehl puts it simply: life (Willenbrock, 2014).

Urban and neighbourhood planning can increase active travel by bringing destinations (homes, shops, restaurants, schools, work, etc.) closer together and thus making it more "walkable" through the mixed land use and higher density (Frank et al., 2007). Living in a more walkable neighbourhood is associated with a higher level of PA and the related health benefits, while the opposite is true for living in a more sprawling and less mixed built environment (Ewing, Schmid, Killingsworth, Zlot, & Raudenbush, 2003; Frank et al., 2007).

In an interview, Andreas Røhl, an associate of Gehl Architects, describes that the contemporary mobility environment shows an increasing tendency and demand for human scale mobility. He points out that a rising number of cities is focusing on the quality of life as a starting point for mobility planning nowadays. Compared to large mobility investments such as new metro lines, bridges or tunnels, the investments in the cycling and walking infrastructure are relatively cheap. Yet, Røhl highlights that these smaller investments have, in comparison, a high return on investment and are "the glue that binds mobility systems together" (Reeves, 2018). This new mobility planning trend is described as mobility management.

> "Mobility management, often called 'smart mobility', is a cost-effective instrument for bringing mobility and transport more in line with sustainability. It is complementary to technology and infrastructure measures and it is the additional key needed to achieve sustainable mobility on the local, national and European levels" (EPOMM, 2013, p. 5).

The European Platform on Mobility Management (EPOMM) is a network of European governments aiming at promoting and developing mobility management in Europe. The network recognizes SUMPs as a tool to realize mobility management on an urban level (EPOMM, 2013). While Denmark is not part of this network, and is not using mobility management as a specific concept, still many elements of this concept have been integrated in the Danish transport sector. The former Formel M project was the first major project on mobility management in Denmark. The Danish or more specifically Copenhagen's applications of mobility management focuses on the improvement of bicycle infrastructure and facilities the promotion of cycling as a

fast, safe and healthy means of transport. Additionally, the municipality targets the improvement of the public transport services, which also includes increasing the share of combined, intermodal trips with different means of transport such as park and ride as well as car sharing and pooling. Soft policies aim to promote a more active and healthy lifestyle through active commuting. In most cases the local projects are financed on a 40/60 basis, which means that the Danish government supports the project with 40 per cent of the funding, while the remaining 60 per cent are paid by the local institution or authority. Yet, the promotion of mobility management projects so far has come mainly from a local or regional level and thus a lack of a national holistic concept exists (Høj, 2011). The adoption of the 2014 national bicycle strategy is a move towards a national plan for one aspect of mobility management (Ministry of Transport, 2014).

In general, the main idea of urban and mobility management is to influence the travel behaviour of the urban population and its visitors. Understanding human behaviour is an important base for developing mobility plans and projects. Therefore, the following chapter investigates behavioural insights that could be made use of when developing urban and transport-related policies.

6 Behavioural Insights

Behavioural sciences are defined as comprising "the systematic analysis of the processes underlying human behaviour, through observation and experimentation. They combine knowledge and research methods from the fields of psychology, economics, sociology, neuroscience, among other sciences" (Lourenço, Ciriol, Almeida, & Troussard, 2016, p. 9). This systematic analysis serves as a foundation for behavioural insights. Within the economic sciences, these insights have led to the creation of the economic science discipline behavioural economics. In 2002, Daniel Kahneman was awarded the Nobel Memorial Prize in Economics for his work, in

which he “has integrated insights from psychology into economics, thereby laying the foundation for a new field of research” (Nobel Media AB, 2002). Besides Kahneman, Richard Thaler was also awarded the Nobel Memorial Prize in Economics 2017 “for his contributions to behavioural economics”, in which he “has incorporated psychologically realistic assumptions into analyses of economic decision-making […] [and] has shown how these human traits systematically affect individual decisions as well as market outcomes” (Nobel Media AB, 2017).

The work of behavioural economists has led to the development of theories diverging from the traditional economic theories of the homo economicus, who is characterized as acting purely rational and having complete knowledge. In their theories, behavioural economists not only acknowledge human errors, but rather analyse, categorize and systematize these errors and thus examine the behaviour of actual human beings. By introducing insights from the field of cognitive psychology, Kahneman and Tversky developed the so-called prospect theory. This theory challenges the traditional rational economic beliefs, especially the expected utility theory, by looking at human behaviour and decision-making under uncertainty and risk (Kahneman & Tversky, 1979; Thaler, 2015). In order to explain these biases in human judgement and decision-making, Kahneman and Tversky have developed a theory of heuristics, which helps to understand systematic human errors (Tversky & Kahneman, 1974). Additionally, based on his research, Kahneman has developed his work on the two systems, which focuses on two modes of thinking and the understanding of how the mind works. It thus helps to understand the ways of how humans think, which is briefly explained in the following section and helps to explain how the biases and heuristics work (Kahneman, 2011).

6.1 The Two Systems

Based on his research on the two modes of thinking, Kahneman (2011) has adopted the psychological terms *System 1* and *System 2* for the two systems that he has

identified as modes of decision making. The idea of the two systems is based on how the brain forms its thoughts. System 1 is fast and operates automatically and involuntarily or unconsciously with only little or even no effort. System 2 is slower and reflective, operates voluntarily or consciously and takes more effort to come to a decision. This makes System 1 intuitive and more efficient for everyday decisions, but also more prone to errors, while System 2 is more reliable, but also requires attention and is too slow and effortful to make every decision of the day. While people mostly identify themselves with their System 2, seeing themselves as reflective and making reliable decisions, most of our everyday actions are really based on our System 1. System 1 is the first to be activated, but when it has difficulties to come to a conclusion or an event violates its maintained world, then System 2 is activated. Thereby, it is normal to have the two systems conflicting in many situations, generally when the automatic reaction (System 1) competes with the intention to control (System 2) (Kahneman, 2011; Thaler & Sunstein, 2008).

As mentioned, most of the every-day decisions are made by System 1, which is also prone to errors. To gain a better understanding for these often systematic errors, the following section will provide an overview over heuristics and biases.

6.2 Heuristics & Biases

Heuristics and biases can be described as being "simplifying shortcuts of intuitive thinking" (Kahneman, 2011, p. 8). To reduce the complexity of the environment and to be able to react quickly and without thinking thoroughly about every detail, people use rules of thumb to help them make decisions. While these heuristics serving as mental shortcuts can be very helpful by making it possible to react or think quickly on the one hand, they can lead to systematic errors in thought and action on the other hand. To understand why these biases occur and how they influence human judgement and decision-making, Kahneman and Tversky have investigated heuristics and biases in more detail (Thaler & Sunstein, 2008; Tversky &

Kahneman, 1974). Yet, to go into detail of all the heuristics and biases that have been identified up until today is not relevant for this research project.

In their original work from 1974, Kahneman and Tversky identified three heuristics: Availability, representativeness as well as anchoring and adjustment. First, the availability heuristic is about how people assess the likelihood of an event by asking themselves how easily examples for this event come to mind. Thaler and Sunstein (2008) describe for example that people are usually more afraid, or think there is a higher chance of the occurrence, of more a easily imaginable and more vivid but really less frequent cause of death (e.g. from natural catastrophes or homicides) than the more frequent but less-vivid cause of death (e.g. asthma attack or suicide). Second, people use the representativeness heuristic when judging the probability that an event (or object) A belongs to (or originates from) class (or process) B. They do this by evaluating the degree to which A resembles B or in other words to which degree "A is representative of B" (Tversky & Kahneman, 1974, p. 1124). For example, people judge the probability that a person has a specific profession by the degree to which he or she is similar, or representative, to the stereotypes of this job (Cherry, 2019). Third, the anchoring and adjusting heuristic is based on the fact that "[i]n many situations, people make estimates starting from an initial value that is adjusted to yield the final answer" (Tversky & Kahneman, 1974, p. 1128). Because the adjustment is typically insufficient, differing initial starting points (anchors) will lead to different estimates; the estimates are biased towards the starting point. For example, high donation suggestions of charity organizations that serve as a starting point will result in larger donations than suggesting smaller donation to begin with (Thaler & Sunstein, 2008).

Moreover, the concept of framing is a cognitive bias and implies that when presenting the same information in different ways, it can bring people to make different decisions based on this information. To some degree, the way in which a problem is described can change how people think about it and consequently

influence the choices made (Lockton, 2012; Thaler & Sunstein, 2008). One example for framing is the information campaign concerning energy conservation presented by Thaler and Sunstein (2008). Here, the first statement announces that people will save money if they use energy conservation methods and the second statement is that people will lose the same amount of money if they do not use these energy conservation methods. The authors explain that the second statement is much more effective, based on the fact that people are loss averse. This is true because "losses loom larger than gains" (Kahneman & Tversky, 1979, p. 279), which is a key finding from Kahneman's and Tverky's prospect theory (see Figure 3). In this theory, the authors describe how people make decisions under risk and uncertainty. The theory demonstrates that people perceive the expected utility relative to a certain reference point, rather than absolute. In the development of the theory, the authors discovered that people dislike losses more than they like the equivalent gains and they take risks to avoid losses, but avoid taking risks to obtain gains (Kahneman & Tversky, 1979; Thaler, 1999).

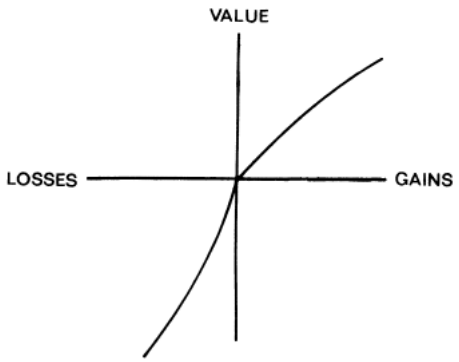

Figure 3. Prospect Theory: "A hypothetical value function" (Kahneman & Tversky, 1979, p. 279)

Thaler and Sunstein have not only worked on the theoretical perspective of heuristics and biases, but have also developed ideas on how to apply and make use of this knowledge.

6.3 Libertarian Paternalism, Nudging & Choice Architecture

Besides their research, Thaler and Sunstein have also both worked in the field of public policy, where they used their behavioural insights and knowledge about human behaviour in order to make public administration more effective and efficient and therefore improve government services (Sunstein, 2013; Thaler, 2015). To justify why using behavioural insights is a legitimate way to improve public policy, the authors have developed a political philosophy which they call libertarian paternalism (Thaler & Sunstein, 2003). Their idea behind this seeming oxymoron is that paternalism should not necessarily be the opposite of libertarianism. The authors argue that many other economists condemn any governmental paternalistic action, as these critics presume that these actions are based on false assumptions and misconceptions. Thaler and Sunstein counter the argument by highlighting that it would actually be a false assumption to think "that people always (usually?) make choices that are in their best interest" (Thaler & Sunstein, 2003, p. 175), as this claim is not supported by empirical evidence. Additional common misconceptions according to Thaler and Sunstein are, first, the idea that any viable option to paternalism exists, as public and private organizations or agents are often faced with situations where they have to make a decision that can and will affect the choices of others and not making a decision would not be an option. To visualize this argument, the authors present the example of a person who is responsible for arranging the food in a cafeteria, knowing that this arrangement will ultimately influence the consumption behaviour of the cafeteria visitors. In this case, Sunstein and Thaler argue that the best decision would be to arrange the food so that people are "better off" judging by themselves, meaning to place healthy food options in the most popular places and making unhealthy choices a bit more effortful, but not taking them away. The same applies when deciding how to set default rules. For various reasons, many people choose the paths of least resistance or the options requiring the least effort. Therefore, if people are confronted with a choice which offers a

default option, many people would end up doing nothing (the option requiring the least effort) and stick with the default.

A second common misconception that Thaler and Sunstein argue against is that critics often see paternalism as coercion, but the authors claim that this would not necessarily be the case. Looking back to the cafeteria example, while in this scenario, the person responsible for arrangement is making a decision about how and where the food is presented, none of the options is actually taken away, so that the visitors would still have a free choice of what to buy and eat. Thus, while visitors are "nudged" to buy a more healthy option (which would make them "better off"), they could still decide against it and choose something else. A nudge is defined as "any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives" (Thaler & Sunstein, 2008, p. 6), and as "any factor that significantly alters the behavior of Humans, even though it would be ignored by Econs [meaning the homo economicus]" (ibid., p. 8). In this scenario, even though the person who arranged the food acted paternalistically by trying to nudge people towards more healthy food choices, the visitors were not coerced and could still make a free decision, therefore it is an example of libertarian paternalism.

Nudges and the kinds of actions described in the earlier examples are part of the idea of choice architecture. A choice architect is someone that is responsible for organizing the environment or context in which people make their decisions. For example, setting defaults or planning the physical environment are part of choice architecture (Thaler, Sunstein, & Balz, 2013). As mentioned earlier, behavioural economists recognize human errors such as difficulties regarding self-control and planning and forecasting their behaviour. Thus, a well-thought-out designed choice architecture can serve as a means to influence people's behaviour in this specific context (ibid.). Thaler et al. (2013) have also looked into what key aspects of human behaviour and which design features need to be considered for choice architecture and thus to influence the decision-making process. Therefore, the next section

focuses on how behavioural insights and knowledge about user experience can be made use of.

6.4 User Experience

Generally, one important task of a choice architect is to make sure that the systems in which decisions are made are well-designed and that people have a good user experience. These thought out and well-designed systems should take into account that all humans make errors and therefore are designed to be as forgiving as possible. An additional design principle should be the giving of some sort of feedback to the users. Moreover, mapping, which in this case means making the available options and potential consequences more comprehensible (e.g. transforming information into numbers), as well as the structuring of complex choices are also seen as an important design principle (Thaler et al., 2013).

The user experience expert Don Norman has dedicated his work, amongst other topics, to the awareness creation and ultimately improvement of human-centred design. Norman argues that a designer's job is to create things that guide the user to the right action at the right time without any effort. He describes that, as a user, good design would be harder to notice than bad design, because it fits people's needs without attracting much attention, while bad design would be very noticeable as it draws one's attention to it. Thus, in his opinion it is the combination of good design principles and good observation skills that should serve as a basis for designing everyday things (Norman, 2013). Therefore, designers should have knowledge about peoples' behaviour to anticipate the future usage and design appropriate solutions (Heuer, 2013). User experience comprises many different aspects to look at an end-users' interaction and experiences with a design product. This could be for example a company, an object or the physical environment. As the usage and applicability of the diverse design principles vary regarding the different design objects, at this point only a brief introduction of some, for this case relevant, design principles follows.

When creating objects or a physical environment, the designers need to have in mind what they want or believe this object is going to be used for. Thus, what something looks like and what it can be used for is called affordances. On the one hand, an affordance is therefore a relationship between an object's properties and a person's capabilities and defines how an object can be used. On the other hand, the prevention of an interaction is called an anti-affordance. Norman (2013) explains this using the example of glass, which affords transparency, but blocks air and most other physical objects from passing through, which is therefore an anti-affordance. Affordances and anti-affordances exist even if people do not see or perceive them. Yet, to be effective, they have to be discoverable and perceivable, which implies that some means of signalling the presence of an affordance is required to ensure visibility. These means are what Norman calls signifiers. He explains that signifiers can be both, intentional and unintentional. This means for example that people can put up a sign as an intentional external signifier, or that a visible trail made by people previously walking through a snow-covered field is an unintentional signifier to identify the best path through the snow. Additionally, strong signifiers can be accidental affordances, such as leaving trash behind which later signifies that this place or object affords leaving trash, even if this was not the intention. Moreover, the consistency, coherence and understandability of a designed product should be ensured. In short, this means that once people have learned something about a product or environment, they will find it easier to apply their knowledge to a similar object or environment. Also, it means that the arrangement of objects or individual parts should be in a way that they create a coherent whole and that the design is taking human errors into account (ibid.).

Building on this knowledge about user experience, the following section analyses how the physical environment, including its design and the user experience, can influence human behaviour.

6.5 Physical Environment

Where people live and what their physical environment is, influences the way they live and move, or as Gehl puts it: "[f]irst we shape the cities – then they shape us" (Gehl, 2010, p. 9). The physical environment is a strong determinant for people's behaviour as it affects which behaviour is possible (what actions it affords) and its design influences how it is used (what signifiers there are). Therefore, a well-designed or readable environment affects the conscious and subconscious decisions differently from one whose design is unclear and misleading (Berveling, Derriks, van de Riet, Smit, & Storm, 2011; Norman, 2013). Another element is the convenience or ease of use, both physically and mentally that people experience in a physical environment. "It helps to think about the environment as the outcome of a global choice architecture system" (Thaler & Sunstein, 2008, p. 195).

In general, people prefer the most convenient, fast and effortless way of travelling. Therefore, the physical environment is an important factor to consider when thinking about influencing peoples' travel choices (Berveling et al., 2011). One example for how physical infrastructure can influence people's travel behaviour is the 1989 San Francisco earthquake, which damaged an arterial road severely, but faced with the discontinuity, users adapted their travel behaviour quickly and the former freeway was ultimately turned into a peaceful city boulevard (Gehl, 2010). In a different manner, the cycling behaviour in Copenhagen can also serve as another example: "As conditions for bicyclists improve, a new bicycle culture is emerging" (Gehl, 2010, p. 11). By improving the safety, comfort and convenience of cycling, Copenhagen has significantly increased its share of cyclists in the city. This demonstrates that the planning of the physical environment of a city is strongly influencing the travel behaviours and patterns of use of its inhabitants and visitors.
Besides the individual's behaviour and the application of user experience knowledge to the design of infrastructure, also the social dynamics have a strong influence on people's decision-making processes and can ultimately have an impact on people's

travel behaviour. Thus, the next section reviews social motives in the form of six principles, which can give inspiration on how to make practical use of heuristics and biases (Lockton, 2012).

6.6 Social Motives

The psychologist Robert Cialdini has developed six principles of persuasion that focus on how peoples' behaviour can be influenced using social influence (Cialdini, 2007). The first principle of persuasion is reciprocity. Here, persuasion is achieved by "creating a sense of obligation to respond" (IAW, 2017), as people are more likely to make a concession, when someone else has already done the same for them as well. The second principle is commitment and consistency. People have a strong urge to be perceived as being and to act consistent when making commitments, because being inconsistent is generally seen as an undesirable trait. The third principle is social proof. One way to determine how to behave correctly is to look at how others behave in the situation. Normally, people perceive their action as appropriate when they see others acting the same way (Cialdini, 2007). This behaviour is intensified when the other person is perceived as being similar to oneself or when a situation is uncertain. One example for uncertainty is when people experience a discontinuity, meaning they are forced out of their fixed patterns and have to make new choices due to changes in their daily lives (Berveling et al., 2011). The fourth principle is called liking and means that people are more likely to listen and follow ideas from someone they like or have sympathy for (even if they do not know them). Additionally, the so-called halo-effect plays a role in this principle. The halo effect occurs when people notice one positive characteristic of someone and this positive view dominates how that person is seen by others. An example for the halo effect is when a good-looking person is also seen as kind, honest, smart and so on, even if the observant cannot know if that is true. The fifth principle is authority. People are more likely to listen and follow a suggested behaviour when this suggestion comes from an authority person based on a "deep-seated sense of duty to authority within

us all" (Cialdini, 2007, p. 160). The sixth and last principle to persuasion identified by Cialdini is scarcity. This is based on the simple rule that if something is or is becoming rare, it is (or has to be) more valuable (ibid.).

After presenting different aspects of behavioural insights and user experience earlier and the social motives now, the following section applies this gained knowledge and theoretical ideas to the topic of promoting physical activity in adults, in order to help answering the posed research questions.

7 Policies for the Promotion of Physical Activity

The design and use of the physical and social environment and thus people's behaviour is influenced by policies from different levels of authority and various sectors. Shaping people's travel behaviour and addressing an increase in cycling and walking in the population and therefore raising the share of active transport is mainly accomplished by local policies, as the "[l]evels of walking and cycling rates vary dramatically across smaller geographics (between cities and between neighbourhoods)" (Winters et al., 2017, p. 279). Additionally, the neighbourhood design and provision of built environment features such as bicycle facilities, available sidewalks, low-cost recreational facilities and public transit stops as well as having important destinations nearby, positively influence the PA level of adults. People who have access to these amenities are more likely to meet the WHO's PA guideline than those who lack them (Sallis et al., 2009).

Identifying and implementing the policies and strategies that increase the use of active means of transport such as walking and cycling and making cities generally healthier, are challenges that many countries around the world have recognized today. Especially local policies are a key determinant for the individual's transport choices. These policies influence the travel behaviour by setting the conditions which include relative benefits, opportunities and incentives as well as relative costs,

barriers and disincentives of active travelling. Thereby, policies can influence the travel decisions directly, by addressing and setting incentives for active means of transport or indirectly, by setting disincentives and creating systems in which the accessibility of public transport, cycling and walking is poor and using the car is cheaper and more convenient (Winters et al., 2017). To make the most effective use of these local policies, behavioural insights could be applied when developing such measures.

To structure the different kinds of policies, they are grouped into society-level policies, city-level policies, route-level policies and individual-oriented policies. To begin with, the society-level policies aim to increase the relative utility of the active means of transport. Part of this strategy is discouraging the car usage by reducing the speed limits for motorized traffic, which consequently would increase the relative speed of cycling and thus the safety for more vulnerable road users as well as reduce the attractiveness of using a car (Buehler & Dill, 2016). While it is true that people in Copenhagen cycle more than in most other cities, the high share of bicyclists in Copenhagen is not based on the fact that people want to make a healthy choice, but rather because they choose the easiest way to get around (Boseley, 2018). Additionally, raising the costs for car usage and ownership and reducing car parking facilities could also lower the attractiveness (Buehler & Dill, 2016). These measures could help to improve the competitive position and "nudges" people towards choosing the active means of transport. Moreover, especially for longer distances, the promotion of public transport could also increase the PA level, as these trips usually begin and end with walking or cycling to and from the station and enable comfort for the travelling of longer distances (Rissel, Curac, Greenaway, & Bauman, 2012; Winters et al., 2017).

Furthermore, city-level policies such as land-use policies influence the urban design of communities and affect the travel choices. These policies could include car-free city centres, bike sharing programmes as well as street connectivity and intersection

density. Also, having diverse and compact neighbourhoods, meaning locating institutions such as schools, work places, restaurants, recreational centres and stores in walking distances, encourages the uptake of active transport. Providing a good linkage between where people live and where they work, can also have a strong influence on the promotion of active travelling. A contrary effect is associated with having sprawled neighbourhoods with longer distances, more obstacles and more and wider urban highways with higher speed limits as these conditions lead to a higher traffic volume (Cui, Mishra, & Welch, 2014; Ewing & Cervero, 2010; Ewing et al., 2003).

Additionally, route-level policies focus on the role of investments in the built infrastructure. For pedestrians, the comfort, convenience and safety could be increased through the provision of connected paths, side- and crosswalks. For cyclists, a connecting network and routes separated from traffic are generally preferred by the users as they are perceived as being safer and could thus also help to encourage more cautious cyclists. In general, the presence of physical infrastructure is a crucial determinant of the amount of cycling and walking in a city (Buehler & Dill, 2016; Winters et al., 2017). Also, research has shown that people who never considered cycling before, have a less positive attitude towards cycling, as they are aware of the benefits of cycling but perceive too many obstacles that keep them from using a bike (Gatersleben & Appleton, 2007). Therefore, policies should also encourage people to consider cycling as a means of transport and eventually foster and maintain a bicycle culture and thus increase the share of active travelling. This is first of all based on the availability of physical infrastructure as well as on its visibility, perceived quality and safety and ease of access.

As mentioned earlier, policies to promote PA are, amongst other things, aiming to enhance a cultural shift or “normalization” of biking in many cities around the world as it already the case in countries such as the Netherlands and Denmark. Besides these two countries, most other countries would first require this cultural shift in which cycling and walking become enjoyable, safe and simply a “normal” or even

fashionable means of transport in order to be perceived as an equally important means of transport (Gatersleben & Appleton, 2007; Gössling, 2013). This cultural shift could also lead to a population-wide increased demand and change in the public opinion of active transport users, which could also include investments into the bicycle infrastructure and further restrictions for the use of cars (de Nazelle et al., 2011).

The urban developments in the technological and physical environment are crucial for influencing peoples' travel behaviour as the built environment serves as a city-wide choice architecture in the urban space, which can be influenced by both, city-level and route-level policies. The work of Jan Gehl demonstrates how relatively small changes to the urban environment can lead to behavioural changes, simply because the context in which people make their decisions was changed. This could be managed through, for example, the reduction of physical and perceived obstacles and the creation of positive user experiences (Gössling, 2013). More active commuting could also be achieved through having more amenities in the area of the route as well as at the end of the trip, such as parking facilities, lockers and showers, which help to improve the user experience of cyclists and create a greater ease of use (Hamre & Buehler, 2014; Winters et al., 2017).

Individual-oriented educational and informational programmes and policies, such as programmes aiming at a specific behavioural change and pro-bicycle initiatives could achieve a mode shift on a population level. An example of such an individual-oriented campaign is the Danish Cyclists' Federation's bike to work (Original title: *Vi cykler til arbejde*) campaign that has encouraged active commuting through a competition since 1997 (VCTA, n.d.). In this campaign, Cialdini's commitment and consistency principle is made use of as, once people have signed up for this competition (made a commitment), they are more likely to keep up cycling, probably also after the competition has ended. Similar programmes also exist in other cities and regions, e.g. in in Flanders (EPOMM, 2013). Additionally, telling friends and family about the new commitment could also help to increase the share of cycling, as they might also take

up or increase their level of cycling as a consequence. This social effect was reported from a pilot project on mobility coaching in Lundby, a district of Gothenburg in Sweden. It indicates that the liking and social proof principles could also help to increase the level of PA, when people hear about other people cycling and walking more (EPOMM, 2013). Moreover, in order to target the individual, the liking and authority principle could help to address more people, if perceived authority figures and well-liked or attractive celebrities help to promote the issue. The scarcity principle could be made use of on an environmental level by highlighting the environmental compatibility of active transport and at the same time making people aware that there is only one planet (a scarce resource) (Lockton, 2012).

Also, the social proof principle could undergird the establishing and maintaining of a cycling culture. In cities that already have a bicycle culture, such as Copenhagen, the social proof principle could be made use of as cycling is widely seen as one, if not the, main transport mode to get around in the city. People who are uncertain about their travel choices would look at what they perceive as the most common transport modes (Boseley, 2018). Thereby, population groups that are easier to influence regarding their travel choices are people who have not already formed strong habits. These could be new citizens, people who move or change their place of work or education. It also includes people whose usual route is disrupted by something, for example road works, experience a discontinuity from their previously habitual behaviour and are forced to make a new choice (Berveling et al., 2011).

The policies could also be developed on the basis of heuristics and biases. For example, the anchor and adjustment heuristic could be made use of when declaring active travelling as a social norm and personal stories as an anchor point for human behaviour. As the perception of social norms has shown to be a strong influence on people's behaviour, people might adjust their travel behaviour more closely to the anchor point. To communicate this, one suggestion would be to target the different age groups and local communities. Another suggestion could be to set normative anchors by advertising personal stories, especially from people with constrained

circumstances (Zimmerman, 2009). The adjustment effect might later be reinforced by the psychological conformity phenomenon, which is expressed through behavioural mimicry or the attempt to gain social approval (Cialdini & Goldstein, 2004). As for any intervention or campaign it is necessary to have sufficient knowledge about the potential target groups. Additionally, as described earlier, the presentation and description of a certain problem can influence people's decision. Therefore, framing could also be helpful to change people's travel behaviour and increase the level of PA. One possibility for this could be to frame cycling or walking as being social, fun and a personal achievement or doing something good for oneself, rather than seen as a duty in order stay fit and healthy. This could change the understanding of an experience from a duty to a rewarding experience (Zimmerman, 2009).

Often packages of different and complementary strategies are implemented together in order to achieve a substantial increase in cycling and walking (Pucher, Dill, & Handy, 2010). This indicates that multifaceted strategies have the highest potential for creating change, but also makes it difficult to isolate the individual strategy's influence on behavioural changes and travel choices (de Nazelle et al., 2011).

8 Copenhagen

Copenhagen is widely recognized as a green economy leader (LSE Cities, 2014). As early as 2007, the City announced its goal to become the climate capital in the world by 2015, which also included the goal of becoming the world's best city for cycling (City of Copenhagen, 2007). In 2016, the City of Copenhagen adopted a climate plan with which the municipality aims at becoming the first carbon neutral capital in the world. This plan includes, besides saving energy and thus decreasing the overall energy consumption, the avoidance of fossil fuels by constructing wind turbines, investments in solar energy and ultimately the conversion to renewable energy

sources. Moreover, it contains ideas for the retrofitting of buildings and purchasing electric and biogas fuelled buses, as well as investments in cycling and other transport initiatives. To focus on the different angles of the goal, the climate plan is linked to the other city plans such as the most recent bicycle strategy and the city's SUMP (City of Copenhagen, 2016a). Additionally, the City of Copenhagen adopted the *Metropolis for People* plan in 2009, in which it states the vision to be the most liveable city in the world and therefore committed itself to goals with a strong focus on the improvement of the urban life (City of Copenhagen, 2009a).

8.1 The Sustainable Urban Mobility Plan

As briefly mentioned, over the years, the City of Copenhagen has developed a number of climate and urban mobility plans. These include the *Eco-Metropolis – Our Vision for Copenhagen 2015* (2007) and the *CPH 2025 Climate Plan* (2016). In the climate plan, the city establishes, amongst other things, CO2 reduction targets for the mobility sector. By 2025, the public transport should be carbon neutral and 20 to 30 per cent of all the light vehicles as well as 30 to 40 per cent of all the heavy vehicles should run on alternative fuels (e.g. electricity and hydrogen). Moreover, 20 per cent more passengers should be using the public transport (compared to 2009) and 75 per cent of all trips in the city of Copenhagen should be either conducted on foot, by bike or public transport. Additionally, 50 per cent of all trips to work or school in Copenhagen should be by bike (cycling accounted for 41 per cent of all trips taken to work and education in 2017, which is a slight decrease from 45 per cent in 2014) (City of Copenhagen, 2016a, 2017, 2018). At this point it is important to note that when focusing only on the modal share of Copenhageners, then 62 per cent of the trips to work and education are already by bike and only nine per cent by car. This means that especially people commuting from the surrounding municipalities are the target group for raising the modal share of the trips in Copenhagen to 50 per cent (City of Copenhagen, 2017). In order to meet these goals until 2025, the City of Copenhagen has implemented a Sustainable Urban Mobility Plan. This SUMP is

connected to the other urban development plans, yet only focuses on sustainable urban mobility and is called the *Action Plan for Green Mobility* (Original title: *Handlingsplan for Grøn Mobilitet*). The plan supplements the city's bicycle strategy (*Good, Better, Best: The City of Copenhagen's Bicycle Strategy 2011-2025*), as well as it looks at different other transport topics such as for example public transport, car sharing, traffic management and technological innovations. The City of Copenhagen has adopted different measures over time, in order to decrease the environmental impact and ensure well-working traffic conditions. The SUMP introduces the new, so-called green mobility package, which builds on the work of other city plans regarding green mobility and aims at making Copenhagen's mobility more efficient and greener, to improve the quality of life, stimulate growth and to contribute to the goal of becoming a carbon neutral city. This green mobility package is grouped into five different but interconnected topics, namely urban development, green means of transport, transport system, incentive and innovation (City of Copenhagen, 2013).

The first topic, urban development, focuses on the development and design of the city in such a manner that makes the green means of transport become the first choice when thinking about transportation. For new urban areas such as Nordhavn, the City's plan is to ensure good public transport access and a bicycle friendly road usage, while also serving as a hub for new technologies. Additionally, parking standards in the city should be adjusted, which means lowering the standard of car parking in dense areas with good access to public transport and improving the standard of bike parking and promoting parking for electrical cars.

The second topic, green means of transport, aims at expanding the green transport system, including pedestrians, public transport, bicycle, car sharing and hydrogen and electrical cars. By expanding the public transport network, such as light rails outside the dense city districts and the new metro ring line, the City aims to improve the overall public transportation. Moreover, it is well known that the reason for the high uptake of cycling in Copenhagen is that it is an easy and fast mode of transport. Thus, the City's aspiration is to make it fast and easy for more people, by providing a

direct, coherent and comfortable bike network, for example by implementing the "PLUSnet" bicycle network consisting of premium bicycle routes. This measure is also part of the goal of becoming the best bicycle city in the world und therefore closely intertwined with the City's bicycle strategy. Additionally, car sharing should become more prominent in the city, as experience has shown that shared cars can replace between four and ten private cars, are driven fewer kilometres than private cars and people who are part of a car sharing programme tend to cycle and use trains and buses more often. Free parking in payment zones and a requirement for car sharing spaces of new buildings as well as company memberships and campaigning should help to increase the number of people using car sharing programmes.

The third topic, transport system, focuses on a smooth traffic flow due to a more efficient use of roads and urban space (green means of transport take up less space per person) as well as integrated IT solutions. Furthermore, the reconstruction of highstreets (e.g. Nørrebrogade and Amagerbrogade) should improve the commercial environment and conditions for cyclists and pedestrians as well as set priorities for buses, while the speed for cars should be reduced and car lanes narrowed.

> "The reconstruction of Nørrebrogade has increased the number of cyclists by 11% on the outer part and by 20% on the inner part. It has also resulted in 45% fewer accidents, 10% shorter travel time for buses and 45% less car traffic, a significantly lower noise level as well as more people staying in the street" (City of Copenhagen, 2013, p. 18).

The inclusion of Intelligent Traffic Systems (ITS) to the management of car traffic could help to expedite a smoother traffic flow, which would reduce the fuel consumption and emissions as well as making it easier to prioritize buses and cyclists. In the longer run, the ITSs should be able to adjust to sudden occurrences and to interact with mobile applications in order to give updated information to the control centre and road users.

The fourth topic, incentive, looks into making green means of transport more attractive. Through mobility management, the use of the infrastructure should be made more efficient by combining tools such as visibility, campaigns and information

with traditional transport planning. This could eventually also lead to a change of attitude. Further programmes include the cooperation with local partners such as authorities, businesses and schools, which promote green means of transport for new citizens, employees and on the first days of school. The municipality estimates that cooperating with schools could result in a 40 per cent decrease of trips to school undertaken by car.

The fifth and last topic of the package, innovation, highlights Copenhagen's role as a research and development hub for new climate solutions and green technology. These solutions could be adopted in the city itself as well as it would reinforce Copenhagen's competitive role in the industry. Part of this theme is to increase the share of electric mobility, especially with a focus on bicycles and cargo bicycles. Moreover, the City's goal is to introduce environmental zones that are based on CO2 and NOx emissions of cars and delivery vans. To introduce these zones, changes in the legislature would be needed, as currently only heavy vehicles and the emissions of particles can be restricted by law. So far "[t]he environmental zone for heavy vehicles has reduced the emission of particles on H.C. Andersen's Boulevard by 16% and the NOx emission by 8%" (City of Copenhagen, 2013, p. 27).

The thesis' purpose is to answer the research question on how SUMPs help to improve the level of PA in the adult population. Therefore, the focus is on active means of transport, walking and cycling, while other green means of transport and topics of the SUMP that concern aspects such as car sharing and new fuels as well as the planning of new neighbourhoods will not be looked into. Also, while walking and cycling are often combined with public transport and improving the share of intermodal travelling could help to increase the level of PA, the expansion of the public transport network and the switch to renewable power sources are also not part of this thesis.

The following section will look into the status of walking and pedestrian networks in the city, but afterwards the main focus will be put on the status of cycling in

Copenhagen and thus will look into the city's bicycle strategy which is also closely intertwined and also partly included in the SUMP.

8.2 Walking in the City

Historically, the promotion of walking as means of transport and the pedestrianisation of Copenhagen began with the 1962 pilot project of the conversion of the city centre's main shopping street, Strøget, from a driveable road into a pedestrian zone. While this process was strongly debated at that time it soon became a success story and paved the way for further measures to limit the use of cars in the city (Gehl Architects, n.d.).

Today, only five per cent of all the trips to work or education are solely undertaken on foot, thus, they are not combined with any other means of transport. Yet, trips on foot account for 19 per cent of all trips in Copenhagen (City of Copenhagen, 2018). The share of pedestrians is especially high in the inner city, where walking makes up around 80 per cent of the traffic. This is where the Strøget is located (Gehl Architects, n.d.).

The City of Copenhagen has adopted the pedestrian strategy *More People to Walk More* in 2011 with the aim to have more pedestrians in the city. This published strategy is not directly part of the city's SUMP, but is included as one of the three main goals of the 2009 City of Copenhagen's plan *Metropolis for People – Visions and Goals for Urban Life in Copenhagen 2015* (besides the two other goals *More Urban Life for All* and *More People to Stay Longer*) (City of Copenhagen, 2009a). Still, the goal to improve the walkability in the city and developing a priority pedestrian network is also part of the city's SUMP. To realize this aim, the municipality has planned to develop a coherent pedestrian network in and between the different neighbourhoods and to interconnect the important local destinations with the shortest ways possible. Additionally, enhancing the safety, comfort and maintenance should improve the experience of walking. Moreover, informative signs about travel distances and times should make it easier for users to include walking into the individual travel plan. By

offering special shortcuts that are only passable on foot, walking could be made faster and thus more attractive than making short trips with the car or even taking the bus. Walking and having pedestrians in the city's neighbourhoods is associated with a good urban life and healthy citizens (City of Copenhagen, 2012).

8.3 Cycling in the City

Denmark is a self-declared country of cyclists, in which nine out of ten people living in the country own a bike (Ministry of Foreign Affairs of Denmark, n.d.). The cycling culture is deeply rooted in Danish history, especially in its capital Copenhagen. Historically, while car use spread widely in Europe and in Denmark during the 1960s, the bike renaissance in Denmark already started in the 1970s as a result of the oil crisis and the following economic recession. The recession led to the cancellation of many different urban development projects that focused on motorized mobility. Also, cycling was still an important means of transport during the car boom and later throughout the 1980s and 1990s, which ultimately led to the self-re-definition of Copenhagen as being a bicycle city. Copenhagen launched its first bike sharing programme in 1995, making it the first of these programmes in the world. The city's long cycling tradition and the fact that "half of the city's current cycling infrastructure already existed in the 1970s" (Gössling, 2013, p. 204) has shown that cycling can be part of the urban agglomeration, but also makes the urban context of Copenhagen unique. It made it easier for officials to establish a shared vision of Copenhagen as the best bicycle city in the world and to treat cycling as a means of transport equal to cars, which justifies the investments and re-distribution of urban space for cycling infrastructure. The municipality has developed and adopted the first cycling policies in the early 2000s, which included infrastructure projects as well as soft policies. To create a shared and positive vision of cycling in the city, the reports frequently use words as "us" and "we" and communicate that being a Copenhagener means being a cyclist as well as communicating a positive urban vision (Gössling, 2013). The following is an example for this:

> "Cycling in Copenhagen brings us closer to the life of the city and the people who inhabit it. Your fellow citizens are right there next to you, propelling themselves effortlessly through the urban landscape. We are one with our town on our bicycles" (City of Copenhagen, 2009b, p. 3).

Choosing cycling as a means of transport has shown to have socio-economic effects, environmental effects as well as leading to improved health. To promote the uptake and use of cycling, Denmark has had different bicycle strategies over the years (City of Copenhagen, 2011; Ministry of Transport, 2014). While cycling in Denmark has decreased by 30 per cent since 1990, the numbers are reversed in Copenhagen, where cycling has increased by 30 per cent since 1998 (City of Copenhagen, 2011). This makes Copenhagen a role model for the rest of Denmark (H. Lundgaard, personal communication, March 28, 2019). Additionally, while walking, cycling and public transport are used for around 69 per cent of all trips within Copenhagen, the car is still the preferred means of transport for all journeys travelling to and from the surrounding municipalities (City of Copenhagen, 2016a, 2018).

With its current bicycle strategy, the municipality targets to achieve a higher share of cycling by improving the physical infrastructure as well as the comfort and service along the routes and by addressing traffic regulations. These improvements include the maintenance and an increase of the capacity of existing tracks and lanes, creating new lanes and shortcuts in the city and around, as well as improving the bike parking situation across the city. Besides these physical infrastructure developments, the goal is also to improve the perceived safety in traffic, as well as the satisfaction with the maintenance of the lanes and tracks and the overall positive effects that a cycling culture has on the city's atmosphere (City of Copenhagen, 2011). Additionally, to move closer towards reaching the goal, which is to positively influence the city's atmosphere through cycling, the so called Green Cycle Routes were and are currently developed and implemented. These routes should offer recreational routes through the city that pass by lakes, disused railway tracks, playing fields and through parks and the different neighbourhoods (City of Copenhagen, 2016b). As mentioned earlier, the communication of the cycling strategies often highlights that being a

cyclist is an important characteristic part of being a Copenhagener. To emphasise this, the latest bicycle strategy starts with a historical photograph from the 1930s, which shows a mass of cyclists on the Dronning Louises Bro. This also signals that Copenhagen has always been a city of cyclists. Moreover, many of the other pictures within the strategy booklet show healthy looking cyclists, often as part of a mass phenomenon, sending the message to the reader that it is a cultural norm to cycle and it is enjoyable for everyone (City of Copenhagen, 2011; Gössling, 2013).

In the years from 2004 to 2017, a total amount of around € 267.6 million (DKK 2 billion) was invested in cycling in Copenhagen. The funding for this came from the municipality, state and private foundations. Calculations on the socio-economic benefits show that the municipality presumably saves € 0.13 (DKK 0.99) per cycled kilometre which accumulate through an increase in productivity and reduced costs for medical treatments. In peak times the socio-economic impact of each cycled rather than driven kilometre is saving even more money, namely € 0.54 (DKK 4.04). Research has also proven that children who go to school by bike can concentrate up to four hours longer than the children who were brought by car. Moreover, the life expectancy due to the more physical active lifestyle is up to five to six years longer compared with a physical inactive lifestyle. 30 minutes of cycling per day, over a longer period of time, can reduce the mortality rate by 30 per cent (City of Copenhagen, 2017). In general, "[t]he health benefits from switching from car to bicycle are 19 times higher than the drawbacks from accidents and air pollution" (ibid., p. 23). While the socio-economic, health and environmental benefits of cycling are widely known, the motivation to choose the bike over a car is still mostly not based on this knowledge, but rather because it is the easiest way to move around the city (Boseley, 2018).

The current bicycle strategy follows the municipality's goal to become the best bicycle city in the world. In order to gain more knowledge on what this strategy comprises, the following sections will look into the details of this bicycle plan.

8.4 Bicycle Strategy 2011-2025: Good, Better, Best

The *Good, Better, Best* bicycle strategy is the municipality's latest plan to make Copenhagen the bike capital of the world by 2025. Besides infrastructural changes, also the lifestyle and image of cycling in the city and the sharing of experiences and therefore the creation of a sort of community are part of this strategy. The goal of these marketing campaigns is to create a sense of ownership ("Your Bicycle City"), as well as targeting groups which have the potential to use their bicycle more often (e.g. new citizens, elderly people, commuters and people now using the car for short trips). A later section of this chapter will present one of the projects, which is also part of the bicycle strategy and the SUMP, the Cycle Superhighways. This project helps to exemplify the development and implementation of sustainable urban mobility planning.

Before that, the three main focus areas of the municipality's cycle strategy are briefly presented while also providing some background information from current research. This helps to give an overview about the current issues and broader perspective regarding cycling in the city. On the infrastructural level, the municipality has identified three main areas that will be worked on to improve the cycling experience. These areas are sense of security, comfort and travel time, but are often interconnected.

8.4.1 Sense of Security

Road traffic injuries are a recognized public health hazard worldwide. Especially the vulnerable road users such as motorcyclists, cyclists and pedestrians make up more than half of all the road traffic deaths worldwide (WHO, 2018). Most industrialized countries have strongly reduced road injuries and injury severity, as well as the total number of crashes, due to higher road safety and better rescue services (Twisk, Bos, & Weijermars, 2017). In 2017, 34,649 injuries in road traffic accidents were reported by the police, hospitals and casualty wards in Denmark. This shows a decrease of

nearly 14 per cent, compared to 40,097 injuries in 2009 (Statistics Denmark, n.d.). Of this total number, 16,257 injuries were suffered by cyclists and around 72 per cent resulted from accidents only involving one transportation unit. Generally, in Copenhagen the traffic safety has improved over the years. In 2011, the risk of being involved in a serious accident was 72 per cent lower per cycled kilometre than in 1996 (City of Copenhagen, 2011). The Copenhagen Bicycle Account states that between each serious casualty lie 4.9 million kilometres of cycling in the city, which equals 122 times around the globe (City of Copenhagen, 2017). Through the new plans of the bicycle strategy, the number of accidents is expected to fall even more (City of Copenhagen, 2011).

In general, shifting from a motorized means of transport to an active transportation and/or public transport does not prevent bicycle accidents or accidents involving pedestrians from occurring. Yet, fewer car rides and a better active transport infrastructure as well as an increased usage of public transport have shown to decrease the risk of traffic casualties, especially the risk of major injuries or fatal accidents (Reynolds, Harris, Teschke, Cripton, & Winters, 2009; WHO, 2018). Additionally, studies have consistently demonstrated that the health benefits from more PA outweigh the risk of traffic injuries by far (Mueller et al., 2015). The promotion of active means of transport and the actual and perceived safety are highly intertwined. While studies have shown that cycling is safer in cities with a higher share of cyclists, they also describe that the rate of cycling injuries falls as the share of cyclists increases. The same applies to pedestrians. This causality could occur due to either the fact that other road users are more aware and watchful of cyclists when it is more common ("safety in numbers"), or it could be the other way round so that the number of cyclists increases due to higher safety and a better infrastructure ("numbers in safety") (Götschi et al., 2016; Jacobsen, Ragland, & Komanoff, 2015; Winters et al., 2017).

The goal of the City of Copenhagen is to increase the share of Copenhageners that feel safe cycling to 90 per cent by 2025 (compared to 67 per cent in 2010). Therefore,

improving the safety is one of the three main areas of interest of the municipal bicycle strategy. The plan focuses on implementing more and uninterrupted cycle tracks and lanes and making them more spacious, meaning they can facilitate more cyclists and allow them to move at a different pace. Additionally, more “green” and “blue” bike connections are planned, which means that more connections run through green areas and alongside the water, but most importantly are physically separated from the motorized traffic. More plans include painting lanes on busy and wide cycle paths, campaigns to promote the cycle path etiquette as a common understanding of considerate behaviour and how to overtake safely, safer routes to school and intersection redesigns (City of Copenhagen, 2011). Bicycle-only purpose-built facilities, such as the aforementioned, help to reduce the risk of traffic injuries and crashes. One major advantage of physical infrastructure modification is that they improve the population- or user-wide safety without any required action from users or reinforcement by the authorities (Reynolds et al., 2009).

8.4.2 Comfort

While studies show that people in Copenhagen are generally pleased with the overall cycling situation, they also found out that some specific topics were rated with lacking contentment. In 2011, only 30 per cent of the people questioned were satisfied with the bike parking situation in the city and only 50 per cent of people thought that the cycle tracks were well-maintained. The municipality is planning to change this and the measures of the bicycle strategy should eventually raise this share of people who think of the cycle tracks as well maintained to 80 per cent by 2025 (City of Copenhagen, 2011). Thus, in order to make cycling an even more attractive means of transport and finally to increase the share of cyclists, the comfort of the cycling situation in Copenhagen should be improved. For example, the bike route maintenance should become better, including snow clearance and sweeping service as well as the usage of a smoother asphalt type when constructing or renewing the tracks. Additional services to enhance comfort include air pumps along

the stretches and partnerships with educational institutions and employers that agree to help to upgrade their facilities on-site for active commuters. Moreover, to ameliorate the bicycle parking situation, the municipality laid out plans to develop and implement more effective parking solutions for bicycles, which include the infrastructure, partnerships with e.g. workplaces, shop owners and public transport providers as well as enhancing the collection of abandoned bikes. Also, the combination of bicycle and public transport can help to improve the comfort of cycling in the city (City of Copenhagen, 2011). Fostering the possibility of intermodal travelling is an important measurement, as a 2016 survey in the Capital Region found out that for 61 per cent of the interviewed persons it was (very) important to make it easier to switch between the different modes of transport (Capital Region of Denmark, 2017). Within the City of Copenhagen, the bicycle strategy also includes plans to put the "PLUSnet" bicycle network in place by 2025, which enables a more secure and comfortable cycling due to wider lanes and tracks and high maintenance as well as new bridges and tunnels. This new network consists of chosen Cycle Superhighways, Green Cycle Routes and some of the most congested cycling routes (City of Copenhagen, 2011).

8.4.3 Travel Time

The travel time is a crucial decision-making factor for people when choosing a means of transport. As mentioned earlier, people in Copenhagen choose to use their bike primarily because it is the fastest way to get around the city (Boseley, 2018). Therefore, in order to be able to compete with other means of transportation, cycling has to remain and in some stretches be introduced as the fastest way to get around the city. The municipal bike strategy aims to reduce the travel time for cyclists by 15 per cent by 2025, compared to 2010. Specific plans for this include street redesigns such as small and large short cuts. Small short cuts mean eliminating one-way street regulations for cyclists which would then allow a contraflow and more byways. Additionally, large short cuts involve building or redesigning bridges and

tunnels. Moreover, the strategy includes the implementation of ITS that allow, for example, “Green Waves” for cyclists, GPS solutions and signs with information about the fastest routes and current traffic situation. The cycle strategy also focuses on a continuing promotion of e-bikes, improving the infrastructure, enabling more possibilities and a higher standard to combine different means of transport such as the metro, train, bus and bike. To achieve this, improved parking facilities at stations and bus stops are created and bike sharing programmes put in place and maintained. While all these strategies target the improvement of the cycling situation directly, there are also indirect measures that strengthen the competitiveness of cycling by implementing more hindrances for car usage. These obstacles include reduced parking space, speed bumps for cars and lower speed limits for cars around schools (City of Copenhagen, 2011).

Another measure to reduce the travel time and also to improve comfort and safety is the construction of the new network of Cycle Superhighway. While the City of Copenhagen aims to increase the modal share and number of trips by bike in total and reduce the equivalent numbers for cars, most people who live in Copenhagen are already primarily using their bikes. Therefore, in order to ultimately reach their goals, the municipality is highly depending on the surrounding municipalities, as many people commute to Copenhagen from there. While the Cycle Superhighways are part of the City of Copenhagen’s SUMP, they are a regional project, meaning that while it was originally initiated by the City of Copenhagen, it is now carried out by 25 municipalities within the Capital Region of Denmark and helped to coordinate by the Region itself (Capital Region of Denmark, 2017; City of Copenhagen, 2018; Office for Cycle Superhighways, 2018b; H. Lundgaard, personal communication, March 28, 2019).

8.5 The Cycle Superhighways

As the thesis has been focusing solely on the City of Copenhagen so far, the following section summarizes important bicycle key figures of the Capital Region, in order to integrate the Cycle Superhighways project in the appropriate context.

8.5.1 Capital Region of Denmark

The 2016 *Cycling Report of the Capital Region* (in Danish the region is called Region Hovedstaden, and includes a total of 29 municipalities) has shown that the number of bicycle journeys in the region has increased by a total of 20 per cent in the nine years since 2007 and by 8 per cent when compared to 2012. In 2016, 25 per cent of all journeys in the region were by bike with a total of around 3.6 million kilometres cycled per day (compared to 2.8 million kilometres in 2007 and 3.4 million kilometres in 2012), which is also related to the fact of the population increase in the region (Capital Region of Denmark, 2017).

On a socio-economic level, cycling saves more than one million sick days in the Capital Region and on average, every 1,200 kilometres cycled reduces the number of taken sick days by one day. According to the report, this means that cycling has contributed to reducing the number of sick days by 50,000 since 2012. At the same time, commuters who were taking the car spent over 130,000 hours sitting and waiting in traffic, with this lost time waiting being worth an equivalent of around € 1.14 billion (DKK 8.5 billion) or on an annual level 22,000 full-time jobs. Additionally, the report states that the improvement of the air quality and reduction of noise also helped to lower the costs for the healthcare system. Also, looking at the environmental benefits in numbers, according to the report, in 2016 the amount of cycling saved 147 tonnes of NOx, 3.2 tonnes of particulate matter, as well as 114 million tonnes of CO2 emissions, which equals the yearly emissions caused by 15,000 persons (Capital Region of Denmark, 2017).

As part of the Region's opinion poll, 43 per cent of the interviewed persons believed that it was (very) important to improve the conditions for motorized road users, while 68 per cent thought that it was (very) important to improve the conditions for cyclists. Also, the report points out that the most cycling growth potential in the Capital Region is in the suburbs and in the countryside – outside the centres of Frederiksberg and Copenhagen, where a high share of people already cycles – as well as for journeys of longer distances (Capital Region of Denmark, 2017). To improve the overall comfort and safety for cyclists, reduce the travel time, increase the share of bicycles commuting to and from Copenhagen and share of rides on longer distances, the Cycle Superhighways are a joint project between now 25 participating municipalities and the Capital Region of Denmark (Office for Cycle Superhighways, 2018b).

8.5.2 The Project

The Cycle Superhighways (in Danish: S*upercykelstier*) project was initiated in 2008 by the City of Copenhagen. Originally, the municipality contacted its neighbouring municipalities with regards to a potential cooperation for the development of the Cycle Superhighways. Soon after, the Capital Region authority got involved, as one of their tasks is to help to coordinate inter-municipal projects. At the moment, the Cycle Superhighways are a cooperation project between the involved 25 municipalities[2] and the Capital Region of Denmark. Together they have created the *Office for Cycle Superhighways*, which takes care of the overall management, communication and evaluation. The office is financed by the partaking municipalities, together paying a sum of around € 134,000 (DKK 1 million) and the Capital Region of Denmark, paying around € 400,000 (DKK 3 million), for the soft measures of the project. The funding for the infrastructural hard measures of the project is split between the municipalities (50 to 60 per cent) and state funds (50 to 40 per cent) (Van der Pas,

[2] The participating municipalities are Albertslund, Allerød, Ballerup, Brøndy, Egedal, Fredensborg, Frederiksberg, Frerderikssund, Furesø, Gentofte, Gladsaxe, Helsingør, Herlev, Hillerød, Hvidovre, Høje-Taastrup, Hørsholm, Ishøj, København, Lyngby-Taarbæk, Rudersdal, Rødovre and Vallensbæk

2015; Office for Cycle Superhighways, 2018a; H. Lundgaard, personal communication, March 28, 2019).

As mentioned earlier, whereas the bike traffic exceeds motorized traffic in Copenhagen's city centre, the national trend is reversed. On a national level the number of bike trips taken is decreasing, while motorized traffic is rising. The same is true for the Capital Region of Denmark. In the municipalities surrounding Copenhagen, motorized traffic is currently increasing and therefore CO2 emissions have also risen. Additionally, around 25 per cent of the population in the region fail to achieve the minimum physical activity recommended by the WHO. Thus, as one contributing part of the strategy to become the bicycle capital of the world and as a major part of the city's SUMP and climate goals, the Cycle Superhighways were developed (Office for Cycle Superhighways, 2018a).

The new Cycle Superhighways were designed in order to make cycling an easier and more convenient transport option for commuters, by connecting the different municipalities and interlinking traffic hubs, schools and colleges as well as residential areas and areas in which many people go to work (Capital Region of Denmark, 2017). Moreover, the highways can help to increase the level of PA and therefore contribute to health improvements as well as reduce CO2 and NOx emissions by reducing the number of car trips. At the moment, 45 cycle superhighways are planned, which amount to a total of 746 kilometres. From these 45 routes, eight routes are currently in use (status May 2019). The subsequent expansion is planned until 2045, by which year all routes should be in use (Office for Cycle Superhighways, 2018a). An overview of the planned and existing routes is presented in the following Figure 4.

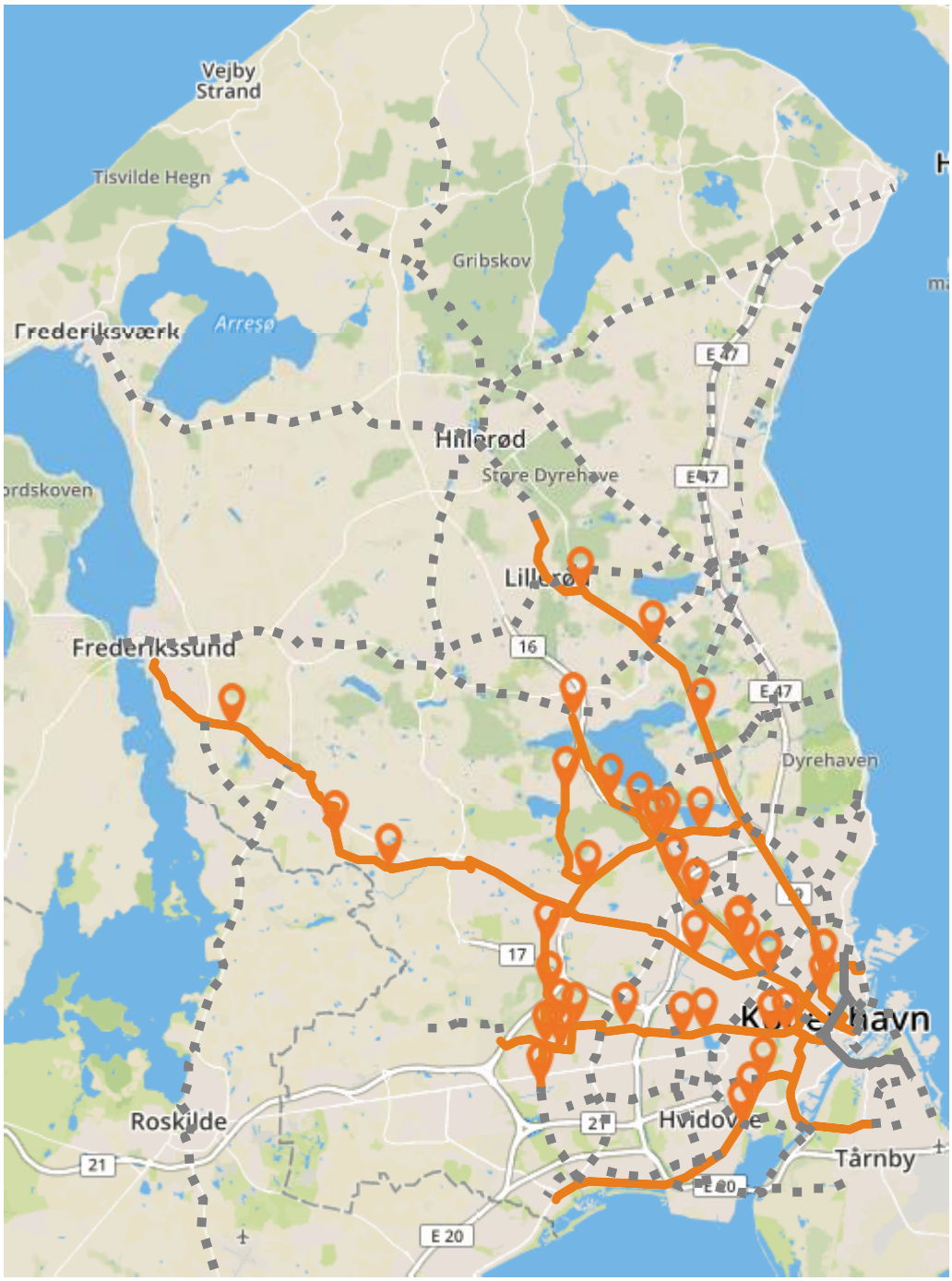

Figure 4. Overview of the Cycle Superhighways, status April 2019 (Office for Cycle Superhighways, n.d.)
Existing routes – orange line; planned routes – grey line; not financed yet – grey dotted line

The planning process of the Cycle Superhighways focuses on four quality measures for the routes, namely accessibility, directness, comfort and safety. First, the highways have been planned out to be located along and close to the public transport stations, making a combination of the two means of transport more accessible. Additionally, the highways are designed to be cohesive and connect all the cooperating municipalities. Second, the highways should provide the fastest possible route between the residence and work places. This means that the routes are as direct as possible, spacious and also decrease the number of stops for cyclists. This can be achieved through, amongst other things, green light waves and countdown traffic lights for cyclists. Third, the comfort of the route is measured by the physical quality of the highways, such as a smooth surface, additional services (e.g. automatic air pumps along the route) and a good maintenance level. Fourth, the highways improve the perceived and actual safety of the cyclists by reducing the risk of accidents with an upgraded infrastructure and safety features such as lightning along the routes and in tunnels (Bom & Clemmesen, 2012; Office for Cycle Superhighways, 2018a).

A visual identity for the Cycle Superhighways has been created with a logo that shows the big letter “C” against an orange background. The aim is to make the Cycle Superhighway logo as recognizable as the Metro and S-Train signs (Office for Cycle Superhighways, 2018a).

Figure 5. Logos of Cycle Superhighways, S-Train and Metro (f.l.t.r.) (Office for Cycle Superhighways, 2018a)

As previously mentioned, the development of the Cycle Superhighways is also a part of the City of Copenhagen's bicycle strategy and SUMP, which aims to increase the bike share in daily commuting to work and education to 50 per cent by 2025 and decreasing the total number of trips taken by car (City of Copenhagen, 2011, 2018). The highways have the potential to especially help to increase the number of bike trips for longer distances and therefore also the modal share of people who commute to work and education by bike coming from the municipalities outside of Copenhagen. In the Capital Region of Denmark, around 60 per cent of all trips shorter than five kilometres are conducted by bike, while the bike is only used for around 20 per cent of all trips longer than five kilometres (Copenhagenize Design Co., 2017). The expansion of the new network especially targets the daily commuters of the participating municipalities. The evaluation of the current routes has shown that for example the average distance that the daily commuters travel on the Farum route is 14.7 kilometres. Also, first successes can be measured for two of the initial routes that were built in 2012. Since then, the bike trips on the Farum route and the Albertslund route have increased by 61 per cent and 34 per cent respectively (Office for Cycle Superhighways, 2018a). While research conducted two years after the opening of two improved routes, namely the Vestvolden and Albertslund routes, has shown that most of the increase is traced back to people switching from other routes, only a modest share, around 4 to 6 per cent, of the cyclists have switched from other modes of transport. Nevertheless, the satisfaction with the lighting conditions, the surface as well as perceived personal security and safety have significantly increased on the two analysed routes. The researchers point out that this satisfaction among users may serve as a convincing advertisement for others, which could bring more people in the population to switch to cycling (Skov-Petersen, Jacobsen, Vedel, Thomas, & Rask, 2017).

8.5.3 Socio-Economic, Environmental & Personal Benefits

The Office for Cycle Superhighways estimates the total cost of the highways to be € 295 million (DKK 2.2 billion), with an annual economic return of € 765 million (DKK 5.7 billion). These numbers were calculated taking into account the resulting 40,000 fewer sick days per year, as well as the 30 per cent lower mortality rate of adults who cycle every day. Additionally, the number of total car trips would ultimately be reduced by one million and bike trips in the Capital Region increased by six million (Incentive, 2018; Office for Cycle Superhighways, 2018a).

The Danish economic consultancy firm Incentive performed the analysis on the effects of the Cycle Superhighways. The firm acknowledged that the data basis is uncertain due to missing numbers and the lack of a general well-established method to calculate the long-term benefits of cycling. Therefore, they based their analysis on existing key figures and explained their method in more detail in the report. Besides the socio-economic benefits, Incentive came to the conclusion that the Cycle Superhighways will contribute to a healthy environment as they help to reduce the CO2 emissions by 1,500 tonnes and the emissions of NOx by 2,500 kg per year (Incentive, 2018).

Apart from the socio-economic and environmental benefits, the commuters' perceived benefits of taking the bike are, amongst others, getting fresh air, staying fit and healthy and not having to give up as much free time on exercising, a more convenient parking situation and lower costs than they would have when taking and maintaining a car. Other improvements that people have mentioned, when asked what would incentivise more commuters to use the bike, are improved safety and a more attractive infrastructure and better facilities at their workplace (Office for Cycle Superhighways, 2018a).

9 Discussion

The following discussion of the sub and main research questions is based on the knowledge presented within this thesis. This chapter is structured in the way that it begins with answering the two sub questions, which serve as a preparation for the following answering of the research question.

The First Sub Question

The first sub question (SQ1) that was posed in the first chapter is: What challenges arise during the development and implementation of a SUMP?
There is no simple answer to this question. The development and implementation of a SUMP consists of many different aspects and opportunities and is prone to different internal and external challenges. Therefore, the answer is divided into two parts. The first part presents the knowledge gained through the conducted interview with Helen Lundgaard and the second part supplements additional challenges that were identified in the *Users' needs analysis on SUMP take up* by Chinellato et al. (2017) and national programme analysis in Durlin et al. (2018).

As Mrs Lundgaard is working for the Capital Region of Denmark and not the City of Copenhagen, she is therefore not directly involved with the city's SUMP, the *Action Plan for Green Mobility*. However, her experience and knowledge about urban mobility planning and close working relationship and exchange with responsible persons from the Copenhagen municipality, allow drawing inferences to the planning processes in Copenhagen, especially since some findings mirror the results of the report from Chinellato et al. (2017) and Durlin et al. (2018), which underlines the similarity of international SUMP planning processes. The following challenges for the development and implementation of a SUMP were identified through the interview with Mrs Lundgaard:

On a financial level, the first challenges constitute the high maintenance costs of the initiated measurements, which are required in order to keep up the same level of quality. The second financial challenge is the availability of resources such as national and/or regional funds because the municipalities are not able to realize extensive infrastructural changes without the funding from higher authorities. This financial support is closely linked to the political will and allows the employment of project managers, whose job is dedicated to the sustainable urban mobility planning only and who effectively drive the ideas and projects forward.

On an organizational level, the first challenges arise through the communication in or between departments, as different infrastructural changes might be scheduled for the same area, but not necessarily discussed and coordinated beforehand. Secondly, coordination becomes also a challenge when taking into account different local plans or standards. While cycling, climate, environmental and plans concerning the urban atmosphere mostly supplement each other; other public and private goals might not always go in the same direction and therefore be counterproductive to each other to some degree.

On a political level, the lack of political will and political changes or a change of priorities after elections can constitute challenges to coherent sustainable urban mobility planning. The right timing and the knowledge to create strong arguments can help to ensure support throughout the political field. Another challenge is the fact that the big environmental and climate issues can never be solved by one country alone, and in no case by only one municipality. As mentioned earlier, raising the numbers of cyclists in Copenhagen also strongly depends on the cooperation with other municipalities. Therefore, stakeholder engagement, cooperation and the willingness to compromise are crucial. While this is not necessarily the case for all SUMPs, the City of Copenhagen's plan also included at least one project, the Cycle Superhighways, which depends on the voluntary commitment of other municipalities that have different political priorities.

Two more challenges are first, the lack of a standardized method for monitoring and data collection, which prevents meaningful evaluations. Second, it is impossible to plan everything beforehand and political changes or unforeseeable expenditures can rupture the planning or implementation process, also the plan itself might have its flaws and turn out unrealistic after all.

Besides the knowledge gained through this interview, the report of Chinellato et al. (2017) identified additional challenges, which are the cooperation between the different levels of authority, including city, regional and national authorities and the national support and sufficient regulatory framework. Moreover, opposing citizens and lack of public support constitute a challenge as well as the pace of technological change and innovations, which require regulatory frameworks. Furthermore, Durlin et al. (2018) identified the deficiency of awareness and cooperation on a national level plus a lack of professional support and focus on traditional transport planning as challenges for the SUMP take-up and planning processes.
It can be briefly summarized that the main challenges that arise when developing and implementing a Sustainable Urban Mobility Plan are of financial, organizational or political nature and are often closely intertwined.

The Second Sub Question

The second sub question (SQ2) that was posed in the introductory chapter is: How can behavioural insights promote change in the PA level of adults in Copenhagen?
Choosing active means of transport and engaging in PA is the result of a mix of the individuals' needs, attitude and preferences as well as the social and physical environment. Therefore, ascribing any behavioural outcomes to specific policies, choice architecture or social motives is difficult (de Nazelle et al., 2011; Winters et al., 2017). The policies for the promotion of PA were already explored in the seventh chapter. Therefore, this answer will recapitulate the findings of the earlier chapter and link them to measures of the Copenhagen SUMP, in order to answer SQ2.

Winters et al.'s (2011) literature review has identified four levels for the application of policies to increase active travelling and thus enhance the level of PA. These are first, the society-level, second, the city-level, third, the route-level and fourth, the individual-oriented.

The goal of the policies targeting the society-level is to increase the relative utility and attractiveness of active transportation. This is approached by, on the one hand, discouraging car usage and ownership (e.g. by raising high costs, restricting parking facilities, implementing speed limits etc.), which the Copenhagen SUMP aims at with the introduction of environmental zones, the reconstruction of highstreets and the lowering of parking standards for cars (City of Copenhagen, 2013). On the other hand, this encourages the use of active and public means of transport, which also help to improve the level of PA, as this includes the active travel component of walking or cycling to and from the station (Buehler & Dill, 2016; Rissel et al., 2012). These measures can serve as nudges for the population.

City-level policies include land-use policies, which can influence people's travel behaviour through the design of urban space and serves as a city-wide choice architecture. While car free city centres with streets such as Strøget and bike sharing programmes as well as short distances, good linkages and diverse land use can increase the levels of cycling and walking, the share of active transport users is reduced through high traffic volume, urban motorways and high speed limits (Cui et al., 2014; Ewing & Cervero, 2010; Ewing et al., 2003).

Route-level policies concern the investments in the built urban environment, which includes the provision of cycle routes, side- and crosswalks. The availability, visibility and accessibility of physical infrastructure which can be used by cyclists and pedestrians are crucial as a basis to establish a culture of active travelling (Winters et al., 2017). As an example, the reconstruction of highstreets such as the Nørrebrogade has changed the physical infrastructure of the road and led to an increase of cycling and people staying in the street. Cialdini's social proof principles can be made use of in order to foster a cycling and walking culture and to ultimately enhance a cultural

shift. This can be especially successful when people have not yet formed strong habits (e.g. new citizens, relocation of home, and change in place of work or education), or even if the usual route is disrupted (e.g. by a construction site) or a new route is constructed (e.g. Cycle Superhighways) (Berveling et al., 2011; Cialdini, 2007). An application of this is found in the SUMP of Copenhagen, which has planned to cooperate with local authorities, businesses and schools. In general, cycle routes that are physically separated from motorized traffic are perceived as being safer and thus encourage the use of bicycles (Buehler & Dill, 2016). Therefore, stretches of the "green" and "blue" routes and the Cycle Superhighways have been physically separated from the car roads (City of Copenhagen, 2013; Office for Cycle Superhighways, 2018a).

The built environment presents an urban choice architecture that influences how people travel through the city and determines which modes of transport are possible to use. As mentioned earlier, the high share of bicyclists in Copenhagen is not achieved through the fact that people want to make a healthy or environmentally friendly travel choice, but rather because they choose the easiest way to get around (Boseley, 2018). Small changes in the urban design as well as the provision of parking and shower facilities at work places have proven to have an influence on people's commuting behaviour (Hamre & Buehler, 2014). By creating a positive user experience and enabling ease of use, public and private investment in infrastructure could increase the level of active traveling and thus the level of PA respectively.

Individual-oriented campaigns such as informational and educational programmes aim at positively influencing people's attitude towards cycling or the usage of bicycles. During informational campaigns, Cialdini's commitment and consistency principle could be applied to the promotion of PA through campaigns that include, for example, competitions (e.g. the bike to work programme). Once people have made a commitment and entered the competition, they are more likely to keep up the cycling during and even after the programme ends. Telling friends, family and colleagues about the participation in such a programme, or the discovery of a new

route, is a good advertisement and also makes use of the liking principle. Having popular or authority figures promoting PA and active means of transport could increase the level of PA through the application of the authority principle. By communicating a scarcity on an environmental level (e.g. “there is only one planet”), and the environmental impact of motorized traffic versus the environmentally friendliness of active means of transport, an increase in PA could be promoted in form of active travel choices (Cialdini, 2007; Lockton, 2012; Skov-Petersen et al., 2017; VCTA, n.d.). In order to achieve a substantial increase in cycling, supplementary strategies and a combination of soft and hard measures are often implemented as a package. While such multifaceted strategies seem to have the highest impact on behavioural changes, this also means that the relative importance of each component is not necessarily measurable (de Nazelle et al., 2011; Pucher et al., 2010).

As mentioned before, also heuristics and biases could be exploited to promote PA in the form of active transport. The anchor and adjustment heuristic could be made use of when declaring active traveling as a social norm and as an anchor point for human behaviour. As the perception of social norms has shown to be a strong influence on people’s behaviour, people might adjust their travel behaviour closer to the anchor point. Also, the travel behaviour could be altered by using frames that associate cycling and walking with being a fun and social activity as well as doing something good for oneself or a personally rewarding achievement (Zimmerman, 2009).

The Research Question

After obtaining knowledge about challenges of SUMPs and the role of behavioural insights for the promotion of PA, the following will answer the posed RQ: How can Sustainable Urban Mobility Plans improve the level of physical activity of adults?
As mentioned in the second chapter, the idea of SUMPs is to improve urban accessibility and the provision of high-quality and sustainable transportation and

mobility in the urban area (European Commission, 2013). By adopting the *Action Plan for Green Mobility*, the City of Copenhagen implemented its own SUMP, which is closely intertwined with other urban strategies. As discussed in the eighth chapter, a major part of the city's SUMP is focused on cycling, in order to ultimately achieve the city's goal to become the world's best city for cycling. Besides the "PLUSnet", shortcuts and cycling services, the Cycle Superhighways are also integrated in the SUMP. With its SUMP and bicycle strategy, the City of Copenhagen aims at influencing the individual's travel behaviour, by implementing hard and soft policies. The measures designed to improve the bicycle experience and eventually increase the share of cyclists have a strong focus on the three topics security, comfort and travel time, which aim at inviting more people to cycle, walk or also to combine the active modes of transport with public transportation. Additionally, the regional cooperation and introduction of a cross-municipal bicycle route system such as the Cycle Superhighways with coherent signifiers (the orange "C") that ensure visibility can help to make active commuting the fastest and most convenient way of commuting to, from and within Copenhagen by improving the connectivity and quality of cycle routes (City of Copenhagen, 2011, 2012).

By increasing the absolute and relative numbers of cyclists and pedestrians, the urban pace would eventually decrease and move closer to a human scale mobility, which is seen as creating a higher liveability and improving the city's atmosphere. This urban transformation is fostered by urban strategies such as SUMPs. Yet, in order to forward this transformation, an increase in the uptake and a successful implementation of measures is required. An in-depth knowledge about human behaviour is crucial in order to predict if measures will be a success later on. Therefore, behavioural insights should be integrated when designing urban spaces and implementing policies regarding the physical infrastructure and soft measures. The findings of SQ2 provide a list of, by far incomplete, policy measures that make use of behavioural insights and previous studies that can be applied to sustainable urban mobility planning, especially regarding an increase in cycling and walking. A

higher share of active transport users can help to increase the level of PA in the population. Thus, by incorporating behavioural insights and the knowledge about active traveling and its impact on PA in the city's SUMPs, urban mobility planning can have a significant impact on the PA level of its population, which has been proven, is correlated to many health benefits and the prevention of NCDs.

10 Limitations

The research comprises a careful selection of suitable theory and methodology and the results form a summary of planning challenges of SUMPs and their applicability on the promotion of PA of adults. Nonetheless, this research has its limitations:
First of all, conducting expert interviews is a valuable tool to gain deeper insight and knowledge about urban planning and public administration. However, this limits the choice of possible interview partners that have case specific knowledge immensely and the acceptance of an interview is voluntarily. Therefore, the study would have benefited from more interviewees in order to learn more about the City of Copenhagen's SUMP. Pitfalls during the interviews could have been avoided through more experience and training of the interviewer. Second, while the literature review of urban planning, mobility management and behavioural insights was carefully selected, the time and scope of this thesis was limited, which led to a reduction and simplification of the theoretical work. Therefore, this work also neglects academic disputes such as for example Daniel Kahneman's and Amos Tversky's dispute with Gerd Gigerenzer (see Gigerenzer, 1991) or criticisms of the nudge concept or the philosophy of libertarian paternalism (see Hausman & Welch, 2010). Third, the research is limited within the boundaries of a single case study. While the data literature research was supplemented with an interview, this communication was scientifically processed using Philipp Mayring's content analysis, which ensures the validity of this study. Yet, the transferability of the findings is very limited, as local

prerequisites and socio-economic development play an important role in urban mobility and planning. Future research that could improve reliability by using several interlinked methodological approaches (e.g. a triangulation of different methods) is needed. Changes in the research design would have added new perspectives to the issue under study, thereby balancing the current subjective access to the topic. The results of this study and the limitations outlined above provide promising opportunities for future research.

11 Conclusion & Recommendations

The ongoing trend of urbanization and its impact on the environment as well as the living conditions of the populations in the cities call for a wide range of multifaceted measures. One urban aspect that needs to change is the transport sector. Urban transportation accounts for nearly a quarter of all CO2 emissions in the EU and most of its energy consumption is based on fossil fuels (State of Green, 2016). Therefore, the transformation of the transport sector is crucial for the reduction of CO2 emissions, build-up of GHG and emissions of other pollutants as well as to combat climate change. To support a more sustainable growth of cities and ensure social justice in the form of accessibility, sustainable urban mobility planning should be integrated in future urban planning processes. To acknowledge this, the EU developed the SUMP concept, which aims at decreasing the climate and environmental impact of urban transport, as well as to improve the attractiveness, accessibility and liveability in the urban space (Wefering et al., 2014). Furthermore, this new planning approach can help to promote the level of PA and thus improve the physical and mental health of the urban population. These insights help make sure that the implemented measures will have the desired effects. Thus, a thorough analysis of people's behaviour and understanding of how people react to certain changes are of high importance for the SUMP development and implementation

processes. The knowledge about behavioural insights and patterns as well as the acknowledgement of systematic non-rational behaviour of humans and social dynamics should serve as the basis of urban planning. The City of Copenhagen's SUMP includes different measures of which many strongly focus on the expansion and improvement of the public transport system and the municipality's goal to become the best city for cycling in the world. Some of these measures can be directly linked to existing knowledge and behavioural insights as shown in the discussion. Knowing that citizens engage in cycling mainly because it is the easiest and fastest way to move in the city, also points out the key elements that should be included in urban mobility planning (Boseley, 2018).

Policies are generally implemented as packages and thus it is not possible to analyse which effect each of them would have individually. Further research should therefore look at the causal relationship of single-sided implemented measures, in order to identify its impact, which could save resources through the omission of less successful measures. It could also lead to a helping guideline to which joint measures generate the greatest uptake of active travelling. Moreover, the applicability of behavioural insights on urban planning policies should be tested in further research and studies. Also, more research is needed on how to address the groups in the population that are least likely to engage in active transport, as not all non-cyclists are the same.

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Appendix A – SUMP Take-Up in Denmark

City	SUMP take-up
Aarhus	In April 2018, the Aarhus City Council voted for the adoption of the new mobility plan for the Aarhus city centre (Aarhus Kommune, 2018b). As the city is growing and expecting 50,000 new inhabitants by 2030, urban space is very limited and calculations show that a population growth of this extent would result in 20,000 new cars on the streets of Aarhus. The new mobility plan sets the framework for the future development of urban mobility and aims to make active modes of transport, such as walking, cycling and public transport, more attractive and to prevent the increase of motorized traffic. In this matter the new plan replaces the previous traffic plan from 2005. To impede the growth of car traffic, not only the private transportation is of interest, but also commercial transport and distribution of goods and services should become as efficient as possible. The city's four main topics of interest for the future urban development are growth, environment, urban life and health (Aarhus Kommune, 2018a).
Odense	The City of Odense has had several mobility plans over the past years, such as for example the traffic and mobility plans from 2009, 2014 and 2015 (Odense Kommune, 2014). The City does not only have sequential mobility plans, but also parallel plans like *the Traffic and Mobility Plan 2008-2020,* the *Bicycle Action Plan 2015-2018,* the *Strategy for Public Transport 2014-2020,* the *Strategy for Traffic Safety 2015-2020* and the *Parking Strategy for 2013-2020*. All these plans are now included in and replaced by the new *Action Plan for Mobility and Urban Space 2017-2024*. This new plan is dynamic, which means that it includes a catalogue of projects which are the basis for the annual budget and implementation prioritization in the City and the Cultural Committee. It also suggests that new projects can be included and already listed ones can be deleted. Odense's vision is to become Denmark's greenest city and to be a hub for smart mobility solutions. One of these solutions is the implementation of rain sensors in traffic lights that interact with motion sensors along the city's Super Bike Highway. These sensors lengthen the green light period by 20 seconds so that cyclists do not have to wait in the rain. The city's goal is to create better traffic flows without investing in the construction and expansion of infrastructure and without affecting any road user group (Odense Kommune, 2018; State of Green, 2017).
Aalborg	The City of Aalborg has developed a new mobility strategy as an umbrella for specific action plans. The overall goal of the city's mobility strategy is to create smart mobility solutions and to increase the modal share of active means of transport by promoting the intermodality of different modes of transport and by enhancing the alternatives to cars. The City's main ideas in order to achieve its goal are to change the travel behaviour through advancing technological solutions and improving the physical environment (Aalborg Kommune, 2013).
Esbjerg	The traffic and mobility plan for the Esbjerg municipality was adopted in 2013 and covers the years from 2013 to 2030. The plan is a working tool for the municipality's traffic planning and serves as an overall framework for the implementation processes and ensures coherence between the different measures. The main goal of the plan is to ensure good mobility in Esbjerg and, amongst other things, it aims to make urban transport more sustainable and environmentally friendly, to manage the expected increase in road traffic and make the municipality more attractive for residents, visitors and businesses. The traffic and mobility plan consists of a background report and an action plan. The background report is a

	catalogue of ideas; the municipality has identified the future challenges and 50 possible measures to ensure good mobility as well as the impact of the measures. The action plan focuses on a reduced number of the ideas and initiatives that were mentioned in the background report and divides them into short-, medium- and long-term focus areas and forms the basis for the implementation of projects (Esbjerg Kommune, 2013a, 2013b, 2013c).
Frederiks-berg	The Frederiksberg municipality has developed its most recent traffic mobility plan as a vision for 2018, which was published in 2013. The plan supported the municipality's vision to be the healthy and vibrant heart in the capital and a sustainable metropolitan area. As Frederiksberg is surrounded by neighbourhoods of Copenhagen, the mobility plan highlighted the importance of an ongoing dialogue between the Frederiksberg municipality and the City of Copenhagen. The idea was to create a link between the existing different municipal plans. The municipality's bicycle policy includes having a modal share of cycling of at least one third of all trips in the municipality which is already the case (34 per cent in 2009) and the CO2 action plan captures the municipality's goal to reduce its emissions by 35 per cent by 2020 (compared to 2005). Based on focus group interviews, the municipality has laid out projects that aim to help improve the mobility of its citizens and visitors (Frederiksberg Kommune, 2013).
Gladsaxe	The Gladsaxe traffic and mobility plan's purpose is to ensure good accessibility for all types of transport but especially to increase the proportion of road users who choose the bike or public transport as preferred means of transport. This plan is included in other plans of the municipality to ensure a sustainable development, such as the CO2 and environmental plan and the overall municipal plan (Gladsaxe Kommune, n.d.).
Randers	The most recent mobility plans for the Randers municipality were developed for the periods from 2013 to 2014 and the following one from 2015 to 2018. The municipality perceives innovative, active and sustainable transport solutions as cornerstones to maintain Randers as an attractive city and municipality to live and work in or to visit (Randers Kommune, 2015). Following the last mobility plan, Randers is currently working at a new strategy for a local sustainable climate and environmentally friendly urban development for its citizens and for potential new businesses (Randers Kommune, 2019).
Roskilde	Roskilde has not adopted a mobility plan for the whole municipality; instead it has adopted plans for smaller particular areas. For example, the municipality has adopted plans for the conversion of the former industrial site *Musicon* into a residential, business, culture and education area (Roskilde Kommune, 2010; Tetraplan & Formel M, 2014). To manage this transition and to limit the impacts on the environment, the Roskilde municipality has adopted a mobility plan for the area in 2010. Additionally, the municipality announced plans to develop the Roskilde city centre to become more vibrant and attractive; the municipality also highlights the importance of sustainable mobility. Therefore, the municipality focuses on the improvement of cycling routes through the city centre by reducing travel time and increasing accessibility. Moreover, the public transport system will be improved by giving buses higher priority in traffic (Roskilde Kommune, 2018; Tetraplan & Formel M, 2014).
Helsingør	The vision of the Helsingør municipality is to become the most attractive municipality for families in North Zealand. For this and to achieve the ultimate goal to become carbon neutral by 2050, the municipality has developed a mobility plan as the transport sector is the sector with the largest amount of CO2 emissions in the municipality. In the plan, the municipality introduces infrastructure projects, traffic and transport policies as well as supportive projects. Additionally, the

	municipality's aim is to attract more people to work or live in the community, to visit the municipality and to improve the populations' health through physical activity (Helsingør Kommune, 2015).
Køge	The most recent traffic and environmental plan for the municipality of Køge was established in 2013 and is an audit of the previous plan of the period from 2008 to 2012 as well as a new project plan. The focus of the plan is to continue to improve road safety and limit the environmental consequences of motorized traffic in the municipality by improving and extending the use of public transport and bicycle traffic (Køge Kommune, 2013). An additional step forward in the field of green mobility is the plan for the construction of the Køge Nord Station which is expected to open in May of this year. The station is a joint project of Banedanmark, the Køge municipality and DSB and aims to promote railway transport in Denmark by making intermodal travelling easier. The station is a transport hub for pedestrians, cyclists, buses, the S-train and a planned high speed train connection between Ringsted and Copenhagen that is scheduled to be finished this year. The plans regarding the station help to improve railway timetables and travel time from and to Copenhagen and improve the route for commuters ("About Køge Nord Station," n.d.; State of Green, 2017).

Appendix B – Interview Guideline

A	Person and Responsibility
1	Please, can you briefly describe your area of responsibility in the municipality?
2	How is your work related to the city's *Action Plan for Green Mobility* and the Bike Strategy?
B	**Action Plan for Green Mobility**
3	In your opinion, which factors play a key role in the planning process the Action Plan for Green Mobility?
4	Who are the main drivers behind local planning of sustainable urban mobility?
5	Which role plays the promotion of physical activity in the development of urban mobility planning?
6	What are the different obstacles when implementing the city's Action Plan for Green Mobility?
7	Are any of the used measures especially successful? (e.g. information, education, campaigns, nudges, choice architecture)

C	Cycling
8	In your opinion, which factors play a key role in the planning process of a new cycling route?
9	How are people's opinions and needs taken into account?
10	Which challenges arise during the planning and implementation process of cycling routes?
11	Which measures to increase the share of cyclists have been most successful?
12	How do you make sure that the new cycle route is a "success"?
D	**Evaluation**
13	How do you measure the success of an implemented measurement?
14	What are the criteria for a successful implementation?
15	Which method do you use to evaluate your implementation?
E	**Monitoring**
16	Do you have an ongoing monitoring process for the Action Plan and the individual projects?
17	Who undertakes this monitoring process?
18	To whom is the monitoring reported to?
F	**Benchmarking**
19	Does the city have any role models regarding sustainable urban mobility planning?
20	Does the city set any benchmarks regarding sustainable urban mobility planning?
21	Who is responsible for the benchmarking and is the person held accountable when these goals are not met?

Appendix C – Interview Transcript Helen Lundgaard

The interview began with an introduction and short clarification on Mrs Lundgaard's person and responsibilities and the role of the region. Questions 1 and 2 of the interview guideline discussed, but as Mrs Lundgaard is working for the Capital Region of Denmark and not the Copenhagen municipality and is not involved in the municipality's SUMP, the questions were not included in the main interview part.

HL: Maybe some of them [the questions] I could answer, if you say region instead of municipality, because the action plan is not our plan, but we have our own plan. So it depends if you are analysing one specific plan?

CG: Yes, I am looking at the Copenhagen Plan, but that is just because this is a selected case, but the goal is to later use it for other plans as well. So if I have other examples that would also be good.

HL: Okay. I can give you examples from how we work on a regional level and then you can choose if you can use it.

CG: What is the regional plan?

HL: We have more than one. You could just call it the Regional Plan for Green Mobility, but we do not have a green mobility plan. We have sort of a plan that is looking at different aspects, not only climate and environment, but also congestion and health. So it is a much broader plan.

CG: But is it one plan or is it a combination of many plans?

HL: It is one plan, but it is very complicated, because this plan needs an update. Because we had a big organizational change last year, which means that half of the plan is no longer applicable because there was a centralization of certain tasks that we were responsible for that no longer is a regional task.

CG: So it has gone back to the municipalities?

HL: Both, municipalities and state. So, for example, our prime task was business development and to create economic growth and work places and this is not our task anymore, so therefore it is not our purpose anymore. But of course we can still work for framework conditions to make business grow. So, our task is clearer now, I think. It is on environment, climate, traffic and a few things concerning education. And the

region is a health authority, so we are responsible for hospitals and so on. So, where I work is a very small part of it. Everything is hospitals and health care and so on. The department where I am is so small that hardly anyone knows that we exist. So I speak from the point of view of that small part.

CG: And this department is on environment and traffic?

HL: It is called regional development, centre or department for regional development. And we comprise a region of 1.8 million people and I think we have 28 municipalities. So each municipality has its own plans, works with physical planning and traffic planning, local roads and works, also with environmental issues, climate issues. So, when we work with those issues, specifically on traffic, we do have some authority, but we also have a lot of coordination. Our prime task is to coordinate and make municipalities and other actors work together, because if you have an environmental problem or climate change or congestion, it will always never be just one small municipality that can solve it. And in this sense, if you look at the Copenhagen action plan, they probably also work with fewer cars and congestion and so on. But since a lot of people commute into Copenhagen every day, they are also depending on what goes on outside of Copenhagen. So in this sense we work with the region across municipalities and each of the municipalities will also handle their issues within their local borders.

CG: But do you coordinate when municipalities work together?

HL: Sometimes. We do not have to and we do not want to do it all the time because that would be a lot of work. But sometimes we recommend it, we pledge for cooperation. We point out which issues or questions are very relevant to work on across municipal boundaries. And that could be the infrastructure of the new light rail that is on its way and will go through 11 municipalities. And you asked also for biking, our biggest project is Cycle Superhighways, which of course a very good example of where we actively support municipalities in working and cooperation on good cycle infrastructure. So, sometimes we do and sometimes we do not.

CG: Do the municipalities ask you to?

HL: Sometimes and sometimes we ask them. And we do not have to, it is not a duty. But we do not want to interfere with local problems. We interfere and try to create regional solutions to issues, problems, challenges that cannot be solved locally. That is very delicate and very difficult to find out when and where to do something and when and where not to do something.

[Discussing the background of the thesis]

HL: Of course, I know a lot about the municipality of Copenhagen and the municipalities, but I have no specific knowledge of the action plan. I know that Copenhagen wants to be carbon neutral in 2025 and that they are very busy and that they will probably not reach that goal, and partly because they are dependent on all the others [municipalities]. But they are very ambitious and I think they are the most ambitious city in Denmark. They really are doing a lot.

CG: So, in your opinion, which factors play a key role in the planning process of the Action Plan for Green Mobility or the regional plan then?

HL: Yes, this is one of the things I cannot answer.
[Clarification on the goal of the question]
Of course I cannot answer on behalf of the municipality. I think, that is my personal opinion, that you cannot plan everything beforehand. It is always a problem about making a plan that a lot of it will not be successful, because it was not realistic. And I think that also applies to the plans we make in the Capital Region. But sometimes you need to make a plan and set a high goal for something and then you try to get there somehow. You do not know how to get there. Sometimes you think it will not succeed and sometimes it shows up to be easier than you thought. [Short excursion on the example of Maersk and their approach to sustainability goals] You try to describe it, but you will have to adjust a lot along the way. And that works for what I do in the Capital Region, we do not know if we will succeed. But we try of course to be realistic and sometimes we also need to be more ambitious than we think is realistic, because we are steered by politicians and politicians are visionary people. They want to change the world and as an employee you try. Also in the Capital Region we do not have so much authority, so you can decide you want something, but you cannot force anyone to cooperate with you. So, you can decide you want a network of Cycle Superhighways, but you need to convince a lot of other people and to establish the resources, so you do not know if you will succeed, but you try.

CG: So, it is mainly the vision of the politicians?

HL: Sometimes you make a plan or a strategy and then you make an action plan that is supposed to be a little more realistic and you have been actually talking to stakeholders. We try in the region to have stakeholder views and stakeholder dialogues when we make our strategies, our visions. We try and normally it is the municipalities that we have dialogue with. A key role in the planning process is to get the engagement by stakeholders, but you cannot be sure that you have the stakeholders with you even though they approve of something. Sometimes it is very difficult to have 28 mayors to decide on something and to agree. There is a lot of compromise. When you get to the execution process, money and resources is a good thing and play a role in success. But you cannot do that without the engagement and the interest of others. And of course knowledge is also a key factor in the planning process. If we speak about cycling, in the Cycle Superhighway project knowledge has

played a key role, because we create the arguments for the project. How much will we gain in health and environment and all these societal gains that we can prove. This is the kind of knowledge that is very crucial for the success afterwards, to make the municipalities, the politicians believe in it, keep putting money in it and so on, and also to get the funding, co-funding from the national level. Maybe, money and resources and knowledge and stakeholder engagement are important.

CG: Is there a reason why not all municipalities participate in the Cycle Superhighways?

HL: Yes, that is because it is not something we can force them to. There are other political priorities. And it is not been stable 23 [municipalities]. We started with, I think, 18. And then it has been a different number and sometimes the political situation changes and there will be other priorities. We have municipalities that have been in and out and in and we have municipalities that this year just now, are joining the project for the first time. And we have municipalities that have left the project, so it is not stable, it is a dynamic thing. And you can see, typically the municipalities that are not in it are the more rural municipalities, where the potentials are less strong. If you need to pay a lot, invest a lot of money in cycle infrastructure but you cannot make a lot of the citizens to cycle, then you will not participate, you will not join in because you do not see the potential. There is no doubt that the potential is bigger when you are in the densely populated areas, the more urban areas.

CG: Was that initiated by the region?

HL: It was initiated by the municipality of Copenhagen, the City of Copenhagen, in 2008. And this was actually in the recognition that Copenhagen wants to be carbon neutral, but they could see and I think they had also goal of maybe was it 50 per cent that was supposed to cycle. But they were not able to. The Copenhageners, they already bicycle, so if they should change the numbers and reach their goals, they needed to get the numbers from outside to change. In recognition to create high class cycle infrastructure in and out of Copenhagen, the City of Copenhagen invited, I think it was something like 15 municipalities, the municipalities that are just close to Copenhagen but it ended up in a short time that there were about 18 municipalities joining and the Capital Region. So we joined it, because we had the resources, we could gear the project with the real money and also because again now it was suddenly not a local project, but a cross-going project. And then at the same time, the national government announced 1 billion DKK for what they call the cycle billion, so there was a big fund that you could apply for co-financing of concrete projects, like the actual building of the infrastructure. Because the region cannot support concrete asphalt any operations, we can only support with money the more soft things, like relation building, cooperation, project management, communication, analysis and all these soft things that are also needed for such cooperation. But paying for the actual infrastructure, the building of the infrastructure that is typical something that the

municipalities apply to the national government in the fund cycle funds they have and then they get around 50 per cent of the costs. And then I think it has started around 2008/2009. And we just secured the cooperation until 2022, because my politicians, called the Regional Council, put 12 million DKK on the budget this year, which is for the financing of the next 4 years of the project. So this is how it works. It is 12 million [DKK]; 3 million [DKK] each year. We pay 3 million [DKK] and the 23, and now because there are two more municipalities joining in, 25 municipalities that share 1 million. So the yearly budget for the project, not the building of the infrastructure, but the soft things is 4 million a year, so 75 per cent is financed by us and 25 per cent is financed by the municipalities. So, they all pay a little bit to it.

CG: Which are the two municipalities that are joining this year?

HL: Tårnby and Dragør. So Amager is certainly on it. This is totally new; there is probably a press announcement this week or next week where some of our politicians will say some nice things. This is very new, so this is breaking news, but it is not secret news. And we also have the City of Roskilde that is actually outside our region, in the neighbour region, but there is a good chance that they will be part of it also.

CG: There is a lot of commuting between Roskilde and Copenhagen.

HL: Yes, and they are also building Cycle Superhighways.

CG: And then they could be connected to each other?

HL: Yes. So, it is a good time for Cycle Superhighways right now. Also, the national government announced, in their new infrastructure plans that they will put 1 billion DKK aside for cycling infrastructure. This means there will be a fund, a national fund, for where the municipalities can apply for co-financing.

CG: But that is not the funding that you use?

HL: Now, actually our funding is also this money that we get from the municipalities. Now, it gets very complicated again. We do not have a tax authority, so we depend on money from the state, block grants and development grants from the state and municipality, so this is how it has worked that each municipality has to pay a development grant to the region and this will be pooled in one big fund and that will then go back into cross-going projects.

CG: So, the money goes back to the municipalities.

HL: Yes, and it forces them in a way to do projects and cooperation that go beyond their own geography.

CG: Who are the main drivers behind local planning of sustainable urban mobility?

HL: Well, politicians I should say. Because you need politicians to say 'yes, we want spend our resources on that'. Some municipalities they do not work a lot with it and some municipalities they work more with it, because they have politicians who are in favour of green mobility, or sustainable urban mobility.

CG: And it is probably also the people demanding it from their politicians?

HL: Yes, so, of course in the end it is always. It is a democracy, so people vote for the politicians that represent their attitudes of course. So, I think also project managers play a role. You need some people that have a dedication to sustainable urban mobility. But these project managers would not exist if there was no funding and local authorities that decided to do something together. So, for example, if we use Cycle Superhighways, it is a project that has its own project secretariat that is financed by us. But they are dedicated only to work with that. Because if you look at me, I do not only work with cycle infrastructure, I have many different tasks. I only spend a small part of my time working with that. I sort of control, or am responsible for a contract with the project secretariat. They get money from us; we make a contract and then make a project. They also make an action plan and so they get the money and they execute the ambitions. So you need dedicated people that can concentrate and spend all their time on that thing.

CG: Which role plays the promotion of physical activity in the development of urban mobility planning?

HL: I think from my point of view, we do not work with the mobility only because of health. We work with it because of different arguments. Health is undoubtedly the most important reason that we should engage in cycling, in promoting cycling, because we are, as I told you, a health authority. Unfortunately, the money we spent on our health sector cannot be directly related to the gains from people cycling. People get less sick, they have less sick days and so on. They are hospitalized less; they live longer and so on. And you cannot relate that directly to the hospital sector that is paid year by year. And maybe the effects of working with cycling will only show in 20 or 30 years. But health is definitely a good argument. But also congestion, mobility, accessibility, climate change, pollution, air pollution and noise pollution also play a role. So, it is actually maybe the multitude of good arguments and gains together that makes it such a winner case. We see politicians actually support the agenda of promoting cycling, because it is difficult to say you do not want that. It is kind of an agenda that makes politicians that normally disagree, agree, also at the national level, I think. But still, you do not see the same investments in cycling as in heavy traditional infrastructure. So there is some kind of mismatch between all the good arguments and the priorities and where most is spent.

CG: On a national level?

HL: Everywhere. So that is a mystery. How come, that is also one of the conclusions of the hearing yesterday [referring to the conversation before the interview began, about a hearing on healthy modes of transport in the national parliament]. Of course all the politicians that want to promote this case, they were there. And all the politicians that do not spend so much time on that agenda, they were not there. So the big question is how come we have all these fine arguments. This is such a good idea to support and to put a lot of money in cycling promotion, how come we do not do it? Even in Copenhagen and in Denmark, where we have pretty good cycling culture and infrastructure, we still think there is not put enough attention to this. Now, I am also talking a little bit on behalf of myself, my personal opinion, because as matter of fact, I should represent the political viewpoints, but I think, I also present political viewpoints of the Regional Council when I say this: There is really a big support for cycling in the Regional Council that consist of 41 politicians, regional politicians.

CG: But there is still a lot of investment in motor infrastructure as well, or is the focus shifting now?

HL: No, on a national level we have a very conservative liberal agenda and they want to support especially roads and road infrastructure, in order to avoid congestion and with the belief that if you make the roads bigger, then you will avoid congestion. There is not a lot of focus on collective transport; this is not a priority right now. But I think, by building roads, also part is for the cycling infrastructure. So, maybe there is a need to, when they want to improve the existing roads, maybe make them broader and whatever, also make the cycling infrastructure better could be a solution.

CG: So, a combination of both?

HL: Yes. So, nationally everybody wants to promote cycling, but still right now there is a very car-friendly government. It is a liberal and conservative government.

CG: So supporting cycling while not harming car drivers.

HL: Exactly.

CG: What are the different obstacles when implementing the City's or regional plan for green mobility?

HL: I think, I said before, resources. Money and manpower are important, but also priorities. When politicians they prioritize cycling it is not because they do not think it is a good idea that is because they find it difficult to find money for all the good

things that they would like to improve, like the population getting older, more expenses to health care, more expenses to elderly care and more expenses to children's homes and so on. These are a lot of good things that you would like. How to prioritize between these things? Political priorities, I think that would be everywhere in the world. And people do not want to pay too much in taxes.

CG: Are any of the used measures especially successful when promoting sustainable mobility?

HL: That was my immediate answer: no. We try many things. I have seen things that are successful, but I have not seen anything that changed everything. I have not seen one measure that is changing things dramatically. We can see when we built Cycle Superhighways; we actually improved the cycling infrastructure a lot and nurture the cyclists and so on. Then you get more cyclists. We also had a lot of success with the promotion of e-bikes, to let people lend an e-bike. These are small things that are actually very successful, but it is not part of a big plan. It is still something that we are doing on project levels. And it is still, you should for that, you should put much more emphasis on that if you should be able to measure the results. So, I think that I have not seen. I think the right question here is to say that all these different measures in combination are the right thing to do. And you need all hard measures and soft measures together and timing should be right. For example there is much more focus on climate now than there was before. And maybe you could mention carpooling. I think maybe there is a good timing for carpooling right now, but ten years ago there was not. I cannot tell you why it is like that. But we have not seen yet something that changes everything, a game changer or what you call it. I think we have tried a lot and we can see isolated that it works to improve infrastructure for cycling. It works to let people try an e-bike and so on. But we need to do it much more if we need to change something. And now we are talking about Copenhagen region it is a densely populated region with a lot alternatives to cars and I do not know it will even be more difficult if you go to a rural place, where you do not have all these alternatives. So I am talking from the Copenhagen region perspective now. So we actually talked a lot about cycling now.

CG: In your opinion, which factors play a key role in the planning process of a new cycling route?

HL: I think I already answered that: Cooperation, funding, political will.

CG: How are people's opinions and needs taken into account?

HL: Are you thinking of, if you for example realize a stretch of the Cycle Superhighways, how much you interact with the people?

CG: Yes.

HL: We so something. I do not know if we do it systematically, but I think Cycle Superhighways do a lot of using the social media for example asking people that are in the Cycle Superhighways group about their opinion, about this and that. And you have an email where, as a citizen you can write to the Cycle Superhighways secretariat if there is problem on the roads or if you want to have some kind of improvement. We do not have hearings on Cycle Superhighways and should it be this or that. This is too small for that, I think. I think, there is so much evaluation on everything we do that of course we use that evaluation as a learning point. So, when we do the next Cycle Superhighways, we have learned something. And this is the whole idea of a lot of municipalities working together and having a secretariat where you sort of collect all the knowledge, evaluate and so on. So if one municipality wants to know something about lightning or wants to know something on how the intersections should cross or to deal with the interaction between buses and bicycles or whatever, then there would be knowledge a possibility of knowledge sharing and expert knowledge in the secretariat of Cycle Superhighways. So, I think, this is really a project where you talk to the people use the infrastructure a lot and actually use evaluations and actually do a lot interaction. Sometimes in the winter time they put up a place where they give out coffee to the people and then they can have a talk to them about how it is and what is important for you. Or something that they also like to do a lot is to visit the work places along the routes. So in the lunch break or whatever they would have place where the people can come and hear about the Cycle Superhighways, have dialogue. So I think, they do a lot in that sense. But you don't plan a cycle infrastructure and involve people a lot. This is not how it works. This is something you do on the basis of what you already know. You would probably get much more information if you would talk to the people in the Cycle Superhighways secretariat, because they are lot more into details. I think they do it really well and they are very professional.

[reads the next question] Which challenges arise during the planning and implementation process of cycling routes?
Well, we have been talking about it before: Political changes and political will and priorities sometimes happen and sometimes you have elections and you have new politicians that want something else. Or certainly there was a big expenditure on something that you did not take into account and you need to re-prioritize. And then other plans, meaning that sometimes you have plans for different objectives. And sometimes these different objectives, they do not play well together. We spoke in the beginning that green transportation and healthy transportation often meet in the same goals. So when you promote the one thing, you promote the other thing. But that is not always how it works. So, different plans and different objectives will often go in the way. I do not know how often we have seen that we have planned a Cycle Superhighways and the plan was to inaugurate it in 2017 or whatever and then they found out that somebody was supposed to make a road work there in 2018, so they stopped the project because it does not make sense to make everything nice and

spend a lot of money and you know the year after it will all be torn out again. And this is so difficult to make different actors in the same department speak together. You have road work all the time and nobody knows. Right hand does not know what left hand does.

CG: So communication is important.

HL: Yes, and if it is possible to coordinate these different plans. They want to improve the bus lanes, but the bus people did not speak to the cycle infrastructure people and it will be like that all the time. Or they need to prepare for climate change, so they need to change all the pipes in the ground, so they dig it all out. All these different people, the climate people do not speak to the cycle people that do not speak to the bus people and so on. Different plans come in the way.

CG: Which measures to increase the share of cyclists have been most successful?

HL: I think that Cycle Superhighways are a very good example of where it actually works. They can see that the numbers of people biking is decreasing in many places, but the places where they upgraded the infrastructure to Cycle Superhighways, they everywhere can see increases. It is hard core arguments and proof that it works. They have different successes and some highways are showing better results than others. For many years they only had the results for the first two routes Albertslund and Farum routes, but they just published an evaluation one month ago. Because there are eight routes now and they always took pre-measurement and after-measurement, one year after the implementation and I think on all the eight routes there has been an increase, was it 23 per cent increase. So that is pretty good. This is what they can see; they can prove it works.

CG: How do you make sure that the new cycle route is a "success"?

HL: I just said it is a success; it could be even a much bigger success. So, you need of course a higher standard to make it a success, but there is never money for that. The criticism that we had since we started this project that is ongoing criticism is that it is not super enough. So, when you approve a Cycle Superhighways, you have a scheme of different criteria where you measure, does it live up to this, and does it live up to this and so on. And then you can score different points, but you never score high points on everything, we nearly always dispense for something. When we realize the Cycle Superhighways, they are never as good as we would like them to be. If you can have success, even though they are not super super, just a little bit super or at least better than they were before, then I guess you could have much more success. And of course, if you have them, you need to maintain the standard and that is also difficult to have a high maintenance level on these roads. And we talked about that next year there is suddenly a road work, so to ask the bus people or the climate change people that they should remember to, when they close their project, to make the cycle

infrastructure just as good as it was before. You need constantly to look over this infrastructure in order to make it just as good as it was when it was inaugurated, but you could even make it even better when there was more money. And then we also spend a lot of time on communication. You also have to let people know that now there has been a lot of improvement on this stretch, so to actually tell people to use this stretch, because it is very good. So, a lot of communication about it also works. This is why the Cycle Superhighways secretariat, they so often go and visit work places along the routes, they make newspaper articles and so on. Because they constantly also need to make people pay attention to the possibility. So, they have all these good stories about cyclists that use the routes and different aspects of that. 'This lady started to bicycle on the Cycle Superhighways and she bikes so many kilometres each day and now she is much happier and she lost 5 kilos' or something. They do all these stories about happy and healthy people using the bicycle lanes.

CG: Now, the evaluation: How do you measure the success of an implemented measurement?

HL: [reading her notes] I told you that we measure any Cycle Superhighways before, when it is in the planning process. They make a measurement. Some people, they actually go out there and measure how many bicycles are there now, they stop some of them and ask those questions and they make the road better and one year after the inauguration, approximately, they do another count and they again ask people the same questions. And so that is how they find out, it actually works. This is a systematic procedure that they measure before and after. Of course, we also measure the project cooperation and are the municipalities happy about how it works and what could be better and should we do more of this and that. But that is more an evaluation of their cooperation, the project, it is not so much an evaluation of the concrete infrastructure and whether it works or not.

CG: Okay.

HL: [reads the next question on the interview guideline] What are the criteria for a successful implementation? I think, as I told you, we measure how many cyclists are there. So, that is a concrete. Like 61 per cent more cyclists on the Farum route, for example. This is the best result we have ever seen, we use it a lot. But then also, if you stop people and ask them, then you find out how big a percentage of these 61 per cent increase are actually new cyclists, who did bicycle before and who used a car before. So, they get an impression, are it just people going another route or are it people that started biking? And then they also ask people: how long do you bike every day? How often do you bike? And so on. And for this reason, they can see that the average length or distance that people bicycle on the Cycle Superhighways is even a longer distance than the average distance that people travel on bus or train. So this is what you can see. You can actually have people cycle longer distances than they commute by train or bus, not by car. This is what you measure. For this reason,

when do we consider it a successful implementation, we look if it actually creates more cyclists, especially more cyclists that did not bicycle before. And why is that important? That is important because we want a healthier population; we want less pollution, less carbon emissions and so on.

CG: Okay.

HL: [reads the next question on the interview guideline] Which method do you use to evaluate the implementation? I told you, before and after. And then we also have a project, we are working on having the same methods and the same data across the municipalities. Because there has been often a tradition that you do it a little bit differently. Then you cannot compare. There is good working going on right now to make the municipalities measure in the same way, use the same method, ask for the same things, do it at the same time of the year and all these things and actually standardize and make higher quality of data. That is also part of Cycle Superhighways, it is not only the infrastructure, but also the way we work with infrastructure.

CG: Okay. Also within the municipalities?

HL: Yes. [reads the next question on the interview guideline] Do you have an ongoing monitoring process for the action plan and the individual projects? Yes, I think I answered that. Like for the Cycle Superhighways, they have their own way of measuring. But I know that you are not only asking for cycling, I know that I tend to talk a lot about cycling. To finish the thing about cycling, then I think I sent you the regional cycle accounts. So this is a way that we try to measure every third year: How is it going with cycling? Some municipalities make these accounts on a local level and the City of Copenhagen does. We do not have the same systematic and professional approach to monitoring green mobility. But we should have, we just do not have yet. It is also still quite new to work with electric cars or to work with carpooling or car sharing or you work with mobility management in general of these different soft measures that you can use. There is not really one systematic approach to that. I think it is still on a project level that you work on green mobility, so it depends a lot on the concrete project, how much evaluation and monitoring you are doing. As long as you are working with projects, that is because, I think, if you look at green mobility as a whole, there is a lot of tests and test projects and pilot projects and what happens when people borrow an e-bike, what happens if people borrow an electrical car, what happens if we ask some people to drive together for a month. As long as we are working with these projects, we always measure and evaluate, because we do that in order to find out if it works. It is not systematic, but we tend to look at the small projects and see how they work.

CG: And to find out if they are fit to bring them on a bigger scale as well?

HL: Yes.

CG: Okay. Who undertakes the monitoring process? Is that the region itself, for the bicycle account for example?

HL: The bicycle account is our tool and we initiate and we pay for it and this is our own account.

CG: Who do you pay for it to do it?

HL: We have used a consulting agency called Incentive. They were actually also making a presentation at the hearing yesterday [in parliament]. So, I think, they are leading within measure cycling economy and measuring cycling benefits and societal effect on cycling in Denmark. But there are also people or agencies that can do it. We have used them, because I think, because they are the best. But it is again, it is much depending on the project, who is monitoring it. Whenever we give money for a project, not only Cycle Superhighways, we have also financed a lot of mobility management projects right now, we are financing mobility management project called 'moving people' and before that we had the 'test an e-bike' a we have had many different kind of projects, we always ask for an evaluation and monitoring of the results. So every time you have a project, you will also get an evaluation. When we give money, we need some kind of report back.

CG: So, this is also the next question. So it is reported back at you every time you have a project?

HL: Yes, if we have put money in it, then we ask for evaluation and a report.
[reads the next question on the interview guideline] Does [the city or in this case] region have any role models regarding sustainable urban mobility planning? No, not really. But maybe we should have. The City of Copenhagen is a role model for everybody in Denmark. They have a whole cycle programme, only working with cycling in the city, improving cycling. You will not see that anywhere else. Of course we also compare ourselves to the Netherlands and I think on a regional scale, they do better. Then I think you are not the only one that we speak to. There is so much interest on cycling abroad, in Europe and even in the whole world. So if you look at how much money is canalised into cycling, you will see that there is much more spending and much more investment in cycling everywhere else than in Denmark. But we are just lucks that we planned for cycling so many years and we have a good foundation. So, we should, we could look abroad for role models where they put much more public finances into cycling promotion. Again, cycling is one thing, but if you ask me about carpooling or electric mobility, then we would not be the best. But when you talk about cycling, I think we are among the best in the world. So, I am sure there are cities in Germany also that are doing well, but maybe we did not get it yet

that we are lacking behind. So that is why I say that we do not have any role models, because we are still thinking that we are so good. That is ironic.

[reads the next question on the interview guideline] Does the region have any benchmarks regarding sustainable urban mobility? Yes. I know that Copenhagen has. We have, actually when I say we have different plans, when I work with urban mobility, sustainable mobility, I work with it in the region as geography, across the 28 municipalities, but I am also a project leader of a project within our own work place. So, as I told you, we are a health authority with big, big hospitals, we have 45.000 employees in the Capital Region, working in the hospitals, doctors, nurses, so on. So, we have around 100 locations in the Capital Region where there is some kind of hospital or specialized institution, psychiatry institution, something. We also work with our own business. Within that plan, where we work with green mobility in our own company, our own organization, we have a goal to be fossil fuel free in 2050 and we want to reduce carbon emissions by 12 per cent in 2025 compared to 2015. So, we have some actual missions. As I told you in the beginning, we try. But we make a plan and we try to make it as realistic as possible but we do not know if we will reach it. We can see that most of our carbon emissions from the hospital sector come from flying. Because, actually a lot of our employees they go by plane, because we have a lot of researchers that go all over the world for conferences and so on.

CG: That is hard to scale down.

HL: Yes, we have an objective, a vision of being a world class hospital or health class system, both in hospital or health research and also within the treatment of diseases. So, to have that objective is very counterproductive compared to an objective of being fossil fuel, because there is so much flying. This is a concrete example of how we find it difficult to reach our goals, because we have other goals that are counterproductive to our carbon, fossil fuel free goal.

CG: Do you have a benchmark for cycling?

HL: Our benchmark for cycling is the one that they have for Cycle Superhighways, because Cycle Superhighways are our one and only project. So, we have decided that our goals for the Cycle Superhighways are also the region's goals. I think, the Cycle Superhighways have a vision of being the best cycle region in the world. So this is also our goal. And then because we have a vision plan for Cycle Superhighways, where we want, I think it is before 2045, an infrastructure of 750 km Cycle Superhighways. It should have all these benefits; we can measure all these things, so this is more or less to reach our goals in the vision plan. And for the geography as a whole we also have a mission or vision or goal of being fossil fuel. It is not only within cycling; it is within everything we want to be fossil fuel in 2050.

CG: Okay.

HL: [reads the next question on the interview guideline] Who is responsible for the benchmarking and is the person held accountable when these a goals are not met? No. It is good intentions, we also oblige to the UN goals and the Paris agreement goals, all the goals that are set on EU level and UN level for carbon reductions and so on. In some sense we are part of that, so we should take measures to try to help our nation to reach those goals. But we have no authority and we cannot hold anyone responsible. We have election every fourth year, where we choose our politicians, so if our politicians, they say that they want to do this and that in order to make our region more green and more healthy and spend a lot of money on cycling or electric mobility. And if the population do not think that they were not responsible enough actually reaching the goals, then they can vote for somebody else. That is basically how we hold people responsible.