
# THE BICYCLE RING IN AARHUS, DENMARK:

*a case study of maintaining people friendly environments while managing cycling growth*

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STUDENT REPORT

# Abstract

This research project seeks to analyze the relationship between cycling and people friendly environments, specifically focusing on the growth in cycling numbers and the associated challenges. To exemplify this relationship, this research project uses a case study of the Bicycle Ring (Cykelringen) in Aarhus, Denmark. Four corners around the Bicycle Ring, with different characteristics in the built environment, are explored further.

In cities with a growing population, such as Aarhus, mobility is an important focus because the amount of travel will increase, putting a higher pressure on the existing infrastructure. In Aarhus, cycling is used as a tool to facilitate the future demand of travel and to overcome the negative externalities associated with car travel. The outcome of improved mobility and accessibility is seen as complementary to a good city life in public spaces. Therefore, it is argued that cycling is a tool to facilitate people friendly environments.

Recently, the City of Aarhus has implemented cycle streets around the Bicycle Ring as a solution to improve the conditions around the ring. Cycle streets can contribute to a people friendly environment because it encourages a slow and considerate behavior from cars. However, a big issue observed around the ring is a certain bicycle mentality, which can hinder the benefits of cycling in the city. It is concluded that there needs to be a level of management for both infrastructural and behavioral aspects in bicycle planning to manage the challenges associated with growing cycling numbers.

# Preface

This research project is a master's thesis conducted as a part of the program Urban Planning and Management, at the School of Architecture, Design, and Planning at Aalborg University. The subject matter was inspired by the researcher's respective internships at the Center for Urban Development and Mobility at the City of Aarhus and the Dutch Cycling Embassy. The research and writing was carried out from February to June 2017. References in this research project are cited according to the Harvard style. A full reference list with the corresponding sources are found at the end of this report. Transcripts of the interviews and observations conducted are found in the appendix. Images without a source are adapted by the authors and all of the photographs are taken by the authors as well.

Lastly, we would like to thank our supervisor Assistant Professor, Ph.D., at Aalborg University, Gunvor Riber Larsen for her insightful guidance and encouragement throughout the project. We would also like to send a big thank you to the City of Aarhus, especially to Smart Mobility for answering all of our questions and providing us with helpful information.

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# 1. Introduction

With more than half of the world's population living in cities, and with numbers continuing to grow, the positive and negative externalities of urbanization is greatly affecting today's industrialized cities. Cities can be a place where consumption of resources, such as land and fuel, can be saved through compact development (Warren, 2014). However, the growth in cities is also putting a higher pressure on the existing traffic infrastructure, while at the same time, there is an increase in demand for mobility (Lennert & Schönduwe, 2017).

After World War II, the car was perceived as the 'mode of the future' in many European countries, and urban planners and engineers planned for a car-centric future. In both Copenhagen and Amsterdam, neighborhoods were destroyed to widen streets, and public spaces were turned into car parks or multi-lane boulevards for cars (Van der Zee, 2015; Ruby, n.d.). However, as more cars are flooding city streets, this type of mobility is becoming compromised due to congestion, a decrease in noise and air quality, and a reduction of people out on the streets (Warren, 2014; Jacobs, 1961).

In the 1960s, a discontent about the car-centric development was expressed by pioneers within the field, such as Jane Jacobs and Jan Gehl, arguing that the rise of the car changed the nature of cities (Jacobs, 1961; Gehl, 2010). The city was neglected as a meeting place for people by giving less priority to public space, walking, and cycling. The necessary planning dimension of planning for people was missing (Gehl, 2010). Many of the cities today, do not encourage human interaction (The Human Scale, n.d.). By planning for people friendly environments by inviting people to reside, cycle, and walk, there are many benefits to a city. For example, cities can become more lively and safe, when people are out on the streets, travel at a slower pace, and interact. Cities can also become more sustainable due to less carbon emissions from cars and a more efficient use of space. Further, active transportation facilitates daily physical activity leading to improved physical and mental health (Gehl, 2010).

Therefore, cycling is promoted as a solution to many of the issues facing cities. For example the capital of Denmark, Copenhagen, is focusing on the human dimension in their planning, such as using the bicycle as a tool to facilitate more people friendly environments. Copenhagen is promoting the bicycle and investing in improving the conditions, leading to a steady increase in cyclists (City of Copenhagen, 2011). However, in recent years, the city is facing challenges with the growing numbers of cyclists, such as a lack of parking spaces and congested bicycle lanes during peak hours, causing the city to bring attention to these challenges (Dambeck, 2013; City of Copenhagen, 2011). This phenomenon of managing growing cycling numbers to maintain the quality of the mode and its effect

on the city is not just happening in the bigger cycling capitals, but it is also challenging smaller cities with growing cycling numbers.

This research project focuses on Aarhus, Denmark, to study how cycling can affect people friendly environments. Aarhus is Denmark's second biggest city, and has the fastest growing population in the country (Aarhus Kommune b, 2016). The city has experienced a large growth in cycling in recent years. Since 2000, cycling has increased with 30%, leading to it being the mode of transportation that has increased the most (Aarhus Kommune a, 2016; Aarhus Kommune b, 2016). The City of Aarhus acknowledges the relationship between mobility and its effect on city life. The population growth will lead to an increased need for transportation, which will challenge the city. However, Aarhus is focusing on smart growth and developing a dense city to facilitate active transportation, which can enhance the city life (Aarhus Kommune d, 2017).

To exemplify this relationship a case of the Bicycle Ring (Cykelringen) in the city center of Aarhus is researched. The Bicycle Ring facilitates a connection for cyclists around the city center without having to cross the pedestrianized inner city. It is interesting from an urban planning perspective because it represents a way of organizing and prioritizing cycling in a city center. This research project wants to gain more insight of how public space and city life can be affected by cycling. As cycling numbers in Aarhus increase, new challenges that require attention, arise. If the growth is not managed this could hinder the quality of cycling, making the mode less attractive, and having a negative impact on the public space.

## 1.1. Research questions

Presented below are the research questions and justifications. The two sub-questions draw out certain aspects of the case that are relevant and can be investigated further, and help support answering the main research question.

**With growing cycling numbers on the Bicycle Ring, how can this growth be managed to facilitate a people friendly environment in the city center of Aarhus?**

The main research question first explores how growing cycling numbers can challenge a city. Then it focuses on how to manage this growth while maintaining and improving the conditions for cyclists in the city. Cycling has many benefits, as mentioned above, and should be encouraged when planning for people friendly environments. The quality in mobility is also an important factor to maintain the attractiveness of the mode. Therefore, it is important to manage the cycling growth so the city life in public spaces are not compromised.

1. What is a people friendly environment and what role does mobility play when applying the definition to the context of Aarhus?

This sub-question first defines aspects of a people friendly environment, acknowledging the relationship between mobility and city life. Secondly, the definition is put into the context of Aarhus, explaining a people friendly environment with a focus on mobility. This sub-question is important because it creates a context for the main research question.

2. How does the built environment influence people's mobility behavior around the Bicycle Ring?

The aim of sub-question two is to create an understanding of how the built environment can influence the way people move in the city. This is important to analyze because the built environment sets a framework for people's movement. Therefore, the built environment facilitates certain mobility behaviors, which can affect the quality in mobility.

## 1.2. Project structure

This report is structured into eight chapters, from introduction to conclusion. Chapter two, literature review, includes four main concepts which are inspired by the research questions: planning for people, the built environment, mobility, and active transportation. The main concepts are researched with a mobility focus and form a theoretical framework which is used for analysis and discussion.

Chapter three, background, provides a context for the case study. It includes a shorter introduction to Denmark and then introduces Aarhus and several of the municipal documents from the City of Aarhus, relevant for the research.

Chapter four, methodology, first presents the philosophical approach to this research project. Followed by an explanation of case study research, delving into relevant aspects within this kind of research. Further, sections including collection of data and analyzing the data are included. In every section of this chapter the theoretical aspects are first presented, then they are followed by an explanation of how they are applied to this research project.

Chapter five, findings, presents the most prominent findings from the empirical data collected from the observations. This chapter is divided based on the four corners, from which the Bicycle Ring is analyzed from; Grønnegade/Klostergade, Mejlgade/Graven, Mindebrogade/Skolegade, and J.M. Mørks Gade/Frederiksgade/Østergade.

Chapter six, analysis, answers the research questions, starting with sub-question one, followed by sub-question two, and lastly the main question. Sub-question one is divided into two sections, first defining a people friendly environment followed by an explanation of how a people

friendly environment can be explained in Aarhus with a focus on mobility. The second sub-question first explains the bicycle mentality in Aarhus, then it is divided into three themes, shared space, scripts and atmosphere. The three themes include examples from the Bicycle Ring to showcase and analyze different situations. The main research question first explains the challenges with growing cycling numbers, going into how these challenges can be managed. Then, it focuses on the growing cycling numbers on the Bicycle Ring, how this challenges the ring and how different solutions can be applied to Aarhus.

Chapter seven, discussion, consists of two main sections, discussion and methods discussion. In the first section, aspects that have not been touched upon are brought up for discussion, including the concept of people friendly environments being too idealistic and the language used in traffic planning. In the second section, the methods applied to this project are critically viewed, to explore what could have been done differently for the future.

The last chapter of this research project is its conclusion, where the most important aspects from the main research question is extracted.

# 2. Literature Review

This research project's starting point is a literature review, building the theoretical framework. A literature review is an important aspect in research. It provides information on what type of research already exists in the field, and who the key contributors to the research are (Bryman, 2012). This section is divided into four keywords, which are inspired from the research questions. The four keywords are 1. Planning for people: entails researching the shift from car oriented planning to human oriented urban planning and its effect on cities. 2. The built environment: researches the built environment and its effect on how people move in the public space. 3. Mobility: highlights the change in seeing mobility, from a transportation perspective, as more than just a derived demand but an activity in itself. 4. Active transportation: highlights the benefits and challenges of active transportation to the user and the city. Lastly, specific aspects of the theoretical framework are applied to each research question.

## 2.1. Planning for people

This section entails researching the shift from car oriented planning to human oriented urban planning and its effect on cities. To set the context of how the ideas for planning for people came about, first a description of the increase in cars after World War II is discussed, emphasizing the planning practice during this period. Then, pioneers that set the human dimension as a focus in planning, such as Jane Jacobs and Jan Gehl, are discussed to explain the discontent of the modernist planning approach in cities. Different concepts that can be seen in this paradigm shift from a car centric focus to the social dimensions, such as sustainability, smart growth, and livability, will be discussed further. The aim of this section is to help answer the research questions by defining the attributes of a people friendly environment.

### 2.1.1. Rise of the car

Since the rise of the car after World War II, cities started to change shape. Automobiles were used in cities as a convenient mode of transportation and gave citizens the freedom and independence to transport oneself. However, the dependence of the car, in relation to the city, has many complex facets, which include land use issues, and social and environmental challenges (Newman & Kenworthy, 2015).

Modernist planning and the rational planning model greatly influenced the type of planning in the 1950s (Koglin & Rye, 2014). Both of these types of planning valued hierarchy and comprehensiveness (Hemmens, 1992). The type of 'planning from above' was practiced, meaning that planners and architects would plan the land use from maps and make decisions from a broad

perspective. Buildings were constructed on a large scale and consumed the whole street block (Gehl, 2010). In addition, modernism aimed to organize the urban environment as a coherent whole, and focused on implementing efficient transportation, meaning the car, at the top of the hierarchical structure (Hemmens, 1992).

With modernism, came a focus on motorized traffic, which caused a trend to eliminate the street and replace it with the road. The street was generally perceived as an old-fashioned place where people would meet and urban life evolved. Alternatively, roads were seen as a place where motorized traffic could flow fast without disturbances caused by other modes of transportation (Koglin & Rye, 2014). Modernism aimed to solve many problems through a single narrative, which therefore often neglected complex social and environmental concerns (Hemmens, 1992). Within modernism planning, the focus was on modern traffic, which soon became interchangeable with car traffic (Koglin & Rye, 2014).

Urry (2007) argues that the urban landscapes built in the modernist time favored cars and discouraged other forms of movement. The space between private places, such as home and work, are filled with *"dead spaces for car only environments"* (p. 122, Urry, 2007). Usually, cars are static and take up two or three parking spaces, one for home, one for work, and another for places of interest. This type of land use is wasteful and only serves one use, which is a place for cars (Urry, 2007).

Mattioli (2013), presents four changes in the public space after the increase in car traffic. Public space can be defined as:

> *"Those areas and locales, especially in towns and cities, outside the private spaces of the home and work, where people can congregate, socialize and organize in relatively unregulated ways"* (p. 31, Mattioli, 2013).

First being a fight over space, meaning, that when the automobile rose in popularity, roads were made into car only areas aiming to improve the safety and efficiency for cars, which decreased the conditions for alternative modes of transportation, such as walking and cycling. The second change is the construction of parking lots and roads, which led to shrinking public spaces, such as parks, sidewalks, and squares, in urban environments. The motorized traffic led to cities expanding, causing urban sprawl. Leading to the third change, which is the decrease in quality and quantity of urban space in suburbanized areas. The fourth change is the barriers caused by constructing highways and major roads, which led to the urban geography being dismantled (Mattioli, 2013).

### 2.1.2. Shift in urban planning

Banister (2008) states two contrasting views in transportation planning, one supporting the car centric paradigm and the other, towards more sustainable mobility. The conventional, car centric, approach focuses on travel in terms of cost and time, and travel as a derived demand and not a valued activity. With this planning approach, motorized traffic is valued, thus, causing cities to become decentralized. The sustainable mobility approach encourages dense development, modal shift, and trip length reduction, to support active transportation and public transportation (Banister, 2008).

Pioneers within the field such as Jacobs (1961), Schneider (1979) and Gehl (2010) all express similar discontent on the changes cities went through during the post-World War II era. Schneider (1979), an urban planner, states that the automobile started a plague, which destroyed American cities, both environmentally and socially. Cities have always had a main role in civilizations and have been the center of achieving excellence. However, the giant scale of automobile planning has changed the nature of cities. Highways and large roads have split the livelihood of neighborhoods and destroyed city centers (Schneider, 1979). Jacobs (1961) was an activist for rebelling against the modernist type of planning. Her work argues for the importance of life in the city's streets, stating that the streets are a place for people to interact and form a sense of community. Streets are for more than just carrying cars, but serve a much bigger purpose, they are the *"most vital organs"* of a city (p. 29).

Gehl (2010), an architect, expresses that the human dimension has been shadowed for decades in urban planning. In the past, urban planning has focused on other elements, such as efficiency in car traffic, flow of cars, and planning to make the 'car happy'. The dominating view of modernism has reduced the priority of public space, walking, and cycling, and neglected the city as a meeting place for people. Gehl criticizes the planning in the 60s and 70s for causing an increase in pollution, noise, car traffic, and a lack of life in city centers. Cities have been missing a necessary planning dimension, which is planning for people (Gehl, 2010).

In some cities, the mobility benefits of raised highways have not been strong enough and they have been torn down in favor to other types of road infrastructure, such as boulevards and tree lined parkways (Cervero, 2009). Cervero (2009) argues that to some, *"this represents a paradigm shift, from designing cities for "automobility" to a focus on "livability" and from a modernist to a postmodernist perspective of infrastructure and its role in the city*" (p. 216, Cervero, 2009).

### 2.1.3. The human dimension in planning

Jan Gehl is inspired by the *"grandmother of humanistic planning"*, Jane Jacobs (see section 2.1.2), for emphasizing the value of human scale (Anderson-Oliver, 2013). Human oriented planning is

focusing on the human dimension in cities, meaning, creating inviting spaces for people compared to the previous modernist way of planning (Gehl, 2010). Gehl argues that cities should be shaped to impact the "*human lives lived within them, rather on traffic efficiency and parking spaces*" (Bramley, 2014). Banister a (2011) mentions the work of Jan Gehl to "*push the urban debate towards involving the people*", and to give priority to people, create attractive places, and increase activity in cities (p. 954, Banister a, 2011).

Tibbalds (2000) argues that cities were built for people, however when walking around major cities, this does not seem apparent due to large construction sites, and the amount of motorized traffic. From the human scale, large motorized roads, can be daunting for slower modes of transportation, such as walking and cycling. A human environment is one with a comfortable human scale and pace for pedestrians. This does not mean that buildings need to be built small and one dimensional. Cities can still have high buildings; however, they must be thoughtfully placed with the human perspective in mind and aesthetically designed with a top and bottom appealing to humans. Details of buildings should be at eye-level, so pedestrians and cyclists are not alienated from the environment. Maintaining the integrity of the human scale, and viewing the city from eye-level can make people feel more comfortable and invited in a space (Tibbalds, 2000).

Gehl (2010) proposes an argument for including the human dimension in planning by presenting four aims for cities: a lively city, a safe city, a sustainable city and a healthy city. These aims rely on strengthening public space through human oriented planning and active transportation. They can be holistic in the field of urban planning but can also be seen as separate goals.

The four aims for a city can all be reached by inviting people to walk, cycle, and reside in the city's public space. A lively city relies on the perception of public space as an inviting area. Car dominated cities tend to have people to travel fast without staying in an area, which leads to the public life in cities suffering. A safe city, both the actual safety and the perception of safety, is an important factor to feel comfortable in a city and travel within it (Gehl, 2010). Jacobs (1961) also stresses the importance of people in the streets to improve the actual safety and the perception of safety in a city. Jacobs introduces the concept of 'eyes on the street', which means that people walking in the street are all subconsciously looking at each other, which brings a sense of security (Jacobs, 1961). A sustainable city can be achieved through using active transportation because cycling and walking has minimal environmental impact compared to other forms of transportation (see section 2.4.2) It is also important that the public transportation system is well connected in the city and facilitates a comfortable and safe trip. The last aim for cities is a healthy city. Recent changes in society such as more sedentary workplaces, more transportation in cars, and other non-physical activities, such as elevators and escalators, have made cities less healthy. The lost daily exercise has

negative consequences in form of a lower quality of life, higher healthcare costs, and even shorter life expectancy. Using active transportation to and from daily activities is a way to give people the necessary daily exercise to prevent these issues (Gehl, 2010).

#### *2.1.3.1. Sustainability*

Building on Gehl's notion about the 'sustainable city' the topic of sustainability is explained further. When researching the broad concept of sustainability, it is often divided into three pillars; environmental, social, and economic. The pillars are intertwined and are therefore, difficult to address individually (Morelli, 2011; Gibson, 2006). To achieve sustainability these three pillars needs to be addressed equally (Circular Ecology, n.d.).

In environmental sustainability, the main issue is to find a balance in how to fulfill the needs of the present, while at the same time, not compromising the resources for future generations. Therefore, it is important to take care of nature's assets (Morelli, 2011). In social sustainability, urban policy often includes concepts such as, livability, social mix, and affordable housing (Davidson, 2010). In short, social sustainability refers to the argument that both physical and social health should be equal for everyone (Crowhurst Lennard, n.d.). Economic sustainability, according to Doane and MacGillivray (2001), can be perceived as the most complicated pillar. Crowhurst Lennard (n.d.) explains economic sustainability as an economy that ensures a minimum wage for everyone, and therefore does not enrich a minority of the population at the expense of the rest (Crowhurst Lennard, n.d.).

One approach to develop in a sustainable manner is smart growth, which focuses on the relationship between transportation and development. Its origin is in the United States, as a planning philosophy to overcome the dominance of the car, combat urban sprawl, and create better communities. Smart growth argues that the development patterns affects the modal choice of people. For example, low density development makes driving a car a necessity (Handy, 2005). Creating such urban forms, like smart growth, which focus on dense, mixed use, pedestrian and cycling friendly environments, enhance the livability in cities (Kashef, 2016).

#### *2.1.3.2. Livability*

A by-product of cities developing in a sustainable manner and smart growth enhances the interaction among people, civility, and sense of community (Kashef, 2016). When areas are mixed use and have less traffic, public spaces are more pleasant for residing (Banister b, 2011).

Livability is difficult to define since it is based on people's perceptions (Balsas, 2004; Okulicz-Kozaryn, 2013). The concept is sometimes discussed as referring to a local context, since it includes aspects such as culture and infrastructure, which can be perceived local (Lowe et al., 2015). The

concept of livability refers to several constructed views about human quality of life, in any environment. The term integrates both the physical and social parameters of human well-being (Kashef, 2016). It relates to *"quality of life, standard of living or general well-being"* in areas (p. 433, Okulicz-Kozaryn, 2013). Further, Kashef (2016), claims that urban livability is strongly related to the concepts of 'urbanity' and 'urbanism', meaning the culture or people's way of life in cities. In these settings, the interaction between people and the urban environment can be seen as an explanation for people's behavior (Kashef, 2016).

The concept of 'livable cities' became popular in the literature in the 1980s, relating to the growing environmental issues and the increasing competition between cities, trying to improve their economies and attract investments from abroad (Kashef, 2016). There are several magazines, such as Mercer, Monocle, and the Economist Intelligence Unit, that annually rate the world's 'most livable' cities (The Economist Intelligence Unit, n.d.; Monocle, 2016; Mercer, 2017). These types of rankings look at parameters in a broad spectrum, such as public transport, nightlife, and cost of living (Okulicz-Kozaryn, 2013). However, they can be criticized for measuring differences between cities, but they do not acknowledge the disparities within them (Lowe et al., 2015). Okulicz-Kozaryn (2013), also points out that the rankings measure the standard of living and not the quality of life (Okulicz-Kozaryn, 2013).

Livability is closely linked to the broader notion of the three pillars of sustainability; social, economic and environmental, therefore, the goals of planning for a sustainable and livable city can be seen as complementary. The terms show similarities in relating to people's well-being and both being concerned for the future of life and society (Lowe et al., 2015). Kashef (2016), argues that citizens must minimize their impact on the environment to improve the livability of an area (Kashef, 2016).

## 2.2. The built environment

To be able to answer the research questions, this section entails a definition of the built environment, the impact of urban form on transportation, and managing different modes of transportation in the built environment. The built environment is important to research when focusing on transportation, because it correlates to many aspects, such as the transportation network and mobility behavior.

### 2.2.1. Definition

The built environment is a concept with several dimensions, and within urban planning, the term 'built environment' is used in various ways. For example, urban designers tend to look at the relationship between the built environment and public space, and the appearance and arrangement of the physical elements in the space. Transportation planners are often more interested in how land use and transportation systems are linked and the level of service on the transportation network.

Land use is defined as the distribution of activities in the built environment, including the grouping and location of amenities, such as housing, commercial, and businesses. The transportation system encompasses elements in the built environment such as roads, bicycle lanes, sidewalks, and bridges (Handy & Boarnet, 2002).

The World Health Organization (WHO) defines the built environment as the physical environment that is man-made, as opposed to the natural environment. It includes the land use patterns, the transportation systems, and the spaces around them (World Health Organization, 2009). Yao (2013) also defines the built environment as the "*human-made setting to accommodate human activities*", including both the buildings and the transportation system (p. vii, Yao, 2013). Handy and Boarnet's (2002) definition includes the elements stated above, but also incorporates the patterns of human activity and level of service into account. The built environment is forever changing both rapidly and slowly. For example, the exterior of buildings deteriorates over a long period of time, but the amount of pedestrians on a main boulevard over the day changes rapidly (Handy & Boarnet, 2002). In this research project, the built environment includes the land use, transportation system, and man-made physical environment, including the traffic signs, traffic calming measures, and markings on the road.

### 2.2.2. Dense cities and mode choice

Urban form is the characteristic of the built environment, including the density, size, and configuration of settlements. It is the pattern and concentration of the land use and can be analyzed through either the dispersal or density of these uses. This can be on multiple scales, such as regional, local, and street level (Royal Town Planning Institute, 2015; Burton et al., 2013).

The patterns of urban form in a city are interlinked with the development of the transportation system. This combination affects the accessibility in cities. Especially with expanding cities, the urban form and dispersion of amenities relies greatly on the type of transportation that is needed to access those places. If cities are more sprawled, with low density, then it requires faster modes of transportation to reach the destination. In addition, car dominated transportation systems require much more space than other transportation systems (Rode et al., 2017). When amenities are densely located in an area, these areas are deemed 'pedestrian-oriented' or 'walkable' (Handy & Boarnet, 2002). Banister b (2011) proclaims that the built environment affects travel behavior by reducing the need for travel and which type of mode to use for travel. Dense, mixed-use, urban areas have reduced travel distances and decreased the need to travel, particularly for car use, and made walking and cycling easier (Banister b, 2011). Litman (2010) argues that communities that are oriented for active transportation have several qualities in common. They are "*compact, connected,*

*designed at a human scale, have attractive sidewalks and paths. This improves accessibility, affordability and community livability*" (p. 3, Litman, 2010).

A compact city is a city which focuses on high-density, mixed-use development and is a contrast to urban sprawl and low density of modern car cities. Higher density cities support public transportation, walking, and cycling as a viable mode of transportation. The advantage of more compact cities includes the need for less car travel, easier access to business and work places by sustainable modes of transportation, revitalization of city centers, and increased efficiency of infrastructure and utilities. These advantages contribute to the overarching goal of sustainable development (Burton, 2000). The density of a city can also affect city life either positively or negatively. For example, newer dense cities tend to have high rise buildings, which can alienate people from the street because there can be gusts of wind, dark streets, and increased noise pollution. However, older neighborhoods tend to be dense but the buildings are at a lower scale, which facilitates an inviting public space. Newer developments can also facilitate good public space by being mixed use and building proportional to the human scale (Gehl, 2010).

### 2.2.3. Mode division

It is often assumed that constructing infrastructure that separates cyclists from other modes of traffic is the best way to avoid accidents (Heinen et al., 2010). Modernist planning promoted a physical separation between the modes of transportation. However, more recent planning ideas have challenged this idea (Jensen, 2014). The concept of shared space is challenging the automobile dominated cities and the planning ideas of separating the vulnerable road users from motorized traffic (Karndacharuk et al., 2014). Shared space is allowing different modes of transportation in the same public area (Gehl, 2010; Karndacharuk et al., 2014). This concept is not new, however, the developed ideas where vulnerable road users share the space with faster and larger mass vehicles, such as cars, are more recent (Karndacharuk et al., 2014).

In the Netherlands during the late 1960s, people were searching for solutions to reduce the impact traffic had on the quality of public space (Hamilton-Baillie, 2008). The concept was further developed as residential shared spaces, called 'woonerfs', which roughly translates to 'living yards'. These streets point out the various functions of public streets, e.g. the function as a 'place'. It also points out the shift in demand and expectations from people away from motorized traffic towards sustainable and safe transportation options for everyone (Karndacharuk et al., 2014). The popularity of shared space in the Netherlands quickly grew to other parts of Europe such as, Denmark and Sweden (Hamilton-Baillie, 2008).

Dutch traffic engineer Hans Moderman had a notion that if streets contain 'village-like' qualities, meaning no signs, no speed bumps, curbs, or sidewalks, and asphalt replaced with brick

pavers, road users will drive safer and be more aware of their surroundings. This theory was applied to several Dutch towns and showed that motorists were driving much slower, because cars were confused of who the space belonged to, and that ambiguity caused drivers to be more accommodating to cyclists and pedestrians. Rather than separating modes and creating clarity, the main roads looked like narrow roads in villages. The design of the roads caused motorists to automatically change behavior, compared to the regulatory force of signs. Skeptics claimed that Moderman's ideas could only be successful in smaller towns and villages. However, in London, on Kensington High Street, which is a very busy corridor for cars, pedestrians, and cyclists; traffic planners removed the metal railings that separated pedestrians and traffic, removed the street markings, and signs. After the changes, there are fewer accidents in the area. Pedestrians are crossing more frequently and not at the crosswalks, causing cars to drive at lower speeds (Vanderbilt, 2008).

Gehl (2010) acknowledges the issue of the quality of space when implementing shared areas. He argues that a sufficient shared space relies on the notion that all modes of traffic have to travel in the same speed as the slowest mode of transportation using the space. He claims that the quality is impaired for vulnerable road users when they constantly have to be aware of other modes. For example, there can be issues with older people not feeling safe to choose certain routes, and issues with kids playing not being aware of the other modes of transportation in the area.

In accident statistics, shared space is shown to help reduce incidents in traffic. A shared space forces pedestrians and cyclists to pay attention to other modes of transportation using the same space, which reduces the amount of serious accidents (Gehl, 2010). Toth (2009) agrees with this statement, and argues that compared to separating each mode, shared space causes people to be more alert and have eye contact with one another, which can reduce fatal crashes (Toth, 2009). Jensen (2014) states that in roads that are shared between cars and bicycles, speed is an issue. A solution is to put a speed bump, to slow down the speed of those modes (Jensen, 2014). Toth (2009) claims that shared space is not against the car, but a solution for motorists to integrate with slower modes of transportation and be a 'guest' and adapt to the speed of the slowest mode (Toth, 2009). However, Jensen (2014) argues that most urban planners and urban designers agree that some kind of division between the different modes of transportation is needed to protect the most vulnerable mode of transportation.

### 2.2.4. Traffic calming

The main aim with traffic calming is to slow down traffic. It is typically applied to residential areas to reduce vehicle traffic speeds. A goal with traffic calming is to create a safe environment for all types of modes (Black, 2010). When the speeds are lower on the roads, it is safer for each type of mode (Horton, 2010). Several techniques to slow down traffic are to place physical barriers, such as

speed bumps, or bollards on the road, so motorists or cyclists must slow down and avoid these obstacles (Black, 2010). This can however, be an inconvenience for cyclists depending on the magnitude of the bump (Rupprecht Consult, n.d.). Reducing speeds through the use of regulatory measures, such as one-way signs and speed limit signs, can also be effective in calming traffic (Horton, 2010). However, narrowing the streets and mixing traffic (e.g. cars and bicycles) is proven to have positive results in reducing motorists' speeds. When the streets are wide, cars tend to go much faster compared to streets which are narrower and have pedestrians and cyclists on the road. Road design is an important factor in traffic calming, meaning that the road should be designed in a manner that cars automatically slow down, or seems natural to reduce speeds (Rupprecht Consult, n.d.). If the road is very busy with cars, traffic reduction can be an option by redirecting the motorists or bicycle traffic to an alternative route to maintain the safety of both modes (Rupprecht Consult, n.d.).

## 2.3. Mobility

This section will discuss the terms of mobility and mobilities. First it will provide a definition of mobility. Then it will describe the 'mobilities turn' which describes a new focus on researching mobilities. Further this section, inspired by Jensen (2014) and Jensen et al., (2016), will explain the concept of mobilities design. Several theoretical concepts are presented which will help analyze the findings from the empirical data collected. Followed by, a discussion of behavior change and its associated challenges. A broad view on how to manage people's mobility behavior is also presented.

### 2.3.1. Definition

Mobility is the *"movement of people or goods"* (p. 29, Litman, 2003). Mobility can be both social and physical, such as the movement between social classes, or the movement from A to B (Litman, 2003; Wang et al., 2011). In this project, mobility is in terms of transportation, and the way people move in the environment. This movement can be accomplished through various modes of transportation and through different routes as well. When researching everyday mobility, it is more than just the movement from A to B but can also serve as an activity on its own. The travel time can be seen as more than 'wasted time', but a time for social interaction and other physical and mental benefits (Jensen et al., 2016). Mobility used to be a synonym for 'traffic' or 'transportation', however, in recent times in Denmark, this term is used in municipal strategies and plans to address more than its basic definition of moving people and goods from one place to another. When mobility is viewed beyond its practical movement, the term can serve as a new perspective in creating livable environments. The change towards mobility can also showcase a wider recognition of mobility, "*not as an isolated phenomenon, but enmeshed in issues of sustainability, efficiency and economic growth*" (p. 38, Jensen et al., 2016).

### 2.3.2. Mobilities turn

Sheller and Urry (2006), claims that there has been a 'mobility turn', which is an effect of this change spreading into social sciences and transforming them, and changing their relationship to transportation research. This has led to a 'new mobilities' paradigm that has been formed within social sciences, with contributions from different fields such as geography, anthropology, and transportation studies (Sheller & Urry, 2006). According to Urry (2007) mobilities is more than just the movement of people, but it is the 'movement-driven social science', which enables new theories and concepts which are not previously researched.

The amount of travel and distance travelled is increasing in the world. This increase can be seen in a positive light, meaning, it shows that personal mobility is increasing, as well as economic growth (Banister & Marshall, 2000; Banister b, 2011; Sheller & Urry, 2006). However, different kinds of mobilities create 'fast and slow lanes' for people around the world, meaning that the mobility will increase for some people and decrease for others, especially when crossing country borders (Sheller & Urry, 2006). It is not only people that are on the move, but also materials. The technology has increased making the world more connected, for example, with the Internet allowing new ways to interact with people from far away. The issues that can be seen with movement, either by too much or too little movement, such as diseases, train crashes, and congestion are important for many people and organizations (Sheller & Urry, 2006).

Jensen et al., (2016) expands on the 'mobilities turn', previously mentioned and states there is yet another turn. Jensen et al., (2016) claims that in mobilities research the *"practical and applied dimensions of mobilities"* (p. 26) have been given more attention. When dealing with some of the world's biggest challenges, such as environmental issues and new changing demographics, there is a need for a practical approach, with *"new knowledge, processes and solutions within policy-making and planning of contemporary mobilities*" (p. 26, Jensen et al., 2016).

### 2.3.3. Mobilities design

Jensen explains a Staging Mobilities framework (see image 1), which identifies two different perspectives on mobilities. He claims that *"mobilities do not 'just happen' or simply 'take place'"* (p. 15, Jensen, 2014). Mobilities is well thought out through planning, design, regulations, and institutions, which Jensen (2014) calls 'staging from above'. However, the way the mobilities are *"acted out, performed, and lived"*, which is called 'staging from below', is equally important (p. 15, Jensen, 2014). Therefore, mobilities is a both a process of "*creating lived mobility practices*" as well as creating the physical setting, and design to perform these (p. 15, Jensen, 2014).


Image 1 Staging Mobilities model (p. 15, Jensen et al., 2016)

Mobilities design is "*exploring the very physical and tangible layouts and designs*" of the built environment, including bicycle systems and transit spaces (p. 17, Jensen, 2014). Focusing on the key issues between the design and the analysis of mobilities. The definition of design can vary depending on the perspective, such as architects, urban designers, or traffic engineers. There are both common and specific definitions depending on the field (Jensen, 2014). Mobilities design can be both viewed from the practical perspective, meaning infrastructure is designed as solutions to solve efficiency and connectivity issues, but can also be designed beyond its practical means as a way to stimulate multifaceted and unpredictable urban effects (Jensen et al., 2016).

Relating to image 1 above, Jensen (2014) proposes several theoretical concepts to aid in mobility analysis, presented below:

- Mobile *sociopetals* and *mobile sociofugals* both deal with the notion that some places and settings are good at either drawing people into an area (sociopetal) or push people away from an area (sociofugals).
- *Mobile body semiotics* is stemmed from the concept of 'mobile semiotics' which deals with how signs either coordinate, afford, or demonstrate the physical circulation of people in systems of infrastructure. In 'mobile body semiotics', the human body does not just move and react to the material, but also acts as a 'sign', and communicates the norms and intentions in the physical environment.
- *Mobile with* deals with the social dynamics that are created when people move together in groups. *"Humans make sense of their environment as they move and this is important to the way we engage with our consociate whether or not we know certain things"* (p. 47).
- *The ballet* refers to the interactions between people at eye-level. Such as the gazes and gestures that take place during mobility.

- *Mobility affordances.* This is the "*specific relation between the moving body and its material environment open up to particular modes of mobility, different speeds, trajectories, temporalities, etc.*" (p. 49).

Expanding on affordances, Gibson states that "*affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill*" (p. 119, Gibson, 2014). This definition allows for an unlimited number of possibilities for the environment to afford, however, once the behavior is actually performed in a real-word context, then it becomes an affordance. Jensen et al., (2016), applies Gibson's definition to mobility situations. Jensen et al., (2016), uses the concept of affordances to theoretically research the relationship between mobilities and the designed environment (Jensen et al., 2016). In the Merriam Webster Dictionary, affordance is defined as; "*the qualities or properties of an object that define its possible uses or make clear how it can or should be used"* (Merriam-Webster, n.d.). Jensen et al., (2016) claims that affordances suggest how materialities can enable or disable the way people perform mobilities, just because the materials exist, it does not mean that people's behavior will adapt to it. For example, a red light signal does not mean that everyone will follow the signal and stop. Jensen et al., (2016) uses affordances as a tool to analyze *"the performative effects of materialities in mobile situations",* at the same time acknowledging that people also play an important role in the performance of mobilities (p. 30). When involving the material world in the research, a deeper understanding of real-life mobilities in their actual situations can be gained.

The way places are structurally designed can influence how they are being used by the user. For example, Michael Walzer, a political theorist, describes the function of places as either 'single minded' or 'open minded'. The first view, 'single minded', are places which are designed by planners and developers with only one purpose. The other view, 'open minded', are places which provide an opportunity for a variety of uses. Mixed-use areas or places with multiple uses within are two examples of open-mindedness in cities. These areas have different functions, which promotes various behaviors and interactions between people (Rogers, 1998).

Expanding on 'single minded' and 'open minded' spaces, Jensen (2010) states that there are 'movement spaces' and 'staying spaces'. Meaning, places of transit, and areas where people congregate and interact. These two types are not isolated cases but can be present in the same area. Places can be more than just a 'sociofugal space', places where transit forces people to move, and equally they can be a 'sociopetal space' which brings people together in an area. Within public space, the interactions between people and other modes are called 'negotiations of space'. People negotiate not only the routes in an area but also an interaction in motion through dynamic flows. There are various types of negotiations in space between people and different modes. Between pedestrians,

there can be a direct negotiation when there is eye contact and a reading of body language. There is indirect negotiation, mostly seen between cyclists and pedestrians, when there is an estimation of the situation through reading and evaluating body language. Lastly, there can be no negotiation between people (Jensen, 2010).

### 2.3.4. Behavior change in mobility

The environmental issues coming from transportation are acknowledged by many politicians, professionals, and the public. There are negative effects such as congestion, air pollution, and the increase in land use (Banister & Marshall, 2000). The transportation sector contributes significantly to global warming due to its emissions of $CO_2$ (Lennert & Schönduwe, 2017). In recent years, the car use has increased rapidly (see section 2.1.1) but, despite these trends of increased motorized traffic, new alternatives to transportation have emerged (Rode et al., 2017). A change towards more active transportation instead of the car has an impact on people's quality of life in different ways, for example, economic benefits due to less congestion, and health benefits because modes of active transportation produce little carbon dioxide. Lastly, it can also make people appreciate the local community and environment, making people enjoy the space more (Banister a, 2011).

There is an understanding that behavior change is needed to reduce the $CO_2$ emissions from the transportation sector (Schwanen et al., 2012). Demographic, economic, and geographic factors play a role affecting travel behavior (Litman, 2010). Habits have a central place in reducing car traffic, and the common challenge is how to break the unsustainable habits that emit carbon dioxide (Schwanen et al., 2012). Urry (2012) claims that habits are one of the main issues in transportation patterns, since it makes people's behavior more difficult to change (Urry, 2007). Schwanen et al., (2012) explains habits as a more or less automatic behavior, that it is repeated and reinforced in a positive manner (Schwanen et al., 2012). Habits play a big role in mobility behavior, especially for commuters, because commuter trips can be seen as a stable and repetitive behavior (Brette et al., 2014). According to Urry (2007), people tend to have contradicting views about cars, meaning that many 'love' their cars, but at the same time, dislike the system that the car represents (Urry, 2007).

There are different views in how to accomplish behavior change with less people choosing the car (Schwanen et al., 2012). Efforts are being made to design appropriate infrastructure and to reduce pollution (Banister & Marshall, 2000; Rode et al., 2017). Economic instruments, such as pricing and taxing, as well as, building denser cities, have been favored means through time (Schwanen et al., 2012). Restricting the ability to use a car, for example, by removing parking lots, can encourage people to shift to another mode of transportation (Banister & Marshall, 2000). However, the assumption that behavior change can only be reached by 'hard' system-based measures, or regulations have been challenged in recent years, and 'soft' policy measures and smarter choices

have gained recognition (Brög et al., 2009; Schwanen et al., 2012). There has been a shift towards more 'soft' measures, defined in Brög et al., (2009), as *"voluntary behavior change initiatives"* (p. 281, Brög et al., 2009). Changes in the urban environment away from the construction of urban highways, has also come from within cities, where citizens are worried about the quality of life, social capital, and the historic preservation of their city (Rode et al., 2017).

The broad field consisting of policies and actions that aim to make transportation more sustainable is often referred to as 'travel demand management' (TDM). TDM focuses on changing people's travel behavior, most often with the goal of reducing car use (Black, 2010). This approach is also sometimes referred to as 'mobility management', 'traffic demand management' or 'transportation demand management' (Litman, 2010; Planning for Sustainable Travel, n.d.; Victoria Transport Policy Institute, 2014). The range of policies and actions can exist on two levels. At the surface level, the concept can support public transportation, carpooling, and active transportation alternatives for people who want to change their traffic behavior. On a deeper level, it can be argued that TDM is involved with urban design and municipal planning. The strategies can strengthen a greater engagement with transportation alternatives, and guide citizens to use them more often. Key concepts can be *"walkability indices and 'complete streets', sustainability, urban livability, and the integrated management of key transportation corridors"* (RideAmigos, n.d.).

The way traffic infrastructures are structured and developed can influence the amount of traffic. Induced demand is a concept that reflects this. It means, in short, that due to the relationship between supply and demand, more traffic will come as a consequence of the construction of additional roads. This phenomenon is recognized among traffic planners, however, since roads are still being built as a solution for issues such as car congestion, it is clear that it is not fully acknowledged within traffic modeling (Næss et al., 2012). Induced demand can also be applied when improving the conditions for active transportation users. For example, there can be an increase in cyclists if the conditions for cycling are improved, as well as, the conditions for pedestrians. This can have a positive effect on city life, since a vibrant city is created by people being out on the streets (Gehl, 2010).

## 2.4. Active transportation

This section provides a definition of active transportation, as well as, its role in the transportation system. Then, the benefits of cycling are presented to strengthen the argument for why cities should focus on active transportation. Following, the challenges of cycling are presented to illustrate the difficulties in planning for and promoting cycling in cities.

## 2.4.1. Definition

Active transportation, also known as non-motorized transportation, or human powered transportation, includes the modes of transportation such as walking, cycling, and other variants of those modes (Woldeamanuel, 2016; Litman, 2010). Active transportation plays an important and unique role in an efficient transportation system (Litman, 2010). Walking is one of the oldest forms of transportation, and although it may not be the fastest mode of transportation, it is the most common (Urry, 2007). Most motorized trips first start with a non-motorized mode of transportation, such as walking or cycling to public transportation or to a parking garage (Urry, 2007; Litman, 2010).

## 2.4.2. Benefits of cycling

People cycle for many different reasons, including recreational, social, utility, financial, and environmental. The built environment and social norms also influences the amount people cycle. Cycling as a utilitarian mode of transportation can aid in relieving some of the challenges associated with climate change and urbanization. Cycling does not only have user benefits, such as improved health, but can also have a significant role in facilitating broader goals on the municipal level, such as economic prosperity, and improved quality of life (Woldeamanuel, 2016).

#### *2.4.2.1. Environmental*

The increased frequency and distance of travel has put a substantial stress on the environmental quality in cities because transportation is one of the main sources of carbon emissions (Rode et al., 2017). Much of the travel in cities is fueled by carbon, and there is a clear scientific link that global climate change is affected by carbon emissions (Banister b, 2011). There are two main factors to consider when measuring carbon intensity from transportation. First is the motorized distance traveled, which is largely dependent on the built environment. Secondly, the carbon efficiency of the mode (Rode et al., 2017). One of the most common air pollutants in cities comes from vehicle emissions (Johansson et al., 2017; Rode et al., 2017). However, motorized traffic is still in popularity for various reasons, ranging from behavior, to urban form.

Cycling is promoted in cities because it emits zero carbon emissions. For cities to have higher $CO_2$ efficiency, decreasing the number of cars in the city is an important factor, which improves the air quality (Rode et al., 2017). Cycling not only reduces $CO_2$ emissions, but also noise pollution and creates a more attractive city (European Cyclists' Federation, 2016). In addition, cycling and walking are an efficient use of roadway capacity, and thus reduce congestion (Litman, 2010; Tsenkova & Mahalek, 2014).

#### *2.4.2.2. Economic*

Higher density areas have greater opportunities for bicycle transportation. Dense, urban development provides direct economic benefits because the land is efficiently used and takes advantage of economies of scale, and decreased amount of infrastructure needed. Car dependent developments cost more than dense development because more roads and utility improvements are needed. By shifting away from car infrastructure, there can be capital cost savings by focusing on walking and cycling infrastructure. The maintenance costs of car infrastructure are also much higher than active transportation infrastructure (Rode et al., 2017). For the user, owning and maintaining a car is much more expensive than a bicycle (Woldeamanuel, 2016).

Cycling also has several indirect economic benefits, such as more jobs from bicycle related businesses, less money on health costs, and reduced congestion costs. The European Cyclists' Federation divides the job sector into two categories: bicycle sales and retail, including rental, repair, and tourism, and bicycle manufacturing. These jobs are increasing as the modal share in cities increase (Blondiau & van Zeebroeck, 2014). Bicycle facilities are also being used to bring economic life and revitalize city centers (Rode et al., 2017). In bicycle friendly city centers, cyclists have been reported to buy more over the course of a month, compared to motorists. There is more interaction between stores and the patron because a cyclist is more likely to make an impulse purchase or stop compared to motorists, who just drives quickly to the next destination (Badger, 2012). A reduction in car traffic would also reduce the costs associated with congestion and the price for more roads and parking lots (Purusram, 2015). As mentioned in the section 'planning for people' (see section 2.1), Gehl states that planning for active transportation can reduce health costs because people are receiving their daily physical activity. A Dutch study highlighted that employees who cycled to work, took less sick days over the course of the year, which resulted in economic benefits for the company (Hendriksen et al., 2010).

#### *2.4.2.3. Health*

There is a known relationship between health and physical activity. Physical activity can be beneficial to improve mental health and have less chronic disease. However, there is a challenge to have people instill physical activity in their everyday lives. Obesity rates and health issues are increasing in countries where active travel is not encouraged or declining for everyday mobility (Carnall, 2000; Saunders et al., 2013; Woodward & Samet, 2016).

Transportation is normally part of an everyday routine. If cycling and walking are part of that daily habit, physical activity is integrated, without being an extra burden, like going to the gym. This daily physical activity from cycling can improve mental health (Saunders et al., 2013). The World

Health Organization (WHO) is an advocate for promoting active transportation from the healthcare perspective, claiming that governments should create policy changes and incentives for people to choose walking and cycling over a motorized mode of transportation. In order to promote physical activity, it must come from a multidisciplinary approach (World Health Organization, 2009).

There has been some speculation if the health risks for breathing in air pollution actually combat the positive health effects of cycling. As air pollution increases in most urban areas, this poses a severe risk to cyclists (Woodward & Samet, 2016). However, Tainio et al., (2016) conducted a study that concludes that the benefits of cycling outweigh the threats that air pollution poses. Saunders et al., (2013), conducted an analysis of the main findings from over 20 studies indicating that cycling improved aspects of health. Ranging from children who cycled to school, to adults who just cycle a few times a week. This type of integrated approach to physical activity shows promising benefits to overcome obesity, health disease, depression, and diabetes. The positive health effects rely on the distance and intensity of the active travel, as well as, the demographics of the person (Saunders et al., 2013).

#### *2.4.2.4. Social equity*

The foundation of social equity is rooted in social justice, which is the *"fairness in the apportionment of resources"* (p. 1,970, Burton, 2000). This definition is also part of social sustainability. In the urban context, social equity is related to social exclusion, meaning that an equitable society is where there are no exclusionary practice and everyone has access to the same amenities. Accessibility is a fundamental part of social equity, stating that the built environment, specifically the services and facilities, are able to be reached by everyone and are not hindered by the cost of transportation. The availability for people to walk and cycle in an area can have a great impact on improving the social equity in an area, especially in cities that are car oriented (Dempsey et al., 2009).

In car-dependent urban forms, societies are separated due to the larger distances, and there is a lack of social cohesion. Cycling is an affordable mode of transportation (see section 2.4.2.2) which can overcome some of the monetary barriers of cars (Burton, 2000). Cycling can provide a sense of independence for people because it provides more travel options. If people choose not to drive a car or do not have the economic means to drive, it limits their accessibility to the city (Woldeamanuel, 2016).

#### *2.4.2.5. Quality of life*

Quality of life is difficult to assess and define because it is a complex term, which contains many facets. However, The World Health Organization (WHO) applies five different domains to

identify quality of life, which include physical health, psychological health, environmental factors, level of independence, and social relationships (World Health Organization, 2017).

As mentioned above in health benefits of cycling (see section 2.4.2.3), cycling improves the amount of daily physical activity, which can also improve health, as well as mental health (Carnall, 2000). Reducing the number of cars in the city can greatly improve the air pollution and environmental aspects (see section 2.4.2.1). Increasing the number of cyclists and pedestrians can create safe and attractive places for people to live and work and enhance the sense of livability. Slower modes of transportation promotes social interaction between people, which is an important factor to community development and quality of life (Woldeamanuel, 2016). The quote below, from Gehl Architects, reinforces the dynamic of planning for pedestrians and cyclists, to promote a people friendly city:

*"Thinking of the city of bicycles as one contribution among many which are intended to promote an attractive urban environment, has turned out to be highly effective: the city of bicycles, the pedestrian city, the healthy city, the attractive city and the accessible city are all facets of the same issue. Planning for pedestrians and cyclists is thus an obvious place to start in order to create a sustainable and people-friendly city"* (Kielgast, n.d.).

## 2.4.3. Challenges of cycling

Despite the benefits of cycling in cities, there are many challenges from both a planning and user perspectives to overcome. The built environment and social norms can be barriers to increase the number of cyclists in a city. With growing cycling numbers, there can also be a challenge to manage this growth without decreasing the quality in mobility for cyclists. Presented below are several challenges that face bicycle planning, urban planners, and citizens.

### *2.4.3.1. Planning for active transportation*

Litman (2010) argues that the transportation systems can be seen from two different perspectives, which have varying implications for active transportation. A traditional transportation system's perspective, focus on the efficiency and performance of mobility, specifically from an automobile point of view. For example, focusing on the level of service for a certain road, traffic flow, and the speed of the car. From this perspective, it hinders the role of cycling and walking in the transportation network because active transportation plays a limited role and seems unnecessary to plan.

Another perspective is to view transportation systems from the accessibility viewpoint, which is the ability to reach desired services and activities (Litman, 2010). Litman (2010), states several

factors that improve accessibility, which include land use (the distribution of amenities in relation to the distance traveled), network connectivity (the quality and availability of roads and paths), and the quality and integration of various transportation options, such as public transportation, walking, and cycling. Therefore, an efficient transportation system is one that does not just focus on efficiency in mobility, but accessibility as well, and planning for active transportation can contribute to this end goal (Litman, 2010).

Economic analysis, such as cost benefit analysis, rarely includes all the benefits in active transportation because some are unable to be accurately quantified. Decision makers tend to demand for an economic overview for investing in active transportation, and a comprehensive range of benefits are not able to be included, which results in a lack of funding for active transportation infrastructure. Too often, the justifications for active transportation are not strong enough to overcome the merits for motorized transportation (Litman, 2010).

#### *2.4.3.2. Perception of cycling*

The perception of cycling from the user's point of view can also reduce the number of cyclists on the road. Some people are hesitant to ride the bicycle based on the safety, health, and their personal circumstances. Many people do not cycle because they think they are not in shape and that it takes too much effort. Others have the perception that cycling is too dangerous and unsafe. Some people may not be able to cycle based on their personal circumstance, such as the distance of commute or the need for multiple stops (Rode et al., 2017).

Heinen et al., (2010) discuss, the relationship between bicycle infrastructure and safety, both subjective and objective. Subjective safety is the perception of safety that the cyclist feels while cycling, while objective safety refers to the statistic and the actual amount of accidents with bicycles. There are different forms of bicycle infrastructure varying from infrastructure where the bicycles are totally isolated from other traffic or sharing streets with cars, or having bicycle lanes on the side of the streets.

Heinen et al., (2010) confirms that the type of bicycle infrastructure matters when it comes to the share of cyclists. Countries with more facilities for cycling tend to have a higher share of cyclists and higher levels of bicycle safety than countries with less (Heinen et al., 2010). The number of cyclists on the road can enhance the perception of safety. When there are more cyclists, there is a stronger presence towards other modes of transportation, and there is less individual danger. In countries with a higher modal share, like Netherlands and Denmark, cyclists tend to feel safer and have more shared space (Wardlaw, 2000).

Electric bicycles, also known as e-bike and pedelec, have been growing in the market. These bicycles have an electric motor integrated into the bicycle and are helpful to overcome the personal

effort to cycle. Electric bicycles assist in pedaling up hills, for longer distances, or people who are less athletic (Rode et al., 2017). However, these electric bicycles are moving at faster speeds and causes some challenges mixing with regular bicycles (Dill & Rose, 2012).

#### *2.4.3.3. Distance*

When researching an individual's transportation choice, distance is usually taken into consideration (Heinen et al., 2010). As Banister (2008) expresses, distances are increasing in cities, and time is becoming more important to the user. Planning has a great role in reducing trip lengths, so the closeness and proximity of amenities and services are easily reached. When choosing modes that emit less $CO_2$, distance can be perceived as a barrier (Banister a, 2011). There is an expected decrease in people cycling when the distance grows, since it results in an increase in time and effort needed for travelling. Evidence from the Netherlands shows that the biggest bicycle share can be found in small and medium sized cities. Further, people commuting by bicycle tend to live closer to their work. For commuters, the bicycle can also be used as a mode of transportation for part of the trip, for example to the train station (Heinen et al., 2010).

#### *2.4.3.4. Growing cycling numbers*

There is a gap in literature of what happens when cycling, heavily and rapidly increases and the infrastructure cannot meet the demand. Several articles from newspapers and websites address issues such as overfilled bicycle parking areas and congested bicycle lanes.

Dambeck (2013) at Spiegel Online claims that there is a risk that cycling "*choke[s] on its own success"*. He expresses issues, such as lack of bicycle parking and congested bicycle lanes, that urban planners meet when the bicycle share increases in cities, and the infrastructure and facilities reaches their capacity (Dambeck, 2013).

In urban cycling, bicycle parking is a central issue. In popular cycling cities, bicycle parking is either flooded with bicycles, or they are often parked in places that are not designated parking. This could be because there are not enough parking spaces, or the parking spaces are not located in the popular areas. The randomly parked bicycles become a nuisances or obstacle in the area (Jensen, 2014; Fujii, 2005). Amsterdam is an example of a city that struggles with issues of lacking bicycle parking. According to O'Sullivan (2016) the city has run out of space for the bicycles (O'Sullivan, 2016). Many Amsterdammers have several bicycles, and according to an article in the New York Times there are 880,000 bicycles in a city with 800,000 residents (Tagliabue, 2013).

Several other cities around Europe, apart from Amsterdam, also experience issues due to the increase in cyclists. Berlin and Copenhagen, for example, are challenged with bicycle congestion due

to the lack of road space (Dambeck, 2013). Copenhagen has, as mentioned in background (see chapter 3), for the first time more bicycles than cars on their streets (Cathcart-Keays, 2016).

## 2.5. Applying the theoretical framework

To answer sub-question one, '*what is a people friendly environment and what role does mobility play when applying the definition to the context of Aarhus?'*, it is important to understand how the rise of the car shaped cities and how this sparked a shift in planning towards including the human dimension in urban planning. Within this shift, planning concepts such as sustainability and livability became relevant when focusing on quality of life in cities. This understanding creates a context for the definition of a people friendly environment. Since a people friendly environment is about more than just inviting people to reside, mobility also plays a factor in defining the term. In addition to using the literature review, sub-question one uses the background to set a context for the case study of the Bicycle Ring.

Sub-question two, '*how does the built environment influence people's mobility behavior around the Bicycle Ring?'*, uses the literature review to provide a context of the built environment. To answer the question, a compact city is investigated as a way to influence people's mobility behavior. This question explores three themes, shared space, scripts and atmosphere, illustrating different perspectives of the built environment. Therefore, the section of shared space is used to understand the benefits and challenges of this type of planning. To analyze the scripts found in the built environment, the theoretical concepts in the mobilities design section are used. The theme of atmosphere is analyzed based on the empirical data collection.

The literature review brings forward a gap in academic literature about the newer phenomenon of the challenges cities face when the increasing numbers of cyclists surpasses the existing infrastructure. Therefore, to answer the main research question, '*with growing cycling numbers on the Bicycle Ring, how can this growth be managed to facilitate a people friendly environment in the city center of Aarhus?'*, it draws from the analysis of the sub-questions and the empirical data collected.

# 3. Background

This chapter provides a context of the case in this research project. First, aspects relevant to this project are presented, such as the context of Denmark and the capital, Copenhagen, as well as, cycling in Denmark. Followed by a description of Aarhus, and the municipal plans that define livability in the municipality. Due to the research focus on mobility in this project, mobility in Aarhus will be explored, followed by an introduction to the area of analysis, the Bicycle Ring.

## 3.1. Denmark

Denmark, a country in Scandinavia, is located in northern Europe with about 5.7 million people (Ministry of Foregin Affairs of Denmark a, n.d.) The topography is relatively flat with a large coastline to the North Sea and Baltic Sea (Ministry of Foregin Affairs of Denmark b, n.d.). The country puts environmental and social issues as a priority, and one of Denmark's key goals is to create a green and sustainable society (Ministry of Foreign Affairs of Denmark c, n.d.). The country is frequently cited *"as one of the world's best countries to live in"* (Ministry of Foreign Affairs of Denmark d, n.d.). The capital, Copenhagen, has been a role model for other European capitals due to the city's headway in environmental and sustainable initiatives. Copenhagen has created a reputation for Denmark, and also brands the country as a livable, environmentally forward country (European Union, 2013).

### 3.1.1. Copenhagen as a livable city

As mentioned previously, the capital, Copenhagen, plays a large role in maintaining the reputation of the country (European Union, 2013). Copenhagen has been ranked at the top of 'livability' aspects for several years in a row. Since 2007, Copenhagen has been declared the 'most livable city' three times up until 2014. These results were based on Monocle's 'Quality of Life Survey', which focused on aspects of culture, transportation options, global connectivity, and architecture. Copenhagen continues to strive to be the leader of environmental, quality of life, and transportation success through the city's goals and initiatives (Ministry of Foreign Affairs of Denmark c, n.d.).

Eco-metropolis is a municipal document which reinforces the vision of the city, and aims to brand itself as the *"Eco-metropolis of the world"* (City of Copenhagen, 2007). The capital is also focusing heavily on cycling and using it as a tool to create a better society, this is reinforced by the following quote: "*cycling is not a goal in itself but rather a highly prioritized political tool for creating a more livable city*" (p. 5). Good, Better, Best: The City of Copenhagen's Bicycle Strategy 2011 - 2025 claims that by improving cycling and creating a better cycling city, this will create a more livable city (City of Copenhagen, 2011).

Copenhagen, is already argued as the world's 'cycling capital' and the city is continuing to invest in bicycle infrastructure and green initiatives (European Union, 2013; Ministry of Foreign Affairs of Denmark c, n.d.). In Copenhagen, cycling has risen by 68% in the last 20 years and in 2016, the city, for the first time, had more cyclists than car users in the city center (Cathcart-Keays, 2016). As mentioned in the literature review (see section 2.4.3.4), too many cyclists can cause challenges for a cycling city. During rush hour, Copenhagen's bicycle lanes are under pressure. The city is focusing on providing more space to cyclists to increase the sense of security and make cycling an attractive mode for current and new users. The bicycle lanes will be widened in certain places, or alternative routes will be created for cyclists to relieve congestion (City of Copenhagen, 2011).

### 3.1.2. Cycling in Denmark

Cycling in Denmark is a favorable mode of transportation because it is an attractive additional transportation choice. The three largest cities in Denmark; Copenhagen, Aarhus, and Odense, have each implemented cycling promotion schemes and prioritized cyclists in the city. As a result, cycling is a popular mode of transportation and the Danes appreciate the positive values associated with cycling (Ruby, n.d.). However, the Danish tradition of cycling has been challenged throughout history.

In the 1900s, the bicycle was a popular mode of transportation in Danish cities. Men and women linked the bicycle with transportation freedom because it allowed the Danes to leave the busy inner city and travel around in the clean air to the growing suburbs. All social classes cycled and professions, such as mail carriers and household helpers, used the bicycle daily in their jobs. In the early half of the 20$^{th}$ century, the bicycle became an iconic part of Danish culture, diving into art and literature. However, in the 1960s, the use of the bicycle started to decrease. This was due to the standard of living in Denmark increasing, which allowed more people to afford cars. Single-family homes and car ownership was welcomed in the 1960s because they were both symbols of a prosperous future and that the dark days of World War II and the depression in the 1930s were in the past (Ruby, n.d.).

This shift from focusing on cars and not on people started to change the dynamic of cities in Denmark. Danish planner, Søren Elle, states that:

*"In the 60s and 70s, we thought that if you built huge blocks with apartments and efficient traffic systems, everyone would be happy… But quality of life is more than square meters, concrete, lifts, motorways and subways"* (Cathcart-Keays & Warin, 2016).

Danish cities were faced with a common dilemma; either reconstruct the city into a modern car-centric city, or make minor adjustments to cope with the rise of the car. As highways were being built in Europe in the late 1950s, such as the Essingeleden in Stockholm and the inner ring road in

Birmingham, Denmark was left at a pivotal point to either follow suit or maintain the city's cycling culture. However, Copenhagen and other Danish cities were dealing with car congestion in the inner city, and it reached a state where it was deemed 'necessary' by traffic engineers to invest in highway infrastructure (Cathcart-Keays & Warin, 2016; Ruby, n.d.).

The negative effects of the increase in cars brought a sense of discontent among Danish citizens. Citizens noticed the increase in pollution and car accidents in the city and were not pleased at the vision of the capital. Copenhagen, as well as other Danish cities, were no longer havens for cyclists, but a dangerous environment overtaken by motorists. Anti-highway protests started to fill the streets of Copenhagen, resisting the new development plans in the city. In 1968, the primary newspaper, Politiken, in Denmark started to mirror the citizen's views and opposed the highway plans (Cathcart-Keays & Warin, 2016). The city was getting poorer, and highway development was not seen as a viable solution. In 1973, the city stopped the plans in conjunction with the global oil crisis and environmental revival (Gössling, 2013).

In 1970s, there was a bicycle revival in Denmark. The 1973 oil crisis sparked a large-scale oil and energy conservation movement throughout the country. Car-free Sundays were introduced throughout Denmark and the government placed higher taxes on energy and oil consumption (Walsh-Samso, 2009). Consequently, people started to use their bicycle again. Unsatisfied with the cycling conditions, protesters in Copenhagen demanded for segregated bicycle lanes. They started to paint white crosses on places where cyclists died to show the government areas that needed immediate attention. The protesters' efforts were not lost on the government, which in the late 70s reintroduced speed limits for cars, and mandatory seat belt laws. In the mid-80s, the demands were finally met, and segregated, curbed bicycle lanes were constructed in Copenhagen (Walker, 2016). The momentum in Copenhagen transpired into other parts of Denmark. Currently, there is an estimated 7,000 km of segregated bicycle lanes throughout the country. In the four largest cities (Copenhagen, Aarhus, Odense, Aalborg) there is a combined total of more than 1,350 km of bicycle lanes (Dansk Cylist Forbund & Dansk Firmaidræts Forbund, n.d.).

## 3.2. The City of Aarhus

This research project's case study focuses on the Bicycle Ring in the City of Aarhus. Aarhus is located by the water on the east coast of Jutland (VisitAarhus, n.d.). Aarhus is characterized by its steep hills and the long distance from suburbs to the city center (Aarhus Kommune a , 2016). Aarhus is Denmark's second biggest city and has around 320,000 people (Aarhus Kommune b, 2016). The city has a vibrant mix of young people, boasting as the highest concentration of students in the country (VisitAarhus, n.d.). Aarhus is the fastest growing city in the country, with a growth of approximately 4,000 new citizens every year (Aarhus Kommune b, 2016; Rambøll & Aarhus Kommune, 2016). The city is expected to have 450,000 citizens and 250,000 workplaces in 2050 (Rambøll & Aarhus Kommune, 2016). During the past 10 years, the population has increased with around 15,000 residents and 20,000 new workplaces (Aarhus Kommune b, 2016). The population growth has put a pressure on the city's infrastructure and urban development, at the same time, the city has an ambitious goal of becoming carbon neutral in 2030 (Aarhus Kommune a, 2015). To reach the goal of becoming $CO_2$ neutral, several aspects are taken into account, such as, constructing a light rail (see section 3.2.3.1), improving the conditions for cycling (see section 3.2.3.2), inviting citizens and employees to participate in the efforts, and climate adaptations, so the city is protected from flooding (Aarhus Kommune a, n.d.).

Image 2 Map of Denmark showing Aarhus

As mentioned above in this chapter, many suburbs in Denmark have in the past been constructed as single-family housing built over a large area. Aarhus is going through major reconstruction in and around the city, and new residential areas are being built. The old hospital on Tage Hansens Gade is being transformed into housing, new neighborhoods are being built in Aarhus Docklands, as well as, construction of new residential areas in the rural areas of Lisbjerg (Aarhus Kommune a, 2015). As discussed in the literature review (see section 2.2.2), new urban areas should be densely built to be environmentally sustainable, and to make the city more livable. Denser neighborhoods are also more beneficial from a mobility perspective since it allows public transportation to reach more people. For example, the new residential area in Lisbjerg will be densely built and connected to the city via the new light rail, which will be further explained later in this chapter (Aarhus Kommune a, 2015).

## 3.2.1. Managing growth in a livable manner

The starting point for planning for livability in the City of Aarhus lies in the two municipal documents the Story about Aarhus (Danish translation: Fortællingen om Aarhus) and the Urban Development Vision 2015 (Danish translation: Planstrategi 2015). These two documents set the frame for how Aarhus will be developed towards 2050 (Rambøll & Aarhus Kommune, 2016).

#### *3.2.1.1. The Story about Aarhus*

The municipal document, the Story about Aarhus, expresses what the municipality is wishing for the city. Aarhus is described as a city where everyone is welcome and has a vibrant city life with nature as its closest neighbor. The city's vision 'Aarhus - a good city for everyone - and a city in movement' is seen as a guideline for what the municipality is aiming for. The city has a growing population and therefore, is developing and reconstructing areas. The character of the city is consequently changing with a light rail, a new hospital, and additional neighborhoods. It is important for Aarhus not to lose its identity while growing, therefore the vision, 'Aarhus – a good city for everyone – and a city in movement' mentioned above, has been expanded. Aarhus should not just be 'a good city for everyone' and 'a city in movement' but also 'a city with the power to act and with a community feeling' (p. 1-2, Aarhus Kommune b, n.d.). The following seven, more specific goals, have been set to guide the growth and development:

- Create 2,000 workplaces annually until 2030
- Have a BNP, in the Business Region Aarhus, over average in Denmark
- Be $CO_2$ neutral in 2030
- 95% of the young population have an education
- The proportion of citizens that support themselves are over Denmark' s average
- Be a good city for everyone
- Be a city with a high degree of citizenship (translated from Danish, p. 3-4, Aarhus Kommune b, n.d.)

In 2016, a survey, Aarhus Goals (Aarhusmålene – Temperaturmåling), was conducted to explore how well the municipality is meeting the two last goals; 'being a good city for everyone' and 'being a city with a high degree of citizenship'. The term citizenship means that the aim for Aarhus is to make more citizens participate in the development of the city, while at the same time, create a framework which does not hinder the initiatives from the citizens. The results found from investigating the first goal showed that the citizens of Aarhus are happy with their city, mostly because of the culture, nature, size of the city and the study life. When being asked, what could be

better, the three most common aspects involved infrastructure; public transportation, the conditions for cars and the conditions for bicycles. Regarding the second goal, the survey showed that more people want to participate, or are participating in the city's development, compared to citizens who are not participating at all (Aarhus Kommune & Epinion, 2016).

#### *3.2.1.2. The Urban Development Vision 2015*

In the municipal document, the Urban Development Vision 2015, the frame for urban development in Aarhus is set, highlighting the physical dimensions of urban growth, overall infrastructure, and disposition of land. The vision acknowledges the fact that the population of Aarhus is growing, and that the city, therefore will meet challenges consequently to this (Aarhus Kommune b, 2015). The vision highlights smart growth, defined as:

*"...with smart, we mean to have sustainable development - social, economic, and environmental - at the same time, we create a better urban quality and a higher degree of livability. The city council wants to focus the growth, so it is ensured, that the city develops to be even stronger towards 2050"*
(translated from Danish, p. 8, Aarhus Kommune b, 2015).

The Urban Development Vision 2015 is divided into four, politically important, strategic main areas that each aim to contribute to smart growth. Including that, Aarhus should have a strong position regarding economic growth, on both a national and international level, Aarhus should adjust to being a big city, meaning that land should be developed in a way that facilitates the growth. Further, Aarhus should focus on urban quality and livability, to ensure it being a good city and create an even better city with a high quality of life and standard of living. Lastly, Aarhus should be a city where there is room for everyone, that is diverse and has a high degree of social sustainability (Aarhus Kommune b, 2015).

#### *3.2.1.3. Defining livability in Aarhus*

In a collaboration between the City of Aarhus and the consultancy firm Rambøll, the concept of livability in Aarhus is defined. It is perceived as consisting of two correlated elements; standard of living and quality of life. The image below mirrors a complex reality where the indicators are intertwined and to some extent, dependent on each other. For a city to become livable there is a need for integrated solutions between these parameters, with a starting point in the citizens, businesses, and city's needs (Rambøll & Aarhus Kommune, 2016).


Image 3 Livability in Aarhus (Rambøll & Aarhus Kommune, 2016)

## 3.2.2. The Municipal Plan 2017

The city council wants all projects conducted and implemented in the city to have high quality and contribute to a more livable city and a good city life. The Municipal Plan 2017 focuses on several aspects such as smart growth, quality of the city, livability, city development, and the adjustment to a big city. Presented below are aspects of the plan which are particularly relevant to this research project.

As mentioned in the Urban Development Vision 2015, Aarhus wants to have smart growth by focusing on a sustainable development, both social, economic and environmental. The smart growth is divided into four topics, first being ensuring the frames for economic growth and an attractive everyday life, by developing a compact city where the different functions in the city are close. A compact city can benefit interactions between people and strengthen the relationship between the functions. Second, Aarhus wants to have mixed neighborhoods, meaning having people with different demographics, to ensure a social balance in the city. Third, Aarhus wants to develop as a denser city, which can help the city conserve their resources. A dense city can also minimize the need for transportation. Car trips will be reduced and shortened, and a dense city facilitates better opportunities for more sustainable modes of transportation, such as cycling. Therefore, Aarhus will be developing a denser city to help reach their goal about becoming $CO_2$ neutral in 2030. Lastly, Aarhus wants to be prepared for changes that require attention, such as climate change and changes in the patterns of settlement (p. 12-14, Aarhus Kommune d, 2017).

Livability is as mentioned above, is a focus in the municipality, and is therefore also highlighted in the Municipal Plan 2017. The plan lists several aspects that will help the city develop in a livable manner, one being public space and city life. Aarhus wants to combine the goal regarding 'mobility and accessibility' and the goal about 'more city life and a good city environment'. The plan acknowledges the fact that Aarhus is growing, and a denser city can benefit the city life, but at the same time the growing city will lead to an increased need for transportation. The space in the city has to be divided between the different modes of transportation, with a focus of having the biggest growth in public transportation, cycling and walking, at least in the inner city. The car has less priority due to space issues and the environmental challenges. Focusing on modes that take less space will lead to new possibilities for the public space in the city. In the city center, the traffic should be in a slow tempo, which will enhance the safety and noise nuisance coming from traffic. The streets should be organized so they invite people to reside and not only used for transit (p. 39, Aarhus Kommune d, 2017).

Mobility and traffic structure are aspects relevant for this research project, which are touched upon in the section about city development in the Municipal Plan 2017. As mentioned above, the city wants to relate this goal to the goal about public space and city life. The increased need for mobility, within the city, as well as, to and from the city center, should be accommodated by an increase in sustainable modes of transportation, meaning focusing on public transportation and cycling. Cycling is mentioned as a good alternative to reduce motorized traffic congestion. Therefore, the city aims to continue to improve the conditions for cyclists in the city (p. 107-109, Aarhus Kommune d, 2017).

### 3.2.3. Mobility in Aarhus

The increased amount of people living in Aarhus means that there are more people sharing the public space in the city. The City of Aarhus is developing a new Traffic and Mobility Plan, that aims to support the city life and ensure good mobility in the city center. It prioritizes the public space in the city, so a framework is set for aspects such as wellbeing and positive experiences. At the same time, the plan aims to ensure that the infrastructure can support the growing amount of people travelling to and from, and within the city center (Teknik og Miljø, Aarhus Kommune, n.d.).

If traffic continues to grow, by 2030, the number of cars in Aarhus will increase by 20,000 (Aarhus Kommune c, 2016). This will lead to longer travel time and congestion on the roads in the city (Aarhus Cykelby, n.d.). However, the city is promoting alternative modes of transportation to the car, such as the construction of a light rail and promotion of cycling.

#### *3.2.3.1. The new light rail development*

Denmark's first light rail is being constructed in Aarhus, opening in August 2017 (Letbanen a, n.d.; Kjær Petersen, 2017, interview). The main objectives with implementing the light rail is to avoid further car congestion in areas with a rapid population growth, and to handle the congestion in a manner that is not affecting the environment in a harmful way (Aarhus Kommune, 2013). The light rail aims to be a sustainable and efficient transportation option in Aarhus, it will therefore be coordinated with the bus network to reduce travel time for commuters (Letbanen c, n.d.). The increase in efficient public transportation is an important prerequisite to reach the city's goal of being carbon neutral in 2030. The light rail is a huge investment for the city, and therefore needs many passengers, for a positive return on investment (Aarhus Kommune a, 2015). To increase the ridership, the light rail will connect newly developed cities and promote redevelopment around the corridors (Letbanen b, n.d.).

#### *3.2.3.2. Cycling in Aarhus*

Aarhus is branded as a 'cycling city' and cyclists are well established in the traffic network. The bicycle is a popular way to travel in Aarhus with one in four residents getting on a bicycle to commute to work, the number of cyclists has increased 18% in the past four years (Celis, n.d.; Aarhus Kommune d, 2016). Since 2000, cycling has increased with 30%, leading to it being the mode of transportation that has increased the most. Aarhus has also had an increase in cycling the past years, even though the country, as a whole, has experienced a decrease (Aarhus Kommune a, 2016). The citizens of Aarhus mainly choose the bicycle as a mode of transportation because the cyclists appreciate the exercise and fresh air, the bicycle is fast, cheap, and flexible (Aarhus Kommune f, 2016). However, the increase in cyclists puts a higher pressure on the existing infrastructure. There is a demand for more and wider bicycle lanes, more parking, and more possibilities to combine the bicycle with other modes of transportation (Aarhus Kommune a, 2016). Aarhus is opening the first bicycle highway on Grønnegade in August 2017 to make it easier to commute by bicycle (Kjær Petersen, 2017, interview). This bicycle highway connects Lisbjerg (new residential area), the Business Park Skejby, the new University Hospital, to the Aarhus Central Station (Smart Mobilitet, Aarhus Kommune, 2016).

The city is starting several initiatives to maintain the bicycle as an attractive mode. Cycling is promoted in Aarhus as a mode of transportation that is healthy, environmentally friendly, and takes up less urban space than, for example, car infrastructure (Aarhus Cykelby, n.d.). The City of Aarhus has focused on improving the conditions for bicycles with a Bicycle Action Plan from 2007, which is being renewed in 2017 (Aarhus Kommune a, 2016). The main objective of the Bicycle Action Plan

from 2007 is to change the modal share, causing a larger share to use the bicycle and public transportation, over the use of the car (Aarhus Kommune, 2007).

This plan has been the starting point for many of the improvements for bicycles in the city, and has played a part in the increase of cyclists in the city (Aarhus Kommune c, 2015). The goal of the renewed plan is to create more than the 'best' mobility in Aarhus, but balance the goal of increased mobility with other themes which characterize the future development of Aarhus. The four most important themes are growth, environment, urban life, and health (Aarhus Kommune a, 2017).

### 3.2.4. Case study focus: The Bicycle Ring

This research project focus on a piece of infrastructure in the city center of Aarhus, the Bicycle Ring (see image 4). The Bicycle Ring was implemented in 1996, with the aim to minimize the number of cars in the city center and redirect them outside the ring. The Bicycle Ring was intended for cyclists, the area within the ring is for pedestrians, and outside is for cars. The ring allows cyclists to get to certain parts of the city without cutting through the inner pedestrianized areas. For example, a cyclist can use parts of the ring to go either east or west, in order to get to their destination (Celis b, 2017, interview). In addition, the Bicycle Ring is also used by both pedestrians and cars to get around the city center.

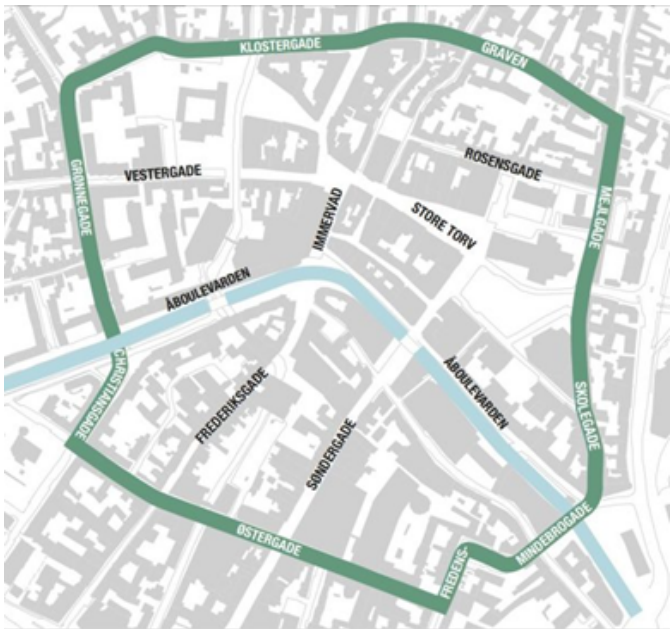


Image 4 The Bicycle Ring (Skovgård, 2016, Graphic: Aarhus Kommune)

During 2016 and 2017, several improvements were made around the Bicycle Ring. One being transforming numerous streets into cycle streets (Fredensgade, Østergade, J.M. Mørks Gade, Christiansgade, Grønnegade, Klostergade, Frue Kirkeplads, Graven, Skolegade, Mindebrogade and Fredens Torv). The City of Aarhus describes a cycle street as a road where the road space is reserved and prioritized for cyclists, but other modes of transportation are still allowed. However, the other modes, such as cars, are not allowed to drive faster and overtake the bicycles, meaning, cars are driving at a considerate pace. Car parking are only allowed in designated places. On these streets, the city points out the importance of looking out and being considerate for each other (Aarhus Kommune e, 2016; Aarhus Kommune b, 2017). The aim of transforming the

Bicycle Ring into cycle streets is to give the people in Aarhus a bicycle network that is good, safe and spacious (Aarhus Kommune c, 2017).

Other improvements, include constructing 180 new bicycle parking places, and installing air pumps, and information signs around the bicycle infrastructure. On Grønnegade, trees have been planted to make the street more appealing, along with a speed table to make the street safer to cross for pedestrians. The improvements aim to strengthen and promote the over 20 year old Bicycle Ring, which also strengthens the bicycle culture in Aarhus (Aarhus Kommune e, 2016).

Parts of the Bicycle Ring has been analyzed before in the municipal project Bylivsindex. In the fall of 2016, observations of the intersection Grønnegade and Klostergade were conducted, as well as, interviews with cyclists in the area (Smart Mobilitet, Aarhus Kommune, 2016).

# 4. Methodology

This chapter will explain the methods that are used to answer the research questions. It provides a framework for the project to identify what type of data that needs to be collected and how to collect the data. It entails a definition of a case study, this project's research design, the case study description, the methods used for data collection, as well as, how this project analyzes the data. Each section starts with a general definition of the topic, and then how that definition applies to this research project. The aim of this chapter is to illustrate the measures taken from the initial research inquiry to the final findings and conclusions.

## 4.1. Pragmatism

Pragmatism is a philosophical movement which is rooted in the idea of practice or action. In other words, it is looking at phenomena the way it is in real life (Mounce, 2000; Rorty, 2000; James, 1975). In this research project, pragmatism is used because the researchers are analyzing the relationship between a people friendly environment and cycling by looking at a specific piece of infrastructure in Aarhus city center (the Bicycle Ring). Charles Peirce introduced the philosophy and states that *"all realities influence our practice"* (p. 29, James, 1975). This statement by Peirce solidifies the researchers' decision to use a case study as a method because the realities when researching a people friendly environment can be different depending on the context.

Pragmatism is built on 'practical consideration', which states that reasonings' exert a certain type of power, which affects the researcher's perception and experience when researching a type of phenomenon. The basis of all knowledge is formed through experience (Delanty & Strydom, 2003). Therefore, the development of knowledge can take place in a variety of ways and in different contexts (Delanty & Strydom, 2003).

Pragmatists state that it is practice over theory, and action rather than contemplation, which contributes to finding truth (Ihde, 2009). In earlier philosophies of science, 'truth' was defined as resulting in the same conclusions independent of the methods used. If a researcher sought out to find, for example, the 'velocity of light', it would not matter if different methods were used, but the results would be the same (Hookway, 2016). This definition of truth is objective, because there is only one 'right' answer. However, the pragmatic view does not agree with this type of truth. William James, a well-known pragmatist, argues that a pragmatic truth is benefited by a person's way of thinking. The formulation of 'truth' places experience as a central role (Hookway, 2016).

In this research project, the observations are based on the researchers' experience, and are subjective, however, they are conducted with a theoretical foundation. The data collected is qualitative because, in order to answer the research questions, quantitative data does not provide the

necessary information. For example, when observing confusion between different modes of transportation, an explanation of how this situation has occurred is needed, which numbers cannot provide. The researchers have sought the truth and gained knowledge by conducting observations and street interviews to experience the environment and obtain an understanding through these means. The main research question of this project *'with growing cycling numbers on the Bicycle Ring, how can this growth be managed to facilitate a people friendly environment in the city center of Aarhus?'* takes a pragmatic approach, because it is not just theory that is researched but also involves the awareness of the physical world of the research area.

## 4.2. Case study as a research method

There are various understandings of the word 'case study' in social sciences. Yin (2014) brings out a twofold definition of what a case study is, covering both the scope as well as the features. Yin states that a case study is an inquiry to investigate a modern phenomenon in detail within its real-world context (Yin, 2014). Flyvbjerg (2001) states a case study as an example which describes a certain phenomenon. He also explains the power a case can have on hypothesis development in the field. By analyzing a particular case in detail, it can provide broader knowledge to be used for scientific development, which is a common misunderstanding by most standard social science textbooks, which state an opposing view. Flyvbjerg argues that context dependent, practical information is more valuable than theoretical based, context independent knowledge. The foundation of expert knowledge is using concrete examples and specific knowledge about a certain topic. Understanding and expertise are the cornerstones of case study research, which can then be used to contribute additional knowledge in the field (Flyvbjerg, 2001). Farthing (2016) argues that a case study can be used to exemplify a certain topic or case. It can be used as a way to view a particular case in time, and apply research and methods to reveal additional information about that case. Methods can include observations and interviews, in order to analyze the case further. Case studies can also be perceived as a type of research design (Farthing, 2016).

In this research project, Farthing's definition is used, because the Bicycle Ring is explored during a particular time to obtain new information through a specific set of methods. It is also this project's, explained in the next section.

## 4.3. Research design

Research projects have either an implicit or explicit design for the research process. The research design is the logical system in which to connect the research questions to the findings (Yin, 2014). It is a plan for collecting and analyzing data for the researcher's initial proposes (Ward, 2014).

There are a variety of steps between the initial research questions to the final conclusions, which includes what type of data needs to be collected and how to analyze it (Farthing, 2016).

Each research design is particular to the project because every project has many design decisions to make, and the decisions are very different, therefore, Farthing (2016) argues that there are a vast number of research designs.

The image below presents the research design for this project. This project is using a case study applying methods such as documents, observations and interviews, to put the theoretical framework into context. These will be further explained below in this chapter.

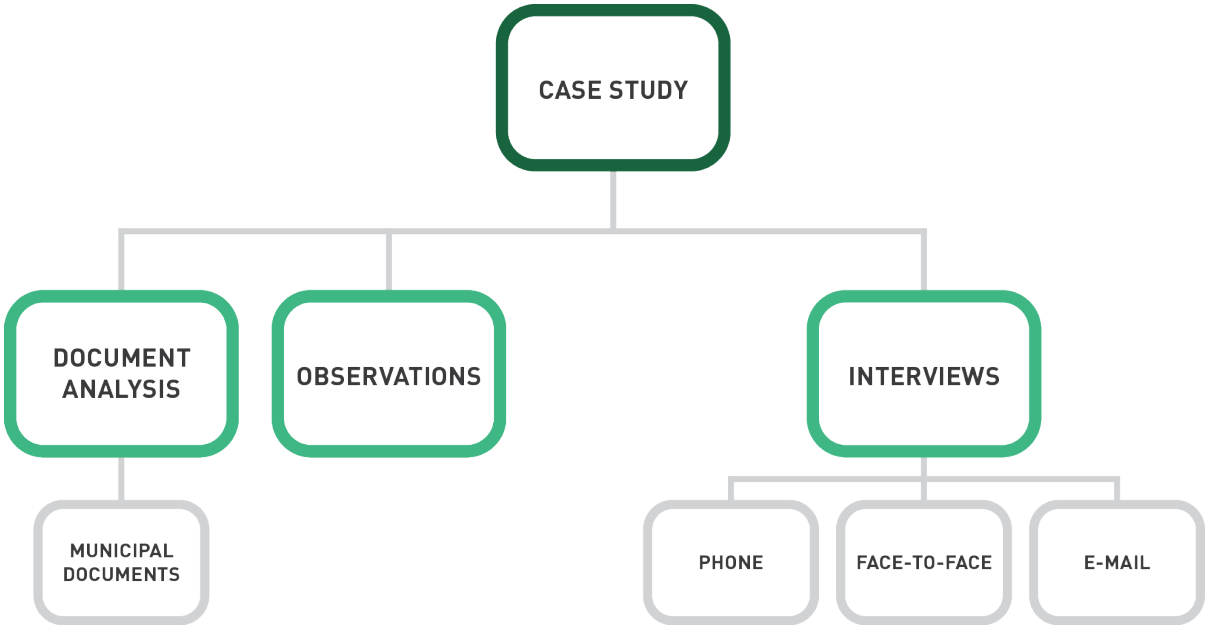


Image 5 Research design

### 4.3.1. Research questions

Research questions are important because they provide a direction for what type of information is needed to be collected and what type of methods are used to obtain that information (Farthing, 2016). Presented below are the research questions in this project and a justification of the methods used for data collection.

**With growing cycling numbers on the Bicycle Ring, how can this growth be managed to facilitate a people friendly environment in the city center of Aarhus?**

The results from the two sub-questions support the main research question's answer. First an understanding of the phenomenon of growing cycling numbers is needed, which is obtained through the theoretical framework. Then, the findings collected in this project are analyzed with the knowledge gained from the expert interviews.

1. What is a people friendly environment and what role does mobility play when applying the definition to the context of Aarhus?

This question has two parts to answer; first being, defining a people friendly environment, and the second, putting that definition into the context of Aarhus. The literature review creates a theoretical framework which is used to understand the concept of a people friendly environment, and then the City of Aarhus' municipal documents are researched to understand the city's goals. Aspects from the municipal documents are applied to the theoretical framework and a context-based explanation is then defined.

2. How does the built environment influence people's mobility behavior around the Bicycle Ring?

This question requires an understanding of the built environment and mobility behavior, as well as, the relationship between these two topics. The theoretical framework is used to understand these topics. The empirical data is used to answer this research question, which consists of observations, streets interviews, as well as expert interviews.

## 4.4. Case study design

This research project uses a single, descriptive, and explanatory case study. It highlights the potential issues in case study research, including validity, reliability, generalization, and how this project mitigates these concerns. Since this research project is taking a pragmatic approach, pragmatic validity will also be explained. This section also defines the unit of analysis for this case study.

### 4.4.1. Validity and reliability

There are several critiques with case study research which influences the reliability and validity of the information (Flyvbjerg, 2001). Yin (2014) presents four tests that have been commonly used to judge the quality of empirical social research; construct validity, internal validity, external validity, and reliability. These four tests are to minimize the risk of the research findings to be invalid, unreliable, or overly generalized.

The first test is construct validity, which is about identifying the appropriate operational measures for the case study. Case study research has been critiqued to have subjective judgments and that the research fails to create a sufficient set of measures for the case study (Flyvbjerg, 2001; Yin, 2014). In this project construct validity is strengthened by defining specific words in the research questions. For example, a 'people friendly environment' can be a subjective term and difficult to

create a specific set of measures for. Therefore, sub-question one, which defines a people friendly environment in the context of Aarhus was established. The answer to sub-question one supports the main research question and reduces subjectivity. Construct validity is also strengthened by using multiple methods to collect data for a specific topic (Yin, 2014). In this research project, a combination of observations, interviews, and municipal documents are used to gather multiple perspectives of the subject matter.

Internal validity, the second test, is only a concern for explanatory case studies and not descriptive or exploratory studies. In this test, the researcher establishes a causal relationship, where specific conditions are understood to lead to other conditions. For example, in explanatory case studies, the researchers try to explain why event x led to event y. A common mistake is that researchers assume that events x leads to event y, without including some sort of third factor, z. The internal validity is threatened because the research design does not take other factors into account. Another concern that affects the internal validity is that the researcher will make inferences. Internal validity mostly takes place during the analytical phase of the research. In this project, internal validity is strengthened by the researchers' addressing rival explanations when analyzing the collected data. For example, when analyzing scripts both infrastructural and behavioral aspects are taken into account.

The third test is external validity, which deals with the issue of knowing if the findings are able to be generalized beyond the initial study. The type of research questions can either help or hinder if the results can be generalized. When the results can be generalized, the external validity is strengthened. Since this research project is about a particular piece of bicycle infrastructure, the findings from the observations are specific to the area, making it difficult to generalize. However, the analysis brings forth aspects, such as issues with narrow streets and shared space, that can be seen in other cycling cities and therefore can be transferred.

The last test, reliability, aims to ensure that if another researcher does the same case study again, the findings and conclusions will be the same. The aim is the reduce the errors and biases in the study (Yin, 2014). Reliability is important in both science and social sciences to reinforce the information and test the hypotheses or claims being made. To achieve reliability, the research process should be viable and clear, and use sources that are tested and reputable (Shuttleworth, 2008). This research project strengthens reliability by being transparent in the methods. Observation and interview guides are created, and the sources and type of methods are exposed.

### 4.4.2. Generalization

Case study research is often critiqued for being overly generalized or simplified, in order to relate to a broader context. Meaning, the findings in a single case study are based on assumptions

and generalizations. Case study research is imperative to social science development because it is important to understand how certain events occur in the field (Flyvbjerg, 2001). One mistake that can be made when conducting case studies is to see the case study as a sample from which you can statistically generalize your findings. The findings from the collected data in a case study should rather be seen as a way to 'shed empirical light' over the theoretical aspects that are aimed to be investigated (Yin, 2014).

The groundwork for an analytical generalization is created in the theoretical framework, complemented by the empirical findings collected during the study. New generalizations that have not been included in the theoretical framework can emerge from the findings as well, when completing the case study. The role of theory and theoretical propositions in case study research is immensely beneficial for deciding a research design and appropriate data to collect. The theoretical framework developed in the case study will become the main driving force for generalizing the findings from the case study (Yin, 2014).

An example of generalizing from a single case study is Jane Jacobs book, *The Death and Life of Great American Cities*. This book uses a single case study of New York City. The book draws experiences from this case to further develop planning theory, such as the role of streets and sidewalks, the need to have compact, mixed-use design, and the role of neighborhood parks. The findings from these examples are able to be generalized and contribute to the theoretical development in urban planning (Yin, 2014).

As mentioned in the previous section, this project is about a specific case making it more difficult to generalize. However, aspects from the case study can be extracted and applied to other cases to contribute to bicycle planning.

### 4.4.3. Pragmatic validity

For pragmatists, 'truth' is something that facilitates action in a certain manner so that the desired results from people in action are achieved. The desired results are associated with values and ethics and can therefore differ. The pragmatic validation supports observations and interpretations, however, there is also an intent to act based on this collected data. It is important to implement 'a change' and not just be stuck in the analyzing phase. In a practical context, action and decisions require a presupposed consensus between involved actors, compared to a scientific discourse that can be seen as more or less endless without any direct claims for action. In pragmatism, actions are important and knowledge's effectiveness is demonstrated by the effectiveness of actions. Therefore, in a pragmatic approach, the validation of knowledge is conducted in how the knowledge is acted out, rather than how the knowledge can be justified (Kvale, 1997).

Kvale (1997) argues that there are two types of pragmatic validity. First, if a statement is followed by action, meaning, that if a verbal statement is followed by actions supporting this statement. In interviews, for example, the response from the interviewee is not valid unless the statement is followed by action supporting this statement. Second, which is a stronger type of validity, being if a statement of knowledge encourages a change in behavior. For example, interventions based on a researcher's knowledge can initiate an actual behavior change versus just a verbal guarantee of change.

In this research project the findings from the observations and analysis provide a platform to motivate future action from the involved actors. The findings and analysis have a practical foundation versus a theoretical, which can be easily transferred into future urban planning in Aarhus.

### 4.4.4. Single case study

Before collecting data, the researcher has to decide between doing a single case study or a multiple (Yin, 2014). A single case study is a thorough study of a single unit of analysis that depicts a certain phenomenon over a certain period of time. This is most often used in social science research to explore, explain, or describe a certain case and support theory (Willis, 2014). Multiple case study design is used if the inquiry uses 'replication logic', meaning it is intended to reveal certain aspects through multiple examples. Multiple case studies are also used for comparative studies, when two or more cases are used to show similarities or differences between two different contexts (Yin, 1994; Yin, 2014).

This research project uses a single case study as a method. Yin (2014) presents five rationales for why to use a single case design. One being, a 'common' case, which is the rationale for this research project. The aim with a common case is to *"capture the circumstances and conditions of an everyday situation"* (p. 52) in relation to the theoretical interest in the research (Yin, 2014). Bryman (2012) calls this type of common case 'representative, typical, or exemplifying' because the chosen case may not be unique or extreme but reflect a broader category (Bryman, 2012). In this research project the objective is to use a piece of bicycle infrastructure in Aarhus city center, the Bicycle Ring, as a case to collect knowledge about and explore the correlation between the bicycle as a mode of transportation and the ideas of a people friendly environment. Although the Bicycle Ring has unique aspects to it, it represents broader efforts in bicycle planning.

### 4.4.5. Descriptive and explanatory case study

Continuing from the issue of external validity, it is helpful for a researcher to consider a distinction between the various types of cases (Bryman, 2012). This can provide insight to the type of questions being asked and what type of data to obtain. In a descriptive case study, the main aim is to

describe a phenomenon in a real-world setting, while in a explanatory case study, the purpose is to explain how or why something became to be (Yin, 2014). This research project is both a descriptive and explanatory case study. First, this case study describes the Bicycle Ring and the phenomenon of growing cycling numbers. Further, it explains how growing cycling numbers can affect quality in cycling and public space in the setting of Aarhus.

## 4.4.6. Unit of analysis

The unit of analysis relates to understanding the research area, which first deals with defining the case, as well as, bounding the case. Defining and bounding the case is important because it can identify relevant information to be collected, so the researcher does not attempt to collect 'everything' about the case (Yin, 2014). In this research project, the unit of analysis is the Bicycle Ring in Aarhus. However, the unit of analysis is bounded to the city center of Aarhus, specifically focusing on aspects of the built environment, mobility behavior, and a people friendly environment.

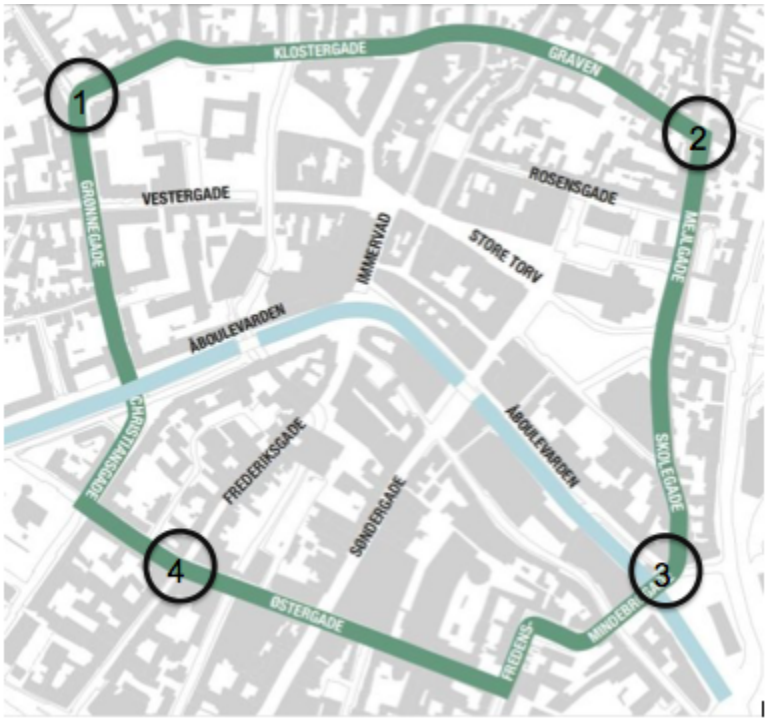


Image 6 The Bicycle Ring (Skovgård, 2016, Graphic: Aarhus Kommune, modified by the authors)

Four locations on the Bicycle Ring are chosen, in this research project called the 'corners' of the ring, illustrated in the image below. The corners are; 1. T-intersection Grønnegade/Klostergade, 2. T-intersection Mejlgade/Graven, 3. T-intersection Mindebrogade/Skolegade, and 4. Intersection J.M. Mørks Gade/Frederiksgade/Østergade.

## 4.4.7. Justifications for the four corners

The four corners are chosen for further analysis because they highlight different aspects of the ring, including various infrastructure types, which are identified during the initial walk through. The City of Aarhus refers to these locations as the corners of the Bicycle Ring, therefore the same name is used in this research project.

#### *4.4.7.1. T-intersection Grønnegade/Klostergade*

The T-intersection of Grønnegade and Klostergade has interesting aspects because it is a prominent commuter route for cyclists. At this location the new bicycle highway (Supercykelsti) will meet the city center, causing a potential future increase in cycling traffic.

In addition, during the fall of 2016, this location was researched in the project Bylivsindex, conducted by the municipality. The aim was to explore the challenges and aspects that can occur when fast cycle commuters, coming from the newly implemented bicycle highway, meet the Bicycle Ring with a slower tempo. This previous municipal project has given this research project a foundation, with already collected qualitative data, such as street interviews (Smart Mobilitet, Aarhus Kommune, 2016).

#### *4.4.7.2. T-intersection Mejlgade/Graven*

The T-intersection of Mejlgade and Graven is located in the Latin Quarter, with narrow streets and low scale buildings creating a 'cozy' feeling making this an attractive place for people. It is interesting to analyze because it represents an area with a high share of people traveling at a leisurely pace, as well as being the busiest commuter route for cyclists on the Bicycle Ring.

#### *4.4.7.3. T-intersection Mindebrogade/Skolegade*

The T-intersection of Mindebrogade and Skolegade has several road connections with a diverse character. The relatively new development, Europaplads, has created a new connection towards the new library (Dokk1), which is popular for pedestrians and cyclists. It is interesting to explore the different travel patterns within the various modes, and how they interact the intersection.

#### *4.4.7.4. Intersection J.M. Mørks Gade/Frederiksgade/Østergade*

The intersection of J.M. Mørks Gade, Frederiksgade and Østergade consists of different types of transportation infrastructure. This intersection is the meeting point of a cycle street, walking street, and shared space between bicycles and cars. This connection is interesting to analyze because it represents a meeting of different speeds from various modes of transportation.

## 4.5. Data collection

Collecting data for a case study can come from various sources. Selecting which methods to use for data collection relies on understanding which method will provide information to best answer the research questions. Distinguishing between which type of data already exists for the particular case, and what type of data needs to be collected is a necessary factor in the beginning of data

collection (Farthing, 2016). In this research project, municipal documents, interviews, and observations are being used to develop the case study and to answer the research questions.

### 4.5.1. Documents

Documents come in various forms and are relevant for every case study. Documents are a stable source of data because they can be reviewed multiple times. They can be both broad or specific because they can cover a long span of time about a certain topic. However, documents can also have bias tendencies, therefore, using multiple, and reliable publications and authors is important. When collecting information about the case study, reports and studies on the case area can greatly enhance the knowledge pool and provide accurate information on the case (Yin, 2014). In this research project, municipal documents are used to support the case study.

### 4.5.2. Interviews

Interviews are a common and important source of data in case study research (Yin, 2014). Interviews can be either structured, semi-structured, or unstructured depending on the context and information needed (Bryman, 2012). In this project, there are a mix of both structured and semi-structured interviews through face-to-face, e-mail, and phone interviews.

Semi-structured interviews have a series of prepared questions, but the interviewer is able to change the sequence of questions, or add questions during the interview. The questions tend to be more general than structured (Bryman, 2012). According to Cochrane (2014) semi-structured interviews work especially well when interviewing professionals. The semi-structured interviews allow for a structure that reminds the participants of the interview's purpose and also helps to ensure that important aspects are covered (Cochrane, 2014). In this research project, semi-structured interviews were conducted for face-to-face and phone interviews.

Structured interviews require that the questions are given in the exact same manner, meaning the order of questions, content, and how they are read is the same for each person. This type of interview works well when there are many people needing to be interviewed because the results can be aggregated. In this research project, structured interviews are used during the street interviews because multiple people are interviewed and the answers need to be categorized for analysis. Structured interviews are also used for e-mail interviews because the questions are sent to the interviewee and there is no room to ask direct follow up questions (Bryman, 2012).

In this project, the City of Aarhus has been helpful in providing insight into the background of the city, the Bicycle Ring, the goals of the city, as well as, giving a municipal perspective on bicycle planning. The academics interviewed work exclusively at Aalborg University, these interviews help the researchers delve deeper and understand concepts relevant for the project. Other professionals are

also interviewed, from the City of Copenhagen, and urban planning consultancy firms in Denmark and the Netherlands. These interviews help the researchers gain knowledge about bicycle planning in various contexts.

#### *4.5.2.1. Face-to-face interviews*

Face-to-face interviews are used with both experts and non-experts. The advantage of face-to-face interviews is that the interviewer can read the body language of the interviewee and establish a type of rapport. The interviewer can observe if the interviewee is confused by a certain question, or if it needs to be restated (Bryman, 2012).

The face-to-face interviews with non-experts are through street interviews. The researchers prepared four basic questions to ask both pedestrians and cyclists at three of the observed corners (Mejlgade/Graven, Mindebrogade/Skolegade, and J.M. Mørks Gade/Frederiksgade/Østergade). There are no street interviews conducted on Grønnegade/Klostergade because data can be extracted from the municipal project, Bylivsindex. The purpose of these interviews is to complement the observations and provide a user's perspective. The questions are:

1. How often to you cycle/walk here?
2. Is there anything you would like to improve here when you cycle/walk?
3. What do you think is good/like when you cycle/walk here?
4. Do you find this area enjoyable?

In addition, it is noted if the interviewee is a cyclist or a pedestrian, and which gender they are. These interviews are conducted during the whole day; however, it is more difficult to stop cyclists and pedestrians during the busy times, leading to the street interviews being conducted during non-busy hours.

#### *4.5.2.2. E-mail interviews*

In this research project, e-mail interviews are chosen as tool for collecting qualitative data. Using e-mail interviews in favor of face-to-face interviews allow for the interviewees to reflect on and prepare their answers (Petocz et al., 2012). E-mail interviews can also be less biased than interviews conducted face-to-face, as there is less risk for the researcher to affect the interviewees behavior or answers (Petocz et al., 2012). However, when conducting e-mail interviews, the questions have to be well thought out to avoid the possibility for misinterpretation and confusion from the interviewee. The answers from e-mail interviews can also be misinterpreted or distorted by the researchers (Petocz et al., 2012). This is avoided in this research project because follow up e-mail interviews are

conducted. If there are answers that do not make sense or can be analyzed from another perspective, another e-mail is sent to clarify.

#### *4.5.2.3. Phone interviews*

There are several advantages to using phone interviews in case study research. One being, there is less time and money spent on travel costs, which can be an advantage for a busy schedule. Another advantage of phone interviews is that the answers are not affected by the interviewees presence. For example, the interviewee is not distracted by the reaction to the answers, and the interviewee can focus just on their answers (Bryman, 2012). Doing phone interviews can, according to Bogner et al., (2009), be a difficult undertaking. It is harder to make experts participate in phone interviews compared to face-to-face interviews (Bogner et al., 2009). However, due to previous internship experience, one of the researchers knows the experts at the municipality and therefore could make communication easier. The length of the interview can also be an issue for phone interviews. A phone interview is unlikely to go beyond twenty-five minutes, but a face-to-face could progress longer (Bryman, 2012).

### 4.5.3. Observations

Ethnography is useful in social science research because in order to understand a certain phenomenon, supplemental information is needed, which interviews and documents cannot provide (Farthing, 2016). Ethnography includes actively studying the everyday context of a specific group or location in a natural setting. Meaning, making observations, asking questions, listening to conversations, and taking notes of an area. Ethnography research is helpful when the issue being investigated is new and when there is an interest in specific aspects on the case (Bryman, 2012).

There are several walk throughs of the Bicycle Ring conducted, one in the beginning of this research project, and another one before the observations. During the initial walk through, the researchers walk around the Bicycle Ring several times to gain a feeling of the ring and learn more about the area. This initial walk through helps decide what areas the researchers want to focus on due to the variations of each corner on the Bicycle Ring. Another walk through, focusing on the corners, is conducted before creating the observation guide, to write the area description of each corner. This helps narrow down specific infrastructure or behavior characteristics on each corner that are interesting, which are to be explored further during the observations.

Each corner is observed once during busy morning hours (7:30 - 8:30), once during busy afternoon hours (15:30 - 16:30), and once during non-busy hours (10:30 - 11:30). These times are chosen because they showcase a contrast in the amount of road users and pedestrians, such as the busy commuting times, versus the leisurely paced time. In addition, the morning and afternoon

commuting times are chosen because they also correspond to the times the City of Aarhus conducted a bicycle counting. Towards the end of this research project, the City of Aarhus implemented cycle streets around the Bicycle Ring (see section 3.2.4). A majority of the observations are conducted before these changes, however, one day of observations are conducted after the changes were implemented. Meaning, that there is not much data collected after the streets were changed.

The researchers separated during the observations to maximize the time, however the first observation in this research project was conducted with both researchers together, to set the parameters for the observations. Observation guides are created prior to the observations and are specific to each corner. The observations are always conducted with sunny weather on weekdays. The aim is to have all observations on Wednesdays, however, due to bad weather, one of the observations was on a Monday. A combination of the following recording methods are used in this research project to document the observations.

#### *4.5.3.1. Recording methods*

In order to maintain credible results during and after the observations, a set of recording methods are necessary. This can be done during the observation or right after, but it is important to record the time and date, as well as the context of the location (Taylor-Powell & Steele, 1996).

#### *4.5.3.2. Observation guide*

To have consistency and improve reliability in the observations for this research project, an observation guide is created. Observation guides are important when there are several observers involved, and when the aim is to obtain comparable data. When collected data is structured in the same way, the results are easier to compare (Taylor-Powell & Steele, 1996). An observation guide is created for each corner of the Bicycle Ring, based on the initial walk through, because each corner has specific qualities to observe and record. The observation guides include aspects of cyclists, pedestrians, and motorists. They focus on behavior, infrastructure, and the flow of each mode.

#### *4.5.3.3. Photographs*

Taking photographs can be used as a helpful tool, facilitating the opportunity to analyze and return to the collected data at a later time. It can also be used to illustrate aspects in the research project (Taylor-Powell & Steele, 1996). In this research project, photos are taken to help complement the observations, meaning, to capture a specific event in time. Photographs are also taken of the built environment to showcase certain aspects that are analyzed further. The photographs are taken throughout the project whenever the researchers went to the study location.

#### *4.5.3.4. Field notes*

Field notes are also used during the observations. This method is the least structured type of recording and is used to give an initial impression of the area, and record any observations that are not included in the observation guide (Taylor-Powell & Steele, 1996). In this research project, a notebook was used to keep an accurate description of the area during the observations and initial walk through.

## 4.6. Analyzing data

Yin (2014) argues that analyzing case study findings is difficult because there is not a set technique and many researchers do not have an idea of how they are going to analyze the evidence, which can stall the research. To successfully analyze the data collected in the case study it is helpful for the researcher to have an analytical strategy. By linking the collected data to relevant concepts, the analytical strategy developed should help the researchers find a direction to analyze the data (Yin, 2014).

In this research project, the analytical strategy is to organize the empirical data and the theoretical framework with the research questions in mind. The aim is to connect the collected data, with the background chapter and the theoretical framework. The information is categorized based on the subject matter, and then, commonalities or conflicting information are identified and analyzed further to answer the research questions. To be able to categorize in a systematic manner, researchers put comments and different colored highlighters are used, with different colors representing the various research questions.

# 5. Findings

This chapter presents a description of each observed corner and the main findings from the observations conducted in this research project. Image 7, 8, 9 and 10, in this chapter illustrates the four corners. The images show the street layout and also details from the street level. In addition, to showcase the number of cyclists on the Bicycle Ring, data is taken from the municipal bicycle countings in September 2016. There has been an increase in bicycle traffic in the last five years around the Bicycle Ring. The biggest increase with approximately 300-400 cyclists, in both morning and afternoon hours, has been found along the stretch between the corners of Mejlgade and Graven and Mindebrogade and Skolegade (Aarhus Kommune h, 2016). In May 2017, all of the streets on the Bicycle Ring have been turned into cycle streets, with signs and bicycle symbols on the road.

## 5.1. T-intersection Grønnegade/Klostergade


Image 7 Corner of Grønnegade and Klostergade

### 5.1.1. Area description

The T-intersection of Grønnegade and Klostergade has a mixture of shared and segregated space between bicycles and cars. Both streets have wide sidewalks with good path quality. The

buildings in this area have varying heights with mostly residential and some mixed-use buildings, with some amenities. People do not reside here but use it as a transit corridor.

As shown in picture one, Grønnegade has a segregated bicycle lane with a curb on the west side and it ends by the Aldi grocery store. The rest of the street is shared space between cars and bicycles. Grønnegade is a one-way street for cars north of Klostergade and is two-way south of Klostergade. Klostergade is shared space with bicycles and cars. As shown in picture two, there is a yielding line when the street meets Grønnegade for both cyclists and motorists. It is a two-way street for cars.

The corner of Grønnegade and Klostergade is the second busiest corner of the ring, after Mejlgade and Graven, with around 6,500 cyclists passing the intersection, between 7:00 - 18:00. In the morning hours, 7:30 - 8:30, about two-thirds of the cyclists heading north on Grønnegade, turn onto Klostergade. Grønnegade has, in both directions, approximately 1,000 cyclists, while Klostergade has approximately 750. In the afternoon hours, 15:30 - 16:30, there are similar amounts of cyclists using the streets (Aarhus Kommune g, 2016).

### 5.1.2. Observations

The intersection of Grønnegade and Klostergade is mainly used by cyclists and cars. The observations show that the area is mostly used for transit, as no one resides there. There is a high tempo on Grønnegade from both cyclists and motorists. Difficulties for pedestrians wanting to cross Grønnegade is observed because there are no crosswalks or other aids for pedestrians to cross. In the morning observation, one collision between a bicycle and van was observed, the cyclist went on the bicycle lane, but in the wrong direction, leading to the van turning into a courtyard not seeing her. The woman drove right in the side of the van, but there were no injuries. The morning observation was conducted after the cycle streets were implemented, showing that cars still drove fast and overtook cyclists on the road.

Overall, the observations show that most cyclists follow the rules, and slow down at the yielding line on Klostergade. Many cyclists do not use hand signals when turning onto Grønnegade, however cyclists are better at using hand signals when turning left from Grønnegade onto Klostergade.

## 5.2. T-intersection Mejlgade/Graven


Image 8 Corner of Mejlgade and Graven

### 5.2.1. Area description

The T-intersection of Mejlgade and Graven is mainly a commuter route for cyclists, but also facilitates car traffic and is a popular area for pedestrians. This corner is located in the Latin Quarter,

which is compact area providing a 'cozy' feeling. Shown in all three pictures, the buildings in this area are low scale, mixed use, mostly restaurants and boutiques with housing on top.

As shown in picture two, Mejlgade is a street shared by both cyclists and motorists, and has a sidewalk for pedestrians. Heading north on Mejlgade, the road is one of the first cycle streets implemented in Aarhus, however in May 2017 the whole road was turned into a cycle street. Mejlgade is a one-way street for cars, however going different directions (north and south), parting at Sankt Olufs Gade.

Graven is a narrow street with very narrow to non-existing sidewalks, and is shared by cars, bicycles, and pedestrians. It is a one-way street for cars going west, away from Mejlgade. As shown in picture one, there is a yielding line on the ground, for cyclists coming from Graven, turning onto Mejlgade. Since the area is compact and narrow, there is a blind corner coming from Mejlgade turning onto Graven, which is shown in picture 1 as well.

Mejlgade is the busiest road on the Bicycle Ring, with around 9,500 cyclists passing, between 7:00 - 18:00. In the morning, 7:30 - 8:30, out of the approximately 1,500 cyclists passing, two-thirds cycle south, towards the city center. In the afternoon, 15:30 - 16:30, the number of cyclists decrease slightly, and there is no longer a dominant direction as seen in the morning hours. On Graven there is not much of a difference observed between morning and afternoon hours and the directions of the cyclists are equally distributed (Aarhus Kommune g, 2016).

### 5.2.2. Observations

This area changes character during the day. In the morning observation, bicycles are the dominating mode, followed by cars and then pedestrians. The cyclists have a high tempo cycling on Mejlgade. It was observed that very few cyclists show hand signals when turning on Graven, creating confusion, and potential dangerous situations. The intersection was at times chaotic, for example, one situation in the afternoon when three cyclists stopped to talk by the yielding line, while at the same time a car comes to turn. The cyclists and the car blocked Graven creating confusion and disturbance of flow in the intersection for other people.

The corner Mejlgade and Graven is very narrow, with buildings close to the street on both sides, which makes it difficult to have a clear sight when turning, for all modes of transportation. When cars turn onto Graven they take up the entire roadway and cross the yielding line on the opposite side of the road. Cyclists have difficulties turning left onto Graven because there are so many cyclists, making it difficult to stop on the side of the busy street and then cross it.

During the observations, issues for pedestrians were identified. There are many obstructions on the sidewalks disturbing the flow, such as benches, signs, and parked bicycles. The amount of obstructions, together with the width of the sidewalks, especially on Graven, pushes people out on

the streets. Delivery trucks sometimes block parts of the cycle street, making the area even more crowded.

## 5.3. T-intersection Mindebrogade/Skolegade


Image 9 Corner of Mindebrogade and Skolegade

### 5.3.1. Area description

This area has several roads that all have a different character. Skolegade, Europaplads and Åboulevarden all feed into Mindebrogade. The surrounding buildings are about three-story high, except Europahuset at Europaplads, which is a much larger, taller building.

Mindebrogade is a busy two-way street both for car and bicycle traffic. There are wide sidewalks for pedestrians and a crosswalk (see picture two) on Mindebrogade to connect Åboulevarden to the newer development Europaplads. Åboulevarden is a street with several restaurants and bars, with seating outside. Europaplads is a pedestrian zone, so pedestrians have priority in the area, and the other modes of transportation are allowed but have to go at a pedestrian pace. In May 2017, Mindebrogade has been resurfaced and has a checkered line to warn road users that there is a difference in road level. Skolegade is a one-way road for cars heading north. It has narrow sidewalks with several bars and restaurants close to the road. As shown in picture three, there is a yielding line for cyclists on Skolegade for turning onto Mindebrogade.

The corner of Mindebrogade and Skolegade is part of the busy stretch coming from Mejlgade. In the morning hours, 7:30 - 8:30, approximately 1,400 cyclists pass the T-intersection. On Skolegade, the direction towards Europaplads is busier with around 300 more cyclists than the opposite direction. In the afternoon hours, 15:30 - 16:30, there are similar numbers (Aarhus Kommune g, 2016).

### 5.3.2. Observations

On Mindebrogade, there are a high number of cars and trucks which drive relatively fast, overtaking the cyclists, however, cyclists also keep a high tempo because this is an area of transit during morning and evening commutes. This was observed prior to the implemented cycle streets in May 2017, therefore, there is not an accurate observation if this behavior has changed.

As mentioned above, there is a crosswalk on Mindebrogade. Confusion between the different modes of transportation was observed, because cars and cyclists usually do not stop for pedestrians that want to cross the street, even though they are supposed to. This creates confusion regarding who has the right of way. Pedestrians mostly waited for no cars or bicycles and then crossed the street. There are more pedestrians in the afternoon than the morning, and they tend to cross Mindebrogade outside of the designated crosswalk. Confusion was also observed for cyclists when they wanted to turn left from Mindebrogade to Skolegade, which caused many different bicycle movements. The intersection is confusing for all modes, since no one seems to be priority.

One of the most popular routes is the connection between Skolegade and Europaplads (see picture three). As seen in picture one, there is a yielding line on Skolegade used by cyclists turning onto Mindebrogade or going straight onto Europaplads. Most cyclists stopped by the yielding line to wait for traffic to be clear. In the morning, it was observed that some cars stopped on Mindebrogade to let the cyclists cross, even though they are allowed to keep driving. This showed some interaction and confusion between modes because the road users had to communicate which mode should go first.

Since Skolegade is a narrow street with narrow sidewalks, it is difficult for all the modes of transportation to fit. It was observed that people with strollers do not fit on the sidewalks. Parked vehicles that either take up the sidewalk or most of the road space was also observed which disturb the flow for all modes.

During the observations, even though it was good weather, no one resided in Europaplads. Pedestrians and cyclists are mostly using the area as a transit corridor, making the area feel stressful because cyclists are moving at a high tempo. However, at Åboulevarden there are less cyclists, and people are sitting outside of the restaurants and bars.

## 5.4. Intersection J.M. Mørks Gade/Frederiksgade/Østergade

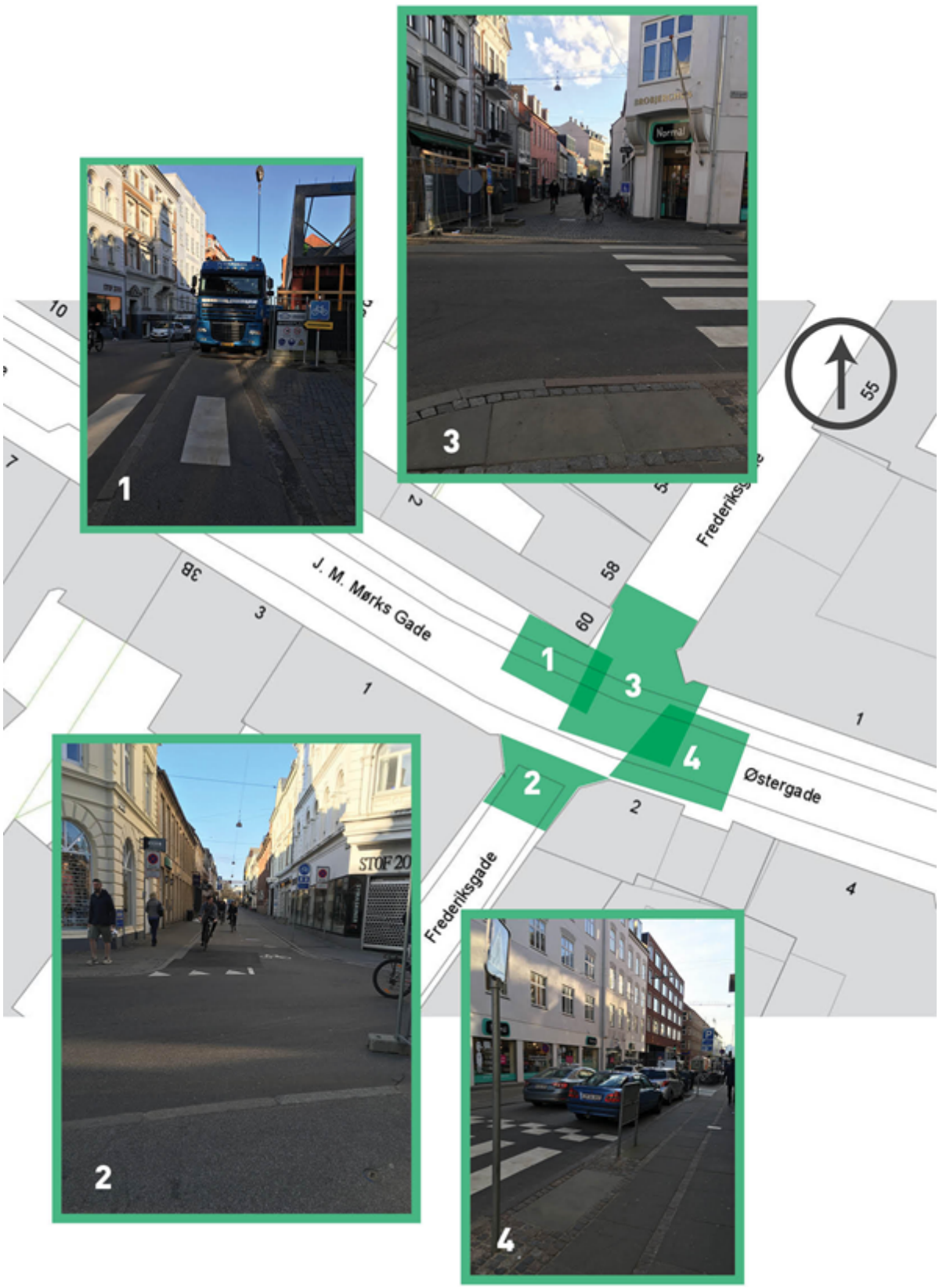


Image 10 Corner of J.M. Mørks Gade, Frederiksgade and Østergade

### 5.4.1. Area description

Cyclists, pedestrians, and motorists use the intersection of J.M. Mørks Gade, Frederiksgade, and Østergade. The intersection of J.M. Mørks Gade, Frederiksgade and Østergade is at the top of a hill. This area is mixed use with restaurants and shops and housing. The buildings on J.M. Mørks Gade and Østergade are taller than other parts of the Bicycle Ring, with four to five stories each. On Frederiksgade, the buildings are two to three stories tall.

The stretch J.M. Mørks Gade and Østergade has a segregated bicycle lane on the north side of the road, which is shown in picture one. During the observations and walk throughs there was construction, so the bicycle lane on J.M. Mørks Gade was always blocked (see picture one). The stretch has wide sidewalks, and good path quality. There is a speed table in the intersection, with a crosswalk in the middle to connect to Frederiksgade, which is shown in picture four. It is a one-way road heading east towards Salling (department store).

J.M. Mørks Gade and Østergade splits Frederiksgade into two different type of streets. On the north part of Frederiksgade is a walking street (see picture three), so motorists are not allowed, and cyclists must dismount and walk their bicycles. On the south side of Frederiksgade, it is a cycle street (see picture two). This street has wide sidewalks and good path quality as well. This street is one-way street for cars heading south towards ARoS (Aarhus art museum), but is a two-way street for bicycles.

Since the stretch J.M. Mørks Gade and Østergade is divided by Frederiksgade which is partly a cycle street, it has to be taken into account that some cyclists turn onto this street. During the day, 7:00 - 18:00, there are about 3,400 cyclists on J.M. Mørks Gade, while only approximately 1,700 on Østergade. On the cycle street on Frederiksgade, there are approximately 4,100 cyclists. Out of the streets around the Bicycle Ring that are counted, Østergade has the least amount of traffic. The morning and afternoon countings (7:30 - 8:30 and 15:30 - 16:30) both show that there are more bicycle traffic on J.M. Mørks Gade than Østergade (Aarhus Kommune g, 2016).

### 5.4.2. Observations

During the morning, it was observed that the tempo was slower than on other parts of the ring. The speed table, in the middle of the intersection, slows down the car traffic on J.M. Mørks Gade and Østergade. The cyclists also go slow on these streets because the intersection is on an incline and there are traffic lights.

In the morning, the stretch J.M. Mørks Gade and Østergade is periodically congested. When the traffic lights further down the street (heading east), towards Salling, turn red, many cars are in a line, and the intersection is filled with waiting cars. This disturbs the flow for cyclists coming from Frederiksgade, the cycle street, because they cannot turn left, right, or cross. Many cyclists cycle

straight on Frederiksgade, from the cycle street onto the walking street and vice versa, even though it is not allowed to cycle on the walking street. This is not a big problem in the morning because the restaurants on Frederiksgade (walking street) are closed and few pedestrians are out.

Confusion is observed in the intersection, at the crosswalk, however not as much of a problem as on Mindebrogade. Pedestrians do not know whether to walk, since all vehicles do not stop. There is also a lack of hand signals from bicycles turning. However, since the speed is fairly slow from all modes, no potential dangerous situations are observed.

# 6. Analysis

In this chapter, the research questions will be answered. First, sub-question one *'what is a people friendly environment and what role does mobility play when applying the definition to the context of Aarhus?'* will be answered, followed by the answer to sub-question two *'how does the built environment influence people's mobility behavior around the Bicycle Ring?'*. Lastly, the main research question *'with growing cycling numbers on the Bicycle Ring, how can this growth be managed to facilitate a people friendly environment in the city center of Aarhus?'* will be answered.

In this research project, the bicycle as a mode of transportation is understood as a viable solution to solve many of the new challenges in today's world, such as urbanization and climate change. The bicycle should be promoted to facilitate a mode shift from the car, and therefore, the planning shift towards a greater focus on the human dimension is needed. This research project acknowledges the ongoing population growth in cities, which will have a higher pressure on the existing transportation network. Due to space and environmental issues, sustainable transportation modes need to be prioritized. Promoting cycling in cities is an ongoing process because the bicycle has to keep competing against the car. Meaning that the conditions for cyclists in cities needs to be prioritized and constantly maintained and improved. In countries like Denmark and the Netherlands, where there is a high bicycle modal share, the capitals have started to see challenges with the growth of cyclists. Even though this is not the case in the majority of the world's cities and can be argued as a 'good problem to have', this is still an issue that needs attention when planning for bicycles so cycling 'does not fall on its own success'. For example, in cities that are growing in cycling numbers, this issue might not need immediate attention, but should be mitigated for the future.

To help analyze the research questions, interviews and e-mail correspondence from different experts within the urban planning field are used: Ditte Bendix Lanng, assistant professor, Department of Architecture, Design and Media Technology at Aalborg University, Pablo Celis, civil engineer, Department of Urban Development and Mobility at the City of Aarhus, Mikael Colville-Andersen, CEO at Copenhagenize Design Co., Mikkel de Vries Bækgaard, project worker, Mobility and Urban Space, The Technical and Environmental Administration at the City of Copenhagen, Ole B. Jensen, professor, Department of Architecture, Design and Media Technology at Aalborg University, Charlotte Kjær Petersen, landscape architect, Smart Mobility, Department of Urban Development and Mobility at the City of Aarhus, Mathilde Løvenholdt Larsen, project manager, Bicycle Projects, The Technical and Environmental Administration at the City of Copenhagen, Rob van der Bijl, independent consultant at RVDB, and Marianne Weinreich, founder and mobility consultant at Weinreich Mobility.

## 6.1. What is a people friendly environment and what role does mobility play when applying the definition to the context of Aarhus?

Sub-question one is answered using the theoretical framework and the background chapter. The answer from this sub-question provides the necessary definition to answer the main research question. A people friendly environment is interesting to research because it is a result of a newer approach to planning, which is focusing more on the human dimension. A growing population will lead to an increase in travel, therefore, mobility plays a strong role in the future of cities growth. Taking space issues and environmental concerns into account, planning for sustainable modes of transportation are becoming a necessity for cities, in order to maintain the quality of mobility and enhance people friendly environments. Presented below is first a definition of a people friendly environment based on the theoretical framework, then that definition is placed in the context of Aarhus, focusing on mobility, based on the background chapter.

### 6.1.1. Defining a people friendly environment

In the early 20th century, the street was perceived as a place where people met and interacted, it was a place where urban life could evolve. However, in the 1950s, along with the modernist planning approach, the car became the focus in urban planning and cities were planned around this new mode of transportation. The streets were now seen as places where motorized traffic could drive fast without being disturbed by other modes of transportation. The increase of cars in cities transformed many public spaces in the city into *"dead spaces for car only environments"* (p. 122, Urry, 2007). Further, Jacobs (1961) claims that streets are the *'*most vital organs*'* of a city, and therefore, serve a bigger purpose than just carrying cars.

Tibbalds (2000) argues that a humanistic approach promotes cities with a human scale, and a pace for pedestrians. However, having a human scale does not mean that the city cannot have high rise buildings, it just means that buildings should be placed and designed in an appealing way for humans, such as details at eye-level. If a city manages to maintain the integrity of the human scale, and also view the city from eye-level, people can feel more comfortable and invited to places.

This research project's definition of a people friendly environment is inspired by Jan Gehl's four aims, which are used as arguments for a human scale planning approach; a lively city, a safe city, a sustainable city, and a healthy city. These aims have in common that they refer to the notion that public space can be strengthened through human orientated planning and by promoting active transportation. The goals can be reached by inviting people to walk, cycle, and reside in the city's

public space. Gehl (2010) points out that these goals can be seen as both holistic or separate in urban planning. In this research project, these goals are seen as a combined result of an increase in active transportation in cities.

A lively city and a safe city can both be reached by inviting more people to stay in an area. In car dominated cities, Mattioli (2013) states that the city life is suffering because the public space is either non-existent or underutilized by people. People using slower modes of transportation tend to stay in the area longer which enhances the public life, and also has economic benefits to the city. It has been reported that in cycling cities, cyclists tend to buy more than motorists, because cyclists are more likely to make an impulse purchase compared to motorists that drives fast to their next destination. Having more people out on the streets also improves the safety in a city, both the subjective and objective safety. Jacobs' (1961) concept of 'eyes on the streets' relies on the notion that people out on the streets subconsciously look after each other, which brings a sense of safety. Furthermore, cities with a higher bicycle share, tend to have more shared space, as well as less accident rates, because there is an increased interaction between modes.

Sustainability is a broad concept, consisting of multiple facets and perspectives, however, there is a shared meaning that the environmental issues, such as congestion, air pollution and the increase in land use coming from the transportation sector needs to be decreased. A modal shift from the car to active transportation can have a positive impact on the environment because cycling emits less $CO_2$ and noise pollution compared to car traffic. It also takes up less space than cars, and gives more space to other activities in the city. This ties directly to the sustainable mobility paradigm expressed by Banister (2008), which aims to reduce car travel and switch to public transportation and active transportation to improve the environmental sustainability of cities. Gehl's aims focuses on environmental sustainability, however, when defining a people friendly environment, the concept of social and economic sustainability are also relevant.

Commuting with active transportation facilitates daily physical activity which can enhance the physical and mental health, which ties into social sustainability. Social sustainability also relates to the social equity in cities because cycling can help improve accessibility for citizens by providing an economic transportation choice. Therefore, the availability of pedestrian and bicycle infrastructure in an area can have a great impact on providing an additional transportation choice for citizens, without the monetary constraints of a car. In addition, societies with car dependent urban forms are separated due to the larger distances and a lack of social cohesion. This can affect the sense of community and social interaction in cities. Cycling can also improve the economic sustainability in cities because maintaining and building bicycle infrastructure is less expensive than car infrastructure. Planning for cycling infrastructure facilities a denser city, which puts less economic strain on the city

because there is less utility and road construction. By focusing on the human dimension in planning and planning for slower modes of transportation, a city can become a 'sustainable city'.

When defining environments as people friendly, it is not about specific characteristics or attributes in the area, but the holistic picture. Meaning that there are a variety of factors which play a role and affect each other in being people friendly. For example, an area which has various routes that road users can use, is not an issue in itself, but together with the high volume of people in the area can either negatively or positively affect this area in being people friendly. In addition, areas can be people friendly when they serve the purpose they are planned to do. For example, if an area is a busy transit corridor, and this area functions well, meaning people are not confused or stressed when traveling, this can also be people friendly, even if people are not residing in this area.

In a people friendly environment, people are out on the street, either residing or traveling. It is a place which does not alienate someone from the built environment, but invites them to reside and move, and interact with others in the public spaces. The movement in the public spaces should be in a manner which does not cause confusion between road users and pedestrians. Confusion can create a stressful environment and hinder the perception of safety for people. A people friendly environment encourages the use of active transportation, however, that does not mean that car trips are not allowed, but travel should be at a pace that is considerate of the other modes around, particularly the more vulnerable modes.

### 6.1.2. A people friendly environment in Aarhus

Denmark has placed environmental and social issues as a top priority, and one of the country's key goals is to create a green and sustainable society (Ministry of Foreign Affairs of Denmark c, n.d.). Copenhagen, has created a reputation for Denmark, and also brands the country as a livable, environmentally forward country. In terms of mobility, cycling is a top aspect for the capital and other large cities in Denmark because the bicycle has many user and city benefits and is already a favorable mode of transportation among Danes (see section 3.2.3.2).

Image 11 A people friendly environment on Graven

Aarhus is Denmark's fastest growing city (Aarhus Kommune b, 2016). The municipality has set goals to manage this growth in a sustainable and livable manner to maintain Aarhus' urban life. The traffic is increasing; therefore, the city is also focused on improving

mobility in the city. Aarhus has great potential to have people friendly environments with a dense city center and amenities in 'walkable distances'. As shown in image 11, Graven has many people sitting outside of cafes and enjoying the public space. This picture was taken during the non-busy commuting hours, so both cyclists and pedestrians are able to either travel or reside in a pleasant manner in the same space.

#### *6.1.2.1. Livability*

Extracting keywords from the Story about Aarhus, the Urban Development Vision 2015, and the Municipal Plan 2017, these documents hold public participation, quality of urban life, smart growth, and standard of living in the highest regard. It can be argued that these documents place the human dimension as a focus. Drawing from these documents (see section 3.2.1.1), the City of Aarhus recognizes the fact that the city is growing and that this growth could hinder the integrity of the city life, as well as the environment. The keyword in the municipality is 'livability', which sets a frame for how the city will be developed in 2050. According to the Municipal Plan 2017, all projects should contribute to livability. Drawing from the plans, sustainability, from an environmental, economic, and social perspective, is an important aspect to accomplish their livability goal. Through sustainable development, an improved urban quality and degree of livability can be reached. By having multiple transportation choices in a city, and creating compact, dense urban forms, this can improve the social inclusion in the city and facilitate a 'better' urban life.

Aarhus aims to be 'a good city for everyone', 'a city with the power to act and with a community feeling' and be 'diverse and have a high degree of social sustainability'. These aims relate to the aspects of social sustainability and Gehl's 'lively city'. As expressed in the section above, cycling can strengthen the social sustainability because it improves the accessibility to amenities for all citizens through an economic mode and improves the social cohesion among people. By focusing on aspects of a 'lively city', creating places for people and strengthening the public life in the city center can bring forth a sense of community among people, meaning, they feel like they have a sense of belonging to the city. As mentioned in the Municipal Plan 2017, Aarhus also has an environmental goal of being $CO_2$ neutral by 2030. This goal permeates into how the city is being reconstructed and developed, and how they are managing transportation through more $CO_2$ efficient means. As mentioned above, having a modal shift towards more sustainable modes of transportation can have a positive effect on the environment.

#### *6.1.2.2. Mobility*

In the survey, Aarhus Goals, citizens were asked what can be improved in the city. The three most common aspects were the conditions for public transportation, the conditions for cars and the conditions for bicycles. This shows that the citizens of Aarhus deem transportation as an important

aspect, and want the conditions improved for their experience in the city to be better (Aarhus Kommune & Epinion, 2016).

In the Municipal Plan 2017, mobility plays an important role for the future growth in Aarhus, emphasizing the connection between mobility and establishing a good city life. The Traffic and Mobility Plan focuses on ensuring there is good mobility in the city center, while supporting the city life. The word 'good' is not defined in the plan, however when matching 'good mobility' with 'supporting city life', the researchers have concluded that the city is not just focusing on the efficiency of the mode, but also the positive and negative implications of each mode. In addition, the head of the Mobility Department at the City of Aarhus, Susanne Krawack, states that 'good mobility' is a "*journey with a good experience*", having the possibility to travel, and that the quality is good. It is not a matter of erasing the car completely, but reducing the number of cars, so the people who do need their car will have a good experience (Krawack, 2016). With a growing number of citizens and travel, cars are not an efficient means of transportation to satisfy the travel. The City of Aarhus recognizes that car oriented planning is not an efficient use of land and induces negative externalities, such as increased air pollution and lack of city life.

In the Traffic and Mobility Plan, public space is prioritized in the city. As mentioned above, car dominated cities have a negative impact on the public space and formation of the city. Causing the public space to be either non-existent or underutilized by people. This further emphasizes Gehl's notion of making public space an attractive and inviting space in the city. Aarhus is focusing on smart growth as a solution to manage the growing population through sustainable means. Aarhus wants to build dense neighborhoods and connect the city with the new light rail being built. The city is also focusing on improving the cycling conditions. However, the city is not just focused on the 'best' mobility in Aarhus, but finding the balance between increased travel while still maintaining the growth, environment, urban life, and health.

### 6.1.3. Conclusion

Concluding on the plans in Aarhus, mentioned above, Aarhus has a strong desire to have a vibrant city life, increase sustainability from social, economic, and environmental perspectives, have a livable city through a high quality of life and standard of living, increase the modal share of alternative modes of transportation, and prioritize public space for people. Aarhus is following the paradigm shift expressed in the literature review (see section 2.1.2) from a car dominated society to one that emulates the human dimension in the city. The city is focusing heavily on both sustainability and livability for the future direction of Aarhus. Both of these concepts can be realized through the application of human oriented planning. When a city is built to human scale, it facilitates walking and cycling through dense development, and has attractive public spaces for people to interact, the city is

inviting to people. According to the City of Aarhus' definition of livability, this is a broader concept compared to people friendly environments. It incorporates aspects such as healthcare, housing, and economic prosperity, which a people friendly environment can help contribute to, but does not directly tie into.

A people friendly environment, is an area which invites people out on the street to reside and interact with others in the public space. Active transportation plays an important role in a people friendly environment because it contributes to a lively, healthy, sustainable and safe city. In Aarhus, mobility is seen as complementary to facilitate the goal of a vibrant city with a 'good' city life in the public spaces. The city aims to reduce car travel and promote the use of more sustainable means to facilitate the increase in travel. Susanne Krawack states that "*a city will probably not become livable if the mobility is not sustainable"* (Krawack, 2016). This quote agrees with Kashef (2016) stating that citizens must minimalize their impact on the environment to improve the livability of an area (Kashef, 2016). Apart from constructing a light rail, Aarhus is focusing on cycling. Having a high modal share of cyclists allows for people to be out on the streets, compared to car travel, where motorists have less of an opportunity for interaction. This also benefits the public spaces of the area because these types of modes improve the environmental quality of the area and are slower. However, it is important that the different modes of transportation are considerate to each other, meaning driving in the pace of the most vulnerable mode in the area.

## 6.2. How does the built environment influence people's mobility behavior around the Bicycle Ring?

This research question is analyzed by using concepts from the literature review, and applying them to the data collected from observations and interviews. The answers to this research question provides valuable information about the relationship between the built environment and the mobility behavior on the Bicycle Ring. Mobility is an important aspect when planning for a people friendly environment in Aarhus, because there has been a shift in viewing mobility as an activity in itself compared to travel as a derived demand. Mobility, especially active transportation, is a critical part of reaching several of the city's goals, e.g. becoming $CO_2$ neutral in 2030, decreasing the number of cars, and prioritizing public space.

In order to answer the main research question, *'with growing cycling numbers on the Bicycle Ring, how can this growth be managed to facilitate a people friendly environment in the city center of Aarhus?',* the built environment can provide insight into how cycling can be managed on the Bicycle Ring. For example, if an area can be expanded or not, in order to accommodate growing cycling numbers. It is also important to understand how the mobility behavior is affected by the built environment, because to have a people friendly environment, people should travel in a certain way.

Meaning, to have a high share of active transportation and that the various modes of transportation are considerate to each other. The built environment should not alienate anyone from moving, residing, or interacting with people in the city's public spaces.

Presented below, the bicycle mentality in Aarhus is first analyzed. Followed by three themes, shared space, scripts and atmosphere, which are extracted from the analyzed observation data. These will be further explored building on the background chapter, theoretical framework, and the empirical data collected. The examples within these themes are taken from the four corners of the Bicycle Ring to highlight various mobility behaviors, and how they are affected by the built environment.

### 6.2.1. Bicycle mentality in Aarhus

Within the last five years, cycling in Aarhus has increased exponentially (Aarhus Kommune a, 2016). The Bicycle Ring is a busy connection intended to provide cyclists a convenient way to bypass the pedestrianized city center. Due to the limited road space, there are several modes battling over the space on the Bicycle Ring, leading to negotiations and interactions between car users, cyclists, and pedestrians.

In this research project, when observing the mobility behavior around the Bicycle Ring, a specific bicycle mentality is apparent. A behavior where cyclists feel entitled to the area, leading them to take over the space by not obeying the rules and not being considerate to other modes. It is observed that cyclists ride fast, which can be argued is because the built environment affords this behavior. Cycling is a flexible mode, meaning that it allows cyclists to take shortcuts and ride on undesignated roads. This mentality is reinforced by Charlotte Kjær Petersen, stating that speed is a primary issue in Aarhus, cyclists also tend to take the fastest route, and follow the behavior of others (Kjær Petersen, 2017, interview). The aspects of the bicycle mentality can also be tied into the discussion around habits role in mobility behavior (see section 2.3.4). Habits are a reinforced and repetitive behavior, which can explain why this behavior keeps persisting.

This bicycle mentality might hinder the development of people friendly environments around the Bicycle Ring because when cyclists are not considerate to other modes, and more vulnerable modes, such as pedestrians, and less experienced or slower cyclists, it can feel less safe in the area. For example, when the bicycle mentality is combined with a lack of organization in space, such as Europaplads (see section 6.2.2.2). This area is hindered by the large number of fast cyclists traveling in the pedestrian zone. It is expressed from both cyclists and pedestrians from the street interviews that the area is confusing because people do not know where to go, leading to people not feeling safe (see appendix B).

## 6.2.2. Shared space

The concept of shared space was developed in the Netherlands, when searching for solutions to decrease the impacts traffic had on the quality of public spaces (Hamilton-Baillie, 2008). In countries with a higher bicycle modal share, there tends to be more shared space and cyclists tend to feel safer (Wardlaw, 2000). It has been argued that shared space reduces accidents in an area, since the pace is slower when the different modes of transportation have to be considerate of each other (Toth, 2009). However, issues of the quality of space have been acknowledged when implementing shared spaces meaning, that the most vulnerable road users' perception of safety decreases since they constantly have to be aware of other modes (Gehl, 2010).

It is difficult to measure safety in cycling because accidents rarely are reported to the police, and the perception of safety differs individually. Statistics from Statistics Denmark state that less than 5% of bicycle accidents are reported to the police, making it difficult for the municipalities to prevent bicycle accidents because it is hard to identify where and why the accidents occur. Therefore, several hospitals in Denmark have started to register road accidents, to enhance the data base (Rambøll, 2016).

Shared space is chosen as a main theme for this research question, because the whole ring has elements of shared space. Shared space represents a way of organizing the road space, however there are different views on how to implement a 'good' shared space. Therefore, two corners around the ring which bring out different aspects are chosen to exemplify a discussion around this concept.

### *6.2.2.1. Mejlgade and Graven*

The area around the T-intersection Mejlgade and Graven are both shared space between bicycles and cars. The streets are located in the old neighborhood, the Latin Quarter, and is therefore characterized by narrow sidewalks, leading to pedestrians being forced to use the road space. It can therefore be argued that the road space to some extent is shared between cyclists, motorists, and pedestrians.

Image 12 The busy T-intersection of Mejlgade and Graven

There is an intensity of activity in the area because Mejlgade, a cycle street, is one of the busiest streets for bicycle commuters in Aarhus, and is therefore often congested by cyclists (Aarhus Kommune g, 2016). The Latin Quarter, is also a popular area for pedestrians, with stores, restaurants and cafes. As illustrated in image 12, there is a constant battle over road space, where different road users

negotiate about the space. The concept of 'body semiotics' is relevant since all road users become signs to take into account when moving in the area. For example, pedestrians look out for cyclists and cars before they walk and cyclists maneuver around pedestrians like they are objects to avoid. Having to be constantly aware of other modes of transportation in the area can be argued to decrease the perception of safety, since people are afraid of collision. However, in research about shared spaces (see section 2.2.3) it is also argued that shared space increases the objective safety, since the pace in the area is slowed down when people are focused on the other people moving in the area (Gehl, 2010).

The amount of bicycle commuters, combined with the high number of pedestrians walking on the streets due to the narrow crosswalks with obstructions, is seen as an issue, especially during morning and afternoon peak hours. For this area to be an attractive and people friendly environment, with a high share of cycle transit, it is important that the different modes of transportation go in a slow pace and that they are considerate of each other. However, Jensen (2014) states that there should be some sort of separation between modes to protect the most vulnerable mode. In this example, there is a separation for pedestrians, but the sidewalk is very narrow, thus, pushing them out into the street. The cyclists are driving fast in the road space that is designated for them, which would not be an issue if pedestrians also had an appropriate space for them.

Image 13 The blind corner on Mejlgade and Graven

Another issue, discovered in the observations, is the blind corner in the T-intersection of Mejlgade and Graven (see image 13). Since Graven is a very narrow street, with buildings located very close to the street, it is difficult for the different modes of transportation to look around the corner. Marianne Weinreich argues that this area should be a car free area because these narrow streets are not originally built for cars. This would give more space to pedestrians and cyclists and make a safer environment for them, as well as, reduce noise pollution in the area (Weinreich, 2017, interview). When cars come from Mejlgade and turn onto Graven they take up the whole street, and therefore cross the opposite directions bicycle lane and the yielding line for bicycles wanting to turn onto Mejlgade. This causes a disturbance of flow for cyclists and also pedestrians that have to yield for the car coming. When wanting to turn, the car becomes the number one priority because the other modes cannot pass before the car has safely turned. In this particular situation, it could be better if cars were not allowed on Graven, at least not during the busiest hours.

However, the biggest issue seen in this area is not the cars, but rather the interaction between cyclists and pedestrians. During the busy hours there are too many bicycles in the narrow area and together with the number of unpredictable pedestrians trying to fit on the sidewalks, this creates issues with safety, flow, and confusion. Mikael Colville-Andersen argues that this new type of bicycle congestion "*is a problem that most cities on the planet would beg for. There can never be too many bicycles as transport*" (Colville-Andersen, 2017, interview). This statement is in agreement with Aarhus' goals because the city wants to promote cyclists and prioritize them in the city. However, this narrow road space and narrow to non-existent sidewalks cannot be widened. This causes problems in the area making it difficult to negotiate through the space with the high amount of people, thus negatively affecting the people friendliness.

#### *6.2.2.2. Mindebrogade and Skolegade*

Both Mindebrogade and Skolegade are shared space between cars and bicycles on the road. There are wide sidewalks on Mindebrogade, so pedestrians have a place to walk, however, Skolegade is a much narrower street with narrower sidewalks, so people walk in the street as well.
Looking at the 'mobile ballet', there are many interactions between modes because this area has three feeder roads to Mindebrogade, which are Skolegade, Åboulevarden and the newer connection to Europaplads. Meaning, cyclists and motorists have multiple travel options in this space, and there is not a clear distinction of which route they are going to take. This further instills the concepts of 'negotiations in motion' and 'mobile body semiotics' because the road users are considered objects and the direct or indirect interactions need to be negotiated in the space.

In addition, the new connection to Europaplads affords a direct route between the city center and the main library (Dokk1), and the water, improving street connectivity (see image 14). This connection is wide and has smooth paving, which affords cyclists to ride fast. However, the open area is regulated as a pedestrian zone, meaning that pedestrians have priority. This ties into the bicycle mentality expressed above (see section 6.2.1), because cyclists drive fast and take over the space.

Image 14 Cyclists using the connection from Europaplads

Referencing the municipal project Bylivsindex, interviews expressed issues about this shared space area, saying: *"chaotic, bicycles ride on Europaplads, unsafe*" and *"Bicycle lane! There are issues that cyclists are everywhere on Europaplads, so the pedestrians have a risk of being hit*" (translated from Danish). These quotes exemplify that shared space can be perceived as chaotic when there is no traffic organization and when it is a busy area (p. 27, Smart Mobilitet, Aarhus Kommune, 2016). As mentioned above, and also seen in this example, the perception of safety decreases when people are constantly having to be aware of others using the area.


**Image 15 Confusion in the intersection of Mindebrogade and Skolegade**

During the observations, confusion between modes was witnessed, as illustrated in image 15, because it is not clear where the road users and pedestrians are going and if they are going to follow the rules in the area. For example, cyclists not showing hand signals, and cars and bicycles not always stopping for pedestrians at the crosswalk. This T-intersection is a meeting point with pedestrians, cars, and bicycles, having multiple travel options. One of the main conflicts is that the built environment does not provide a specific script for how to negotiate the space between modes and routes. This is further reinforced with the popularity of cyclists traveling to and from the newer connection between Europaplads and Skolegade. Coming from Skolegade, is it difficult to communicate to other modes that a cyclist is going straight to Europaplads or turning right onto Mindebrogade, and vice versa. In addition, it is also difficult for cyclists to cross coming from Europaplads to Skolegade because the connection does not have a place in the intersection. In this situation, 'mobile body semiotics', 'negotiations in motion', and 'mobile with' are three concepts to evaluate the situation. Cyclists look out for cars and other cyclists to cross safely and manage through the space. Cyclists also subconsciously move in groups to cross to and from Europaplads to Skolegade. Meaning, cyclists grouped together waiting to go straight, and it was observed, once one bicycle would go straight, others followed.

On Skolegade, cyclists and motorists have to maneuver away from pedestrians walking on the road. During the morning rush hour, a woman came with a stroller and did not fit on the narrow sidewalk, so she was walking in the road. This caused some conflict between cyclists moving around

the woman. In addition, delivery vans and trucks park on Skolegade, forcing all of the modes to maneuver around them, causing a disturbance of flow. This street is narrower than Mindebrogade, so if there are any obstacles on the road, it can cause difficulties for road users to pass and maneuver through the space.

To conclude, confusion between the different modes of transportation can be seen as an aspect hindering a more people friendly area. Along the T-intersection of Mindebrogade and Skolegade, shared space contributes to cases of confusion because the modes do not know who is the priority in the area, or the travel routes each mode is performing. A confusing area negatively impacts mobility as an enjoyable activity. The actual safety can be enhanced through confusion because modes slow down and are aware of each other. However, the amount of awareness one needs when traveling can decrease the perception of safety. Ditte Bendix Lanng states that traffic needs a level of organization and control, therefore it can be argued that this area needs a higher degree of management (Bendix Lanng, 2017, interview). Furthermore, as mentioned above, Jensen (2014) states that in order to protect the most vulnerable mode there needs to be some degree of mode separation.

## 6.2.3. Design scripts

Design scripts, referred to as scripts in this research project, are how the built environment facilitates rules of how people are supposed to behave. For example, implementing crosswalks and other regulations in the built environment, with the intention to make rules that people cannot just bend (Bendix Lanng, 2017, interview).

In this research question, scripts are chosen as a main theme, because it highlights how urban planners, designers, and architects try to guide people's behavior by using the scripts in the built environment as a tool. Referencing 'staging from below', scripts are analyzed by observing the interactions and individual performances of the road users and pedestrians (Jensen et al., 2016). Furthermore, it is interesting to identify the scripts around the Bicycle Ring and observe if people are using the scripts as intended.

#### *6.2.3.1. Crosswalk on Mindebrogade and yielding line at Skolegade*

There is a crosswalk on Mindebrogade to connect Åboulevarden to Europaplads (see image 16). At crosswalks, cars and bicycles are supposed to stop for pedestrians, however, as witnessed during the observations, the crosswalk affords a different behavior and very few cars stop and hardly no cyclists stop for pedestrians, leaving them to wait until there are no cars or bicycles to safely cross. Both motorists and cyclists are not being considerate to the most vulnerable mode (pedestrians) and are also not following the script of the crosswalk. This creates confusion in the area because even

though there is a clear script of the crosswalk, road users are not abiding by the regulation. This can affect the perception of safety for pedestrians because they cannot safely cross the street without looking and waiting for other modes to pass. However, when a group of pedestrians approach the crosswalk or if a group begins to cross, cars and sometimes bicycles stop and wait. This further exemplifies 'mobile with', because cars and bicycles stop when multiple people cross, in addition, most bicycles stop when cars stop for the pedestrians.


**Image 16 Crosswalk on Mindebrogade and cyclist yielding on Skolegade**

In addition, some pedestrians also do not cross the street at the crosswalk, but choose the most direct route, and walk freely across the street. The crosswalk is intended to be 'single minded', meaning, to give pedestrians a safe option to cross the street. However, pedestrians treat this space as more 'open minded' and walk throughout the intersection. Pedestrians have to negotiate their way through the space between cars and cyclists. 'Mobile with' is also explored in this situation because, as witnessed in the observations, pedestrians tend to cross the street freely when other pedestrians are also crossing.

As shown in image 16, there is a yielding line on Skolegade for cyclists to turn right onto Mindebrogade. Based on the observations, when cyclists wait at the yielding line on Skolegade, there are a few occasions that cars stop on Mindebrogade to let the cyclists turn, even though the cars have the right of way. The car is being considerate to the most vulnerable mode, however, this can cause confusion for cyclists, because according to the script, cyclists should wait until there are no cars to turn. This contrasts to the above example with the crosswalk because there, the crosswalk is intended for the most vulnerable mode to have priority and be able to safely cross the road, but the road users do not abide by that rule.

These examples questions if 'being considerate' is following the rules, or if 'being considerate' is giving priority to the most vulnerable mode, even though it can cause confusion. In the example with the crosswalk, it would improve the perception of safety and reduce confusion if all the road users would stop for pedestrians. In the example with the yielding line, cyclists wait at the yielding line until there are no cars, so when a car stops for cyclists and disrupts the flow, it can cause confusion for the cyclists and other motorists in the area. In both cases, when the scripts are followed, it can

reduce confusion and increase the perception of safety because the scripts provide a guideline for how to act.

The examples in this intersection shows that it is not only the bicycle mentality that is an issue, but also the behavior from motorists and pedestrians. In this intersection, all three modes, cars, bicycles and pedestrians, do not follow the scripts of the crosswalk.

#### *6.2.3.2. Scripts on J.M. Mørks Gade and Østergade*

As mentioned in findings (see chapter 5), the stretch J.M. Mørks Gade and Østergade have both a speed table and a crosswalk as traffic calming measures. The goal with traffic calming is to create a safe environment for all types of modes (Black, 2010). In this area, it is interesting to analyze how these scripts can be assembled together and facilitate a people friendly environment, while taking the argument that areas without scripts benefits an area into account (see section 2.2.3). The speed table in the intersection is scripted to slow down car traffic, and is followed by motorists because they cannot go over it without damaging the undercarriage of the car. The crosswalk is scripted to facilitate an easy and safe way for people to cross the road, which it does for the most part. There are some issues with motorists and cyclists not stopping for pedestrians, however, the speed table helps since cars have to drive at slow pace when approaching the crosswalk.

In the intersection, various modes of transportation meet with a walking street, cycle street and shared space between cars and bicycles (see chapter 5). According to observations made in the area, people are not confused, even though there are different modes with different paces, it can be argued that this has to do with the type of scripts guiding people's behavior. People are considerate of each other, which can enhance the perception of safety in the area. Compared to the T-intersection of Mindebrogade and Skolegade, which has a similar transit environment but fewer scripts and a high degree of confusion, there is less confusion observed here which could be a result of the type of scripts. However, according to the street interviews, some cyclists thought it was stressful to cycle here with the cars. One interviewee stated that she "*like[s] walking here more than cycling*" because cars come close. Another woman expressed that *"there are many cars, I get nervous when I cycle*" (see appendix B).

Building on the definition of 'single' and 'open minded' areas in the literature review (see section 2.3.3), this area can be argued to be both, depending on which street observed. The cycle street and walking street on Frederiksgade are both 'open minded' because they are not planned for one specific purpose, there is both transit, shopping, and many other things here. However, as expressed in an interview with Ditte Bendix Lanng she puts the concept into a traffic context and claims that in traffic when a place is regulated, it is 'single minded'. Meaning that this area can be

seen as 'single minded' because directions and road space are regulated (Bendix Lanng, 2017, interview).

To conclude, in this intersection there are several scripts, and each mode has an allocated space making it clear how to use the area. This contradicts Moderman's argument that spaces should have no signs or markings to guide people's behavior (see section 2.2.3). However, there is a difference between commuter traffic and a leisurely ride. When there is a lot of traffic, places can become too chaotic (see section 6.2.2.2) which can hinder the people friendliness. This space is appealing to all modes because it manages unwanted behavior and encourages desired behavior through the use of scripts. It should be noted that the stretch J.M. Mørks Gade and Østergade is one of the less busy stretches on the Bicycle Ring, which could be a factor to the functionality of this area.

#### *6.2.3.3. Walking street on Frederiksgade*

This example aims to explore when a script affords a behavior that does not follow the regulation, in this case, cycling on the walking street Frederiksgade, see image 17.

Image 17 Cyclist on the walking street Frederiksgade

In the morning hours, before stores and restaurants are open, there are few pedestrians on the walking street, which can explain why many cyclists see this connection as an efficient route. The fact that the walking street has cobblestone paving, usually not favored by cyclists, does not seem to hinder cyclists using this road. This street provides a shortcut through the city, and since the bicycle is a flexible mode, meaning cyclists can essentially ride anywhere, such as on undesignated roads, they use this road to cut through the city. The walking street affords a different type of behavior than it is intended to. Charlotte Kjær Petersen states that culture is a big issue, when one cyclist breaks the law, others follow. This further strengthens 'mobile with', and the bicycle mentality in the area.

This example is adding to the discussion of 'single minded' or 'open minded' spaces. The walking street is intended to be used only by pedestrians, which it is during the busy pedestrian hours, when shops are open and people are out. The script aims to give pedestrians a comfortable environment. However, during the non-busy hours, when shops are closed, and this area does not

attract as many pedestrians, this area could be 'open minded' and afford cyclists to use this as a direct route through the city. Based on the observations, cyclists mostly use this street when it is the non-busy pedestrian hours, and follows the script when many people are out. It is in question if this is an issue or not. This area could be more regulated, for example, by adding more signs, or it can be seen as a non-issue as long as the cyclists do not disturb the pedestrians.

To conclude, the built environment in this example provides an alternative route for cyclists to use, even though, the street is not intended for them. Affordances is a concept used in this example because this street affords cyclists to use it, and it works well since the cyclists use this road during the early, non-busy pedestrian hours. The combination of cyclists being flexible, the affordances of the road, and the bicycle mentality mentioned above, can create a certain type of bicycle behavior in this area.

## 6.2.4. Atmosphere

Everybody recognizes the atmosphere of an area, however it is difficult to conceptualize (Jensen, 2017, interview). Ole B. Jensen claims that atmosphere is what emerges between the meeting of the material world and people's perceptions of it, meaning that "*you are coming into a space with the whole luggage as the way you perceive the world, and the space is there, with the strong and old buildings*" (Jensen, 2017, interview).

In this research question, atmosphere is chosen as a main theme for analysis because the way a person feels in an area can affect their mobility behavior. For example, a cyclist's behavior might change when riding along a waterfront, compared to a busy road, depending on how the person feels in the area. In this research project, atmosphere takes the amount of people into account, their behavior, the buildings and their function, as well as how the researchers perceived the area. This theme relates to the notion of the change from transportation to mobility, where mobility is seen as travel that can be seen as a valued activity in itself.

#### *6.2.4.1. Grønnegade and Klostergade*

The T-intersection of Grønnegade and Klostergade is an example of an area that is mainly designated for transit, with wide streets and sidewalks, and a high tempo. Therefore, it can be argued that the area is a 'movement space'. The amount of people changes during the day, however, even though there are less people and a slower tempo during some hours, the area never becomes an inviting area, in the sense that people go there to reside. One reason for this, could be the land use of the buildings. For example, it is mostly a residential area with few functions that attract people to stop and stay. The area is illustrated below in image 18 and 19.


Image 18 Grønnegade south of Klostergade

Image 19 Grønnegade north of Klostergade

Referring to the municipal project Bylivsindex, issues in the area are found, such as several maneuvers to avoid accidents, issues with delivery trucks disturbing the flow by blocking people's view, and issues for pedestrians trying to cross Grønnegade (Smart Mobilitet, Aarhus Kommune, 2016). Based on the observations in this research project, the same issues are highlighted, however, since this is a transit area with a higher tempo than the other observed corners, speed is seen as the biggest issue.

In cities, there is a need for a variety of public spaces. Meaning, that not every place can be for residing, and some areas need to be for transit, however, this does not mean they are not people friendly. Therefore, in this area, the goal might not be not to invite more people to reside, but rather to create a better 'movement space' where people are considerate of each other, by reducing the speed to protect the more vulnerable modes.

In this research project's observations, few conflicts are observed. In general, the wide streets and sidewalks give a lot of space for the different modes. However, during the busy hours, more interaction between different modes negotiating the space is observed. Difficulties for pedestrians crossing Grønnegade is observed during the busy hours, because there is no pedestrian aid, such as traffic calming measures and crosswalks, in the area, which is also shown in Bylivsindex (Smart Mobilitet, Aarhus Kommune, 2016).

It is concluded that, an area can still be an enjoyable environment, consisting of people friendly elements, if it functions well for its purpose. This area has wide streets and sidewalks, so the area has the potential to be a sufficient 'movement space', however, the bicycle mentality is hindering this, which is reinforced by a quote from the Bylivsindex *"Busy... the framework is fine, but the culture is not that good"* (translated from Danish) (p. 19, Smart Mobilitet, Aarhus Kommune, 2016).

#### *6.2.4.2. Mejlgade and Graven*

As mentioned above, the T-intersection of Mejlgade and Graven is located in the Latin Quarter, characterized by narrow streets and narrow sidewalks, and low scale buildings located close to the streets (see image 20 and 21). The observations show that this area is favorable for people, which is further reinforced by the conducted street interviews, stating that the area is "*very nice to walk and relax [in]*" and has a "*cozy feeling with the shops and buildings*" (see appendix B).

Image 20 Graven

Image 21 Mejlgade

Relating to the concepts of 'sociopetal' and 'sociofugal', and building on Jensen's (2010) notion of 'movement spaces' and 'staying spaces', this area can be argued to be both. This is a transit area which forces people to move, but at the same time, this area has an inviting atmosphere that brings people together. It is important to highlight that the number of bicycle commuters changes drastically during the day, leading to it being argued that the area also changes in atmosphere depending on the time of day. In the street interviews, one women stated that she uses this area mainly to walk and thinks it is enjoyable to walk there, however, *"I don't hang out here"*. This was reinforced by a man stating that it is an enjoyable area, but it would be better if the cars bypass the narrow streets, making it easier to walk in the area (see appendix B).

In the busy hours, the number of cyclists take over the area, leaving little space for other modes of transportation, as shown in image 22. In addition, there are also many pedestrians sharing the sidewalks when walking to and from work. The atmosphere can be perceived as stressful, due to people constantly negotiating through the lack of space. During the non-busy hours, the tempo becomes a lot slower and pedestrians and cyclists do not have to look for the other modes as much. It can be inferred that the area becomes more enjoyable because people can be more relaxed and the perception of safety increases.

Image 22 The corner of Mejlgade and Graven during rush hour

Since the area is not only planned for one purpose, it can be argued as 'open minded', the area provides opportunities of a variety of uses, such as residing, shopping, and for transit. These different uses promote various behaviors and interactions between people, which is also seen during the observations. The meeting between different uses, have benefits but also some challenges. In this area, there are a lot of people out on the streets and social interactions occur, which most likely would not have occurred in, for example, a car oriented area. However, in this area, it is observed that the numerous interactions and different behaviors sometimes can be perceived as chaotic. For example, during the busy afternoon hours, a meeting with three cyclists was observed by the yielding line on Graven. The cyclists stop to talk to each other, leading to them blocking traffic. In this situation, several cyclists try to pass the three cyclists but since this area, and especially the T-intersection, is very narrow, this is problematic. This meeting, which is an encouraged activity, creates confusion for others that have to maneuver around the cyclists.

It can be concluded, that the biggest issue in this area, are the lack of space for the number of cyclists and pedestrians. Even though this area attracts people because it has several people friendly qualities such as human scale buildings, multiple functions, and a large amount of active transportation users. The attractiveness of the area can be hindered when there are too many cyclists and pedestrians negotiating in the space, causing a stressful environment. This type of mobility behavior, such as, constantly having to fight over space and be aware of other people, affects the atmosphere because the area becomes less relaxing and therefore, less inviting.

### *6.2.4.3. Europaplads and Åboulevarden*

Europaplads and Åboulevarden, as illustrated in image 23 and 24, are connecting roads to Mindebrogade, and are a part of the connections expressed above (see section 6.2.2.2). In this area, there are a variety of atmospheres. For example, the newer area of Europaplads is an open area, regulated as a pedestrian zone, which is framed by a large, tall building, Europahuset, and the water. Compared to Åboulevarden, which is a street lined with cafes and restaurants and the buildings are at a smaller scale. These two areas are separated by Mindebrogade which is a 'movement space'.

Image 23 Europaplads

In Europaplads, Europahuset is larger than other buildings in the area, and the facade is minimalistic and not diverse on the top, but it does have a restaurant with a patio on the bottom, which adds some variety to the building when the restaurant is open. Based on the conducted street interviews (see appendix B), most people did not like the atmosphere in Europaplads, stating it was *"dull"*, *"bland"* and *"not welcoming"*. Europaplads has elements to invite people to reside in the area. There are seating opportunities and is an 'open minded' space because people can freely move in the area. However, based on the conducted street interviews and interviews conducted in the municipal project Bylivsindex (see section 6.2.2.2), it is not a place that people would necessarily choose to hang out. This area is surrounded by busy car dominated roads, so this could also be a factor which affects the atmosphere of the area.

Comparing this space to Åboulevarden, the scale of the area is different. The buildings in Åboulevarden are built at a human scale and there are interesting elements at eye-level. Here, the functions are inviting with restaurants and cafes with outdoor seating, inviting people to reside and interact.


Image 24 Åboulevarden, with Europahuset in the background

In conclusion, this area symbolizes the affect the building size and functions can have on people wanting to reside in the area, in turn, affecting the atmosphere. It is interesting to explore how Europaplads, planned as an open area with seating opportunities, has become more of a 'movement space', with a flow of transit. However, even

though Europaplads is described as *"dull"*, *"bland"* and *"not welcoming"* it seems to attract people for transit because it is a direct route between the city center and the water. Based on the location of the area, during good weather, this is a popular area with people residing (Smart Mobilitet, Aarhus Kommune, 2016). However, it is a question if the amount of travel in the area, undermines the potential of the area as an attractive place to reside every day.

### 6.2.5. Conclusion

The themes above allows the researchers to analyze the built environment from different perspectives, in which various mobility behaviors can be extracted.

The two shared space areas discussed above have in common that they are busy commuter routes, especially during peak hours, and both require a degree of management to function better. In the literature review, it is stated that some level of organization is needed in shared spaces, to protect the most vulnerable mode (see section 2.2.3), which is particularly apparent in these areas during busy hours. In both of these areas, road users need to negotiate and battle over space between other modes. The biggest issue in Mejlgade and Graven is that this area has too many cyclists and pedestrians for the narrow streets and narrow sidewalks, compared to Mindebrogade and Skolegade, where there is more space, but few scripts to organize the various connections. According to the literature review, shared space is supposed to improve the actual safety of an area, because people are aware of each other and travel at a slower pace. However, the perception of safety is affected in these areas because there are issues with the space allocated for vulnerable road users.

In the three examples exploring design scripts stated above, different kinds of scripts are highlighted, which bring out different types of behavior. This research project, argues that scripts should be followed, and therefore problematize the allocation and type of scripts in the built environment. Meaning, scripts are necessary to help manage a space that, for example, has a lot of traffic, because it creates a level of organization. In addition, it is an issue that people do not follow the scripts, which can be argued is related to the bicycle mentality mentioned above. When people follow the scripts it can reduce confusion, enhance objective and subjective safety, and make mobility a more enjoyed activity. This does not imply that all areas need to be heavily regulated but rather that they need to be evaluated based on their character, amount of activity, and their function.

Atmosphere can either draw people into an area or push people out. This is important in this research project, because a people friendly environment should be inviting for people. Therefore, the atmosphere of an area can play a role when investigating people's mobility behavior. The examples above illustrate differences in the atmosphere around the Bicycle Ring, to showcase this relationship. All three examples are busy during peak hours. Grønnegade and Klostergade have good potential of becoming a well-functioning transit area, however, the people using it are not considerate to each

other, leading to issues. Mejlgade and Graven have many attractive attributes, such as low scale buildings and many functions to invite people, but the attractiveness is hindered by the high volume of people commuting. Lastly, Åboulevarden has inviting functions, while Europaplads has the potential to attract people to reside, but functions more as a transit space.

The built environment provides the structure for how mobility can be performed in a city. The built environment can afford people to act in a certain way, for example, a smooth paving and wide road space can afford a bicycle to go faster. The built environment is different all around the Bicycle Ring, therefore, people's behavior differs. However, the bicycle mentality is present throughout which could negatively influence the mobility behavior.

## 6.3. With growing cycling numbers on the Bicycle Ring, how can this growth be managed to facilitate a people friendly environment in the city center of Aarhus?

The main research question is building on the conclusions from the sub-questions, as well as, the background chapter, theoretical framework and empirical data collected. This question is interesting because there is a gap in the academic literature about the phenomenon of cities experiencing challenges from the steady increase in cyclists. These challenges require attention in the field of urban planning because cities need to acknowledge and manage these issues to keep an increase in cycling, while maintaining the quality of the mode.

Drawing from sub-question one, people friendly environments can play an important role in planning for the wider concepts of livability and sustainability. It can be argued that there is a strong link between bicycle planning and planning for people friendly environments, because mobility plays an important factor in affecting the quality of city life. Kielgast (n.d.), from Gehl Architects, reinforces this argument by stating that *"planning for pedestrians and cyclists is thus an obvious place to start in order to create a sustainable and people-friendly city".* For example, the bicycle improves air quality, reduces noise pollution, and promotes social interaction. When people are cycling, it is at a slower tempo than cars, and the interactions between people are at eye-level.

The two biggest cities in Denmark, Copenhagen and Aarhus, both see the goals of good mobility and livability as complementary. Therefore, it can be argued that it is not a coincidence that Denmark is ranked high as both a cycling country and a livable country. For example, taken from Copenhagen's bicycle strategy, "*cycling is not a goal in itself but rather a highly prioritized political tool for creating a more livable city*" (p. 5, City of Copenhagen, 2011). In Denmark, cycling is a popular mode of transportation because the citizens appreciate the positive values associated with cycling (Ruby, n.d.). The bicycle is enrolled as a cultural artifact which is ingrained in the culture. Meaning, almost every Dane owns a bicycle, and it is seen as a mode of transportation, compared to other

countries like the United Kingdom or the United States where the bicycle is mainly for recreational purposes (Jensen, 2017, interview). This bicycle culture can be a supplemental factor to the higher bicycle modal share compared to other countries and help facilitate a mode shift to the bicycle within cities.

### 6.3.1. Managing growth in cycling numbers

Pioneering cycling cities such as Copenhagen and Amsterdam, that have promoted cycling for many years and are experiencing issues because the demand for cycling is higher than the capacity in some areas. In 2016, Copenhagen reached the milestone of having more bicycles than cars on the streets (Cathcart-Keays, 2016). Issues that have become apparent are bicycle congestion due to a lack of road space, and a lack of bicycle parking to facilitate the number of bicycles in the cities (see section 2.4.3.4). This section uses Copenhagen to showcase a cycling city and their efforts to manage cycling growth. It can be argued that Aarhus in the future will potentially meet the challenges Copenhagen is currently managing.

To manage the growth of cyclists, and maintain the attractiveness of the mode, Copenhagen has increased the amount of bicycle lanes and also widened them to make comfortable conditions. From 2006 to 2016, Copenhagen has constructed 46 kilometers of bicycle lanes, 44 kilometers of which are three lanes. During this period, there has been an increase of 19% of driven bicycle kilometers. The efforts the city has put into cycling has proven positive results from the citizens. The satisfaction among people with the amount and width of bicycle lanes has increased. In addition, the perception of safety among citizens has also increased. These positive results show that it is not just the amount of bicycle lanes in a city which make cyclists satisfied, but it is also the conditions in which they are built (de Vries Bækgaard, 2017, interview).

The amount of space cyclists has plays a role in how safe they feel when cycling. In areas where the roads are narrow and there is not enough space to either widen or add bicycle lanes, a solution that Copenhagen has implemented are cycle streets (de Vries Bækgaard, 2017, interview). In Denmark, this solution was first implemented in Aarhus, on Mejlgade and Frederiksgade (Aarhus Kommune, 2007).

Another way of managing cyclists is expressed by Mathilde Løvenholdt Larsen. She states that the municipality is considering the possibility of ‘way finder signs’, guided by the traffic tower in Copenhagen, which is expanding their tasks by not only looking at cars but including bicycles. Meaning that signs will tell cyclists that there, for example, will be rainy weather and that it is better to get wet than be stuck in car congestion. However, she is critical to this solution arguing that the fast commuter cyclists will not have time to read the signs when they come fast and are focused on

maneuvering the situation. She argues that signs can do a lot but not as much as having good infrastructure (Løvenholdt Larsen, 2017, interview).

In correspondence with, Marianne Weinreich, Mikael Colville-Andersen, and Rob van der Bijl, it is expressed that they all are in consensus that the most important aspect to solve these issues with a lack of space is a redistribution of traffic space, meaning allocating less space for cars and more for bicycles (Weinreich, 2017, interview; Colville-Andersen, 2017, interview; van der Bijl, 2017, interview). Further, Rob van der Bijl expands on this, stating that *"a technical elaboration of this could be sharing space and traffic calming. And less plus slower cars"* (van der Bijl, 2017, interview).

### 6.3.2. Growing cycling numbers in Aarhus

In the City of Aarhus Municipal Plan 2017, the goal of 'mobility and accessibility' is complementary with the goal of 'more city life and a good city environment' (see section 3.2.2). With the growing population, more travel will occur, which will put a stress on the existing infrastructure. However, Aarhus acknowledges this fact, so it is focusing on promoting sustainable modes of transportation, like building a new light rail and improving conditions for cyclists, in order to reduce the amount of car travel. In 2007, the city created the Bicycle Action Plan 2007 to make cycling both safer and more attractive for people in Aarhus (Aarhus Kommune a, 2016). As a result, Aarhus has experienced a growth in cycling (see section 3.2.3.2) in the past decades and the citizens consider the bicycle as a preferable mode because it is a healthy and sustainable means of transportation. Around the Bicycle Ring, there has been a steady increase in bicycle traffic the last five years. The busiest cycle street in Aarhus, Mejlgade, facilitates over 9,500 cyclists between 7:00 – 18:00 on a weekday (Aarhus Kommune g, 2016).

Pablo Celis states the municipality wants to keep increasing the number of cyclists on the Bicycle Ring (Celis a, 2017, interview). Charlotte Kjær Petersen argues that if you prioritize cycling in the city and have the political and financial backing to follow, there will be more cyclists (Kjær Petersen, 2017, interview). This statement further reinforces the initiatives in the Bicycle Action Plan 2007, because the municipality received both state level and municipal level funding to promote and maintain the quality of cycling in the city. Between 2009 – 2012, the city council allocated 70 million DKK to realize several projects expressed in the plan. These projects included a campaign to brand Aarhus Cycling City, create Denmark's first cycle streets on Mejlgade and Frederiksgade, a comprehensive bicycle parking plan, resurfacing bicycle lanes, and improving the safety at crossroads (Aarhus Kommune, 2007). These initiatives from Aarhus further highlights that Aarhus is taking action to promote cycling, as well as, improving their cycling conditions. Marianne Weinreich, states that becoming a cycling city is an ambition without an expiration date. Meaning that a city "*continuously*

*have to promote cycling, monitor the situation and continuously adapt the city to the situation*" (Weinreich, 2017, interview).

### 6.3.3. Managing growth in cycling numbers in Aarhus

Aarhus, as mentioned above, is promoting the bicycle as an efficient and sustainable mode of transportation, and even though the bicycle modal share is not as high as the capital, similar issues can be seen throughout the city.

In the observations conducted in this research project, it is discovered that areas around the Bicycle Ring suffer from too many bicycles for the existing road space, leading to congestion. In these areas investigated, the issues in the road space are a combination of narrow spaces and too many bicycles sharing the space with other modes of transportation. When having to share the space, speed becomes a problem, because bicycles are trying to maneuver around pedestrians and cars are driving too fast.

Efforts to manage the growth and to improve the conditions for cyclists in the city have been made. In the spring 2017, the Bicycle Ring was transformed into a network of cycle streets. The new rules make cyclists the number one priority in the road space, meaning that car users have to be considerate and not overtake cyclists (Aarhus Kommune e, 2016). The cycle streets are a way to deal with the issues of space, making it more difficult for cars to travel in the area (Kjær Petersen, 2017, interview). Charlotte Kjær Petersen, states that it is a small step in the right direction towards a mode shift. Parts of the Bicycle Ring that have been turned into cycle streets are very narrow (Kjær Petersen, 2017, interview).

The city is also expanding the bicycle network, for example, by constructing a bicycle highway, opening in August 2017, connecting the suburban area of Lisbjerg with the city center. The city also wants to widen bicycle lanes and implement new routes in the bicycle network that goes through green areas instead of being connected to roads (Kjær Petersen, 2017, interview). However, it can be argued that the conditions for cyclists are becoming 'too good', meaning the bicycle highway is wide, with smooth paving, which makes cyclists go very fast. When cyclists are going fast, accidents become more severe. Speed is also an issue when meeting slower cyclists. For example, funneling into the existing bicycle network when cyclists are riding at a slower tempo. Issues with speed and intersections have also been seen in Copenhagen, where there are several bicycle highways (Kjær Petersen, 2017, interview).

The city also has issues with not having enough bicycle parking (Aarhus Kommune, 2007). In 2016, 180 new bicycle parking spaces were implemented around the city, however these new parking spaces mostly aim to manage the current issues. According to Charlotte Kjær Petersen more parking spaces needs to be built to solve the future's demand (Kjær Petersen, 2017, interview). The city is

discussing the possibilities of building a new bicycle parking garage by the Central Station (Kjær Petersen, 2017, interview; Aaen, 2015).

#### *6.3.3.1. Applying solutions to the Bicycle Ring*

Based on the correspondence with Marianne Weinreich, Mikael Colville-Andersen, and Rob van der Bijl, expressed above, there are different solutions to manage growing cycling numbers. Traffic calming measures and shared space being two of them, are already analyzed in sub-question two (see section 6.2). Four other solutions highlighted are, widening cycle space, constructing alternative routes, reallocating road space, and implementing cycle streets on existing roads. To answer this research question, Aarhus and the Bicycle Ring are placed in the context of these solutions.

The alternative of widening the road space for bicycles around the Bicycle Ring is neither a feasible or a needed solution for all the corners analyzed in this project. The narrow streets that are very busy during peak hours, and particularly needs attention are the T-intersection of Mejlgade and Graven, and Skolegade. On these streets, the road space cannot be widened because the buildings are close to the road. This solution might work in other analyzed parts of the ring, such as Grønnegade and Klostergade, but here there is not as much bicycle congestion issues, which can be argued is because it already has a wide road space. Therefore, on the narrow streets, the other solutions presented below could be an option to manage bicycle congestion. The narrow streets have a particular character, which draws people into the area, they are 'cozy' with older, low scale buildings (see chapter 5). The amount of bicycle traffic mixed with pedestrians in the area hinders the attractiveness, making the environment less people friendly.

The second solution is to build alternative routes to relieve the pressure on congested roads. As expressed above, the City of Aarhus is constructing new routes and a new bicycle highway. The bicycle highway brings up potential challenges for the Bicycle Ring with the new connection feeding into Grønnegade. One of them being that fast commuters from the highway will be funneling into the slower tempo of the Bicycle Ring. In addition, expanding the existing bicycle network within the city center is a difficult task because the city center is mainly pedestrianized. For an environment to be people friendly, it should function well for its purpose. Areas with commuter corridors, especially for bicycles, are needed in a city to facilitate an efficient movement of cyclists. When the bicycle is a convenient and fast mode, it can be an alternative to the car, facilitating a mode shift, which has positive benefits to the city.

The third solution for road space issues is to reallocate the space, meaning taking space from the car and giving it to the bicycle. This solution could be interesting to propose on parts of the Bicycle Ring, however it could not work everywhere since the Bicycle Ring also facilitates car traffic.

For this research project to realistically apply this solution to the Bicycle Ring, the whole transportation network would need to be taken into account and be analyzed further. In the literature review it is presented that prioritizing the car leads to a reduction in the amount and quality of public spaces (see section 2.1.1). Therefore, it can be argued that by reducing space for cars in the city center it can contribute to a people friendly environment because it gives more space for constructing public spaces and implementing alternative transportation infrastructure.

One solution that does not get rid of the car but lowers its priority is through the implementation of cycle streets. As mentioned, (see chapter 3) Aarhus is implementing cycle streets all around the Bicycle Ring. To guide people's behavior bicycle symbols are painted on the road and cycle street signs are placed around the ring. In addition, there are signs explaining that cars are guests on cycle streets (see image 25). Since the Bicycle Ring is in the well-established city center, this is a viable solution to manage cycling growth because it does not implement major changes in the built environment, but rather relies on behavior change. This solution is geared towards managing motorists' behavior. The aim is to reduce the speed of cars, prioritize cyclists, and give them more road space (Aarhus Kommune c, 2017).


Image 25 Sign explaining that cars are guests

Image 26 Car overtaking cyclist on cycle street

It is acknowledged that the cars are also an issue on the Bicycle Ring, due to them driving fast and close to more vulnerable modes. As shown in image 26, cars are still overtaking cyclists even though the cycle streets have been implemented. However, in this research project it is not only the cars that are the problem, but also the bicycle mentality, meaning that cyclists are not considerate of

other road users and pedestrians. It can be argued that cycle streets will just reinforce the bicycle mentality since it is giving cyclists more priority in the area, making them feel more entitled.

The idea behind the cycle streets would positively affect a people friendly environment, with road users traveling at a slower tempo and are more considerate to the other modes. However, as explored in sub-question two, the bicycle mentality in Aarhus is prominent. For example, based on the observations, cyclists ride fast, do not stop for pedestrians at crosswalks, and ride on undesignated roads. The bicycle mentality is mainly an issue in busy areas when several cyclists are performing these behaviors. However, there are still issues with fewer cyclists performing in this manner because it can be argued that the behavior can spread on a larger scale. Behavior is difficult to change, and solutions take time to be effective (Kjær Petersen, 2017, interview). This is further reinforced by habits, which can play a large role in people's mobility behavior (see section 2.3.4).

### 6.3.4. Conclusion

Cycling cities, such as Copenhagen and Amsterdam, are experiencing issues with the number of cyclists because the demand is higher than the capacity in some areas. Aarhus and the Bicycle Ring has also experienced growth in cycling numbers in the past years, and similar issues are becoming apparent. Commuter routes in the city are congested during rush hours and the parking facilities are filling up.

There is a risk that if this growth is not managed, it can hinder the attractiveness of the mode and the quality of the area, leading to it not being as people friendly. A high share of cycling numbers in narrow areas, combined with the revealed bicycle mentality, can create chaos around the Bicycle Ring. This can reduce the perception of safety and hinder the efficiency and enjoyment of cycling. If the conditions for cycling are not constantly improved and maintained, it can be argued that the mode might 'fall on its own success'.

With Aarhus bringing attention to these issues, the city can sustain the growth in cycling and maintain the quality of the mode, before the issues become too prominent. Therefore, the efforts made on the Bicycle Ring by the City of Aarhus, such as implementing cycle streets, are needed. Aarhus has the framework for a people friendly environment, however, it can be questioned if the cycle streets will have the desired result and manage cyclists and motorists' behavior. Even though, behavior is hard to change, there is a need to focus on the behavioral aspects to solve the issues with the bicycle mentality. Therefore, there should be a mix of behavioral and infrastructural efforts to facilitate a people friendly environment in the city center of Aarhus.

# 7. Discussion

The discussion chapter aims to draw on aspects that have not been touched upon in the other chapters. In the first section, there are two topics discussed, one being the vision of a people friendly environment being too idealistic, and secondly, the language used in planning to promote the bicycle. The second section is a methods discussion which aims to be critical of the methods used in this project to answer the research questions.

### Is a people friendly environment an idealistic vision?

In planning, municipalities are creating visions as a form of communication between the municipality and its citizens to express the direction the city is taking to approach future issues. Municipalities are using 'catch all' words, such as livability and quality of life, to describe the vision of their city. These visions can be argued as being too general, because these terms are difficult to define into concrete actions. Within the vision, there are combinations of positive words, which motivate new thoughts and provide a higher-level framework to approach and manage future issues, however these solutions are difficult to realize in practice.

The concept 'people friendly' can also be argued as idealistic because it does not have any concrete substance. This concept can be viewed through multiple lenses, for example an architect will define people friendly differently than a traffic engineer. It is also influenced by the values and perceptions of people, causing it to be subjective. Meaning, some people might think an area is dull and unattractive, but others might think the opposite and decide to reside in this area. Realizing a people friendly environment is much more difficult to accomplish in practice compared to conceptualizing it on a higher municipal level. For visions to become reality, they must have a set of realistic, tangible goals, which facilitate a type of action.

For visions and goals to be realized there has to be a support from the citizens as well, meaning that citizens have to be open to the idea of changing behavior. For example, the goal of reducing the amount of car travel in a city. Planners can improve the attractiveness and convenience of alternative modes of transportation, such as cycling, by prioritizing the mode and implementing facilities. However, for people to use the bicycle, as opposed to the car, there must be a willingness from the people.

### Language in traffic planning

Urban planners and others in the field use similar language and actions when promoting the bicycle and the car as everyday modes. In Aarhus for example, the Bicycle Ring was built 20 years ago

to facilitate bicycle traffic, the same way as the Ring Road going around the city was built to facilitate car traffic. Bicycle highways are constructed to improve the efficiency of the mode, the same way as car highways are built to improve the efficiency of the car. The difference is that it does not have the same consequences to the city, because bicycles are more beneficial while cars can be detrimental.

Concepts like induced demand have been acknowledged within traffic planning for cars, as a negative effect of building more infrastructure. However, in bicycle planning it can be argued that induced demand is a desired effect since cities aim to promote a higher share of bicycles. In contrast, this challenges cities because with increasing cycling numbers, it causes a city to constantly improve and maintain the bicycle infrastructure, in order for the bicycle to be a competitive alternative against the car. Using similar language when planning for bicycles and cars, can be argued as a political tool to reach a higher modal share in cities. For a user to shift modes, the bicycle needs to be promoted to be just as efficient and convenient as the car, because commuters will most often choose the most efficient and convenient route and mode.

## 7.1. Methods discussion

This research project uses a pragmatic view of looking at a phenomenon, cycling on the Bicycle Ring, in a real life context. The aim of this project is not to contribute to the theoretical development within urban planning but is research which can be easily transferable into practice. This research project collects qualitative empirical data that can be subjective, aiming to explain a situation which the use of only quantitative cannot provide. For example, the researchers view cycling as a solution to many issues in a city, and therefore aim to promote cycling as the main mode. This shapes the way the researchers observe the environment, and therefore shape the conclusions. For example, the researchers value the quality of the mode, meaning that there is a focus on looking at aspects which hinder the mode, such as bicycle congestion and negotiation with other modes.

To complement the observations in this project, street interviews are conducted with pedestrians and cyclists to gain their perspective of the areas observed. These interviews helped reduce bias because it provided more opinions to draw conclusions from. These interviews strengthened the arguments in the observations and provided an alternative perspective to the observations. The street interviews were challenging because it was difficult to stop people, especially cyclists, during the busy hours. Therefore, it can be argued that there was not enough of a sample size to make reliable conclusions. In addition, the interviews were conducted during the less busy hours, therefore, the people that were interviewed did not experience the high traffic and their experience might be different compared to the busy rush hour. The interviews were conducted in English, so it affected some of the responses because the respondents had a difficult time expressing themselves fully. The researchers tried to get a mix of genders and age groups, however it was easier to get

women to participate than men. The street interviews could have been improved if more time was spent conducting them, or if a different method to stop cyclists was thought of. For example, handing out flyers with QR codes to cyclists so they could answer the survey questions at a later time. Overall, the street interviews contribute to answering the research questions, however, due to sample size, the interviews do not showcase the whole picture, and generalizations are difficult to conclude.

The observations benefitted this research project because it strengthens the pragmatic approach by looking at the Bicycle Ring in practice. However, due to time limitations and the researchers' distance to Aarhus, only three official observations could be conducted on each corner (morning, mid-morning, and afternoon). The observations were only conducted during the weekdays, so weekend hours could have also provided a different perspective of the ring. These observations provide general insight to the corners, but the findings are not as reliable due to the amount of observations. It can be argued that the issues observed were by coincidence (e.g. collisions). However, when the researchers conducted street interviews, took pictures, and performed the initial walk throughs, the researchers were still observing the Bicycle Ring. Weather also plays an important role in the observations. The observations were only conducted on sunny days and during the spring season, so more cyclists were out compared to cold, winter mornings. Behavior can change depending on the weather. For example, more people residing or walking in an area. Weather also plays an important role in the pictures taken in this project. If it is a sunny day, an area will be captured differently than if it is a cloudy and rainy day. The pictures only highlight certain aspects, but do not capture an entire area.

# 8. Conclusion

In a people friendly environment, active transportation should be the most attractive choice, meaning that it should be both an efficient and enjoyable means of transportation. The Bicycle Ring contributes to a people friendly environment in the city center of Aarhus because it facilitates cycling which has many benefits for city life. However, with the increased growth in cycling numbers in Aarhus, it is questioned if the future growth could hinder the people friendliness of the Bicycle Ring and the city center of Aarhus. It is observed that in some areas, there are too many bicycles for the designated space, too narrow of sidewalks for the number of pedestrians, and cars and delivery vans/trucks are a disturbance to the more vulnerable modes.

This research project problematizes the issues with mixing two types of functions, commuting and residing, as well as different modes of transportation. It is argued that the people friendly aspects of an area can be reduced when modes with different intentions and speeds interact reducing the perception of safety and causing confusion. Therefore, it is concluded that solutions for organizing the space depending on the function needs to be thought of, especially in areas where it is narrow and the built environment cannot change.

The City of Aarhus has implemented cycle streets around the Bicycle Ring as a solution to improve the conditions around the ring. This solution prioritizes cyclists by giving them more road space and reduce the speed of cars. Cycle streets can contribute to a people friendly environment because it encourages a slow and considerate behavior from cars. However, around the ring, a bicycle mentality is observed as a big issue. Cyclists feel too entitled to certain areas, leading to them not being considerate to more vulnerable road users, such as pedestrians and less experienced cyclists. Therefore, it is argued that by giving cyclists even more priority in the area, the bicycle mentality could be strengthened and hinder people friendly environments. It is concluded that there needs to be a level of management for both infrastructural and behavioral aspects in bicycle planning, to manage the challenges associated with growing cycling numbers so the amount of cyclists do not decrease and the attractiveness is maintained.

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# Appendix

# A. Face-to-face interviews with experts

### Ditte Bendix Lanng

Assistant professor, Department of Architecture, Design and Media Technology at Aalborg University, 27th of April 2017.

Part 1: There is an interesting difference between an affordance and a script. We would also sometimes talk about a design script. And that would be much more, at least the intention, would be to make rules that people can't just bend and sort of move around. [Almost more like the built environment should, not force someone to do something but that it should be more natural that they move in a certain way]. Yes, do you know the Danish architect Jan Gehl? [Yes]. He would talk about invitations, and I guess that would be like a synonym to some situations of affordances.

Part 2: Do you know the concepts of single minded and open minded spaces? It is a guy called Walzer, I believe, who sort of, well I guess it is kind of a design concept dealing with how strictly the piece of design, probably an urban space, is programmed, how strict it is scripted for certain uses and, that is how single minded it is for its use. While we can also think about more open minded spaces which would be open for multiple uses and experiences. Maybe that would be interesting, or I think it would be highly interesting to mobilities in traffic because we actually kind of do need a high degree of organization and control of traffic, where as in a city space we would also expect and wish for quite an open mindedness for ourselves to approximate or to appropriate places, and different experiences. So I guess a space like the one you just described [Mejlgade] would kind of be torn between single minded and open minded. And those sort of actually agendas for what we need from an urban space like that maybe. [That is almost the discussion of shared space – we could use those terms for that] Yes, that is true. [If it should be regulated, or not, or a little bit]. Exactly, and how do we balance these… that is quite a challenge in mobilities spaces.

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### Ole B. Jensen

Professor, Department of Architecture, Design and Media Technology at Aalborg University, 4th of May 2017.

#### Is the mobility culture more the behavior of what people are doing and not so much seeing them as objects?

Mobility culture, or culture in general is a terrible term, because it has all these wide connotations, and is used for all kinds of stuff. I think it makes sense to talk about it in a… very often when we talk about mobility culture we are actually thinking about sub-cultures. So, kind of ways in which we

engage with our practices and that turns into… a part of cultures has to do with to recognize behavior. So its not necessary like oh my god I am thinking about how to commute today, I am just doing it because I have done it thousands of times before and I am looking at my neighbor who is commuting and he or she is doing it the same way. It is kind of this classic stuff… It is not just a practice, its also normativity, the values that connects to that. So there will be proper ways of doing things, like going to work, and some people will be really concerned about climate change and CO2, global warming and stuff, and other people will be more concerned about can I make it before 10 o'clock and stuff like that. And so, the mobility cultures are kind of a way of thinking of how the mobility is tapping into the more softer questions about normativity, culture, social values and that sort of stuff. But also at the same time, how it is differentiated a lot on a set of sub groupings. So you will have particular ways of doing things compared to if you are… [in relation to the GreenWay bicycle route in USA] The way people talk about cycling in America, or at least at that time. That it is either a political statement or recreation thing. But the third thing of just getting on your bike and going to work, isn't there. So it a taken for granted thing…This is not just North America, this is the UK as well. For many Danes, it is like knives and forks. You get one as soon as you can walk and you get new ones, and you don't really think much about it. And most Danes have one, even if you don't use it on a regular basis. So it has become an artifact and ties into the mobility fabric and a different type of mobility culture…But the bike, the way we use the bike is enrolled as a cultural artifact.

Can you be very specific and say that certain areas have a specific culture?

Well I guess you could do that (like certain areas make you feel more relaxed, like the harbor front or Vesterbro) I think that is an interesting observation. The challenge would be, whether the area has the culture or the people have the culture and if people are changing overtime, then what is really having there. So maybe what is happening there is that the materialities and layout of that particular space. So I would more choose atmosphere or ambiances. Which are very interesting but hard to pinpoint… and everybody recognizes that, the environment is not just there, everyone tries to make sense of it. I think if you look at a particular area, how it works, how it is configured. The cultural aspects might not be as good, compared to atmosphere… Everyone recognizes atmosphere, you know it. It's like time, it's difficult to conceptualize it. His point is that atmosphere is something that emerges between the objective physical world and the subjective, you know, our perceptions…If you start thinking of atmosphere as something that emerges between this strange meeting. You are coming into a space with the whole luggage as the way you perceive the world. And the space is there, with the strong and old buildings… Authenticity and atmosphere is this meeting… Culture might be too broad of a term.

Susanne Krawack

Head of the Mobility Department, Urban Development and Mobility, City of Aarhus, 23rd of November 2016.

**I am thinking that many of these concepts are connected, which makes it hard. But, we can start with 'good mobility'.**

'Good mobility' – I understand it as a journey with a good experience. Mobility is, not necessarily a concrete trip, but the possibility to travel. And to have good possibilities to both... that there are many possibilities to get around, to travel around and move. But also that the quality is good. The way I'm thinking about it is that it is double – it is also a good experience. Regardless what mode of transportation you choose, what combination you choose or if you just experience that it is easy for you to get around with a good mobility, with a high quality of the mobility.

**And that is with time, and everything.**

Yes, it is time and it is pleasant, it is an experience, and it is clean, nice and cheap, and whatever.

**My article is about livability, sustainability and mobility... in the context of Bylivsindex. I state that there are a strong connection between these three. And I would like to know what you think about this – and if you think it is visible in Bylivsindex because in Bylivsindex we talk a lot about livability and since I think that sustainability is connected to this... with the less cars the better...**

Yes, that is how it is perceived by citizens, and politicians. It is very interesting to talk to the city council and organizations outside of the side because they always want the cars out of their areas. Everybody wants slower pace, more bicycle lanes... away with the fast driving cars, everyone says that. Where they are supposed to drive and why they are there when no one likes them, that I do not know. No, there is of course a connection, that is obvious, sustainability is a part of livability, it is an important part of the work with livability. And a city will probably not become livable if the mobility is not sustainable, that is how I think it is connected. And that does not mean that it necessarily are no cars, but that the cars that are there drives on a different fuels and drive slow. I think that means a lot for how they are perceived. In cities in America there is an extremely amount of car traffic but they

drive slow, and then people do not notice them as much as if they would have been driving aggressive, that many cars do in Denmark.

Yes, I have thought about that too.

So I think that in something that we perceive as a livable city, there can be car traffic, but it has to have lower priority.

## B. Street interviews

Interview guide

Male/Female

Cyclist/Pedestrian

How often do you cycle/walk here?

1. Is there anything you would like to improve here when you cycle/walk?
2. What do you think is good here when you cycle/walk?
3. Do you find this area enjoyable?

***Mejlgade/Graven***

*19th of April, 10:45 – 11:00*

Person 1: Male, pedestrian, tourist

1. Very nice.
2. People are cycling. Not so many cars, easy to walk.
3. Nice with old school buildings, not just concrete.

Person 2: Female, pedestrian, once a week

1. Satisfied.
2. I like the buildings. Nice.
3. Use this area mainly to walk, I don't hang out here.

*22nd of May, 10:00 - 10.15*

Person 3: Male, pedestrian, every day

1. Remove cars. It would be better if the cars had to go around!

2. I like the small houses. The old style of this area.

3. I do, yeah!

Person 4: Female, pedestrian, 1-2 times/month

1. I think it's nice as it is.

2. The re-use shops and Italian shop. And it's cozy that people are sitting outside drinking coffee.

3. I think it's enjoyable to walk and relax.

***Mindebrogade/Skolegade***

*19th of April, 9:15 – 9:45*

Person 1: Female, pedestrian, not too often

1. Safety, all the way to Åboulevarden. People fall in the river. More trees – it is flat and boring.

2. Use it to get from A to B. A lot can be done to make it more welcoming. Never thought of what is good before…

3. No, I would never sit here. Big road [Havnegade]. Maybe if there was a café, that would be nice.

Person 2: Female, cyclist, 2 times/week

1. When coming from Skolegade turning right, it is hard to see people when crossing. In summer, at Europaplads, with bikes and pedestrians, and even cars, it gets confusing. Where do I bike?

2. Nice with less cars on Skolegade, compared to before, now it is more bikes.

3. Not enjoyable, too many people. Mostly go back and forth here.

Person 3: Female, cyclist, 4 times/week

1. Skolegade is very narrow. Hard to bike there. Have to pay attention to other bikes and cars.

2. Beautiful. I like the architecture and harbor. Åboulevarden is also nice.

3. Yes, but wouldn't choose this place to relax and hang out, too many cars and Åboulevarden is expensive. I would rather go north to the forest.

Person 4: Female, pedestrian (with stroller), 2 times/week

1. Skolegade have bad sidewalks, is narrow and confusing. Should be a pedestrian sign on sidewalk. It is very hard to walk there with a stroller, have to walk in the street. People get confused where they're supposed to be – mainly when biking. It used to be different. Bikes don't stop for the yielding triangles, hard with small kid trying to learn how to bike.

2. Europaplads functions but is dull. It is just a passage – functional! It doesn't do anything else, people just walk through.

3. No. Not enjoyable. It does the trick. Skolegade and Mindebrogade doesn't function at all. Europaplads is safe, when on bike you know you need to bike slower.

Person 5: Male, pedestrian, 4-5 times/week

1. Bench. Hard to lay down on it.

2. Haven't thought about it.

3. No, bland. Maybe add something, it is a bit plain.

***J.M. Mørks Gade/Frederiksgade/Østergade***

*19th of April, 13:30 – 13:45*

Person 1: Male, cyclist, 2 times/week

1. Security for cyclists. People's brains. Look, be flexible, take time – this is the biggest problem in the world now. People go too fast. Just relax, wait for the lights, wait for the last car… slow down!

2. It is a place to cycle on, cars are thinking (the people in the cars). They slow down, and are flexible.

3. Cycling is easier than driving the car, don't need to park. The new light rail is coming soon, but they're still selling cars.

Person 2: Female, cyclist, once a week

1. Likes the store [Stof 2000].

2. Many cars – I get nervous when I cycle.

3. Walking – it is very beautiful.

*22nd of May, 11:30 - 12:00*

Person 3: Female, cyclist, 2 times/month

1. More space for cycling. Many cars, stressful to cycle.

2. I wouldn't know, haven't thought about it.

3. I like walking here more than cycling. Stressful to cycle, mostly because of traffic. Cars come close, but it is relaxing to walk.

Person 4: Female, pedestrian, 2 times/week

1. Haven't thought about it. I don't see any problems, maybe it's because I'm so used to walking here. Everyday walking makes me use to it. New person would be better.
2. I like the waking street, it is cozy, intimate, not that much but enough for walking. Don't like to the construction, but can't help it.
3. Yeah, I think so. I walk in my own thoughts. Not too aware! If it was nature I would walk here because it's nice, not in a city. I wouldn't walk here without a purpose. Exercise is also a purpose, I do that sometimes, from Viby to the city.

Person 5: cyclist, 2 times/week

1. Free of cars.
2. Nice variation, nice spaces to sit down and drink coffee, nice between the houses.
3. Yes, sure!

## C. E-mail interviews

### Pablo Celis

Civil engineer, Department for Urban Development and Mobility, Technical Services and Environment, City of Aarhus, 10th of April 2017.

Hi Pablo,
We have a few follow up questions from the phone call in early March.
One of our research questions deals with the expectations of the ring, from both the municipal and users perspective. In the phone call, you mentioned the motivation behind implementing the ring, creating a quick route for cyclists so they don't have to enter the pedestrianized areas. We were wondering:
What are today's expectations of the ring, from the municipality's viewpoint? E.g. do you want to increase the amount of cyclists or just manage the current cyclists? *We want to increase the amount of cyclists.*
What do you think the cyclists expectations are when using the Bicycle Ring? *That they have a good and secure access to and through the inner city. Without too many cars.*
We heard that there is a new campaign to promote the new bike streets. What does it include, what is the aim with the campaign, how do you think it will affect people's mobility behavior? *The campaign will just include some general information about the new streets, legislation and which streets are being rebuild. The aim off the campaign is to learn all the users how to use and behave on a cycling street.*

Are there going to be any changes in the built environment to promote these new bike streets, that will be implemented around the ring? *Only on some few locations we have added trees and widened the pedestrian areas.*

When talking on the phone, you mentioned that the Bicycle Ring was implemented together with the "infrastructure plan in Aarhus". What is it called? Are we able to see it? *Here's the plan- https://www.dropbox.com/s/xwsvfc8rrz63f3c/Bilag%201%20Mobilitetsplan%20Aarhus%20Midtby.pdf?dl=0*

Thank you!

Matilda and Estella

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Mikkel de Vries Bækgaard

Project worker, Mobility and Urban Space, City of Copenhagen, The Technical and Environmental Administration, City Development, 4th of May, 2017.

Dear Matilda and Estella

Thank you for your inquiry. Below I have answered each of your questions.

Furthermore here are the links to the Cykelstiprioriteringsplan 2017-2025 (link) and the annual report on cycling (cykelredegørelse 2016) where you can find more information. Both are unfortunately only in Danish.

**- After reading the 'Good, Better, Best' Bicycle Plan, we understand that Copenhagen is focusing on widening and adding bicycle lanes to manage the bicycle congestion. Have this already been implemented? If so, have there been any positive results?**

As of 2016, 375 km of cycle tracks are established along the roads, and 46 km of them are established during the last 10 years. 44 km of the cycle tracks have 3 lanes. In the same period from 2006 to 2016, there has been an increase of 19 % of driven km on bicycle in Copenhagen. The satisfaction with the amount of cycle tracks has also risen from 65 % to 87 % among the Copenhageners. Furthermore, the satisfaction with the width of the cycle-tracks has risen from 48 % to 62 % and the safety-feeling has risen from 53 % to 76% in the period of 2006-2016 as well (Cykelstiprioriteringsplanen 2017-2025).

- In older areas of the city where changes in the infrastructure are not possible - is Copenhagen implementing any alternative solutions for areas like this?

In streets where there aren't any spaces for cycle tracks, alternative solutions like cycle-streets, which are shared by bicycles and cars, but on the premises of the cyclists, can be established, and contra flow cycling in one-way streets can be implemented with signs and labels on the street.
In the attached publication '*Cykelstiprioriteringsplan 2017-2025'* you can find streets where the different alternatives are suggested.

- How do you find the balance of promoting more cyclists, but at the same time maintaining good conditions for the existing cyclists in the city?

The vision for Copenhagen is that 50 % of all trips to jobs and educational institutions are committed on bicycles in 2025. Therefore, it is essential to get financial support to improve and maintain the existing infrastructure and to establish new. The annual budget for bicycling in the municipality of Copenhagen is approximately 100 mio. DKK. Furthermore, the State of Denmark has from 2009-2015 provided Copenhagen with approximately 18,7 mio. DKK in average each year for bicycle infrastructure (Cykelredegørelse 2016). In Copenhagen bicycling is a mainstream mean of transport, and most car drivers also use a bicycle and public transport to get around in the city. So the challenge for the municipality, is more to strengthen the bicycle as the primary mean of transport and not to promote new target groups/cyclists. This can be done through infrastructure improvements and campaigns for instance.

Good luck with your thesis.

Best regards
Mikkel de Vries Bækgaard
Project worker
Mobility & Urban Space

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Mikael Colville-Andersen
CEO, Copenhagenize Design Co.
Through Julie Kirkegaard, Communications / Executive Assistant to the CEO, 25th of April, 2017.

Good morning Mikael,

We are Urban Planning master students from Aalborg University working on our thesis. Our thesis focuses on cycling's affect on people friendly cities. We are doing a case study of Cykelringen in Aarhus city center.
One of our research questions deals with managing challenges of a growing bicycle city (e.g. bicycle parking, congested bicycle lanes, etc.). Copenhagen has already reached these challenges in certain areas, and we wanted to gain your insight into solutions or techniques to tackle these issues.
Some articles have stated that the increase of bicycles in cities could potentially "choke on its own success." Meaning the promotion and success of cycling cities can hinder the benefits of cycling because bicycles lanes are packed and parking is difficult to find. Do you agree with this statement? What would be your solution to these issues?

Have a nice day!
Best wishes,
Matilda and Estella

Hello.
The following is a reply from our CEO Mikael Colville-Andersen.
"Too many bicycles is a problem that most cities on the planet would beg for. There can never be too many bicycles as transport. Unless, of course, you are a traffic engineer who was educated in the American style of traffic engineering and are merely trying to squeeze bicycles into the car-centric Matrix - or a politician who is ignorant to the benefits to society of having high cycling levels. All the space for cycling is right there... much of it hidden under last-century car lanes."

Best regards,
Julie

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Rob van der Bijl
Independent consultant at RVDB, 1st of May, 2017.

Hi Rob,

I hope you are doing well. I am working on my thesis with a classmate and I was hoping I could get your opinion for one of our questions. Our thesis focuses on cycling's affect on people friendly cities. We are doing a case study of the Bicycle Ring in Aarhus city center.

One of our research questions deals with managing challenges of a growing bicycle city (e.g. bicycle parking, congested bicycle lanes, etc.). Cities such as Amsterdam and Copenhagen have already reached these challenges in certain areas, and we wanted to gain your insight into solutions or techniques to tackle these issues.

1. Some articles have stated that the increase of bicycles in cities could potentially "choke on its own success." Meaning the promotion and success of cycling cities can hinder the benefits of cycling because bicycles lanes are packed and parking is difficult to find. Do you agree with this statement? What would be your solution to these issues?

2. In old city centers with narrow streets, where road space can not be expanded, and a lot of pedestrians are walking, how do you think bicycle congestion should be solved?

Thank you and hope to hear from you soon!
All the best,
Estella Hollander

Sorry Estella for my late reply. Generally 1 and 2 can be solved by a redistribution and design accordingly of space. Hence more for bike less for car.
A technical elaboration of this could be sharing space and traffic calming. And less plus slower cars.
Also substantial improvement of public transport is key.
Please call if you need more info etc.
Success and regards. Rob

Marianne Weinreich

Founder and mobility consultant at Weinreich Mobility, 8th of May, 2017.

Hej med jer

Hermed mine bud på jeres spørgsmål. Håber I kan bruge det. Ring gerne, hvis I vil have det uddybet:

**Aarhus Kommune fremmer cykler, men der findes problemområder i byen. Et af vores underspørgsmål omfatter de udfordringer byer møder når antallet af cyklister øges, for eksempel, overbelastede cykelbaner og manglende parkering. Vores spørgsmål er på engelsk fordi, specialet bliver skrevet på engelsk.**

**Some articles have stated that the increase of bicycles in cities could potentially "choke on its own success." Meaning the promotion and success of cycling cities can hinder the benefits of cycling because bicycles lanes are packed and parking is difficult to find. Do you agree with this statement? What would be your solution to these issues?**

Wanting to be a city of cyclists is an ambition without an expiration data – that means that you continuously have to promote cycling, monitor the situation and continuously adapt the city to the situation. That means that if you are successful in getting people on bikes you also have to make room for them – both on the cycling lanes and for parking. The more cyclists the more space there has to be allocated and the more investments you need to do. But luckily investments in cycling is much cheaper than investments for car infrastructure. And contrary to investments in car infrastructure investments in cycling gives the city both a lot of positive benefits related to both health, environment and quality of space and high return on investment due to these positive benefits.

**In a narrow area like Graven/Mejlgade, where road space cannot be expanded, how do you think bicycle congestion should be solved?**

In my opinion the narrow streets of the Latin Quarter of Aarhus are not build for cars and should be made car free which would make room for and make it safer for pedestrians and cyclists of all ages and reduce noise pollution etc. Cars can park very close in the huge carparks nearby. It's not a human right to drive your car to the front door of your destination. But it's important the city communicates and makes it easy for car drivers to find the car parks and help them find the way to the car free city center.

Venlig hilsen / Kind regards

Marianne Weinreich

Founder / Mobilitetskonsulent

# D. Phone interviews

### Mathilde Løvenholdt Larsen

Project manager, Bicycle Projects, City of Copenhagen, The Technical and Environmental Administration, 17th of May, 2017.

### Are there any solutions, other than infrastructure, that Copenhagen is doing to manage growth?

I work with planning bicycle paths, with the consultants and so, I am not in the idea scoping phase anymore. But because I have ears so I know stuff, I am probably not the right one to ask but I am probably better than no one. There are some like way finding signs, some signs systems where they guide bicycles better through the city, because many of the main infrastructure roads are actually quite slower to bike on than some of the by-roads, or whatever you call them I don't know. So, that's a new system, trying to implement this summer, as far as I know, I haven't seen it and I don't have any faith in it because we have the traffic tower here in Copenhagen. They survey all infrastructure in Denmark and mainly in Copenhagen, and they only focus on cars but now they are going to try and focus on bicycles as well. But, as far as I heard, it's like okay, tomorrow it is going to be some rain so instead of choosing your car please choose your bike because you will only get a bit wet, instead of choosing your car and you will be delayed by 30 minutes or so. It is signs like that on the road, as I understand the sign system. And I don't have any trust in it because when I bicycle on Dronning Louises Bro, with 25 km/h, I will never be able to read stuff like that on a sign. I will be far more busy trying not run over 20 Japanese tourists and not being hit by a swan flying over the road and stuff like that. If I go by bus it takes me an hour to work and if I go by bike it takes me 22 minutes, so that's just my personal opinion. You can do a lot with signs but as soon as you have good infrastructure there will be far better… they have like signs. Some years ago they had a lot with behavior, and how to change behavior in bicycling, but the politicians don't like that anymore, so there's no funds for that anymore. And now we have an election this year so there will be no funds for that this year either, so that's more or less it I think. But again I work with planning and buildings, I am of course in that scope and not in the idea generating.

### The funding will still be there to build infrastructure but just not so much managing behavior and signs and things.

The funding for behavior haven't been there for like 3 or 4 years. When I started here 5 or 6 years ago, then we did some behavioral campaigns. But I haven't heard of any, for some years. And if they are it is very low key because a lot of the politicians they don't like it. As far as I know the politicians like to

have some kind of bow they can cut and say congratulations now we have some new asphalt, and stuff like that. And especially with it being election year, there will be no campaigns. But I am not deciding that, that's just politics, and me trying to be a sidekick.

**Our next question was about behavior, but since they are not doing that, then that is not interesting anymore.**

No, it is very so last year. Because Copenhagen is just drowning at its own success, and because there are no options in Copenhagen. I just had a visit from some high school students and they wanted to hear about how we in Copenhagen plan bicycle paths as a way of exercise. We don't plan it for exercise, we plan it for going from A to B. It has nothing to do with, my opinion, is that I don't bike for exercise I bike because it is a mode of transport, and I think you find that most people in Copenhagen say that. And as soon as you choose some other mode of transport it has to do with convenience and that you're scared. Young people and old people choose some other modes of transport because they're parents or themselves are scared of how it works here.

**So I guess, just quickly, when they are widening bicycle lanes and also we heard about cycle streets as well as the new infrastructure, are these solutions mostly to mange current growth or more to prepare for the future, or a bit of a combination?**

Again, I am just working here, I am not a politician, so the politicians might have one answer but me as just one who has to deal with reality has another answer. So my answer would be that we are only planning for today, if we had the ambition to do anything they would totally shut down the entire city and it would only hurt bikes and the public transport, in my opinion, yeah I am kind of a leftie as well. Right now I am building Søtorvet and H. C. Andersens Boulevard, which is the most congested places in Denmark, both for private cars and bikes. And we are only trying to manage whatever we can do with the limited amount of space we have because when you have a bus you have to have this amount of space and if I delay a bus with 1 minute it will cost me a million krona, so when I have a budget of 2,6 million to do everything I cannot delay a bus, so no matter what I do I just have to do whatever I can within the geography as the city as it is. This city was planned for like horses and carriages, not for bikes, buses, cars, and pedestrians. So we are only planning for today. The politicians tend to be ambitious but they are not when it has to do with the hard core priorities, because then they would say like… I think there should be a lot more roads that don't have any cars, and they don't do that so yeah that's my personal viewpoint, not the politicians.

Pablo Celis

Civil engineer, Center for Urban Development and Mobility, Technical Services and Environment, City of Aarhus, 1st of March 2017.

### What was the motivation behind Cykelringen?

It was implemented in 1996. It was implemented together with the infrastructure plan in Aarhus. Where we were trying to minimize the amount of cars going through the city. So we made a ring that was for cyclists, and then within the ring, we have the area for pedestrians, and outside the ring, we have the area for the cars. The idea with the ring was the split it with 4 even spaces. So when you enter with a car in one space, you can only get of this space the same way you came in, so you don't have this car traffic through the city. This means that we have had a **zero increase** in car traffic in the inner city since we made this thing. So the bicycle ring was actually meant as a quick and fast route for cyclists going to the inner city, so they do not have to enter the pedestrian area but they go in a ring if they have to go north to south or east to west. So that was the basic idea of the bicycle ring. And together with this, we made a bus corridor that went right through this bicycle ring, where we concentrated all the bus traffic so they would have good accessibility to the inner city without too much car traffic or cycling traffic.

### Has it changed since it was first implemented?

No, it is exactly the same thing. People just don't know we have a bicycle ring. People use it, but not as a ring of course. But they actually don't know we have a bicycle ring. That was not the idea of it, not to go in a ring, but use it partially when going from east to west or north to south. But preserving some areas specific for cyclists, and make them priority

### What are the challenges with Cykelringen (implementation, improvements, usage...)?

Yeah, I would say the major problem is that nobody has an area where cyclists are prioritized. So today we are reconstructing the bicycle ring, and transforming it into bicycle streets. Where we will put up the signs that they are bicycle streets, and put up the pavement that this is a cyclist area, and giving priority to the cyclists on the bicycle ring, so they can use all of the road, so cars can enter but they have to stay behind the cyclists. But the thing is, you have to give the cyclists top priority and give them all of the space in the bicycle ring that they can use. Before, they had to keep to the left side of the cars. Which is what you normally do when you are in traffic. Now they can place themselves in the middle of the road. [Is this all the streets on the ring?] yes, all the streets in the ring

are going to be transformed. So that is a project that we are working on now, we are going to implement this the first of May. [But I saw there are some improvements, like streets and stuff, are all the improvements done already?] Yeah, well, those are minor improvements I would say because, some of the parts of the bicycle ring has characteristics of too much traffic. The function of the space has too much traffic. So we wanted to implement some more recreational aspects of the space, so you automatically slow done, traffic can slow down. This is one of the problems we have with the bicycle ring. Is that we have a lot of high speed cyclists, for example. And if you have a corridor that is too long, you just go through with high speed, and suddenly. So the idea was to put a lot of functions in these spaces in the ring, in order to slow down the speed of both the car users and the cyclists. This is what we've been working with the last 7 years, I would say.

### What affect does Cykelringen have on the public space in Aarhus?

I think gradually when we have been transforming them into bicycle streets, the amount of cyclists in Aarhus has been increasing enormously in the last 4 or 5 years. We have almost had a 30% increase. And that is because a lot of the cars have left these streets. So now we have widened some of the pedestrian areas because of the bicycle ring. The fact is that now people are using the bicycle ring as a space where you are drinking coffee, where you sit down, the cafes have brought their tables out and people sit. Where there were normally parked cars, where it was not so nice to sit. So that is one of the side effects of attracting more cyclists to the bicycle ring. Its been more attractive for the pedestrians too, to be in these areas.

### How does the municipality work with the concept of shared space?

Shared space would not work on the bicycle ring because we have too many cyclists. Shared space, I think, only works when you have an overweight of pedestrians setting the pace. So then everyone can set the pace towards the pedestrians. When you have too many cyclists, it is not possible to make shared space because they would never slow down, they will keep the speed they have. Maybe for shorter areas, you can make some shared space, maybe, but the whole bicycle ring, you cannot make into shared space. Too much conflicts and too much accidents. As well as, the accessibility would be awful for cyclists. They would have to spend too much time crossing through this. [But then with cars, the whole bicycle ring will be shared space with cars?] Yeah, that will be shared space between cars and cyclists. That is easier because they have the same speed, almost, in city traffic. So that is not a problem. The problem is when the speed difference is too high.

### What role does Cykelringen have in the Cykelhandlingsplan 2017?

Yes, the bicycle ring is still part of the Bicycle Action Plan. The plan is really to wipe the concept, so we don't only work with the bicycle ring, but all the surrounding streets, so we give them priority for the cyclists. Also some streets where we will make shared space, as part of the bicycle action plan. Some streets where we think we have too much bicycle traffic, and too much activity with pedestrians. So we need to calm down the cyclists. [When can we see this plan, how long will it be done?] By 1st of May we will have the bicycle streets in the bicycle ring. The other projects will be in a year or so. [For the hearings, when are those?] Yeah, there are going to be hearings in May. So we are going to be finished with the plan July or August.

### Do you know if Cykelringen has been mentioned in previous bicycle plans (except Cykelhandlingsplan 2007)?

No, there were no plans before the 2007 plan. That was the first plan that we make.

### Who do we contact for statistics about accidents involving bicycles around the ring?

Yeah, that's me!

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### Charlotte Kjær Petersen

Landscape architect, Smart Mobility, Department of Urban Development and Mobility at the City of Aarhus, 10th of May 2017.

### [Interviewees go through research questions and changes from the last conversation]

It is an interesting aspect to see what can you change here and now with the signs and different communication and what takes time. Or what needs to be done before you see the behavior change. There are still a lot of cars there, still a lot of traffic. Even now, actually it is a law. The signs are a law. The law changed and the laws are different. That could be an interesting debate to see the laws and the culture. And what needs to be done before the behavior change.

You should get a ticket for it. Now the priority is that the bicycles are the first priority. The cars are second priority and they are not able to go faster than the bicycles. Just like Mejlgade and Frederiksgade (But are they only doing this because of the cars?) Primary because of the cars. Also because the hierarchy has been unclear in those streets.

### It was observed the problem on Mejlgade and Graven were between pedestrians and cyclists, and not so much the car, is this anything that has been talked about?

I also think it is because there are no big accidents between the bikes and the people, but there are accidents between the bikes and the cars. It makes it more clear with this type of regulation. For example on Grønnegade, there are much more cars there than Graven. Also if you see the whole ring, there are parts which have bigger problems with the trucks and the vans. Compared to Graven. Also there are areas that the cars are going faster and there are many more of them.

What is the role mobility plays in people friendly environment in Aarhus?

Have you looked at the new municipal plan. In the new plan, it is for now and many years from now. Livability is an important part of this plan. You should see this plan, it is finished now and it is the way we want to work with mobility and the city in the future. They have a definition of mobility and how city development should interact with livability. Also you should see the regulation on the bicycle ring now as a small step to get closer to livable city in the narrow city center, inner city. And it just takes time to make that transition. For example, in the bicycle ring, there is not much change now, but hopefully when you make it difficult for cars to go there, you give them a fine, hopefully they will find another route. You should see it as several small steps in the right direction.

How does the built environment influence people's mobility behavior around the Bicycle Ring? [We have observed a type of bicycle mentality, like cyclists were going fast and are entitled in the area, especially the walking street on Frederiksgade, cyclist went there on the morning. Is it okay to go there when there are no people, and if they do this sometimes will that go to other areas] It has a lot to do with culture. If you see one breaking the rules, the limit of doing it yourself is lower. [So people are following] What we have been with Dokk1, this is the same thing that you described. When many drive illegally and see it is faster and do it too and just follow, and maybe don't see the signs. That this is a big issue with the culture. Pablo even tried on Mejlgade for people to go slow. When you go so fast, you don't see the signs or the crosswalks or you don't respect them because you go so fast that you can't go down in speed. But this is hard work to do with the behavior. [But is this something the municipality is doing, is this on the agenda?] I don't think we have any specific projects, Pablo tried to make a campaign, we also made one on the Festugen try and make good karma on the bicycle paths. But the speed is the primary problem. But it is difficult. When you make smooth and wide paths, they go very fast, but you want to make it each. But no, I do not think we have any concrete projects now. But maybe we should...

Do you think you can ever give cyclists too much priority, that they get more entitled, like with the cycle streets?

Mm, I think speed is the primary problem. And now we are working with the super bicycle highway. There are some intersections and areas that speed can be a problem, because we make it so good and so wide, and we are afraid that the speed can cause more serious accidents. [Is this open now?] Nope, it is open in August. The light rail will open end of September. Might be worth looking at CPH, they have a lot those highways. I know they also have problems with speed. They buy the best bike and they now, I am going to cycle on a highway. [So how Aarhus is promoting bikes, building bike highways, bike streets around the ring, and then your projects, is that how we can summarize how Aarhus is promoting bikes?] Yeah, and also the growth we are having in Aarhus has to be in sustainable transportation. So the priority in the politicians and the money will be on those projects, as well as behavior change. They made these park and ride stations, for example in Lisbjerg. So you can park you car and ride in. They are making it more difficult to park your car in city center, more regulations. More interesting to take your bike.

Copenhagen has reached this "peak", lots of congestion and lack of parking. Copenhagen is widening streets and adding bicycle lanes. But how can this be solved in, for example, Graven, when you cannot widen the streets? How can this be solved in an inner city?

We are trying to make bike paths wider but also make bike paths which are not connected to the road but go through green areas. Or in areas where you can make a short cut. As well as the bike parking. This is already an issue. You need a lot of space to park all those bikes. We are building a parking house by the station, but it's not enough. It has to be all the time, priority for space. [We saw that 180 parking was installed, what that to manage current situation or for future?] Its mostly the current issue. When you come to see the bicycle ring, they also made a lot of new parking, to make it clear it is a ring for bikes. Also where you cannot go straight but a bit curvy to slow down the speed.

We have a statement we have asked CPH, and want to get your thoughts. With the increase in bicycles, could the bicycle "choke on its own success"? And we have gotten different answers.

I think the politicians thinking that you can take your car wherever and take it to any point in the city center, it was the easiest way. Now the politicians are starting to prioritize the money that you have to make a shift. Go easy by car but then it is easy to shift to light rail. Put your car outside the city center. Shift to the bike. That is one target or goal. Then there is also with the priority to the transport. If you give a lot of priority and space of the bikes, if its easier, you will see a lot of that. If you give priority and give it some time, you will see more of it. The money has to follow the priority. If you just

make new routes for car, you will not see a change. Invest in the future and invest in bikes and facilities if you want to see the growth. In Aarhus, it is new to work with mobility and health. It is getting more concrete with project with health and mobility. Before it was two different subjects, but now it is more into one. You see the changes with people moving from passive to active transport. The Health agenda is good. There is a lot of money to prevent.

# E. Observations

## Walk throughs

### *Grønnegade/Klostergade*

| **Grønnegade/Klostergade** | Date: 3rd April |
|---|---|
| **How is the space being used?** | |
| | Mostly transit. No residing at all, there are no opportunities for it. |
| **Atmosphere** | |
| | This are is mostly residental or basic service, like Aldi. Not a very interesting place to 'just walk' but is a good connection to the interesting parts of the city |

| **Built Environment** | |
|---|---|
| Bicycle Infrastructure | Grønnegade - Segregated bicycle lane, with a curb on the Aldi side and stops by Aldi. The rest of the street is shared space. Corner of Vestergade and Grønnegade there is an island with trees, on the Aldi side there is a segregated bicycle lane, other side is shared space between cars. Klostergade - yielding markings |
| Pedestrian Infrastructure | Good width and path quality, no crosswalks |
| Motorist infrastructure | Grønnegade: north of Klostergade is a one way street. South of Klostergade is 2 way until Vestergade. Yielding markings on Klostergade |
| Buildings | Good site for cars, cyclists, and pedestrians. Different sized buildings, mixed-use, commercial on bottom and residential on top. |

## *Mejlgade/Graven*

| **Mejlgade/Graven** | Date: 3rd April |
|---|---|
| **How is the space being used?** | Mostly transit. Also people sitting on benches outside restaurants and cafés. People walk around and window shop etc. |
| **Atmosphere** | Cozy streets. Lots of nice boutiques, makes you walk slow and window shop. Buildings have interesting character, and is a unique area to be in compared to the rest of the city. |

| **Built Environment** | |
|---|---|
| Bicycle Infrastructure | Graven - shared space between bicycles and cars and some people because sidewalk is very narrow. Lines for bicycles on the ground near the intersection towards yielding markings. Mejlgade - shared space between bicycles and car. Bike street from intersection towards Nørrebrogade has bicycle symbol on the ground like Frederiksgade. Towards Europaplads is shared space between cars and |
| Pedestrian Infrastructure | Graven - very narrow sidewalks. Mejlgade - Sidewalk width is okay but many obstructions (tables) |
| Motorist infrastructure | Graven - One way away from Mejlgade (west). Mejlgade - one way street but parts at Sankt Olufs gade |
| Buildings | There is a blind corner coming from Mejlgade turning onto Graven (tight corner). Very narrow, difficult for cars to turn, when they turn onto Graven the cars take up the whole street. Max 3 story buildings, mixed use. Mostly restaurants, housing on top. |

## *Mindebrogade/ Skolegade*

| **Mindebrogade/Skolegade** | Date: 3rd April |
|---|---|
| **How is the space being used?** | Mostly transit, people seem to walk with an intention. Few people residing, however, there are benches at Europaplads (might be different on a sunny summer day for example) |
| **Atmosphere** | This area has nice atmosphere on Åboulevarden with cafes and facing the water. This area feels very open with Europaplads. Skolegade is a narrow street but is not relaxing to walk without sidewalks. Europaplads is a nice area with seating but feels very stark and does not have much character. Europaphuset is out of place for the neighboring buildings. |

| **Built Environment** | |
|---|---|
| Bicycle Infrastructure | Skolegade - Shared space until just before intersection between mostly cars and bikes but also pedestrians that can not fit on the sidewalk. Mindebrogade - Can not bike Havnegade (main road). Shared space with cars and bicycles. Good quality |
| Pedestrian Infrastructure | Skolegade - narrow sidewalks, difficult with strollers. Mindebrogade - Good width and good path quality. Crosswalk to get to Europaplads from Åboulevarden |
| Motorist infrastructure | Skolegade - one way towards north direction. Mindebrogade - 2 way. Europaplads and Åboulevarden - allowed to drive from Mindebrogade. No traffic calming. |
| Buildings | Open. 3 story high. Europaplads is very open and big and high building. |

### *J.M. Mørks Gade/Frederiksgade/Østergade*

| J. M. Mørks Gade/Frederiksgade/Østergade | Time/Date: 3rd April | | |
|---|---|---|---|

| | |
|---|---|
| **How is the space being used?** | |
| | Mostly transit, different modes of transportation.<br>A bench outside Stof 2000 where people sit and relax. |
| **Atmosphere** | |
| | This area has a nice feeling on the walking street, lots of nice shops, wide area to walk. J. M. Mørks Gade/Østergade is mostly shopping, but lots of pedestrian activity. Nice variety of buildings, interesting to widow shop |

| | |
|---|---|
| **Built Environment** | |
| Bicycle Infrastructure | Østergade - Segregated bicycle lane on the "Normal" side towards Christiansgade. Other side is shared space between cars and bicycles. Frederiksgade - Heading south is a bike street. Goood path quality |
| Pedestrian Infrastructure | Wide sidewalks, good path quality. Heading north on Frederiksgade is pedestrians only. Cross walk on Østergade (by Normal) |
| Motorist infrastructure | Østergade - one way towards Selling. Frederiksgade - one way towards Aros. Only delivery between 6 - 7:30am and 10 - 11:30am. Traffic calming, raised intersection |
| Buildings | Commercial, shopping. 4 to 5 story buildings. |

# Morning observations

### *Grønnegade/Klostergade*

**Observation Guide**
**Grønnegade/Klostergade**

Date: May 22nd Weather: Sunny
Time: 7:30 - 8:30

| **Flow** | |
|---|---|
| Obstructions | No obstructions observed. |
| Confusion | Many cyclists show hand-signals, minimizing confusion. |

| **Behavior** | |
|---|---|
| Speed | Cars went fast on Grønnegade, even though it is a cycle street |
| Residing | No residing. |
| Cycle street | Every car observed overtook cyclists. Did not see any signs for cycle street, except the bicycles painted on the ground. |
| Other | Collision between van and cyclist on Grønnegade, north of Klostergade. Bike was cycling in the wrong direction towards Nørre Allé and a van turned to a courtyard without looking that way. New bicycle parking outside Aldi. |

## *Mejlgade/Graven*

**Observation Guide**
**Mejlgade/Graven**

Date: 22nd of May Weather: Sunny
Time: 7:30 - 8:30

| **Flow** | |
|---|---|
| Obstructions | There was a car parked on Mejlgade for the whole observation causing disturbance for cars and cyclists. Especially cars because they had to wait and block traffic until they could maneuver around the car. |
| Confusion | There was not much confusion witnessed. Most cyclists used hand signals when turning. When cars were turning in the narrow streets that made it difficult for bikes to keep riding and they had to get out of the way |

| **Behavior** | |
|---|---|
| Blind corner | It is difficult for cars to turn in these streets and they have to wait a while for the area to be clear to turn. This area is not nice for cars and when they turn, it is not nice for bicycles |
| Pedestrian movement | There are not many pedestrians here in the morning. Shops are not open so that could be a reason. The pedestrians that were there were on the side walk, except for Graven |
| Cycle street | This area is a cycle street and most cars respect it, some moved around a cyclists. One van honked to a cyclists. Graven did not have cycle symbol on the ground, but Mejlgade had new cycle symbols on the ground |

## *Mindebrogade/ Skolegade*

**Observation Guide**
**Mindebrogade/Skolegade**

Date: 19th of April Weather: Sunny
Time: 7:30 - 8:30

| **Flow** | |
|---|---|
| Obstructions | In the morning, there were street cleaners and trucks. Most of the truck went into Åboulevarden (narrow street and had to slow down) and Europaplads. Some car congestion on Mindebrogade for cars going onto Havnegade. |
| Confusion | There was a lot of confusion between cars and cyclists at the intersection between Mindebrogade and Skolegade. Cars slowed down and were hesitant, going either straight or onto Europaplads or Åboulevarden. Cyclists turned right onto Minderbrogade or onto Europaplads. Many different directions to go and little communication between modes, however modes are going slow so there were no collisions. |

| **Behavior** | |
|---|---|
| Cross walk | Cars sometimes stop for pedestrians at crosswalk, bicycles hardly never stopped. Most pedestrians waited for no cars or bikes and then crossed. Bicycles also used the crosswalk for a connection |
| Left turn onto Skolegade | When turning left onto Skolegade, bicycles just turns left with hand signal and did not stop. However, around 8, more cars came from Havnegade, so cyclists waited and then turned left when clear. |
| Residing | No one is residing in the morning, all modes were moving with intention. |
| Other | Most cyclists waited at the yielding triangles to turn. There is a busy connection with cyclists going to and from Europaplads and Skolegade. As the morning went on, there was some car congestion on Mindebrogade going onto Havnegade. Mostly vans and trucks, compared to personal vehicles. Most cars go along Mindebrogade and not drive in Skolegade. Cars stopped for bicycles waiting at the yielding triangles to go to Europaplads. Towards 8:30, there were more personal vehicles, still many vans/trucks. There were very few pedestrians, mostly walk to/from Europaplads. |

### *J.M. Mørks Gade/Frederiksgade/Østergade*

**Observation Guide**
**J. M. Mørks Gade//Frederiksgade/Østergade**

| | |
|---|---|
| Date:19th of April | Weather: Sunny |
| Time: 7:30 - 8:30 | |

| **Flow** | |
|---|---|
| Obstructions | Construction site, on the right side towards Christiansgade. Takes all of the bike lane. |
| Confusion | Crosswalk: some bikes stop, some doesn't. Pedestrians doesn't know if to walk or not. Almost no one are using hand signals to show that they are turning. However, the tempo is slow so no potential accidents were observed. |

| **Behavior** | |
|---|---|
| Cycle Street | Too few cars on the bike street to see any pattern. Pedestrians walked on the sidewalks. |
| Traffic calming | Most cars drive slow in the intersection, but they take the whole street. Usually no issue, only now with the constructions. Most bikes drive slow too, its uphill to the intersection for bikes coming from both Salling and Christiansgade. |
| Modal interaction | When there are red lights towards Salling everything stops at the intersection. There's a line with cars that covers the intersection, making it difficult for bikes from the bike street to turn or cross. The stores and restaurants are closed at the walking street so not many people there. |
| Other | Several bikes from bike street to walking street, and vice versa. Many cars on Østergade, more cars than bikes. Bikes mostly come from the bike street, and turn both left and right (a little bit more right). The closer to 8 the more people were out. The tempo goes in cycles, depending on the traffic lights. |

## Mid-morning observations

### *Grønnegade/Klostergade*

**Observation Guide**
**Grønnegade/Klostergade**

| | |
|---|---|
| Date: 22nd of May | Weather: Sunny |
| Time: 10:30 - 11:30 | |

| **Flow** | |
|---|---|
| Obstructions | There were no obstructions. Some parked cars along Klostergade but did not seem to hinder the flow of traffic because there were less cyclists and pedestrians |
| Confusion | There was not much confusion. Some cyclists coming from Nørre Alle and turning left onto Klostergade met other cyclists on Klostergade also turning left, but was always a smooth interaction. |

| **Behavior** | |
|---|---|
| Bicycle lanes | Cyclists road on bicycle lane |
| Speed | Cyclists are a more relaxed pace than the busy time |
| Residing | everyone still had a destination and were not residing in the area |
| Other | |

## *Mejlgade/Graven*

**Observation Guide**
**Mejlgade/Graven**

Date: 22nd of May Weather: Sunny
Time: 10:30 - 11:30

| **Flow** | |
|---|---|
| Obstructions | There were signs on the sidewalk, which made it harder to walk. Less cyclists, pedestrians walked in street |
| Confusion | There is less people, so less interaction and confusion between people |

| **Behavior** | |
|---|---|
| Blind corner | When a car turns onto Graven, it is an issue taking up the whole space. |
| Pedestrian movement | Walked on the street or sidewalk if possible. Pedestrians walked slower and looked at the shops |
| Cycle street | Less cars, so cyclists were not affected by the cars. But cars respected the cycle street and went behind the bicycle |
| Other | |

## *Mindebrogade/ Skolegade*

**Observation Guide**
**Mindebrogade/Skolegade**

Date: 19th of April Weather: Sunny
Time: 10:30 - 11:30

| **Flow** |
|---|
| The flow of traffic was smooth. There was much less cyclists, cars, and pedestrians compared to the peak hour |

| **Behavior** | |
|---|---|
| Cross walk | Pedestrians used the cross walk and there was less traffic, so they could cross easy. Cars sometimes stopped for pedestrians. Bikes rarely did, unless there was a car also stopping. |
| Left turn onto Skolegade | Cycling turned smoothly onto Skolegade without stopping and waiting . |
| Residing | No one resided on Europaplads, people were still moving with purpose |
| Other | |

### *J.M. Mørks Gade/Frederiksgade/Østergade*

| **Observation Guide**<br>**J. M. Mørks Gade/Frederiksgade/Østergade** | Date: April 19th Weather: Sunny<br>Time: 10:30 - 11:30 |
|---|---|

| **Flow** | |
|---|---|
| | There is still construction on Ostergade, but there is less traffic so it is easier for cyclist to by pass the construction. There is less cars, cyclists, and pedestrians in general |

| **Behavior** | |
|---|---|
| Cycle Street | Only cyclists were observed using this space, no cars were there during our observations |
| Traffic calming | Cars slowed down for the speed hump. Cars stopped for pedestrians at cross walk. |
| Modal interaction | There is not much modal interaction. Cars slowed down for pedestrians, cyclists almost never stopped for pedestrians but slowed down and went around people |
| Other | Some cyclists rode on walking street, but it was not busy with pedestrians |

# Afternoon observations

### *Grønnegade/Klostergade*

| **Observation Guide**<br>**Grønnegade/Klostergade** | Date: 19th of April Weather: Sunny<br>Time: 15:30 - 16:30 |
|---|---|

| **Flow** | |
|---|---|
| Obstructions | There were no obstructions. Some parked cars along Klostergade but did not seem to hinder the flow of traffic. |
| Confusion | There was not much confusion. Some cyclists coming from Nørre Alle and turning left onto Klostergade met other cyclists on Klostergade also turning left, but was always a smooth interaction. |

| **Behavior** | |
|---|---|
| Bicycle lanes | Cyclists obeyed the cycling path on Grønnegade near Aldi, and cyclists were coming from down hill. |
| Speed | Cars driving along Grønnegade from Vestergade went slow when there were cyclists. However, when there were no cyclists, cars drove fast, both on Grønnegade and Klostergade. Cars went faster on Grønnegade coming from Nørre Alle, where there is a separtated bicycle lane. Bicycles were fast on Grønnegade coming from Nørre Alle. They were on a protected bicycle lane and coming form a down hill. Pedestrians - difficult to cross Grønnegade and from Aldi |
| Residing | There was no residing, all modes were moving and seemed to be going somewhere |
| Other | Bicycles were good at yielding at triangles on Klostergade, but many do not signal here. Cyclists were good at using hand signals coming from Grønnegade, turning left on Klostergade. The main mode was mostly bicycles, then cars and pedestrians were even. Klostergade is a popular road, with many cyclists going either left or right. |

## *Mejlgade/Graven*

**Observation Guide**
**Mejlgade/Graven**

| | |
|---|---|
| Date: 19th of April | Weather: Sunny |
| Time: 15:30 - 16:30 | |

| **Flow** | |
|---|---|
| Obstructions | There are many obstructions here; benches, signs and parked bikes. The benches, signs and parked bikes makes it difficult for pedestrians, if they for example have a stroller with them they need to walk on the street on many places. There are also parked trucks/cars on Mejlgade, blocking the bike street. Which decreased the space even more. |
| Confusion | Chaotic with trucks/cars and MANY bikes and pedestrians everywhere. At one point three cyclists decided to stop and talk by the yielding triangles, at the same time a car wants to turn. This made the whole intersection standing still because people didn't know how to behave. |

| **Behavior** | |
|---|---|
| Blind corner | Cars can't turn without crossing the yielding triangles on the opposite side of the bike lane. No issues turning for bikes coming from Risskov direction. Bikes coming from Europaplads direction have bigger issues, people tend to stop when there's a lot of people but when no one is there they just turn. |
| Pedestrian movement | On Graven people walk on sidewalks, but since they are very narrow people end up walking on the bike lane because they can't fit, at some places the sidewalks are non existent due to being too narrow and obstructions. Same thing for Mejlgade, however, there are wider sidewalks here. Pedestrians cross both streets everywhere. |
| Cycle street | Big delivery trucks was parked on the right side of Mejlgade, direction Risskov, blocking the bike lane. Otherwise, not that many cars driving on Mejlgade. |
| Other | Not that many uses hand signals when turning, however, the ones stopping usually put up their hand. Most cyclists come from Risskov direction, on Mejlgade. They're both turning onto Graven and going straight. The tempo is pretty high, with bicycles cycling fast, when some people turn they are just lucky that no one is in their way. |

## *Mindebrogade/ Skolegade*

**Observation Guide**
**Skolegade/Mindebrogade**

| | |
|---|---|
| Date: 3rd of April | Weather: Sunny |
| Time: 15:30 - 16:30 | |

| **Flow** | |
|---|---|
| Obstructions | There was a parked car at 15:30 till the end of the observation. Skolegade is narrow, so all cars become an obstruction for cyclists and disturbs the bicycle flow. |
| Confusion | Some bicycles were confused on how to get from Mindebrogade to Skolegade. It is a confusing intersection for all modes, no one seems to be priority. |

| **Behavior** | |
|---|---|
| Cross walk | Cars often do not stop for pedestrians at the cross walk. Bicycles also do not stop at the cross walk. Pedestrians have to wait for cars and bike to be clear |
| Left turn onto Skolegade | The confusion turning left onto Skolegade caused many different bicycle movements. Some cyclists just turned left with/out signaling. Many stopped at the corner and turned left when traffic was clear. |
| Residing | No one was residing in this area. Some people were sitting at the cafes on Åboulevarden. |
| Other | Cars were often driving faster than the bicycles on Mindebrogade. There was a lot of cyclists going back and forth from Europaplats and Skolegade. Pedestrians were walking everywhere. Cars and bicycles are coming fast from everywhere. |

## *J.M. Mørks Gade/Frederiksgade/Østergade*

**Observation Guide**
**J. M. Mørks Gade/Frederiksgade/Østergade**

| | |
|---|---|
| Date: 22nd of May | Weather: Sunny |
| Time: 15:30 - 16:30 | |

| **Flow** | |
|---|---|
| Obstructions | Apart from the construction site on J.M. Mørks Gade, no major obstructions were observed. |
| Confusion | Little confusion observed. Only sometimes when cyclists stop without showing hand signals. |

| **Behavior** | |
|---|---|
| Cycle Street | Since the streets already are so narrow it is already difficult for the different modes to overtake each other. |
| Traffic calming | The speed table works well, forcing cars to slow down. The tempo is quite low.<br>The red lights on Østergade also help slow the tempo down. |
| Modal interaction | Even though there at times are many bicycles the area is well functioning. People respect the crosswalk more than Mindebrogade. |
| Other | |