

The effects of COVID-19 on bicycle mobility in Groningen

A research to the (structural) effects from the physical distancing measures as a result of the COVID-19 pandemic on the bicycle mobility in the city of Groningen



Master thesis

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Abstract

To reduce climate change and to keep cities liveable in the future, it is clear a shift towards a more sustainable and future proof mobility system in cities is necessary. However, the current car-dominated mobility system seems unbreakable. However, the COVID-19 pandemic has had a massive impact on our lives and our cities. Mobility within cities radically changed within weeks as a result of homeworking. Globally, cities have implemented temporary measures to stimulate cycling and walking, for example by converting car lanes into bicycle lanes. In this way the COVID-19 pandemic could potentially be a window of opportunity for a transition towards more sustainable mobility such as cycling.

This research is an empirical single case study focused on the city of Groningen. The city has been slowly banning cars from the inner city already since the 1970's. The city recently published its new mobility vision, in which they state their ambition to create even more space for sustainable mobility such as walking and cycling. This desire for more sustainable mobility in Groningen could be accelerated by the COVID-19 pandemic, as unexpected events can lead to a game changer resulting in a transition according to transition theory. The purpose of this research is to learn how the physical distancing measures as a result of the COVID-19 pandemic structurally have affected the urban bicycle mobility system and the related bicycle policies in the city of Groningen. The central question of this research is thus: *"How could COVID-19 have a structural effect on the urban bicycle mobility of Groningen?"*. This question has been answered by means of a mixed methods research in which data required from qualitative interviews is supported by quantitative data required from a dataset. It can be concluded that although the COVID-19 pandemic in Groningen was indeed a window of opportunity for stimulating cycling, as immediate (bicycle) mobility was affected severely by the pandemic, in the end not a lot of (policy) action have been made to seize this window of opportunity to effectively stimulate cycling on long-term.

Keywords: COVID-19, transition theory, mobility transition, window of opportunity, bicycle policy, bicycle mobility

Table of contents

List of figures and tables	7
Chapter 1: Introduction	8
1.1 Motivation and relevance	8
1.2 Problem statement.....	9
1.2.1 Research objective	9
1.2.2 Research questions.....	10
1.3 Reading guide	10
Chapter 2: Theoretical Framework	11
2.1 The mobility system	11
2.1.1 The current mobility system.....	11
2.1.2 A mobility transition.....	11
2.2 Transition theory	12
2.2.1 An introduction to transition theory	12
2.2.2 Multiphase.....	12
2.2.3 Multilevel model	13
2.2.4 Managing transitions.....	15
2.3 Transition theory in the context of the COVID-19 pandemic.....	15
2.3.1 COVID-19 as game changer for a mobility transition	15
2.3.2 Necessity of governmental policy actions for a successful mobility transition	17
2.4 COVID-19 and the urban environment.....	18
2.4.1 Urban areas and pandemics.....	18
2.4.2 Urban design and viruses	18
2.5 Conceptual model	19
Chapter 3 – Methodology	21
3.1 Case study as research methodology.....	21
3.2 The case of Groningen.....	21
3.3 Data collection.....	22
3.3.1 Semi-structured in-depth interviews	22
3.3.2 Secondary dataset	24
3.4 Data analysis.....	24
3.5 Ethical considerations	25
Chapter 4 – Results	26
4.1 Role of the interviewed respondents.....	26
4.2 Factors influencing changes in the mobility system in Groningen during COVID-19.....	27

4.2.1 Homeworking	27
4.2.2 Flexible working.....	27
4.2.3 Safety feeling.....	28
4.3 Immediate consequences for bicycle travel behaviour	28
4.3.1 Consequences for bicycle travel behaviour based on data.....	28
4.3.2 Consequences for bicycle travel behaviour based on respondents.....	35
4.3.3 The role of recreational cycling	36
4.3.4 Consequences for bicycle sharing devices	37
4.4 COVID-19 as a window of opportunity for bicycle mobility in Groningen as viewed by the respondents.....	37
4.4.1 COVID-19 as a chance for a shift in mobility policy.....	37
4.4.2 COVID-19 as trigger for behavioural change	38
4.5 Governmental bicycle policy responses on COVID-19 in Groningen	41
4.5.1 Bicycle stimulation projects.....	41
4.5.2 Bicycle parking policies.....	43
4.5.3 Closure of the inner city for bicycles	43
4.5.4 The expected long-term effects COVID-19 will have on cycling policies	45
4.6 Immediate consequences for urban spatial environment regarding cycling.....	45
4.7 Summary of the results	48
Chapter 5: Conclusion.....	49
5.1 Factors influencing mobility system.....	49
5.2 Immediate consequences for bicycle travel behaviour	49
5.3 COVID-19 as a window of opportunity for bicycle mobility in Groningen	50
5.4 Governmental bicycle policy responses on COVID-19 in Groningen	51
5.5 Consequences for urban cycling environment.....	52
5.6 Overall conclusions.....	53
5.7 Reflection.....	53
5.8 Recommendations for future research	54
Chapter 6: References	55
Appendix 1: General contact letter	59
Appendix 2: Interview guide experts	60
Appendix 3: Interview guide bicycle users.....	64
Appendix 4: Transcript interview respondent 1.....	66
Appendix 5: Transcript interview respondent 2 & respondent 3.....	66
Appendix 6: Transcript interview respondent 4	66
Appendix 7: Transcript interview respondent 5.....	66

Appendix 8: Transcript interview respondent 6 66

Appendix 9: Transcript interview respondent 7..... 66

Appendix 10: Transcript interview respondent 8 66

Appendix 11: Transcript interview respondent 9 66

Appendix 12: Transcript interview respondent 10 & respondent 11..... 66

Appendix 13: Transcript interview respondent 12 66

Appendix 14: Transcript interview respondent 13 66

List of figures and tables

Figures	Title	Page number
1	Multiphase model	13
2	The dynamics of innovation on transitions	13
3	Multi-level model	14
4	Conceptual model	20
5	The worked weekly hours in total	27
6	Location of counting site 1	29
7	The cumulative bicycle counts at location 1 in 2019 versus 2020	30
8	Location of counting site 2	31
9	The cumulative bicycle counts at location 2 in 2019 versus 2020	32
10	Location of counting site 3	33
11	The cumulative bicycle counts at location 3 in 2018 versus 2020	34
12	Closure of the inner city for cyclists	44

Tables	Title	Page number
1	Scheme with all interviewed respondents	23
2	Coding scheme	25
3	The bicycle counts on location 1, at 13-11-2019	29
4	The bicycle counts on location 1, at 27-10-2020 (during pandemic)	29
5	The bicycle counts on location 2, at 07-10-2019	31
6	The bicycle counts on location 2, at 10-09-2020 (during pandemic)	31
7	The bicycle counts on location 3, at 11-10-2018	33
8	The bicycle counts on location 3, at 06-10-2020 (during pandemic)	33

Chapter 1: Introduction

1.1 Motivation and relevance

As a result of the outbreak of COVID-19, physical distancing has become the new standard. In the Netherlands a 1,5 meter society appeared in which physical distancing became the new norm. Cities have adapted to these new norms. Shopping streets have been rearranged and also regarding mobility, massive changes have taken place as a consequence of homeworking. This was important as cities are often COVID-19 epicentres during the COVID-19 pandemic (World Health Organization, 2020).

COVID-19 had a lot of immediate impact on urban mobility. As a result of the pandemic, urban mobility suddenly changed within weeks. Worldwide, homeworking has become one of the main policy instruments for governments to decrease the spread of the virus (Reuschke & Felstead, 2020). Especially the shift towards homeworking has had a massive impact on urban mobility and therefore on the spatial environment of the cities itself. Instead of commuting to work, large portions of people now work from their homes. Online working, online business meetings and webinars became the new normal. As a result of this, during the lockdowns, far less commuters were on the road, which had temporarily solved congestion and lowered CO₂ emissions (Reuschke & Felstead, 2020). Homeworking thus had a major impact on urban mobility. It seems that after the pandemic homeworking will still play a significant role, as companies have become used to it. Also, around 85% of the people in the Netherlands want to keep some extend of homeworking, even after the pandemic (Trouw, 2021; KiM, 2020). This thus is an opportunity to permanently reduce commuting travels, as a permanent shift in mobility may occur. In this way less commuters will be on the road, which could permanently solve congestion and could lower emissions. Also, mobility and the destinations of people can change, as more people are able to move to the edges of cities as a result of homeworking (Trouw, 2021). A (temporary) decrease in commuting during the lockdown can shape an opportunity to reshape and redesign public spaces in a way that it stimulates walking and cycling. This (temporary) decrease in commuting could have a long-term effect in people's choice of mobility (KiM, 2020). The current crisis may be an opportunity to stimulate healthy and environmental friendly choices of mobility, but this is mainly dependent on government responses (Lamker, et al., 2020; Acuto, 2020).

As a result of the low mobility during the lockdown periods, a lot of temporary measures with an impact on mobility have been made possible. Immediately after the outbreak of the virus, worldwide a lot of cities have integrated measures for controlling the pandemic with other goals. For example in achieving a mobility transition by promoting cycling and walking instead of using the car. A lot of measures trying to achieve this have been implemented already, of which some had an immediate impact, while other measures were more aimed at an long-term effect. Worldwide, cities are being reshaped and pedestrians and cyclists are being prioritised over cars. This trend has accelerated as a result of the pandemic. Ambitions in achieving a more sustainable and less car dependent city existed already before the pandemic, however the COVID-19 pandemic gave these cities the chance to accelerate and realise their ambitions (The Guardian, 2020).

When the first lockdown started in the spring of 2020, the city of Paris immediately made use of the situation. In a high pace, 50 kilometres of car roads were converted to cycling lanes (NOS, 2020). At first these added cycling lanes were meant to be temporary, to stimulate cycling and walking to relieve the public transport system during the lockdown. Due to the success of the added cycling paths, the city council decided to make these cycling roads permanent, as the bicycle had proved itself as logical alternative for commuting. Already since 2015, Paris aimed to increase its cycling network. However, the pandemic turned out to be the opportunity for Paris to really start give priority to cyclists by

converting car roads into bicycle lanes (Trouw, 2020). Also in Brussels, new bicycle lanes have been implemented to prevent the use of overcrowded public transport and cars and at the same time prevent congestion. Since the beginning of the pandemic, already 40 kilometres of new bicycle infrastructure has been implemented (HLN, 2020). Other measures have been implemented in Brussels as well. In the whole inner city priority is given to cyclists immediately at the start of the pandemic. Because of the lack of traffic in the lockdown days, it was the right time to implement these measures (NOS, 2020). Also in Berlin and Milan new bicycle infrastructure was added during the lockdown. In Berlin firstly temporary pop-up were created. Later these were converted to permanent bicycle paths (NOS, 2020). Also in London the city tried to stimulate sustainable modes of transport during the pandemic. The city offered health workers a three months long bike loan during the lockdown so that they were able to cycle to work while avoid public transport (The Verge, 2020).

1.2 Problem statement

1.2.1 Research objective

The aim of this study is to learn how the current physical distancing measures as a result of the COVID-19 measures structurally affects the urban bicycle mobility system in Groningen. The focus of this research is on the mobility and policy implications that the COVID-19 measures will have on longer term on sustainable modes of transport, in particular on cycling. In this research the opportunities and challenges of the current pandemic, and how it may lead to structural changes on the urban mobility system, will be explored. In this way an understanding of how the COVID-19 pandemic may contribute to a clean, liveable and healthy city can be formed. The aim of this research therefore is to contribute to the knowledge development of the effects of the lockdown measures on the mobility system, with a focus on cycling. This will be done by means of a qualitative research in combination with a quantitative dataset.

Since the beginning of the COVID-19 pandemic, a lot of research has been done about the medical side of COVID-19. A lot less, but still a substantial quantity of research has been done on the consequences of the COVID-19 pandemic on the urban environment of cities and the affected mobility of cities (Kuebler, 2020). However, not a lot research has been done on the structural consequences to bicycle mobility and a potential transition towards more bicycle mobility as a result of the pandemic. Especially in the Dutch context this is still underexposed. This is the knowledge gap which this research tries to solve. More research and knowledge about this can be a valuable contribution to science and may also contribute to a successful transition towards more sustainable mobility such as cycling. The results of this research can also be useful for other cities in the Netherlands and other cities outside of the Netherlands. Insights will be gained on how planners and policymakers can steer towards the most desirable outcome by making use of the opportunities the COVID-19 pandemic gives.

1.2.2 Research questions

The main research question of this research is:

“How could COVID-19 have a structural effect on the urban bicycle mobility of Groningen?”

To be able to answer this research question, the following secondary research questions are formulated:

- *What factors influenced the changes in the mobility system in Groningen during the COVID-19 pandemic?*
- *What are the immediate consequences for bicycle mobility in Groningen as a result of the COVID-19 pandemic?*
- *How did a change in (bicycle) mobility as a result of the COVID-19 pandemic have an effect on the bicycle policies of Groningen?*
- *How did a change in (bicycle) mobility as a result of the COVID-19 pandemic have an effect on the urban environment of Groningen?*
- *What are the expected long-term consequences for bicycle policies in Groningen as a result of the COVID-19 pandemic?*

1.3 Reading guide

This master thesis consists of five chapters. It has the following structure: Chapter 1 gives an introduction of the research background and describes the societal relevance, the research objectives and the research questions. Chapter 2 describes the relevant theories and concepts related to (mobility) transitions and pandemics. Also a conceptual model can be found in this chapter. Chapter 3 describes the research methodology that was used for this research. In chapter 4 the empirical results of this research will be discussed. In chapter 5 these results are reflected upon and a conclusion from the results will be drawn. Also recommendations for further research will be discussed here.

Chapter 2: Theoretical Framework

2.1 The mobility system

2.1.1 The current mobility system

According to Urry (2004), the current mobility system is still very much based on the use of the car. He states that the introduction of the car has massively changed our society and cities. Cities and society have been formed around the car. Social life became much more locked in the new car dependent mobility system. The introduction of the car has resulted in a much higher mobility and flexibility for people (Freund, 1996). Historically, housing, work and recreation always were geographically connected to each other. The car changed this, due to the higher mobility of people, it was not necessary anymore to live close to work or social network. The car thus divided home, workplace and recreational space, resulting in more commuting and more traffic (SceneSusTech, 1998). New urban landscapes were built completely around the car, while discouraging the use of other modes of transport. In this way the emerge of the car has resulted in a path dependent situation, as it is hard to change the mobility system when a certain path already has been chosen. Urry (2004) describes the current car mobility system, which is the dominant system in most cities in the western world, as unbreakable.

2.1.2 A mobility transition

This “unbreakable” car based mobility system has a lot of negative effects. In more recent years this system is questioned more severely. Besides the COVID-19 pandemic, there is a much larger long-term crisis: climate change. According to the Paris Agreement all countries should take effort to reduce climate change to a minimum. The global temperature should not increase to 1.5°C above pre-industrial levels to reduce the risks and impacts of climate change (United Nations, 2015). Mobility is a very important factor in reaching the goals of the Paris Agreement. In the European Union the transport and mobility sector accounts for 33% of the energy consumption and 20,2% of the greenhouse gas emissions (Berger, 2014).

The system of automobility as described by Urry (2004) stimulates the use of the car, as the whole society is formed around it. This negatively influences the rates of healthy modes of transport such as walking and cycling. Besides the negative environmental effects and the known negative health effect of the car dependent mobility system, also the urban environment itself faces negative aspects. The lack of cycling and walking will lead to eroding town centres, as most shops and facilities will be located at for cars accessible locations on the edges of cities. In addition to this, cars take much more space than bicycles. Especially in inner cities this leads to problems. A car based mobility system means a high amount of cars on urban streets, resulting in congestion, air pollution and thus an unattractive and unhealthy city (Maibach, et al., 2009).

Concluding, it is clear a transition towards a more sustainable and future proof mobility system is necessary to reduce climate change and to keep cities liveable in the future. However, Urry (2004) states that the current system of automobility seems to be unbreakable, as urban landscape has been formed around the car and in this way a lock-in situation has emerged. It is thus hard to make a full mobility transition happen in reality. Another reason why a mobility transition is hard to achieve is the fact that people are creatures of habit. People do not always base their choice of transport mode on pure rationality. After people make their decision for a mode of transportation a few times, the chosen mode of transportation becomes a habit. People will in that case no longer choose their mode of transportation rationally and will not change their mode of transportation regularly (Gärling, 1998). It is very difficult to break through people’s usual pattern of choice when it comes to the choice of mode

of transportation. However, during so called life change events, the chances of breaking through existing transportation habits are higher. Life changing events are events that changes someone's life, such as the birth of a child or a starting with a new job. In these situations people are thus more willing to reconsider their travel habits (Chatterjee et al., 2013; Schäfer et al., 2012). Also the shock event of the COVID-19 pandemic can be a life changing event and offers an unique chance to achieve major changes in the mobility system and therefore increase cycling. This will be further elaborated on in section 2.3.

2.2 Transition theory

2.2.1 An introduction to transition theory

An important theory that can be linked with this research is transition theory. Transition theory is in essence about the conceptualisation of processes of continuity and change. "A transition is a gradual and continuous process of change where the structural character of a society (or complex sub-system of society) transforms" (Rotmans et al., 2001, p. 16). Transitions occur when structures in the society (Regimes) are put under pressure by changes in society (Loorbach, 2010). Transition theory is often used for sustainable development and is based complex processes of structural change in society on the longer term.

Transition theory consists of two perspectives: The complexity perspective and the policy perspective. The policy perspective sees transition as a fundamental policy change. The complexity perspective goes further, as complexity perspective sees a transition as a system innovation. This means that for a successful transition, a complete new way of thinking is necessary. The whole system and structure needs to change on societal level. Implemented strategies and decisions will lead to changes in societal structures. This will on its turn lead to a change in the structure of the formal policy processes. In this complexity perspective of a transition, there are a few important features of structural societal change such as uncertainties and nonlinear processes of change and innovation. Also specific patterns and dynamics can drive structural societal change (Loorbach, 2010; Van der Brugge, 2005). The complexity perspective assumes that social-ecological systems are changing as a result of processes of coevolution and self-organisation. This self-organisation is the process of transition without external coordination (Heylighen, 2008). The concept of transition theory is about the fact that unpredictable shocks and disturbances cannot be prevented (Duit & Galaz, 2008). It thus is not possible to avoid this uncertainty completely, uncertainty will always be part of the planning process. Also the current COVID-19 pandemic is obviously such an unpredictable shock. Instead of trying to prevent these shock events, which is very hard or even impossible, there is also the possibility of adapting to the new reality and use the disturbance of the system to create a new improved system. In this research, only the complexity perspective is relevant, as a mobility transition requires a whole new system. The society should change to make a transition to sustainable mobility possible.

2.2.2 Multiphase

Transitions are not uniform, every transition has a different scale, speed and involve a different range of development paths with different directions. As already discussed, governmental policies can influence a transition, but cannot completely control a transition. In a transition there are multiple phases. The first phase is the pre-development phase, in which there is still a pre-transition equilibrium. The second phase is the take-off phase, where the system starts to shift. The third phase is the breakthrough phase, in which visible structural changes take place. The fourth and last phase is the stabilisation phase in which a new equilibrium is formed (Rotmans et al., 2001). This multiphase model of a transition is also known as the S-curve model.

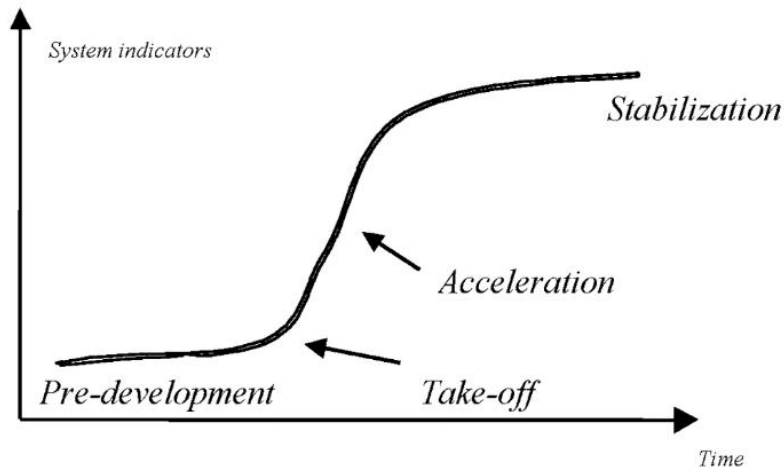


Figure 1: The multiphase model as described by Rotmans et al. (2001)

Another, more recent, model which elaborates on the different phases is the model of Westley et al. (2011). They conceptualise transitions in the model below. When the landscape pressures destabilizes the regimes, niche innovations can break through the dominant regime. The new regime combines the old regime with new successful niche innovations. Transitions can be triggered by disruptive innovations as well.

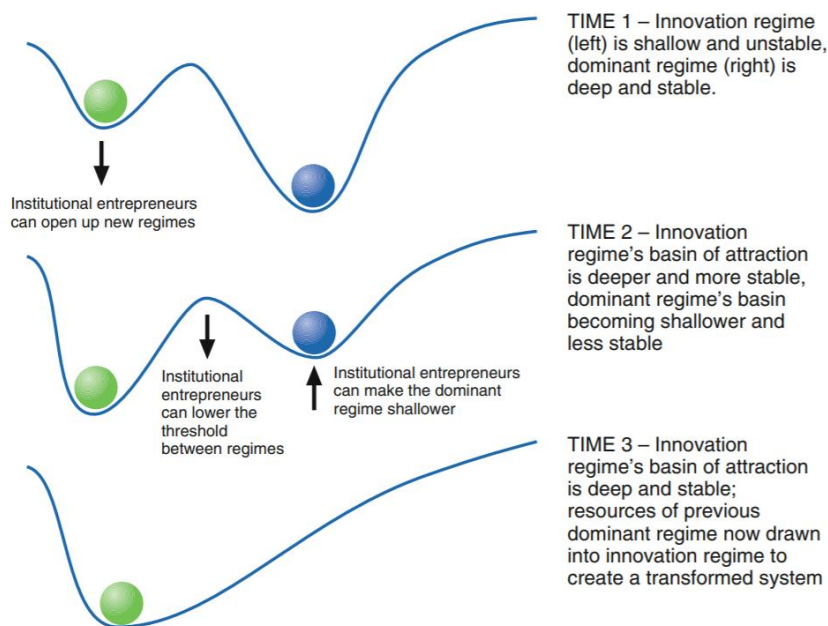


Figure 2: This model shows the dynamics of innovation on transitions (Westley et al., 2011)

2.2.3 Multilevel model

An important part of transition theory is the multilevel model. This model distinguishes multiple levels: innovation in niches, a dominant regime and an external landscape (Loorbach, 2010). In the concept of a transition three different levels can be distinguished. The first level is the micro level (or niche level), which is about individual actors. In this level, new techniques and social practises can start a

deviation from the equilibrium. Consequently, the niche level is very important. Actions and innovations on the niche level can fuel a transition. It can happen that these innovations slowly change the dominant design, that it supports a take-off in a transition at the meso and macro level as well. However on the other hand, a change in the microlevel, can be stimulated by external events and developments in meso and macro level as well. All different levels are interacting with each other.

The second level is the meso level (or regime level), which is about networks and organisations. In this level public policy and private action is being guided by dominant rules and beliefs.

The last level is the macro level (or socio-technical landscape), which is about the (inter)national level. It relates to social values and worldviews at macro level. For example economic cycles and broad social trends are included in this level. Landscape factors are the main reasons of pressure on the dominant regime. A shift in the landscape thus means the possibilities for innovation will also shift. Some innovation can scale-up (Westley, et al., 2011). The macro-level mostly responds to slow transitions and is able to speed it up or slow it down (Rotmans, et al., 2001).

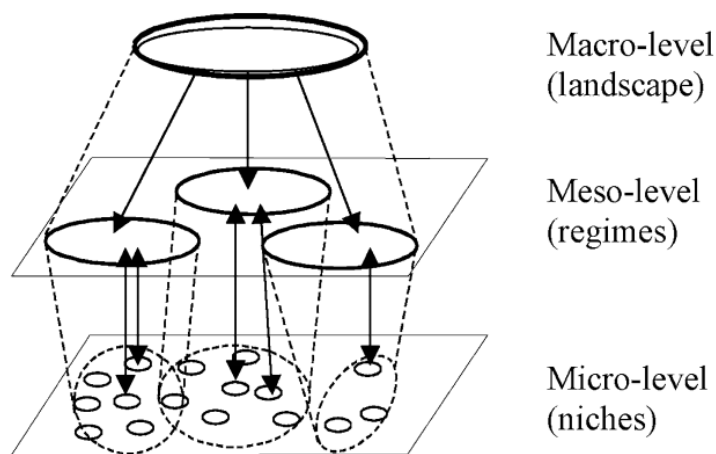


Figure 3: A visual representation of the multi-level model (Geels & Kemp, 2000)

In recent years more research has been done about transitions. In transition processes, often a single pathway was proposed. However, Geels and Schot (2007) developed a multiple transition pathways, in which they use the multi-level perspective. This multi-level perspective sees transitions as a result of developments within multiple levels. They state that timing of landscape pressure is important. When niche innovations are already developed, a transition will be different then when they are not already developed. Niche innovation is important to carry small developments, however it is not always possible for a niche-innovation to make a transition. A window of opportunity is necessary here, to really be able to put pressure on the regime. Also the nature of interaction between the three levels matters, according to Geels and Schot (2007). They distinguish four different transition pathways. The first transition pathway is called the transformation path. In this path there is only medium pressure on the landscape. Niche-innovation here have not been completely developed yet. This means the regime actor will reorientate its direction in development path. The second transition pathway is the de-alignment and re-alignment path. In this path a change in landscape is large and sudden. Regime problems will lead to erosion of the regime. It is possible here that multiple niche-innovations will take place at the same time when niche-innovations are not sufficiently developed. In the end, after a competition, one of these niche-innovation will form the new regime. The third path is called technological substitution. In this pathway there is a specific shock, while niche innovations have

already developed. Although niche-innovations have developed, the regime is still stuck in its old pattern until an external shock happens and thus a window of opportunity arises. The niche-innovations will then replace the existing regime. The fourth pathway is called reconfiguration pathway. In this pathway, innovations developed in niches are just for local problem solving. However, eventually further transition in the regime is being triggered.

The third pathway applies the most to this study. A niche-innovation in the context of this study is the technological innovation of digital (work)meetings and homeworking. This, as the rates of homeworking have major effects on (commuting) mobility (Lamker, et al., 2020). The technology of homeworking was already sufficiently developed, however, this homeworking never really broke through into the regime. A window of opportunity was necessary to start this transition. For this window of opportunity, landscape pressure (a specific shock) was necessary. COVID-19 can here be seen as this specific shock, which can be the window of opportunity for the introduction of digital homeworking. In this way an effect for (commuting) mobility is expected. This will be discussed in more detail in section 2.3.1.

2.2.4 Managing transitions

The management of transitions is called transition management. Transition management is aimed at making short-term innovation possible, while at the same time developing a long-term sustainability vision, which is aimed at achieving a preferred societal transition. Transition management is seen as an approach to guide and accelerate social innovation and change (Hendriks and Grin, 2007). The steering to societal change is a process of searching, learning and experimenting (Loorbach, 2010).

Governance is dependent on its surroundings. As a result of this, there has been a shift towards more interactive policy and network approaches in which, besides the government, other stakeholders are involved. According to Loorbach (2010), governance aimed at realising long-term sustainable and societal change needs to take into account some conditions to be successful. All societal actors are influencing and directing societal change, not only governmental actors. It is thus not possible to fully stimulate societal change by using top-down planning and market dynamics. To be able to really steer societal change, a reflexive process of learning and experimenting is necessary. Although it takes decades for a transition to complete, long-term thinking can shape short-term policy. To successfully manage a transition it is necessary to think in multiple scale levels and multiple actors. The management of transitions is about working towards a transition. It is important to create public support for new policies, a way to achieve this is with a bottom-up way, in which locals supports innovation (Rotmans, et al., 2001). National, regional and local governments should take a leading role in transitions. Mainly by encouraging and stimulating other actors to participate in a change. Especially for local governments it is easier to apply more radical experiments to trigger a transition. In this way they can manage and create opportunities in niches. Also timing of intervening is important. According to Loorbach (2001) in a crisis situation it is effective to take immediate intervention in managing transitions.

2.3 Transition theory in the context of the COVID-19 pandemic

2.3.1 COVID-19 as game changer for a mobility transition

Important concepts within transition theory are the concepts of path dependency, lock-ins and tipping points. Path-dependency is the situation when the current system is not flexible anymore as a result of the development of the system in the past. Once a certain path has been entered, it is difficult to change paths as a result of investments and dependency on the current approach. New technologies are always combinations of previous existing technologies (Westley et al., 2011; Restemeyer et al.,

2017). In this way path-dependency can create a lock-in situation in which a sub-optimal situation exists because it is hard to escape the current situation.

Also the current mobility system is stuck in a lock-in situation, as already discussed in section 2.1. For years now, we have relied on the use of cars as means of transport. Cities have adapted to this system of automobility and have become more car-reliant. Investments have been made in the current system and the society has adapted to the current system: formal and informal institutions have adapted to the systems. The system is thus not flexible and a transition to another approach is therefore not easy: a path dependent lock-in situation has emerged (Restemeyer et al., 2017). A transition towards more sustainable cities is thus necessary to prevent climate change. To achieve this, a mobility transition towards more sustainable modes of transport is necessary. This is hard to achieve as people have become too reliant on their cars and investments in road infrastructure have been made (Urry, 2004).

A transition thus does not occur out of nowhere. It is necessary that multiple developments in several domains should come together to make a transition possible. An impulse is necessary to start a transition. Usually transitions are slow and gradual changes, which usually takes up at least 25 years. However, a transition can be accelerated by unexpected events (Rotmans et al., 2001). A way to escape this situation is by a tipping point. A key feature of complexity approaches is that nothing is fixed forever (Abbott, 2001). There is always the possibility of an unexpected event to occur, resulting in a tipping point. Such a tipping point can mean that a change can happen dramatically in a single moment, as a result of an extreme event (Gladwell, 2000). A crisis creates a disruption at the institutional level. When this disruption occurs, already developed innovations can become dominant and can tip the system (Westley, 2011). Such an extreme event which can lead to a tipping point is called a game changer. A game changer is necessary to escape the lock-in situation and start and accelerate a transition. Game changers are specific events of short-term pressure that can change societal actors and can result in the emergence of new practises. Game changers can accelerate deep changes in the society, and thus play a major role in transitions.(Loorbach et al., 2016) The pause created by the COVID-19 pandemic is a big chance to develop a more sustainable system in our cities. The COVID-19 pandemic can be such a game changer for a transition towards more sustainable mobility. The current pandemic can thus be used to contribute towards a transition to more urban sustainability. (Pinheiro & Luís, 2020; Cohen, 2020).

A turning point should thus occur to make a mobility transition in Groningen happen. Also Kleinschroth and Kowarik (2020) argues that the current COVID-19 pandemic can be such a turning point for more sustainable urban planning in the future, for example by increasing urban greenspace. The article Kleinschroth and Kowarik (2020) is stating that the world can fundamentally change as a result of the pandemic, they argue that the development of more and improved urban greenspace and public space should be expanded. According to (Lai et al., 2020) spatial planning after the pandemic may be focused on new approaches aimed at mitigating the risk of viruses. The pandemic can be a reason for a call for increased attractiveness of inner cities.

However, most opportunities in combining COVID-19 measures with achieving a more sustainable city, lie in a mobility transition. The COVID-19 pandemic has an obvious impact on mobility, this also impacts sustainability and thus climate change. As discussed in section 2.1, breaking through people's mobility habits and their usual choice of mode of transportation is very difficult and almost only succeeds during life changing events (Chatterjee et al., 2013). According to Büchel et al., (2022), the shock effect created by the pandemic can be seen as a life changing event. The pandemic abruptly changed and disturbed the mobility system in cities. Homeworking or flexible working became the norm and lockdowns had a huge influence on people's everyday lives. Also the use of public transport became a risk for a COVID-19 infection. This all led to less commuting and less traffic overall. Congestion

drastically decreased during the lockdowns, which (temporarily) resulted in better liveable cities. The pandemic also caused people to reconsider their travel choices and their mode of transport. In this way travel habits were broken and a behavioural change in people's mobility thus (temporarily) occurred during the pandemic. In this way the pandemic offered a window of opportunity and can be a game changer for a mobility change and an escape from the current lock-in situation that has been created in the mobility system of cities over the years. The pandemic is a big chance for a transition towards a system with more sustainable mobility and can stimulate cycling on longer term (Büchel et al., 2022). Space which used to be used by car traffic became (temporary) available for people (Kuebler, 2020). The pandemic thus creates an opportunity for a different response to urban dilemmas we face in today's cities, for example a mobility transition (Pinheiro & Luís, 2020). Also according to Kanda & Kivimaa (2020), COVID-19 will have an long-term impact. The pandemic can be a trigger for permanent changes in mobility in cities. This as a result of digitalisation and homeworking, which is boosted since the pandemic started. The disruptive change caused by the pandemic can be the kick-start in a transformation towards more sustainable mobility.

A transition to more sustainable cities is usually a very gradual and long-term transition. However, the current pandemic shows us that transitions can actually also occur very fast. The decision making of governments in these crisis situations is much faster than usual. As the threats of climate change are massive, the pandemic offers a window of opportunity to increase a transition towards sustainable mobility. The pandemic can change patterns and can lead to permanent changes in urban mobility (Kanda & Kivimaa, 2020; Büchel et al., 2020). The pandemics long-term impacts can thus lead to permanent changes in urban mobility. It is important to question which effect of COVID-19 are desirable and are worth to retain after the pandemic.

2.3.2 Necessity of governmental policy actions for a successful mobility transition

As discussed in the previous section, the COVID-19 pandemic offers a window of opportunity for a mobility transition towards more sustainable mobility. Positive effects of the pandemic on the mobility system should be retained and strengthened. As already discussed in section 2.2.4, transitions can be managed and steered on short-term, to make a long-term transition possible. To make optimal use of the opportunities and potential of the pandemic for achieving a mobility transition, immediate action is thus necessary. During crisis situations, immediate action results in the most chance of a successful and effective transition (Loorbach, 2001). In the context of a mobility transition, immediate action should be taken to stimulate sustainable mobility such as cycling not only on short-term, but on longer term as well (Kanda & Kivimaa, 2020). Governmental organisations needs to implement new (bicycle friendly) policy measures to maintain the achieved changes to the mobility system and to people's behaviour, to get all the potential out of the current shock effect of the pandemic, to stimulate cycling. This, as behavioural changes as a result of shock effects, such as the COVID-19 pandemic, are often temporary if no policy changes are made (Bücher, 2022; Kanda and Kivimaa, 2020).

For a successful mobility transition, a suitable governmental policy reaction is thus necessary. As discussed, should national, regional and local governments take a leading role in transitions. However, also other stakeholders needs to be involved to achieve a successful transition. A bottom-up way, in which public support for new policies is created, is preferred (Rotmans, et al., 2001). In the case of COVID-19, the government can for example stimulate local employers to support homeworking on longer term to maintain the decrease in commuter mobility after the pandemic.

2.4 COVID-19 and the urban environment

Mobility is closely connected to the urban environment. A change in the system of mobility will therefore also create a change in the urban environment. However, a change in the urban environment will on their turn also have an effect on the mobility. Both elements can be influenced as a result of COVID-19. It is already clear COVID-19 will have an impact on the built environment and thus on mobility. This can be on long-term, but also on short-term, as is experienced during the pandemic. Examples of short-term impact on the built environment, are (temporary) bicycle paths and more pedestrian zones as a result of less car traffic on streets. These short-term measures could in the long-term also have a lasting effect on the built environment (Pinheiro & Luís, 2020).

2.4.1 Urban areas and pandemics

Previous infections and pandemics, such as the plague, have had a major influence on cities and city infrastructure throughout history. The plague outbreaks in the middle ages, which caused millions of deaths in European cities, resulted in new and different planning methods, as it became clear the narrow cramped cities increased the spreading of the virus. Cities became more organised and more attention was paid to public spaces. In this way the 'black death' resulted in major changes in city planning in the whole of Europe (Lilley, 2015). Also the cholera epidemics in the nineteenth century massively influenced city planning. It became clear, open green spaces in the middle of cities had a positive effect in preventing and curing diseases. During the nineteenth century large investments were made in the creation of parks in cities, an example of this is the Central Park in New York (Szczygiel & Hewitt, 2020). Also sewage systems were created as a result of (Cholera) pandemics. Another example of a city being influenced by this epidemic, is the transformation of Paris in the nineteenth century by the baron Haussmann. The whole densely built city centre was destroyed and replaced by a more open and spacious city structure. This was partly decided as a result of recurrent cholera outbreaks in the densely built up city centre of Paris (Jordan, 1995).

It is thus clear city planning does have an influence on the spread of a virus, the design of the urban environment has a massive influence on the spreading of diseases and viruses such as COVID-19. But it works the other way around as well. Virus outbreaks have greatly influenced city planning too, as can be seen throughout history. It is clear that the design of the urban environment has a massive influence on the spreading of diseases and viruses such as COVID-19 (Pinheiro & Luís, 2020). Pinheiro and Luís (2020) argues that a structural approach in changing the urban environment is necessary to be able to tackle the current pandemic and next potential pandemics and at the same time prepare cities for climate change. A holistic approach with structural changes in the environmental environment is necessary. Cities are not only the problem, they are part of the solution as well. We thus have to aim for structural solutions in which the current crisis and potential future virus outbreaks can be solved and prevented, while at the same time create a more sustainable environment.

2.4.2 Urban design and viruses

As already discussed, cities are the ideal place for a rapid spread of viruses as result of the high population density in cities. Urban design does not only influence the spread of viruses and diseases just as a result of cramped cityscapes. Urban design can also influence the behaviour and interactions of people and thereby increase the infection rate. For example, a large distance between living and working space increases the need for travelling and commuting by public transport, this can increase the risk of spreading a disease, as public transport is a high risk environment. It is thus clear urban design plays an important role in the spreading and counteract viruses. Also in the current COVID-19 pandemic urban design plays an important role. Changes in the urban environment can have a positive

effect on the spreading of COVID-19. Pinheiro & Luís (2020) distinguishes five different components of urban space as potential solutions to mitigate the spreading of COVID-19: street paths, public equipment, public transport, green areas and information technologies.

Regarding to street paths, reducing the width of the roads while increasing the space to pedestrian and bicycle paths will help preventing the spread of COVID-19, as pedestrians and cyclists can then better apply physical distancing. This measure does not only has beneficial effects in fighting the virus, but will also contribute to mobility shift towards a more pedestrian friendly city and thus to a more sustainable city. Possible measures regarding public equipment are mostly short-term measures such as distance markers on benches and disinfection systems, these measures can also be made in the public transport component. Also the implementation of more green areas within urban areas are mentioned as potential solutions for mitigating the spreading of COVID-19. Public health can be improved while at the same time mitigate the effects of climate change in urban areas. Especially these urban greenspaces are of vital importance for cities and its quality of life. It improves urban wellbeing as they make cities more sustainable. The current COVID-19 pandemic emphasises this. As mobility during lockdown days has been reduced, the pressure on proximate urban green spaces was large (Kleinschroth and Kowarik, 2020).

As a consequence of COVID-19, parks and other green areas in the urban environment were used more often and valued better. According to Kleinschroth and Kowarik (2020) the pandemic can even reshape the values of greenspaces and increase pressure on improving the urban greenspaces. Greenspaces have a positive influence in physical and mental aspect. Besides these physical measures, also information technology can have influence on tackling COVID-19. This means using smart city technology and integrating all kinds of data. This does not have an instant physical effect on cities, but can on long-term lead to physical changes.

2.5 Conceptual model

In the theoretical framework several relevant concepts and theories related to the research questions of this research have been discussed. This chapter has discussed the necessity of a mobility transition towards more sustainable mobility and has discussed the theories of transition, also in the context of the COVID-19 pandemic. Based on the theoretical framework, a conceptual model has been developed, as can be seen in figure 4. In this conceptual mode, the relations between the different concepts and the research questions are visualised.

The conceptual model shows that before the pandemic there was a general desire for more sustainable mobility. However, as discussed in the theoretical framework, due to a lock-in situation in the mobility system, as Urry (2004) discusses in his article, more sustainable mobility was difficult to realise. The conceptual model shows the COVID-19 pandemic as a gamechanger, which opens a new window of opportunity for stimulating bicycle mobility. It is visible that COVID-19 on short-term leads to factors influencing changes in the mobility system: homeworking, flexible working and the safety feeling of people. These factors influences the immediate consequences for bicycle travel behaviour. On the other side, the COVID-19 pandemic leads directly to governmental bicycle policy actions, which are also indirectly being influenced by the already existing desire for more sustainable mobility. The governmental bicycle policy actions also directly influences the immediate consequences for bicycle travel behaviour, which together with the governmental policy actions, influences the immediate consequences for the urban spatial cycling environment. Eventually, these three factors determine the structural effects for bicycle mobility.

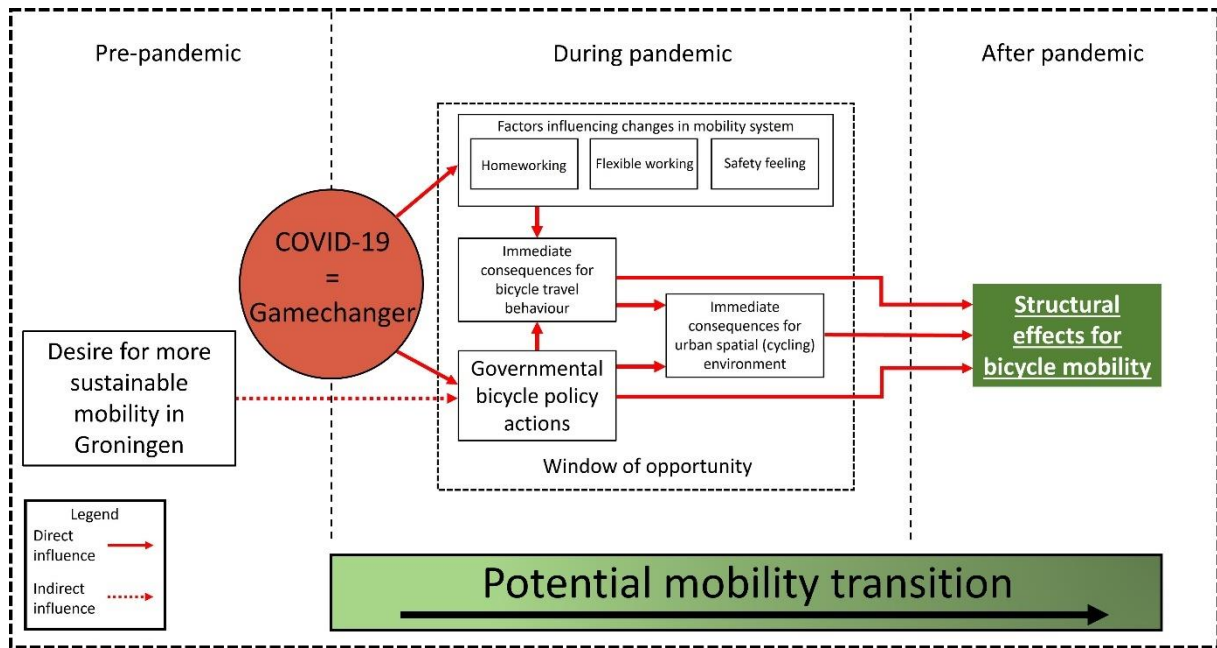


Figure 4: The conceptual model

Chapter 3 – Methodology

In this chapter the methodology of this research including data collection, data analysis and ethical considerations are discussed.

3.1 Case study as research methodology

This study aims to answer the research question of this research: *“How could COVID-19 have a structural effect on the urban bicycle mobility of Groningen?”*. To be able to answer this question, a combination of theoretical research and empirical research has been used. The theoretical research part consists of a literature review of relevant concepts and academic knowledge to gain understanding in the theoretical insights of this topic. This was done in chapter 2 of this research. The empirical research part in this study has been conducted by means of a single case study as research method. Case studies are the preferred research strategy when the research revolves around a “how” or “why” question, when the researcher has no control over the events and when the focus of the research is on a current phenomenon within some real-life context (Yin, 2003). These terms apply to the research questions in this research, so a case study is a suitable research method for this study.

The research method of case study is very flexible and often relies on data triangulation. Data triangulation is the combination of multiple sources of evidence. This means a single case study can contain both qualitative and quantitative research methods. This ‘mixed methods’ approach can give more comprehensive results as it uses the strengths and benefits of both qualitative and quantitative research methods (Crowe et al., 2011; Yin, 2003). Therefore, also in this research a mixed methods approach is used. A focus on qualitative research methods is chosen in this research, as the research problem and research questions are complex. However, also quantitative research methods, in the form of a secondary data set, are used in this research. Section 3.3 will elaborate further on the data collection methods.

3.2 The case of Groningen

This research is a single case study to the structural consequences of the COVID-19 pandemic to the bicycle mobility in the city of Groningen. As case, the city of Groningen is chosen. In this section, the case of the city of Groningen will be introduced. The current mobility system of the city and its ambitions to achieve more sustainable mobility will be explored here.

The use of cities and its mobility system is changing over time. This also applies to the city of Groningen. After the second world war, in the 1960s and the 1970s, the car became the most dominant form of mobility in the city of Groningen. The whole city was aimed at facilitating the car. Main traffic roads were built through the city centre. The Grote Markt, the core of the historic city, was turned into a major traffic intersection. After 1977, the city decided to decrease the role of the car in the city centre. However, still today the car has a slight role in the city centre. Now Groningen is mainly a cycling city, but still the car has a major role in the city, especially in the zones just outside the city centre, such as the Diepenring and Nieuwe Ebbingestraat (Gemeente Groningen, 2019). Now the city sees the time right for a mobility transition towards more sustainable mobility. The municipality of Groningen has the ambition to be a liveable, clean and healthy city. This means concretely the city of Groningen wants to become CO2 neutral in 2035 and at the same time remain and increase the attractive living environment of the city (Gemeente Groningen, 2018; Gemeente Groningen, 2021). Mobility is a very important aspect in achieving this ambition. In April 2021 the municipality of Groningen shared a new mobility vision, in which the vision of the municipality of Groningen on the mobility of the next decades

is elaborated on. The ambition is to create more space for sustainable modes of transport such as bicycles and pedestrians. In the future the municipality of Groningen aims at a transition towards a more space efficient, emission free and more healthy mobility system. In their mobility policy (Gemeente Groningen, 2019; Gemeente Groningen, 2021) they show their intention of making the streets in the whole city even more car-free and turn areas dominated by cars into liveable places. This to create a future-proof and sustainable city where people are central. In reality this means giving priority to pedestrians, public transport and cyclists instead of cars.

It is clear the municipality of Groningen has a lot of ambitions regarding a mobility shift towards more sustainable mobility by giving pedestrians and cyclists more space at the expense of space of cars. However, due to the growing population of the city and a growing mobility it takes a lot of effort to make this shift (Gemeente Groningen, 2021). In their mobility vision, the municipality of Groningen mentions the COVID-19 crisis as a potential opportunity to help make this shift. For years the traffic jams in the city have increased, buses have become fuller and even bicycle paths have become crowded. This despite all investments the municipality made in the improvement of this infrastructure. When the COVID-19 pandemic started in March 2020, suddenly all congestion and crowded public transport was gone as a result of homeworking. After the first lockdown, when the economy partly restarted, it turned out mobility remained lower than before the lockdown. According to the municipality, the COVID-19 pandemic has given the realisation that the current system of mobility is not feasible anymore on the long-term. In this way they state the current pandemic may have an structural effect on the mobility system (Gemeente Groningen, 2021).

As a result of the COVID-19 pandemic, the municipality of Groningen took extensive spatial measures, especially in the beginning of the pandemic, to meet the physical distancing norms. The city rearranged shopping streets and decided in the first lockdown to forbid bicycles and to extent pedestrian zones in large parts of the inner city (Gemeente Groningen, 2020). Later this decision was withdrawn. However, it is clear the municipal government of Groningen did try to intervene in the spatial environment as a result of COVID-19. As a result of the big ambitions of the city of Groningen for more sustainable mobility in combination with the initial response of the municipality of Groningen on the COVID-19 pandemic, the city of Groningen is chosen as a suitable case for this research.

3.3 Data collection

As already discussed in section 3.1, in this research a mixed methods approach is used. This means to answer the research questions, this research makes use of quantitative and qualitative research methods. In this section the data collection methods used in this research will be discussed.

3.3.1 Semi-structured in-depth interviews

In this research the qualitative data was collected by means of semi-structured in-depth interviews. As a result of the semi-structured structure of the interviews, the researcher has the possibility of asking additional and deeper questions. This will result in more useful and detailed information about the topic. Qualitative in-depth interviews give more insight in the problem, it will expose underlying reasons, which cannot be found with quantitative research methods. Qualitative research methods such as semi structured in-depth interviews allows the researcher to get to know the point of view from different respondents and from different angles. Therefore, it will result in comprehensive and detailed answers of the research questions (Clifford et al., 2010).

During this research eleven semi-structured in-depth interviews were held with thirteen different respondents. Two types of interviews have been held. Firstly, nine interviews were conducted with

eleven experts in the field of bicycle mobility in Groningen. All interviewed experts had different backgrounds, as different experts with different backgrounds will have different point of views. In table 1, a scheme with all the functions of all respondents can be seen. The experts were interviewed to gain knowledge about the changes in bicycle mobility in Groningen during the pandemic and to gain an understand in the policy choices, related to bicycle mobility, made during the pandemic in Groningen. The experts were selected on the basis of their function and approached via e-mail. The general contact letter, which was used to contact the respondents, can be found in appendix 1. The interviews with the expert was thus conducted in an semi-structured way, this means that not in every interview the exact same questions were asked. However, the standard interview guide for the interviews with experts can be found in appendix 2.

The second type of interviews that have been held during this research are two semi-structured in-depth interviews with regular bicycle users in the city of Groningen. The two bicycle users were interviewed to gain insight into the experiences and changes of bicycle usage during the pandemic of the cyclists themselves. The two bicycle users were selected randomly on the street and were also interviewed on the street. The standard interview guide for the interviews with bicycle users can be found in appendix 3.

In the scheme below the different respondents, their organisation and role in their organisation are shown:

Respondent	Organisation	Role in organisation	Date
1	Kennisinstituut voor Mobiliteitsbeleid (KiM)	- Mobility researcher - Research to mobility impacts due to coronacrisis	20-05-2021
2	Municipality of Groningen	- Projectmanager spatial development	25-05-2021
3	Municipality of Groningen	- Policymaker mobility	25-05-2021
4	Province of Utrecht	- Policymaker bicycle mobility	27-05-2021
5	Groningen Bereikbaar	- Mobility Manager	01-06-2021
6	Province of Groningen	- "Bicycle broker" - Expert bicycle mobility	02-06-2021
7	RHDHV	- Expert bicycle mobility	03-06-2021
8	Municipality of Groningen	- Policy adviser bicycle mobility	03-06-2021
9	Fietsersbond	- Fietsersbond member & cycling enthusiast	04-06-2021
10	Regio Groningen-Assen	- Mobility expert	08-06-2021
11	Regio Groningen-Assen	- Bicycle expert - Bicycle enthusiast	08-06-2021
12	Cyclist in Groningen	- User of cycling paths	18-09-2021
13	Cyclist in Groningen	- User of cycling paths	23-09-2021

Table 1: A scheme with all interviewed respondents

3.3.2 Secondary dataset

This is a mixed methods research, which means also quantitative research methods are used. A secondary dataset is used in this research. This dataset has been required via personal e-mail contact with the municipality of Groningen via opendata@groningen.nl. The dataset used in this research is a more detailed version of an open data set from the municipality of Groningen (Overheid.nl, 2021; Groningen Open Data, 2021).

The required quantitative datasets consists of bicycle counts on three specific locations in the city of Groningen. Although the range of available bicycle counting locations in Groningen was not inexhaustible, a selection of the most relevant counting locations had to be made to keep this research comprehensible. Bicycle counting location 1 is located at a bicycle path at the entrance of Zernike, counting location 2 is located at a bicycle path at the Eendrachtsskade and counting location 3 is located on a bicycle path at the Eikenlaan. In section 4.3.1 the exact bicycle counting locations will be discussed in more detail. These three locations have been chosen as these locations are all main cycling routes to the centre of the city or to the Zernike campus and are thus relevant for this research. In the required datasets, at each location, the amount of bicycles passing the counting point was counted and divided into timeslots of 15 minutes. The total amount of passing cyclists every 15 minutes was thus visible in the datasets. The municipality of Groningen executed these counts during one week in the autumn. The used datasets in this research are from the year 2020, during the COVID-19 pandemic and the year 2019 or 2018, so before the COVID-19 pandemic.

The secondary datasets will in this research be used to answer the secondary research question: *“What are the immediate consequences for bicycle mobility in Groningen as a result of the COVID-19 pandemic?”*. By analysing the dataset and comparing the bicycle usage before the pandemic with the bicycle usage during the pandemic, it is possible to make a conclusion on this research question.

There are two main reasons for the choice of using a secondary dataset instead of collecting and using primary data. The advantage of a secondary dataset is, that it is possible to acquire a massive amount of valuable data in a small time period (Smith et al., 2011). The other reason is that, in particular for this research, it was not possible to require and collect primary data from the situation before the pandemic. Therefore, there is a dependency on existing secondary data, as it was not possible to collect primary data.

3.4 Data analysis

The analysis of the qualitative data, which consists of 11 semi-structured interviews with 13 respondents, has been done by coding. All interviews are recorded, the recordings are all transcribed with otranscribe.com. As the interviews were all held in Dutch, the transcripts are in Dutch too. The coding however, is executed in English. After transcribing, all transcript of the interviews were coded with the coding programme “Atlas.ti”. All transcripts were coded into the five main categories. These five main categories were already established before the interviews and are thus the result of deductive coding. The categories were based on the literature review and the research questions, as these five main categories all are important topics within this study and largely correspond to the research questions of this research. Each category consist of multiple subcategories, these subcategories were the result of a combination of deductive coding and inductive coding, as a part of the subcategories were already developed before the interviews (deductive) and another part was developed after the interviews (inductive). The full coding scheme can be seen in the table below:

1	Factors influencing changes in the mobility system in Groningen during COVID-19
1.1	Homeworking
1.2	Flexible working
1.3	Safety feeling
2	Immediate consequences for travel behaviour
2.1	Consequences for bicycle travel behaviour
2.2	The role of recreational cycling
2.3	Consequences for bicycle sharing devices
3	Immediate consequences for policies
3.1	Bicycle stimulation projects
3.2	Bicycle parking policies
3.3	Closure of the inner city for bicycles
4	Immediate consequences for urban spatial environment
4.1	Temporary consequences for bicycle infrastructure in Groningen
5	Long term consequences and opportunities for bicycle mobility in Groningen as a result of COVID-19
5.1	COVID-19 as a chance for a shift in mobility policy
5.2	COVID-19 as trigger for behavioural change
5.3	The lessons learned for cycling mobility from COVID-19
5.4	The expected long-term effects COVID-19 will have on cycling policies

Table 2: The coding scheme used in this study

To be able to draw conclusions from the gathered quantitative data, the data has been analysed. The quantitative datasets consists of bicycle counts on three different locations in the city of Groningen during one week at the time of the pandemic and bicycle counts on the same three locations during one week before the pandemic. After this quantitative data was required, it was split up in three time periods a day: the amount of passing cyclists during the morning rush hour from 7.30 – 9.30, the amount of passing cyclists during an afternoon time period from 12.00 – 14.00 and the amount of passing cyclists during the evening rush hour from 16.30 – 18.30. The bicycle counts during one week of each counting location in two different years are visualised in tables and graphs. In this way a comparison can be made between the amount of passing cyclists at an individual counting location during the COVID-19 pandemic and before the COVID-19 pandemic. Besides a data analysis through visualisation in tables and graphs, the data will also be elaborated upon in words.

3.5 Ethical considerations

It is important to take ethics into consideration during a research. Participants of a research should be protected and efforts should be made to provide the safest possible environment for participants. The wish for anonymity of participants, if requested, should be respected (Clifford et al., 2010). Although this research does not have high ethical risks, there are ethical considerations in any study.

In this research the privacy of the interviewees is respected. During the interview process, it is important for the interviewees that they can speak freely and confidentially. Before every interview, the respondents were asked whether they agree with recording the interview. All interviewees will remain anonymous. Therefore, it is chosen that the interviewees names are not mentioned in this research, only their organisation and function within the organisation is mentioned. Before the start of each interview, the researcher made sure the respondents were aware of the topic and goal of this research. This was communicated during the first email contact, as well as immediately at the beginning of the interview during the introduction. All interviews were held online via online video call software as a result of the COVID-19 pandemic, this to prevent contamination.

Chapter 4 – Results

4.1 Role of the interviewed respondents

A total of eleven interviews with thirteen respondents have been conducted for this research. Most respondents were from different companies or institutions. Although all respondents were related to cycling mobility and cycling policy, they all had different roles within this theme. At the beginning of each interview every respondent was asked about his or her role, knowledge and background within cycling policy.

Respondent 1 is researcher at the “Kennisinstituut voor Mobiliteitsbeleid” (KiM) or in English “The Netherlands Institute for Transport Policy Analysis”. He has done research in the field of active mobility, so cycling and walking. The past year respondent 1 has been busy with researching the effects of COVID-19 on the mobility. He also collaborated on the report: “Mobiliteit en de coronacrisis” (KiM, 2020).

Respondent 2 is project manager at the municipality of Groningen and is responsible for the implementation of policy for public spaces.

Respondent 3 is mobility policy advisor at the municipality of Groningen. He is responsible for bicycle policy and other themes regarding mobility in the inner city of Groningen such as P&R’s and HUBS.

Respondent 4 is sociologist and has years of experience in the world of mobility and traffic. Currently he has the role of public space manager at the province of Utrecht. There he is responsible for bicycle policies and the realisation of fast bicycle routes.

Respondent 5 works at ‘Groningen Bereikbaar’ as mobility manager. ‘Groningen Bereikbaar’ is an organisation that aims to create a sustainable and accessible Groningen. It is a collaboration between the province of Groningen, the municipality of Groningen, Rijkswaterstaat and Prorail.

Respondent 6 works at the province of Groningen as ‘bicycle ambassador’ in which she creates and supports policy and action for bicycles in Groningen.

Respondent 7 works at ‘Royal Haskoning DHV’ (RHDHV) as coordinator of the bicycle expert team. He cooperates with cycling projects such as the creation of bicycle fast lanes and bicycle parking projects.

Respondent 8 works at the municipality of Groningen as main policy advisor for bicycle policy, as well in the city of Groningen as the regions around the city.

Respondent 9 represents the ‘Fietzersbond’, which is the most important interest group for cyclists in the Netherlands. The organisation has an advisory role towards the municipality. Besides that respondent 9 is a well-known cycling enthusiast himself.

Respondent 10 is mobility expert with an emphasis on sustainable mobility and smart mobility at “Regio Groningen-Assen”. The main purpose of this organisation is to make municipalities and other governments cooperate and stimulate cross-border cooperation.

Respondent 11 is also working at “Regio Groningen-Assen” where he monitors everything that has to do with mobility.

Respondent 12 and 13 are not experts in the field of bicycle mobility. These two respondents are regular bicycle users in the city of Groningen and were selected to gain insight into the experiences and changes of bicycle use during the pandemic of the cyclists themselves.

4.2 Factors influencing changes in the mobility system in Groningen during COVID-19

There are multiple factors that have influenced the mobility system during COVID-19. In this section, these factors and the effect of these factors on the mobility system in Groningen will be discussed.

4.2.1 Homeworking

As a result of the COVID-19 outbreak, homeworking became the new standard to prevent contamination with the virus. During the peak of the pandemic, homeworking was intensively stimulated by the government. Workers of all non-essential jobs needed to work from home (Rijksoverheid, 2020). Also on regional scale employers and employees were stimulated and advised to work from home, for example by the organisation “Groningen Bereikbaar”. All of the respondents have experienced working from home in some extent themselves. According to the CPB (2021), also in the rest of the Netherlands the amount of homeworking has increased severely:

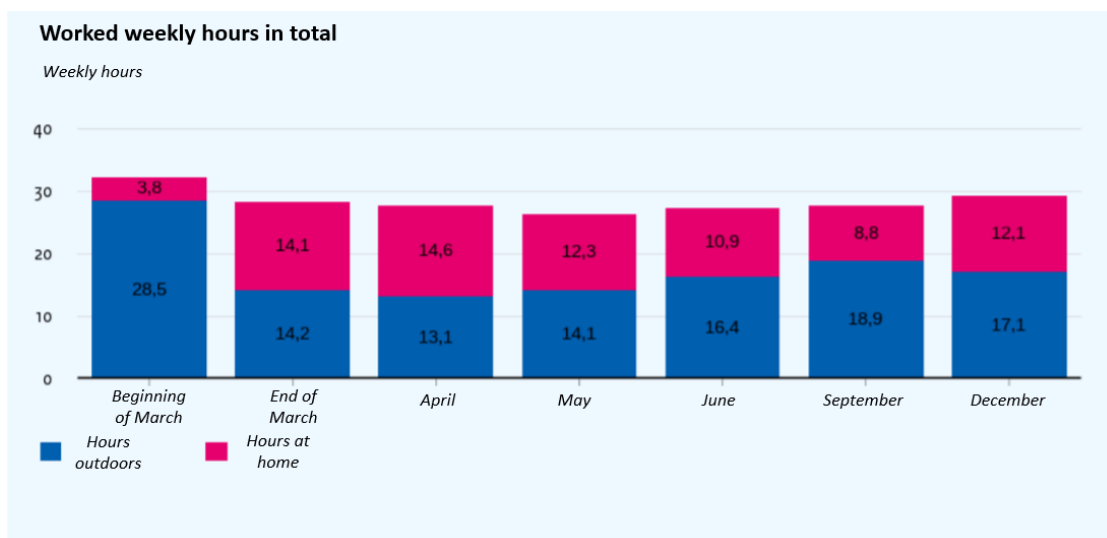


Figure 5: The worked weekly hours in total (CPB, 2021)

This all lead to massive changes in the mobility system in Groningen. As a result of homeworking and flexible working (see section 4.2.2) the peak moments on the road have disappeared. Only a slight decrease in car use will already result in the disappearance of traffic jams (#1).

“I think one of the biggest changes we see is working from home, that is a very important factor in cycling mobility.” (Respondent 1)

According to one respondent it is notable that people with an active mode of transport to their work, such as walking or cycling, are less likely to work from home than people who use the car or the train to commute to their work. This may have to do with the fact that high educated people often work further from their homes and therefore have to use the train or the car. High educated jobs are often better suitable for working from home than low educated jobs (#1).

4.2.2 Flexible working

Another factor which has influenced the mobility system in Groningen is the increase in flexible working as a result of the pandemic. With flexible working the spreading of working times is meant, this to prevent peak moments in traffic at rush hours. An example is that people first work from their

homes for a part of the day before they depart to their work. Already before the pandemic organisations such as ‘Groningen Bereikbaar’ tried to stimulate flexible working to decrease peak moments on the roads. This by cooperation and making agreements with educational institutions, the UMCG and employer institutions. However, it always remained complicated to realise effective flexible working (#2, #3, #5). The outbreak of the COVID-19 pandemic has however, realised in a rise of flexible working as people avoided the rush hours, especially in public transport, for fear of contamination (see section 4.2.3) (#11).

4.2.3 Safety feeling

Most other respondents emphasised another factor that has influenced the mobility system in times of the COVID-19 pandemic. That is the perceived feeling of safety that people have for certain modes of transport. As a result of fear for contamination, people avoided public transport as people did not want to be in crowded trains and crowded busses anymore. In 2020, 35% of the people was afraid to get contaminated with COVID-19. This was visible in their choice of mode of transport (KiM, 2020). As a result of this, a lot of commuters had shifted from collective transportation to individual transportation such as the car and the bicycle.

4.3 Immediate consequences for bicycle travel behaviour

This section will elaborate on the immediate consequences for bicycle travel behaviour as a result of the COVID-19 pandemic. This will be done on the basis of the required qualitative data from the interviews with the thirteen respondents, as well as with the secondary quantitative dataset required from the municipality of Groningen.

4.3.1 Consequences for bicycle travel behaviour based on data

To be able to make objective statements about the consequences for bicycle travel behaviour in the city of Groningen as a result of the pandemic, a municipal dataset has been required from the municipality of Groningen. As discussed in chapter 3, in section 3.3.2, this dataset consists of bicycles counts (the amount of passing cyclists on that specific location) on three different locations at bicycle paths within the city of Groningen. The time period used in the scheme of the morning rush hour is between 7.30 and 9.30 in the morning. The afternoon time period has been set between 12.00 and 14.00. The time period of the evening rush hour is between 16.30 and 18.30. In this section, the bicycle counts of 2020 will be compared with bicycle counts of 2019 or 2018. In this way, statements can be made about the influence of the pandemic on bicycle travel behaviour in Groningen. Three locations will be discussed.

4.3.1.1 Counting Location 1: Zernike

The first counting location is located at a cycling path near the entrance of the Zernike campus at “Paddepoelsterweg” between Crematoriumlaan and Duindoornstraat. This location is chosen as it is located at the “Zernike route”, the main cycling path to the Zernike Campus.

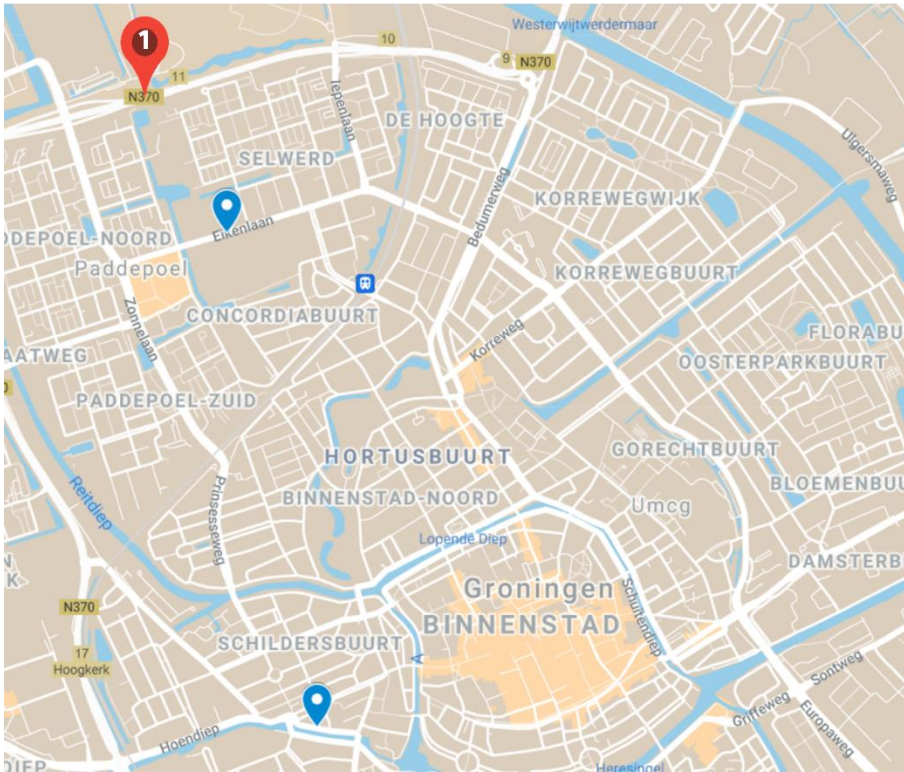


Figure 6: Location of counting site 1 (Google Maps, 2021)

13-11-2019

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Average
Morning rush hour	2712	3807	3485	3490	2918	149	91	2379
Afternoon	3195	3671	3257	3416	2419	466	462	2412
Evening rush hour	3525	3897	3670	3576	2030	358	333	2484
Total	9432	11.375	10.412	10.482	7367	973	886	7275

Table 3: The bicycle counts on location 1, at 13-11-2019

27-10-2020

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Average
Morning rush hour	1120	1241	1180	1103	982	130	70	832
Afternoon	905	1075	975	1065	830	385	296	790
Evening rush hour	1303	1317	1171	1217	958	281	177	917
Total	3328	3633	3326	3385	2770	796	543	2539

Table 4: The bicycle counts on location 1, at 27-10-2020 (during pandemic)

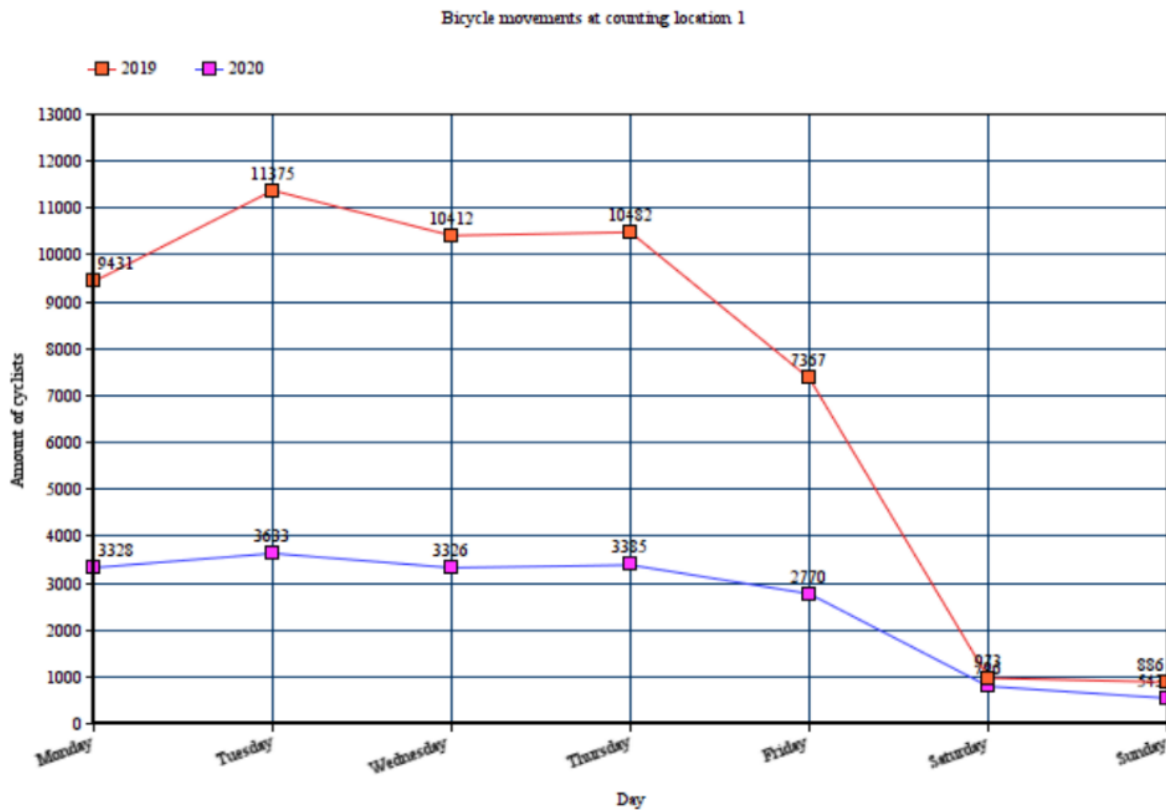


Figure 7: The cumulative bicycle counts at location 1 in 2019 versus 2020

As can be seen in the statistics here, the pandemic caused a drastic decrease in bicycle counts at this location. In total, there was 65% decrease of bicycle movements on location 1. Especially during the weekdays this decrease was substantial. However, during the weekends this decrease was much less visible, here the decrease of bicycle counts was just 28%. According to the respondents, this is mostly a result of the fact that most cyclists at counting location 1 are students heading towards the Zernike Campus. During the pandemic, when the second bicycle counting was done, as a result of digital lectures, a lot less people were headed towards Zernike. During the weekends this did not play a role, therefore the difference between the weekdays and the weekend can be explained.

4.3.1.2 Counting Location 2: Eendrachtsskade

The second counting location is located at a cycling path on the “Eendrachtsskade” between “Willem Barentzstraat” and “Hoendiepskade”. This location is chosen as it is located on the edge of the inner city and other counting points within the inner city were not available.

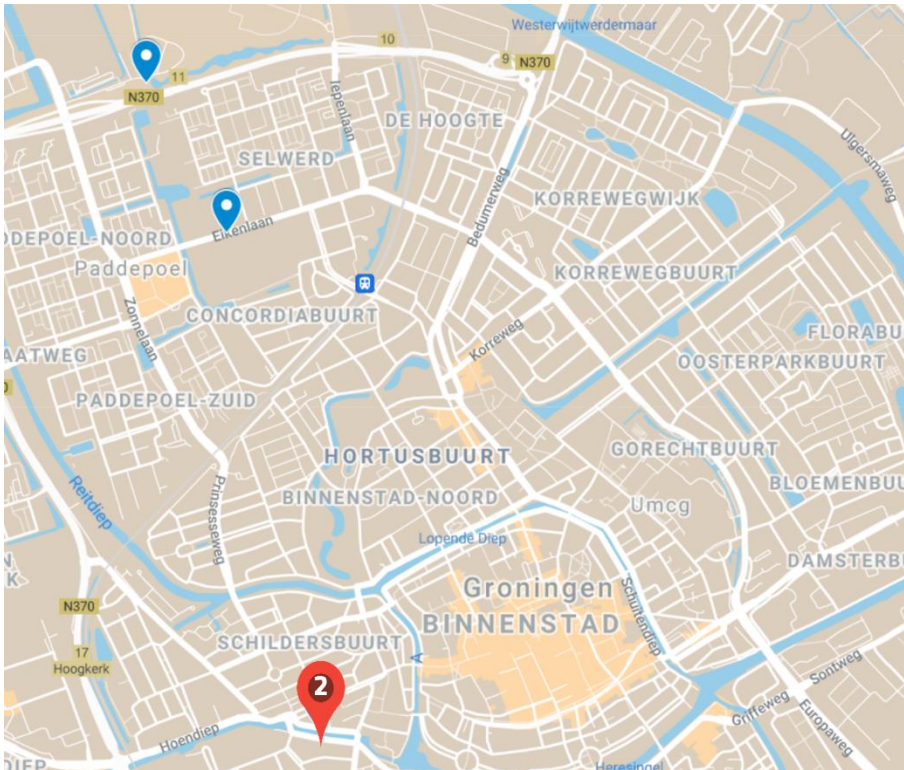


Figure 8: Location of counting site 2 (Google Maps, 2021)

07-10-2019

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Average
Morning rush hour	424	459	465	448	362	133	61	336
Afternoon	260	270	315	289	364	252	151	272
Evening rush hour	450	539	494	450	420	173	113	377
Total	1134	1268	1274	1187	1146	558	325	985

Table 5: The bicycle counts on location 2, at 07-10-2019

10-09-2020

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Average
Morning rush hour	362	347	339	320	326	100	48	263
Afternoon	236	228	237	180	304	247	160	227
Evening rush hour	366	379	365	263	357	195	152	297
Total	964	954	941	763	987	542	360	787

Table 6: The bicycle counts on location 2, at 10-09-2020 (during pandemic)

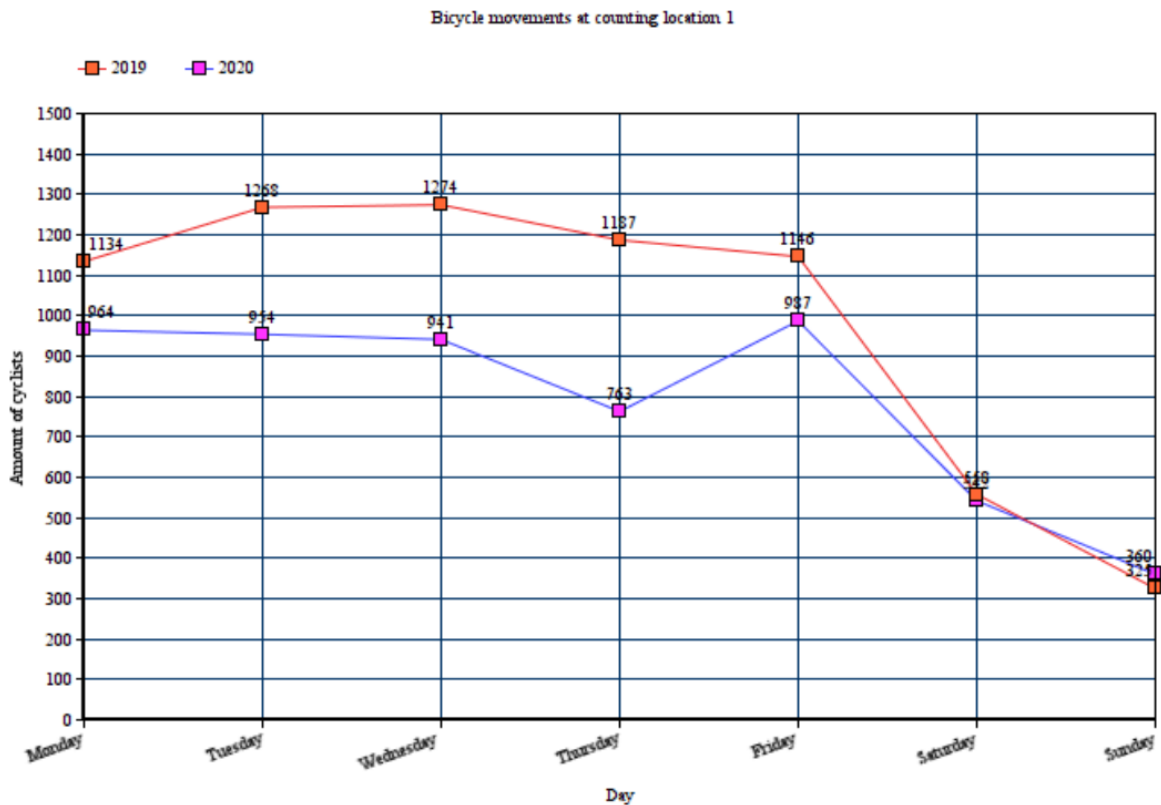


Figure 9: The cumulative bicycle counts at location 2 in 2019 versus 2020

As can be seen in the statistics of bicycle counting location 2, also here a decrease in bicycle mobility can be seen in 2020 compared to 2019. However, the decrease of bicycle mobility in location 2 is less than the decrease in location 1. In total, there was a decrease of 20% of the bicycle movements on location 2. However, also here during the weekends a different pattern can be seen compared to the weekdays. During the weekends the bicycle mobility even increased with 2% in 2020 compared to 2019. According to the respondents, during the weekdays the decrease can be explained with the fact that lots of people worked from home and did not need to cycle to their work. The slight increase during the weekends can be explained with the increase in recreational cycling, however it is not possible to state this with certainty as the purpose of traveling of the cyclists is not included in the counts.

4.3.1.3 Counting location 3: Eikenlaan

The third counting location is located at a cycling path on the “Eikenlaan” between “Dierenriemstraat” and “Elzenlaan”. This location is chosen as it is located on an usually busy cycling route. This bicycle path serves several directions, including the “Zernikeroute” and routes towards “Paddepoel” and “Selwerd”.

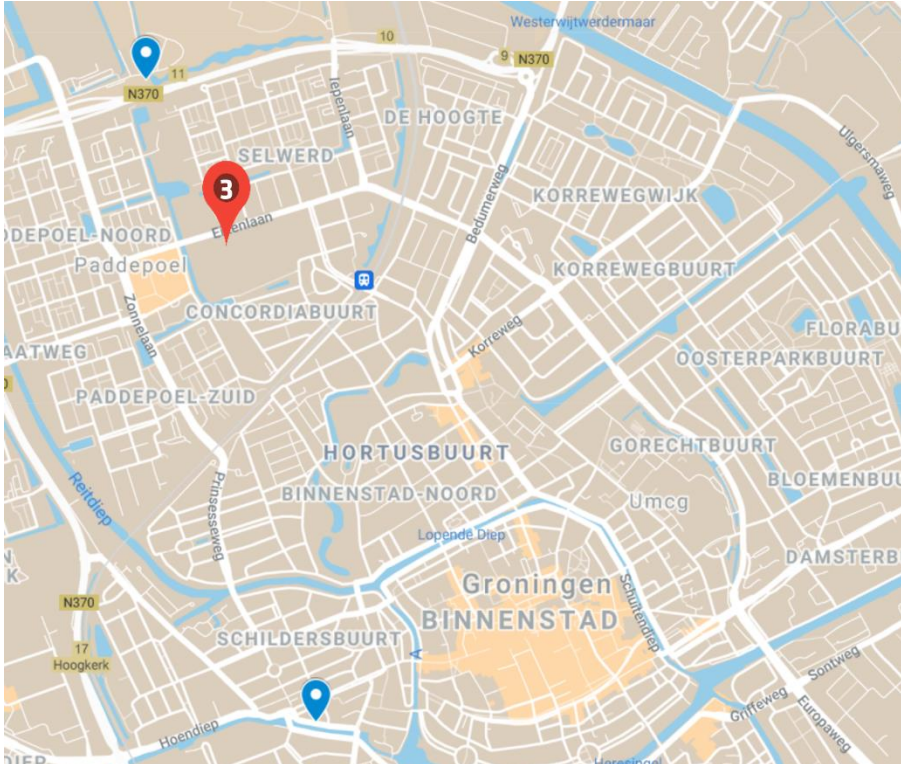


Figure 10: Location of counting site 3 (Google Maps, 2021)

11-10-2018

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Average
Morning rush hour	1322	1724	1533	1436	1358	214	114	1100
Afternoon	952	1165	1088	1083	1137	640	443	930
Evening rush hour	929	886	828	910	654	488	428	732
Total	3203	3775	3449	3429	3149	1342	985	2762

Table 7: The bicycle counts on location 3, at 11-10-2018

06-10-2020

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Average
Morning rush hour	641	750	809	771	633	157	94	551
Afternoon	663	696	684	707	746	478	349	618
Evening rush hour	628	706	716	677	654	323	345	578
Total	1932	2152	2209	2155	2033	958	788	1747

Table 8: The bicycle counts on location 3, at 06-10-2020 (during pandemic)

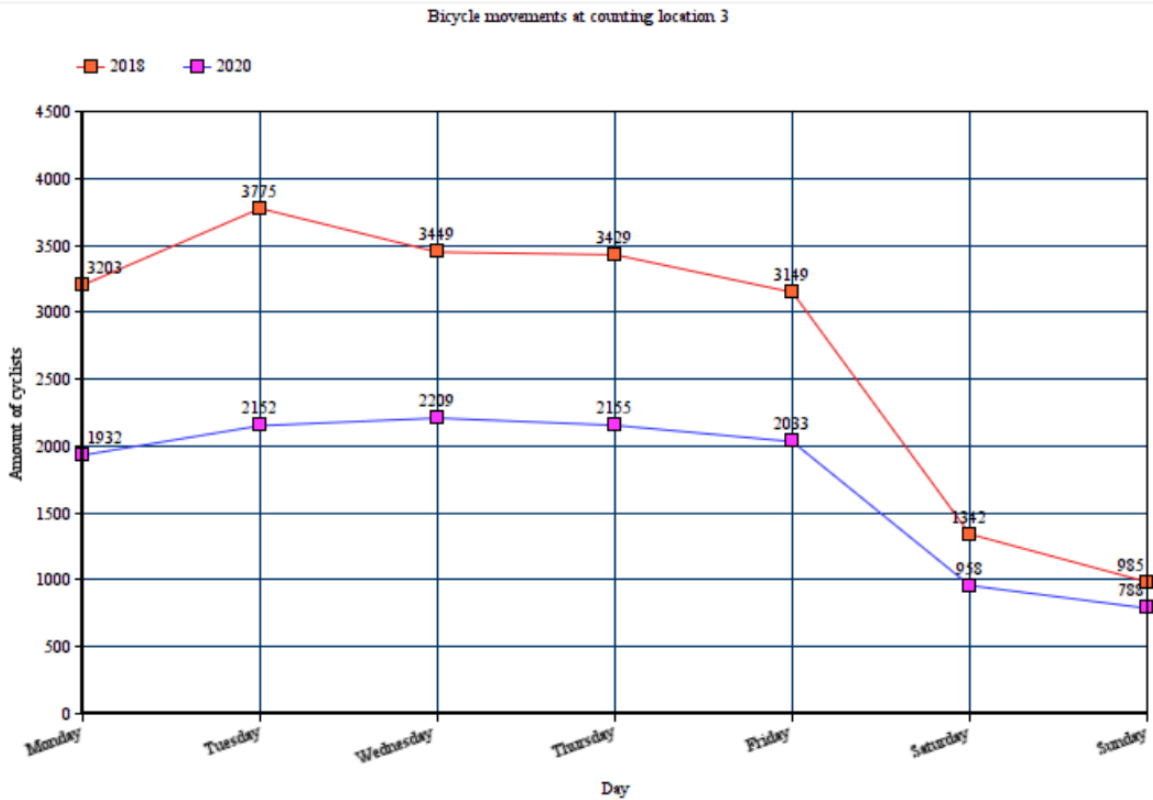


Figure 11: The cumulative bicycle counts at location 3 in 2018 versus 2020

Also in the statistics of location 3 can be seen that a decrease in bicycle mobility occurred in 2020 compared to 2018. . In total, there was a decrease of 37% of the bicycle movements on location 3. This is lower than location 1, but higher than location 2. Also at this location the decrease during the weekends was lower than during weekdays. During the weekends the decrease was only 25%.

4.3.2 Consequences for bicycle travel behaviour based on respondents

As can be seen in the statistics above, the immediate consequences for mobility during the peak of the COVID-19 pandemic were massive. According to the statistics above and to the respondents the rush hours completely disappeared as a result of homeworking. There was a clear decrease in all modes of transport during the lockdown periods, which was also still visible in September and October of 2020 between the first and second lockdown. In the first lockdown there was 40% less traffic on the roads of Groningen. The rush hours completely disappeared. In June 2021, the mobility in Groningen was still 20% less as in the period before the pandemic. The use of buses in Groningen drastically decreased, the use was only 5 to 10% in the lockdown periods. In June 2021, after the second lockdown, the use of public transport was still only 55% compared to the pre-pandemic situation (#5).

Also regarding cycling, an absolute decrease in the number of cyclists is seen during the lockdown periods, just as other modes of transport (#3). Rush hours have disappeared and the amount of cyclists on the road has become more evenly distributed over the week. However, the sales of (e)bicycles has increased drastically, according to the respondents there has not been a direct effect of the increased bicycle sales on the bicycle movements yet, as Groningen was still partly in lockdown at the moment of the interviews (June, 2021). However it is visible that during weekends, the amount of cyclists has become higher as a result of a rise in recreative cycling (see section 4.3.3) (#6). Especially electric cycling has become increasingly popular during the pandemic (#1). Although, all modes of traffic (bus, cars and biking) have decreased in absolute numbers during the pandemic, the modal split has changed as well. The ratio of the use of buses and also cars have become less, compared to the use of the bicycle. This means the proportion of bicycle usage has increased during the pandemic (#5, #8).

Yet, it cannot be said that people who stopped using public transport in Groningen switched to the use of bicycles. This because most people who used public transport in Groningen before the pandemic came from places outside the city, or were headed towards places outside of the city. A switch to bicycle transportation for these people was not always possible, because the distance to Groningen was often too large. In contrast to other major Dutch cities, only a few percentages of the total amount of public transport users in Groningen began and end their trip within the city of Groningen. Therefore the bicycle was not really an alternative for public transport in Groningen during the pandemic (#5, #1).

Respondent 8 even doubts if there has been a decrease in cycling at all. However, it is clear that the lockdowns as a result of the pandemic has had massive impact on the way of cycling in Groningen. Bicycle flows in the city have drastically changed. This is especially visible with the bicycle flows from the city centre to the Zernike Campus. In pre-pandemic times 20.000 cyclists cycled to Zernike every day. As a result of online education, this amount has drastically decreased during the lockdown, as can be seen in the statistics above. In June 2021 at the time of the interviews the old intensities of cyclists, especially at peak times, was still not what it used to be (#4).

“Well, and if we look on the other side to bicycle use in particular, I don't immediately know whether there is much less cycling. Of course, cycling is done in a different way now.” (Respondent 8)

Unfortunately, it is hard to say how exactly the way of cycling has changed during the pandemic. In Groningen there are a few counting points at cycling paths, however it only gives an indication on how many bicycles pass a counting strip in a specific amount of time. It does not give a clarification on the purpose and composition of the counted cyclists. It is very complex to make statements about the motive of bicycle travellers, whether it is commuting cycling or recreational cycling (#11).

The consequences for bicycle travel behaviour as described above, also correspond with the statements made during the two interviews with the bicycle users. Respondent 12 mentioned that as a result of homeworking he was cycling less than he used to. He used to cycle to his office in Groningen five times a week, as a result of homeworking this now has been reduced to one or two times a week. Also respondent 13 indicates that in terms of necessary trips with the bicycle, she started cycling much less, because there was much less need for mobility. Before the pandemic the respondent cycled to the Zernike campus almost every day, however, as a result of the pandemic and online lectures, during the lockdowns these cycling trips completely disappeared.

“Before, I always cycled to the office in Groningen. Now that I work at home, this is of course no longer necessary, so in that sense I really make fewer bike rides.” (Respondent 12)

4.3.3 The role of recreational cycling

Although, as described in the section above, the absolute amount of cyclists during the lockdown periods in Groningen has decreased, or at its best remained stable, all respondents mentioned that recreational cycling during the lockdown periods has drastically grown. Especially during the weekends an increase in (recreational) cyclists is clearly visible in the statistics, although, as already mentioned, it is not possible to state with absolute certainty that the growth in the number of cyclists in the weekends is caused by a growth in recreational cycling, as the composition and purpose of cyclists cannot be counted (see section 4.3.1 for the statistics).

However, a rise of recreative cycling can be supported with the rise in bicycle sales. The respondents mentioned that the sales of bicycles in the Netherlands grew massively during the lockdown periods, especially the sales of e-bikes and racing bikes. According to Koninklijke RAI Vereniging (2021) around 1.1 million bicycles were sold, which led to a record revenue of bicycle sales. Around 547.000 of the sold bicycles were e-bikes, which was an increase of 30%. Regarding the e-bikes it is not yet clear if the growth of e-bikes is a result of people who left public transport as a result of the pandemic and then chose the e-bike as new mode of transportation, or people who were tired of being at home during the lockdown and bought an e-bike pure for recreational purposes (#1).

The reason for this increase in recreational cycling according to the respondents is that cycling was one of the only allowed physical activities still possible during the lockdown. People wanted to escape their homes by cycling. This is also visible from the respondents' personal experiences. Respondent 7 for example mentioned the lack of variety during a workday in the lockdown. He states that he often went out for a bike ride during the day to get some exercise and distraction from the work. Also respondent 9 cycled more in a recreational way as a result of the pandemic:

“On the other hand, at the beginning of corona I bought a racing bike fairly quickly and I started cycling more recreationally. I like that a lot. That's really a blessing now. I really used the bike for commuting and shopping, but less for recreation, that has been added yes. I expect to keep it that way now.” (Respondent 9)

According to the respondents this also applies to other people. Also people who were not used to cycling, began to cycle for recreational purposes (#8). This is also visible at the interviewed bicycle users. Respondent 12 mentioned that the pandemic led him to cycle more recreationally. Due to the fact that gyms closed as a result of the COVID-19 measures, respondent 12 decided to buy a racing

bike to still be able to sport. Also respondent 13 has started cycling more on a recreational basis. According to the respondent during studying from home she often went for a bike ride to get out for.

“Depending on the weather, I cycle at least 1 or 2 times a week on the racing bike. So yes, I have definitely started cycling more recreationally as a result of the pandemic.” (Respondent 12)

4.3.4 Consequences for bicycle sharing devices

Because there were less traffic movements in general, bicycle sharing devices were used less (#5). This is also visible in the use of the OV-Fiets, the shared bicycle of the NS, which experienced a drastic decline of use in 2020 compared to the years before 2020. In 2020 3.1 million rides were done with the OV-Fiets. In 2019 this was 5.3 million. As a result of the pandemic a decline of 41% thus happened (NS, 2021). This is a result of the fact that the use of public transport was much lower and the OV-Fiets is usually located at train stations. Also respondent 4 and 7 mentioned that the risk of contamination and the associated perceived feeling of safety was a reason for people to avoid shared transport devices included bicycle sharing devices.

4.4 COVID-19 as a window of opportunity for bicycle mobility in Groningen as viewed by the respondents

In the theoretical part of this research the role of the COVID-19 pandemic in a transition towards more sustainable mobility has already been discussed. In this section the opportunities for bicycle mobility as a result of COVID-19 in the context of Groningen will be elaborated upon. This will be done on the basis of the required information from the thirteen respondents.

4.4.1 COVID-19 as a chance for a shift in mobility policy

The general consensus among the respondents is that COVID-19 has helped cities to remain accessible. It had some immediate positive outcomes for the urban spatial environment and mobility as discussed in section 4.3. The pandemic has offered cities an unique chance for a shift in mobility policy (#5). Also according to the respondents, the pandemic, which can be seen as a huge blow to the existing mobility system, offers a chance and can be a trigger for breaking through existing (mobility) patterns (#6,#7, #13). By mobility experts the pandemic was seen as an interesting time for mobility, as it had huge consequences for mobility, including some positive consequences (#5). Also respondent 9, as representative from the Fietsersbond, saw a clear opportunity for a more bicycle friendly policy in Groningen. However, respondent 9 has the opinion that this opportunity is missed, as the municipality was too slow in taking any actions (#9).

“But for us as mobility gurus, the pandemic is of course super interesting, because this has brought about so much.” (Respondent 5)

Respondent 2 states that the measures as a results of the pandemic, were only to ensure the 1.5 meter distance and for health/hygiene purposes. At the same time however, some measures, such as a stricter bicycle parking policy, or the stimulation of homeworking, also had a positive effect on public spaces. In this way the measures as a result of the pandemic can in fact also be seen as experiments for potential future permanent policies. Experiments which would not be possible without the pandemic (#2).

“But what you see is that the COVID-19 measures are very close to what you would want for the quality of public space. Actually the implementation of some measures is quite the same, only the motives are slightly different. But both has to do with being able to maintain a decent distance in the public space: being able to have decent space. And now you notice at official level, but also at administrative level, that some of the measures as a result of COVID-19, for example the stricter parking policy, that it tastes like more. why shouldn't we be able to continue that, because actually the measures you take there are very much in line with what you would like for the public space.” (Respondent 2)

The COVID-19 measures gave policymakers for mobility the chance to experiment with certain measures, gave new insights and learned new lessons for mobility policy and public space (#3, #4, #5). Also in some cases, urgency for cycling policies was seen, which helped in accelerating certain cases (#13). However, the general consensus among the respondents is that the pandemic will not result in a drastic shift in mobility policy in Groningen. According to the respondents, this shift has been going on already for a long time. Also the new mobility vision of Groningen, which was released during the pandemic in 2021, should be seen separately from the pandemic (Gemeente Groningen, 2021). It is a continuation from the policies, that stimulated sustainable modes of transport such as cycling and walking, that have been there since the introduction of the traffic circulation plan in the 1970s (#2, #8). Groningen has already a high share of bicycle users, but it is important to stimulate cycling even more (#3). Despite this, the new mobility vision fits well in the current crisis (#2, #3, #8). The pandemic will not result in a drastic new shift in mobility policy, but it does accelerate and strengthen the ongoing process of the stimulation of sustainable transportation methods such as cycling and walking. The pandemic can in this way still work as an accelerator for more attention for more human-centred public spaces (#1, #3, #7, #8).

Respondent 5 and 8 especially sees homeworking and the resulting reduction of mobility as a chance for future mobility policy. This, because during the pandemic rush hours and all related traffic hindrance disappeared (see section 4.3.2). Questions at organisations such as Groningen Bereikbaar were raised how to retain these good consequences of COVID-19. The focus of the city of Groningen always was on getting people out of the car and get them on the bicycle. However, COVID-19 offered an opportunity to completely change and decrease the total mobility by means of homeworking.

“The most saving kilometre is the kilometre not driven” (Respondent 5)

The chance of the pandemic on mobility lies in holding on to homeworking and the spreading of worktimes. Thus, the real chance thus lies in accomplishing a behavioural change as a result of the pandemic (#5, #7, #8). On this behavioural change will be elaborated upon in the next section.

4.4.2 COVID-19 as trigger for behavioural change

Bicycle infrastructure in Groningen is mostly quite good. The opportunities to stimulate cycling in Groningen are therefore mostly on the aspect of mentality. People are creatures of habit. As also discussed in the theoretical framework, it is very hard to change people’s travel behaviour. The COVID-19 pandemic however, is such a massive shock that it can break through people’s normal patterns. A behavioural change can be visible in a structural increase in homeworking, flexible working and a structural change in travel behaviour.

Behavioural change for homeworking

As a result of the pandemic more attention has been paid to homeworking. Working from home has been technically possible for years. However, when before the pandemic when people wanted to work from home it was still seen as a smuggling day. Working from home had a negative connotation and the positive consequences of homeworking were not seen (#1, #5, #6). As a result of the pandemic, working from home became the norm, the negative connotation then completely disappeared, as people did not have another option then to work from home. People thus immediately changed their behaviour. Working from home has gained momentum, employers became open to it and people experienced positive consequences from working from home, the mindset of people has changed (#1, #5, #7). People, companies and schools have found out that they are actually much more flexible than they thought they were (#7).

It is expected by all the respondents that people will still keep working from home to a certain extent after the pandemic. According to respondent 5, 79% of the people want to work from home more often after the pandemic. The expectation of the respondents is that “hybrid working” will be the new norm. Hybrid working is a mix of homeworking and working from the office, it is expected that people will still work 1 or 2 days a week from home. Also meetings from people in Groningen with people in the Randstad will be more digitally in the future as it saves a long train or car ride (#2, #6, #8). However, the government should actively encourage and coordinate hybrid working, by means of consultation with employer organisations, to make hybrid working possible.

“The corona crisis has caused a huge blow to the system. Of course it is a big problem, but it is certainly an opportunity for mobility. Suddenly we had to work from home, while “Groningen Bereikbaar” had been trying to do that for years without too much success. And suddenly you had accomplished homeworking 10 times better, as a result of the virus. That is a very good starting position to hold on to. People now know what it's like to work from home, the possibilities are there, employers are now geared to it. So I think it is now important to hold onto certain things.” (Respondent 11)

Behavioural change for the spreading of working times

Respondent 6 also sees a future in more spreading of working times and school times. On behalf of the municipality and the province of Groningen, the organisation Groningen Bereikbaar collaborates with transport companies, schools and employers, to try to spread the peak hours by stimulate flexible working, this happened already before the pandemic. Groningen Bereikbaar set up a “Gronings Rooster” in which they made agreements with educational institutions about starting times to tackle rush hours. This was a success, however, for companies this cultural shift was a lot more difficult to accomplish (#5). However, the shock as a result of the pandemic, also made clear for companies that it is not necessary for employees to all start at the same time (#2). The spreading of working times is useful to release the pressure on crowded cycling paths. Also conflicts between cars and bicycles during rush hours will be prevented (#6).

Behavioural change for travel behaviour

Structural behavioural changes in homeworking and the spreading of working times will eventually also have an effect for bicycle travel behaviour. As already discussed, the pandemic had some large temporary effects for travel behaviour. People stayed at home, so mobility was lower than before the pandemic. The people who still needed to travel, changed their mode of transportation, as most people left public transport due to the risk of contamination. Some of them took the car, but also a

large amount of people chose to travel by bicycle instead of the car. Instead of just a temporary change of travel behaviour, the pandemic could also lead to a more structural change in travel behaviour. It turned out people experienced the use of the bicycle as positive and expect to continue to do so more often in the future (#1). If homeworking will remain to play a significant role after pandemic, respondent 1 expects that recreational cycling will also remain higher, as people who work from home still want to make their exercise. Also respondent 9 expects that recreational cycling will remain high after the pandemic, as a lot of people have already bought (recreational) bicycles during the pandemic. Respondent 6 is convinced that the advantages of cycling have become clear the last year, especially on the health side. The positive feeling around cycling will last for a while (#6). Also the interviewed bicycle users tend to have a more positive feeling about cycling as a result of the pandemic. Respondent 12 thinks he will continue to cycle more recreationally, also after the pandemic. In the end his feelings about (recreational) cycling have become more positive (#12). Respondent 13 however, does not think her bicycle travel behaviour will be permanently changed after the pandemic.

“In terms of bicycle commuter traffic I don't think there will be such a difference for me. I do think, now that I have bought a racing bike, that I will definitely continue to cycle more recreationally. So in that sense I really discovered recreational cycling.” Respondent 12

On the other side, the pandemic has also shown that people are creatures of habit. When everything is normal again, people fall back into their old pattern (#5, #6). However, respondent 1 states that when people keep cycling for a while, it becomes a new habit and their new normal behaviour:

“We also know that if people keep doing things for a long time, it becomes a new habit. So people learn new habits for themselves. So people no longer consciously make a choice every day (...), but that it becomes actually so common, that they do not think about it anymore. So it will become very common for some people to take the bicycle instead of the bus.” (Respondent 1)

Respondent 4 mentioned that a large percentage of the mobility which is currently done by the car, can actually also be done by bicycle as well. However, this does not happen as a result of habits and convenience. Before the pandemic this was already a theme, however getting car drivers on a bicycle was always difficult. As already discussed in the theoretical framework, changing travel behaviour is actually only possible with a shock effect. Life-changing events, such as getting a new job or getting children are moments when people subconsciously rethink their travel behaviour. As a result of the shock of the COVID-19 pandemic, it can be such moment for people to rethink their travel behaviour. The shock of COVID-19 pandemic thus offers a chance for a behavioural change to get people on the bicycle instead of the car (#4, #10).

“If you want to change people's travel behaviour, then you have to do it with a shock. This was of course already known before. So-called life-changing events are good conditions to get people on a bicycle structurally.” (Respondent 4)

4.5 Governmental bicycle policy responses on COVID-19 in Groningen

According to the respondents, the COVID-19 pandemic thus offers an opportunity for more bicycle mobility in Groningen, especially in the field of behavioural change. However, as discussed in the theoretical part of this study, immediate governmental (bicycle friendly) policy responses are necessary to maintain the achieved (behavioural) changes in favour of bicycle mobility and to get all the potential out of the pandemic to stimulate cycling. In this section the governmental bicycle policy responses on COVID-19 in Groningen will be elaborated upon. This will be done on the basis of the required qualitative data from the interviews with the experts.

4.5.1 Bicycle stimulation projects

The stimulation of cycling has been there for years in Groningen. Organisations such as ‘Groningen Bereikbaar’ were already before the pandemic trying to get people on the bicycle by means of pilots and projects. However, according to the respondents, the changes in the mobility system as a result of the lockdowns (see section 4.3), when people left public transport, was the perfect opportunity to stimulate those people, who usually never took the bicycle, to take the bicycle. It was thus the perfect moment to force a change in the mobility system towards more sustainable mobility in Groningen by stimulate cycling and other modes of sustainable mobility in Groningen even more. Despite this opportunity, not a lot happened to make use of the (temporary) change in mobility system as a result of the pandemic. This was the result of a few reasons. The main reason is that from the beginning of the pandemic homeworking and staying at home was stimulated by the national government. Mobility experts of the province and municipality of Groningen therefore found it difficult to give a useful message regarding to mobility in the city, while at the same time enforcing the national policy (#5, #6). So not a lot explicit stimulation of cycling was done during the pandemic in Groningen. The focus was on the pandemic itself. During the first lockdown everything went very fast, so there was not a lot focus and steering was on bicycle stimulation (#1, #8).

“The main message of the press conferences has always been, stay at home and work at home. We found that difficult, because where do you focus on?” (Respondent 6)

“Because the message was to work at home, it is a bit weird if you then start to stimulate cycling” (Respondent 5)

Another reason that there was not much action taken during the pandemic to stimulate biking, has to do with the fact that the bicycle infrastructure and facilities are already good in the Netherlands compared to other countries. As already discussed, in cities as Paris and Berlin car lanes were converted into cycling roads (The Guardian, 2020). Because in the Netherlands the bicycle infrastructure is already mostly sufficient so this was not necessary anymore in the Netherlands (#4).

Respondent 7, who is bicycle expert at RHDHV, has also not seen a lot of new bicycle stimulation projects as a result of the pandemic. However, commercial consultancy firms as RHDHV mostly work for projects commissioned by the municipalities and provinces. According to the respondent, starting up new projects takes a lot of time, especially for governments, where money and changing politics is often the constraining factor. That is why new bicycle stimulation projects are not (yet) visible in new projects at commercial consultancy firms. Also in ongoing cycling projects, not a lot changed.

Respondent 9, as representer of the 'Fietzersbond' (Cycling Union), believes a lot more policies to stimulate cycling in Groningen should have been implemented during the pandemic. He argues a lot more marketing for cycling should be done, with an emphasis on the positive health aspects, especially because as a result of homeworking people tend to move less.

Although the actions to stimulate cycling in Groningen during the pandemic were limited as a result of the reasons mentioned above, there are some examples in Groningen where there were a few projects started to stimulate cycling during the lockdown. These projects were mostly aimed at stimulating cycling for people with necessary jobs. As these people could not go with the bus anymore, but still needed to go to their work (#5, #6). An important project to stimulate cycling among people with necessary jobs was a project aimed at employees of the UMCG. The organisation 'Groningen Bereikbaar' has set up a group with 20 e-bikes, which only health employees at the UMCG could use for free. The full summer of 2020 employees of the UMCG could use an e-bike as a trial for one month for free. This project was a great success. The e-bikes were well used and it turned out that after the free trial, some employees even bought their own e-bike and thus changed their travel behaviour. 'Groningen Bereikbaar' learned that such a specific target audience, as was the case in this project, really worked in stimulating people to cycle, as normally 'Groningen Bereikbaar' tend to stimulate cycling on a very general level (#5, #6).

Another bicycle stimulation project was a pilot at the P&R of Hoogkerk that the province of Groningen carried out. Normally people park their car at a park and ride and they often take the Citybus to the centre of Groningen. However, as a result of the COVID-19 outbreak, people did not want to go with the bus anymore. To prevent that all these people would drive with their car to the inner city instead of using the P&R, the pilot at the P&R Hoogkerk was set up. Rentable e-bikes were installed there. To make this possible, additional budget was released. In this pilot, the COVID-19 pandemic really helped to speed up policy choices and create additional budget. However, it took longer than expected to realise the project. The aim of the province was to start the pilot around summer 2020, due to long procedures for approval, only in December 2020 the pilot started (#6).

Also some other small scale stimulation projects happened. After the pilot with e-bikes at the UMCG, Groningen Bereikbaar decided to extend the action. In the whole province of Groningen it became possible to try an e-bike for a week, this all with the hope it would stimulate cycling on the longer term as well. This project was in cooperation with bicycle shops in the whole province of Groningen. Although this project was not directly linked to the pandemic, it was marketed as solution for a lack of movement due to homeworking (#5).

The municipality of Groningen also before the pandemic always stimulated cycling. Despite all these small scale stimulation projects mentioned above, the pandemic has not really contributed to the stimulation of cycling in Groningen to a large extent on short-term. Bicycle stimulation projects during the pandemic were merely focused on offering people who avoided and left public transport an alternative (#6). Despite this, according to respondent 6 this focus on people who left public transport is only a temporary situation, after the pandemic the focus on bicycle stimulation should again be on getting people out of the car instead of getting people out of public transport.

4.5.2 Bicycle parking policies

Before the COVID-19 pandemic parked bicycles in the city centre slowly became more troublesome as a result of a shortage of bicycle parking places. Parked bicycles in the city centre took up a lot of space and created chaotic situations. As a result of the decreased bicycle mobility due to the pandemic, also the demand for bicycle parking places decreased. This situation has been seized, as a new bicycle parking policy was implemented and enforced during the pandemic. Bicycle parking thus played an important role in the bicycle policy during the pandemic. The stricter bicycle parking policy has been implemented to create enough space on footpaths and squares in the inner city to ensure that everyone was able to keep 1,5 meter distance. In the inner city it became forbidden to park bicycles on the street. This was strictly enforced. This was done by steering towards behavioural change: stewards in the city centre helped and advised people where they can park their bicycle. If this did not work, bicycles were removed and relocated to the bicycle depot at the Ossenmarkt (#2, #3, #6).

“When I look at the city of Groningen, I was surprised that they have used corona to take extra strict action against parked bicycles” (Respondent 6)

“That is something we see in the pandemic, that it sometimes helps us a lot too. Now we were suddenly able to enforce bicycle parking ban, because we suddenly had enough places to park your bike. Yes, that is something that will continue. I think that's something we want to take with us after corona.” (Respondent 2)

The COVID-19 pandemic thus really has been the trigger for a more strict bicycle parking policy. Because during the lockdowns the demand for bicycle parking places decreased, there were enough bicycle parking spaces for everyone available, which was not the case before the pandemic. Therefore, a stricter bicycle parking policy, as described above, was justified during the pandemic (#3). It turned out to be a success, the chaos of bicycle parking became far less. Therefore, according to the respondents, the stricter bicycle parking policy is there to stay. They do not expect the policy to be quickly cancelled after the pandemic (#8)

4.5.3 Closure of the inner city for bicycles

At 1 June 2020, one of the most drastic COVID-19 measures when it comes to cycling in Groningen was implemented. Cyclists were banned in large parts of the inner city of Groningen. Shopping streets and other (usually) busy streets were now forbidden for cyclists. This is visualised in the figure below. It concerns the following streets: Westerhaven, Brugstraat, Guldenstraat, Folkingestraat, Zwanestraat, Stoeldraaiersstraat, Herestraat, Oosterstraat, Poelestraat, Peperstraat, Zwanestraat, and Kromme Elleboog.

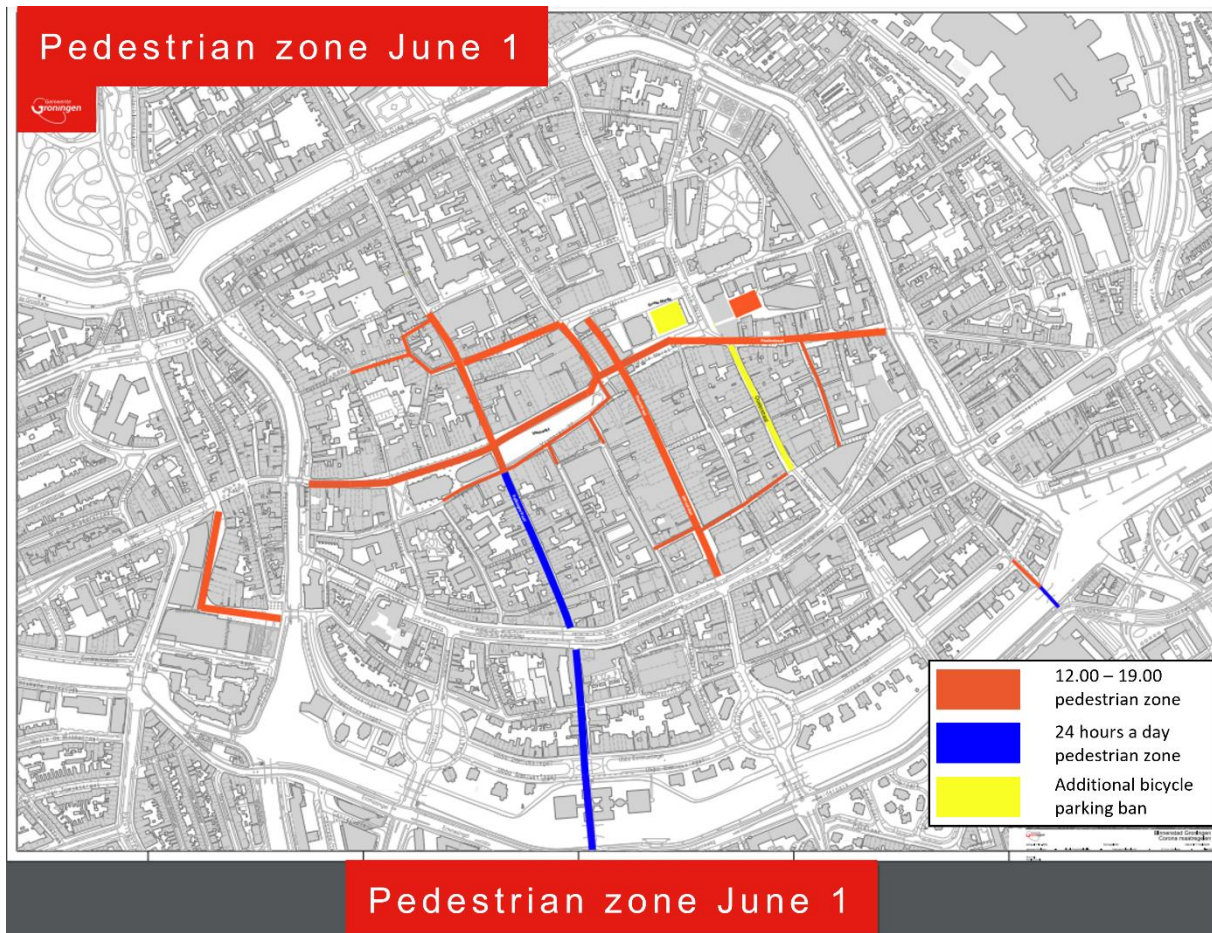


Figure 12: Closure of the inner city for cyclists (Gemeente Groningen, 2020)

Respondent 2, 3 and 8 were all very closely involved in the decision to close down large parts of the inner city for cyclists. In the interviews the underlying reasons for this decision were asked to the involved respondents.

According to respondent 3, the measure was a result of uncertainty. At 1 June 2020 the first lockdown was ending. The municipality of Groningen did not know what would happen after the lockdown ended. It was not clear how many people would go to the inner city of Groningen again and how these people would behave in public spaces. Lots of precautionary measures were made to make space for pedestrians and make the 1,5 meter distance between people possible. Among these measures were the ban on bicycle parking in the city centre, but also the closure of the inner city for bicycles.

“We really wanted to make room for pedestrians so that they had the space to walk around, and that pedestrians can pass each other in safe ways.” (Respondent 3)

Contrary to the bicycle parking ban, which was a success, the closure of the inner city for bicycles was not a great success. Soon after the ending of the first lockdown it turned out that the amount of visitors to the inner city was much less than expected. It turned out the measure was not necessary for enforcing the 1,5 meter distance. Also from the society the reactions on the measure were mostly negative. Respondent 3 and 8, who worked on the measure, now admit that the measure was hard to explain to local shop owners and other citizens. The measure went too far (#8). As a result of these reasons the measure was quickly being withdrawn. However, not the whole measure was completely

withdrawn. At the Folklingestraat the municipality continued with a bicycle ban at busy moments. Also, the municipality of Groningen still has the mandate to close certain streets for bicycles when the streets gets to crowded (#2).

Although in the end the closure of the inner city was not a great success, it learned the municipality some important lessons. The measure was closely linked with the ‘binnenstadvisie’ (vision of the inner city) in which the municipality wants to create an accessible city, especially for pedestrians. According to respondent 8, this was the perfect opportunity to experiment if it was possible to increase the accessibility of the city for pedestrians.

4.5.4 The expected long-term effects COVID-19 will have on cycling policies

Currently there are still not a lot permanent implications for bicycle policy as a result of the pandemic, it is not really tangible yet (#6). Policy changes are a slow process which needs approval from municipal politics as well. It is therefore too early to state if COVID-19 really will have an impact on long-term implications for cycling policies (#11). However, bicycle policies have become higher on the municipal and provincial agenda. The pandemic has resulted in extra attention for the bicycle and the importance to invest in cycling matters. Especially recreational cycling, which was often overlooked, has increased in importance according to respondent 6. This did not lead to concrete policy changes yet, however the thinking has changed. Another thing the respondents mentioned is that the health aspect of cycling also becomes more important. Future cycling policies may be more responsive to this. In March 2022 there are municipal elections, this can also be influential for new investments in bicycle infrastructure and new bicycle policies (#7).

“Due to corona, the theme of recreational bicycle paths has really come on the agenda for the first time. Because until now, almost no one really felt responsible for it. What kind of quality do we want for our recreational network? That always fell somewhere between two stools.” (Respondent 6)

However, some (long-term) effects for cycling policies are directly visible. An example of this is already discussed in section 4.5.2, as a result of the pandemic, a stricter bicycle parking policy was enforced. This measure had a positive outcome for the public space, so it is expected that this measure will still be maintained after the pandemic (#3).

4.6 Immediate consequences for urban spatial environment regarding cycling

Mobility is closely connected to the urban environment. A change in the system of mobility will therefore also create a change in the urban environment. Also governmental policy responses on the pandemic can have an impact on the urban spatial (cycling) environment. However, a change in the urban environment will on their turn also have an effect on the (cycling) mobility. Therefore it is also important to look at the consequences the pandemic had on the urban spatial environment. As already discussed before, in a lot of foreign cities such as Paris, Berlin, Brussel and Milan, massive changes have been made to the urban spatial environment during the first months of the pandemic in order to stimulate cycling and discourage the use of the car. In these cities, kilometres of car roads were converted into cycling lanes (NOS, 2020). These cities thus experienced major (infrastructural) urban changes.

However, according to the respondents this was not the case in Groningen. COVID-19 has not completely changed the way how we use the city. The urban spatial environment of Groningen has not been drastically changed as a result of the pandemic. This was the result of various reasons. Firstly, as already discussed in section 4.5.1, the bicycle infrastructure in Groningen was already good. Massive and easy installable infrastructural urban changes were therefore not necessary and possible to stimulate cycling in contrast with the mentioned foreign cities (#4, #7). Another important reason for the fact that the pandemic has not resulted in a lot of immediate consequences for the urban spatial environment, as mentioned by the respondents, is that the realisation of infrastructure is a long process. This often cannot be sped up as a result of compulsory procedures. The pandemic did not make a difference in that (#4, #6). Another reason that there has not been a lot immediate consequence for the urban spatial environment is that the urgency for it was not felt in Groningen. Administrators and councillors did not felt the need to change (#6).

“I really insisted on it, to use the pandemic to make urban spatial changes possible. I saw from those European examples, that it is really possible to break pattern, and then demonstrate with certain pilots that it works. So I've been hammering and inspiring about that, both at official and administrative levels towards the aldermen of municipalities, I gave presentations about it and showed what is possible and all that. But they all were really all like, it's not that busy here, don't worry so much. That is typical Gronings. I didn't really get through them. (...) But to my frustration, I was not able to tempt them to give the car a little less space. So no actions have happened.” (Respondent 6)

Despite eventually not lot happened, especially in the beginning of the pandemic, within the province and the municipality of Groningen, much thought was given to redesigning the city centre. Among mobility workers at the municipality and province it was clear it was the right momentum for more drastic measures to enforce a change in the infrastructural spatial environment of the city in order to stimulate cycling (#6, #5). For example, respondent 6 mentioned that immediately after the start of the pandemic, the attention of the municipality of Groningen to broaden existing cycling paths increased. As described in section 4.3.3, as a result of the pandemic, recreational cycling increased. Also the use of racing bikes and speed pedelecs increased. Thus, the hindrance increased on the bicycles paths as a result of the increased differences in speed. This in combination with the desire to keep 1,5 meter distance on cycling paths resulted in a call for the widening of cycling paths. Although local politicians and councillors were not in favour of large other changes of the spatial environment as a result of the pandemic, as can be read in the quote above, they did desire a widening of cycling paths. Due to long procedures and slowness of infrastructure planning it was eventually not possible to really be able to broaden cycling paths (#6, #8).

“The annoying thing about infrastructure planning is that, unfortunately, it doesn't go that fast. The process from planning to construction and tendering takes a year. That's difficult.” (Respondent 6)

“Widening bicycle paths remains important, but it is not the case that things have accelerated during the pandemic, because unfortunately it does not work that way.” (Respondent 6)

Within the municipality between the mobility experts, there was also a lot of talk about other potential spatial interventions which could be taken as a result of the COVID-19 pandemic. For years, there has been talked about redesigning the Korreweg to give cyclists more space at the expense of the car. The pandemic was the ultimate chance to take action to this. During the pandemic, the Fietsersbond had the request to make the car lane on the Korreweg (temporary) accessible for cyclists as well (#8). This to ensure the 1.5 meter distance, and as an experiment for a future (permanent) redesign of the street. Also the municipality first reacted positive on the idea of combining the pandemic with the already existing desire to create more space for cyclists at that road. However, the plan could not be carried out, as there were too many negative consequences for traffic. Also for the Zuiderdiep there has been thought of the possibilities of spatial interventions to create more space for pedestrians, cyclists and the terraces. There were options to remove the buses from the Zuiderdiep, or to let cyclist cycle on the bus lanes. In the end, they decided not to take any action, as these proposed actions were too drastic.

“At one point we said: we are not going to redesign the entire city, because that means quite a lot. Removing a lane simply means, adjusting traffic control, which costs money and you have to physically adjust the street. And then the question was, how long will that take. Do we do that for a year or do we do this for a few weeks. We have all kinds of scenarios ready. So if necessary, we can scale up quickly, but in the end we started scaling back quite quickly, because it just was not very busy on the street.” (Respondent 8)

As the pandemic progressed, the urgency for these kind of measures slowly decreased. Keeping distance as cyclist to other cyclists in open air, is now seen less important (#4). The momentum passed (#4, #8). Respondent 8 also mentioned that potential measures for cyclists in the inner city did not play a role anymore during later stages of the pandemic. This in combination with the reasons mentioned above, resulted in the fact that, although there was a lot of talking about potential spatial intervenes, there were not any actions taken.

Despite not a lot happened, there has been some small scale changes. For example in some cases road works, maintenance projects and other planned projects have started earlier than planned, because the lockdown provided a change for it, as there was less traffic on the roads. An example of this was the renovation and redevelopment of the Zernikelaan, which was executed months ahead of schedule. This was possible as a result of the absence of students and buses on the Zernike Campus (#2, #8). However, these situations in which a project could be finished earlier than expected were an exception. In most existing cycling projects nothing changed.

There were also other small scale immediate changes to the spatial environment as a result of the pandemic. An example of this are the templates on the road surface to remind people to keep 1,5 meter distance. Also the station area was during a few weeks in the summer of 2020 car-free to make room for pedestrians and cyclists. This measure was quickly cancelled due to a lack of urgency, the station area was empty and thus the necessity was questioned. Besides consequences for the urban environment related to cycling and infrastructure, not a lot other changes have been made. According to respondent 11, during the pandemic, urban greenspaces were valued higher. The pandemic has thus lead to more attention for urban greenspaces on the longer term. However, on short-term not a lot changes have been made regarding to urban green spaces.

4.7 Summary of the results

In chapter 4, the results of this research have been discussed. In this section the results will be briefly summarised.

There are three main factors that have influenced the mobility system during the COVID-19 pandemic: homeworking, flexible working and the perceived feeling of safety. As a result of these factors, in Groningen the bicycle mobility drastically reduced during the pandemic. Especially during weekdays the amount of cyclists counted on the specific counting locations was far lower during the pandemic than the year before the pandemic. However, there were also signs that the amount of recreative cyclists increased. Besides the negative aspects of the pandemic, the respondents agreed that it also could be an opportunity to stimulate cycling in Groningen, the pandemic could especially be a trigger for a behavioural change for homeworking, flexible working and (bicycle) travel behaviour. To maintain these positive behavioural effects that the COVID-19 pandemic brought, immediate governmental responses in the form of new bicycle(friendly) policies were necessary. However, only a few bicycle stimulation policies were implemented. The first response from the municipality on the COVID-19 outbreak was to close down the inner city for cyclists, which was unsuccessful. Nevertheless did the municipality of Groningen use the pandemic to implement a successful stricter bicycle parking policy. Also on longer term not a lot new bicycle policies are expected, however, on longer term, recreational cycling has increased in importance as a result of the pandemic. Also regarding the urban spatial environment, not a lot changes occurred. The municipality had considered different options to create additional space for pedestrians and cyclists during the lockdowns, but in the end the urgency was not felt by the councillors.

Chapter 5: Conclusion

The purpose of this research is to learn how the physical distancing measures as a result of the COVID-19 pandemic structurally have affected the urban bicycle mobility system and the related bicycle policies in the city of Groningen. This has been accomplished by means of a mixed methods research in which data required from qualitative interviews is supported by quantitative data required from an existing dataset. In this concluding chapter an answer will be given on the secondary research questions and thus finally also to the main research question of this research:

“How could COVID-19 have a structural effect on the urban bicycle mobility of Groningen?”

As not a lot research has been done about the long-term effects of COVID-19 on urban bicycle mobility, the findings of this research can contribute in this knowledge. Also about the role of the COVID-19 pandemic on a potential transition towards more sustainable mobility is elaborated upon in this research. The conclusions about whether COVID-19 can serve as a window of opportunity for stimulating cycling can be valuable for other cities with a desire for a transition towards sustainable mobility. The findings of this research could thus also be useful for other cities.

5.1 Factors influencing mobility system

The first secondary research question is: *“What factors influence the changes in the mobility system in Groningen during COVID-19?”* From the interviewees it became clear that homeworking, flexible working and the perceived feeling of safety were the main influencing factors as a result of the pandemic for the mobility system.

As a result of the pandemic, homeworking became the new standard, rush hours disappeared and thus the mobility system was greatly influenced by it. Also flexible working increased as a result of the pandemic, this also influenced the mobility system, as flexible working and the spreading of working times causes people to avoid rush hours. Also the perceived feeling of safety and the associated risk of contamination had influence at the mobility system as people avoided crowded modes of transport such as buses and trains.

5.2 Immediate consequences for bicycle travel behaviour

The qualitative interviews in combination with the required quantitative dataset, in which bicycle counts before and during the pandemic at three locations in the city of Groningen are compared, can answer the secondary research question: *“What are the immediate consequences for bicycle mobility in Groningen as a result of COVID-19.”*

From the quantitative bicycle counts a few conclusions can be drawn for immediate bicycle mobility in Groningen. In all three counting locations, an overall drastic decrease of bicycle mobility was seen. However, this decrease of cycling mobility was mainly seen during weekdays, during the weekends the decrease of cycling mobility was only very little. In location 2, there was even an increase of cycling mobility during the weekends. This all collaborates with the statements made by the respondents in which they state that the use of the bicycle decreased in absolute numbers. However, according to the respondents, relatively speaking, the use of the bicycle increased. Especially recreative cycling increased, as it was one of the few legal sport activities.

Based on the results it is not possible to state how the composition of cycling has changed during the pandemic. It is thus not possible to state with certainty why exactly the cycling mobility decreased during weekdays at these locations and whether the increased bicycle mobility during the weekends

is a result of increased recreational cycling. Although this is not possible to state by the statistics, the respondents had some explanations for these phenomena. The total decrease of bicycle mobility was obviously the result of the lockdown and the advice to stay and work at home according to the respondents. The increase of bicycle usage during the weekends however, is attributed to the general increase of recreational cycling, as people had free time during the weekends and most other activities were cancelled.

When comparing the three counting locations with each other, it is noticeable that the decrease in cycling mobility in the pandemic is relatively the highest at the first location: the Zernike location and is the lowest at location 2: the location near the city centre. According to the respondents this can be explained by the fact that the counting location 1 near Zernike is actually almost exclusively used by students and staff of the university. As a result of homeworking and online lectures, the vast majority of the bicycle mobility of this cycling path disappeared. According to the respondents, the users and their destinations of location 2 and 3 are more diverse. It are not only students and staff heading towards the university. This means measures such as homeworking and online lectures have less influence on these cycling paths.

It can be concluded that bicycle travel behaviour in Groningen has been drastically (temporary) affected by the pandemic. As is visualised in the conceptual model (figure 4), the immediate consequences for the bicycle travel behaviour are of significant importance for answering the main research question. As discussed in the theoretical framework of this research, temporary changes in people's travel behaviour as a result of a shock, can result in structural changes of people's travel habits (Schäfer et al., 2021). The discussed (major) immediate consequences for bicycle travel behaviour can thus have structural effects.

5.3 COVID-19 as a window of opportunity for bicycle mobility in Groningen

To be able to conclude what the structural effects of COVID-19 on the bicycle mobility in Groningen are, it is necessary to know if the COVID-19 pandemic in Groningen can be seen as a window of opportunity for bicycle mobility on longer term. As described in the literature, the current mobility system is still largely based on the car. Cities and societies have been formed around the car and the current car mobility system seems unbreakable, a lock-in situation has emerged (Urry, 2004). However, a transition towards a system with more sustainable modes of mobility such as cycling could be possible as result of the shock effect of the COVID-19 pandemic, as according to transition theory, transitions occur when structures in the society (regimes) are put under pressure by changes in society (Kuebler, 2020, Loorbach, 2010). In this way COVID-19 could, in theory, be the gamechanger that creates a tipping point to escape the lock-in situation.

Also in Groningen bicycle mobility drastically changed as a result of the pandemic. There was a huge disturbance in the bicycle mobility system, as can be concluded from the previous section. Due to these abrupt changes in the mobility system, a permanent transition towards more sustainable mobility can thus occur according to the literature (Kuebler, 2020, Kleinschroth & Kowarik, 2020, Kanda & Kivimaa 2020). Also according to the respondents of this study, the COVID-19 pandemic offered a chance and a trigger for breaking through existing mobility patterns. Some measures intended to tackle the virus, also had a positive effect on the public space of the city. The COVID-19 measures also gave policymakers the chance to experiment with certain measures, which is according to transition theory an ideal circumstance for steering towards a transition, as the steering to societal change is a process of searching, learning and experimenting (Loorbach, 2010). In contrast to the discussed theory however, according to the respondents, the pandemic did not lead to the occurrence of a completely

new transition towards more sustainable mobility policy in Groningen. This transition had already been going on for years according to the respondents. Based on the multiphase model as described by Rotmans et al. (2001), the transition was already in the acceleration phase. However, the pandemic did accelerated and strengthened the ongoing process of stimulation of sustainable modes of transport including cycling even more.

However, the pandemic did lead to a massive shock and a potential transition in field of a behavioural change related to mobility. The chance of the pandemic on mobility thus mostly lies in holding on to homeworking and the spreading of worktimes, as these measures were the main factors why mobility changed and congestion decreased during the lockdown periods. Thus, the real chance lies in accomplishing a behavioural change as a result of the pandemic. That is where a new transition is possible. Although it has been technically possible for years already, homeworking and the spreading of working time has gained momentum during the pandemic. People changed their behaviour and their mindset changed. Also after the pandemic it is expected that homeworking and the spreading of working times will stay to a certain extend. Also for bicycle travel behaviour, a behavioural change is seen. Especially recreational cycling has increased during the pandemic, it is expected this trend will continue even after the pandemic. According to the respondents, changing people's behaviour is difficult, it is actually only possible with a shock effect. In this way the COVID-19 pandemic could result in a new transition towards more homeworking and spreading of working times, in which people will rethink their travel behaviour, this will also have a massive impact on the mobility system of the city.

As visualised in the conceptual model, COVID-19 (as gamechanger) resulted in a window of opportunity for a potential (mobility) transition. This window of opportunity consist of multiple dependent and independent variables that eventually determine the structural effects for bicycle consequences as a result of the COVID-19 pandemic. According to the theory, as discussed in the theoretical framework, immediate governmental (bicycle friendly) policy action is necessary to seize the window of opportunity for the biggest chance on a successful transition (Loorbach, 2001). In the next section conclusions on the immediate governmental bicycle policy responses on the pandemic will be made.

5.4 Governmental bicycle policy responses on COVID-19 in Groningen

Qualitative interviews have been held with several policy experts in Groningen to answer the secondary research questions: *"How did a change in (bicycle) mobility as a result of the COVID-19 pandemic have an effect on the bicycle policies of Groningen?"* and *"What are the expected long-term consequences for bicycle policies in Groningen as a result of the COVID-19 pandemic?"*

The city of Groningen has been stimulating cycling for years. The pandemic offered the chance to intensify this. Despite this window of opportunity, not a lot new cycling stimulation programs were started during the pandemic. Only small scale bicycle stimulation projects were implemented in the city of Groningen. This was a result of the fact that the main message of the national government during the lockdowns was to stay at home as much as possible. Therefore, it was seen inappropriate to stimulate cycling during the lockdowns. Despite this, some project for stimulating cycling especially for people with necessary jobs, for example health employees, were carried out. Also, during the lockdown period, there have been a few policy changes regarding cycling in the city of Groningen. The municipality decided to enforce a stricter bicycle parking policy and streets were closed down in the city centre to ensure that there was enough space for people to ensure the 1.5 meter distance.

There are still not a lot permanent implications for bicycle policies as a result of the pandemic. It is therefore too early to state if COVID-19 really had a long-term impact on cycling policies in Groningen. However, according to the respondents, the pandemic resulted in extra attention for bicycle policy.

Especially recreational cycling has increased in importance and have come higher on the municipal and provincial agenda. The thinking has thus changed, this may lead to permanent change in bicycle policies.

Altogether, the municipal and provincial government of Groningen did not respond adequately to the opportunities that arose as a result of the COVID-19 pandemic to get all potential out of the current crisis. Also the respondents mentioned that opportunities have been missed regarding the stimulation of sustainable mobility. The municipal and provincial governmental did not respond as would be ideal for stimulating cycling. They did not take a leading role and only very limited new policy was thus implemented. However, there are still opportunities. Especially in the field of a behavioural change, the municipal and provincial government can still keep stimulating homeworking on long-term. This will then also affect (cycling) mobility and the liveability of the city.

5.5 Consequences for urban cycling environment

The fourth secondary research question is: *“How did a change in (bicycle) mobility as a result of the COVID-19 pandemic have an effect on the urban environment of Groningen?”* Also this research question has been answered through qualitative interviews with experts.

As already discussed in the theoretical part of this research, short-term measures and spatial interventions as a result of the pandemic can result in a long-term effect on the built environment (Pinheiro & Luís, 2020). Throughout history, viruses and pandemics have influenced spatial planning and the design of the urban environment. On the other hand, the design of the urban environment has an influence on the spread of diseases such as COVID-19 (Lilley, 2015). According to Pinheiro & Luís (2020), there are five different components of urban space as potential solutions to mitigate the spreading of COVID-19: street paths, public equipment, public transport, green areas and information technologies.

Based on these five components, also in Groningen some changes to the urban environment have been made to mitigate the spread of COVID-19. Regarding street paths, some adjustments have been made as a result of the pandemic. As discussed above, in some streets bicycles were banned to ensure the 1.5 meter distance was possible. However, physical permanent changes to the street design were not made. Regarding public equipment, lots of distance markers were installed on the road, especially in busy shopping streets such as the Heerenstraat and the Folkingestraat. Regarding public transport, the use of it was discouraged during the pandemic. Looking at urban green areas in Groningen however, not much changes have been made as a result of the pandemic. It tend to be difficult to create new urban greenspaces on the short-term. However, on longer term, the COVID-19 pandemic could be a reason for more attention for urban greenspaces according some of the respondents. Regarding information technologies, this does not have an instant physical effect on the city and surpasses the scope of this research.

However in general, in Groningen the pandemic did not lead to massive changes in the urban physical environment for bicycles. Bicycle infrastructure in Groningen was already quite good and decision making and the processes of infrastructure planning in the Netherlands is in general too slow to effectively respond in time to the pandemic and be able to start new projects. Despite lots of thoughts of potential spatial interventions by decision-making institutions in Groningen, in the end the urgency and chances of the pandemic for the urban environment were not seen.

5.6 Overall conclusions

As a result of the COVID-19 pandemic, mobility in Groningen drastically decreased. Homeworking, the spreading of working times and the perceived feeling of safety all led to this decrease of mobility. Also bicycle mobility in Groningen felt a lot of immediate consequences as a result of the pandemic. For the longer term, the pandemic was a window of opportunity and offered a chance for a transition towards more sustainable mobility and thus to structurally influence the urban bicycle mobility of Groningen. Especially a transition in the field of a behavioural change, has the opportunity to lead to more structural effects for (bicycle) mobility in Groningen. To achieve this, the municipality and province of Groningen should take a leading role in the transition and should try to steer the transition by stimulating other actors to participate in change (Rotmans, et al., 2001).

Currently, this is only partially done. There were indeed ways in which the government could encourage cycling during the pandemic, but these have been addressed to a lesser extent. Although, homeworking and the spreading of working times was stimulated by the government during the pandemic, the focus of the governmental policies was mostly on short-term. Therefore, the pandemic may not lead to massive structural effects for bicycle mobility. Only small scale structural effects for bicycle mobility may occur, such as an increased attention for recreational cycling. However, it is still possible to achieve a structural positive effect on the urban bicycle mobility of Groningen. Then, new bicycle policies should be implemented on short-term. Existing temporary policies, such as the stimulation of homeworking, should be more focused on long-term. The municipality of Groningen should think more on long-term, as long-term thinking creates short-term policy. In this way, the COVID-19 pandemic could have a structural effect on bicycle mobility and could sustainable mobility be stimulated effectively and structurally.

5.7 Reflection

In general, the results of this study can be seen as valuable. However, a reflection afterwards learns that the outcomes of this research could have been more valuable. This research started after the beginning of the COVID-19 pandemic. For finding pre-pandemic information about bicycle usage and travel behaviour, this study was thus dependent on secondary data. Via a municipal dataset, a secondary dataset was found with bicycle counts on different locations in Groningen. However, this dataset had some drawbacks. The bicycle counts only give information about how many cyclists have passed a certain counting point. In this way it was possible to compare the bicycle usage at a certain location in 2020 with the years before the pandemic. However, the secondary dataset says nothing about the distribution of types of cyclists and how this distribution has changed. For example, it is not clear whether the share of commuter bicycle traffic has increased or decreased and how this relates to a change in recreational bicycle traffic. To investigate this, a physical observation, survey or interview with passing cyclists was necessary. However, this was no longer possible in this study because this study started after the COVID-19 outbreak. It is not possible to trace people's attitudes to cycling from before the pandemic. A comparison with the pre-pandemic time was therefore no longer possible.

Another drawback of the municipal dataset was that there was not a large selection of counting points. The choice for relevant counting locations was therefore tight. Also some of the dates of the bicycle counts in 2020 and the pre-pandemic years did not completely match. At counting location three for example, bicycle counts were only executed once in two years. Therefore, a dataset from 2019 was not available.

5.8 Recommendations for future research

Future research can be focused on the (structural) effects on the bicycle mobility as a result of the COVID-19 pandemic in Groningen compared with other cities, especially with foreign cities. It is interesting to see how the immediate and especially the structural effects for cycling mobility differ between countries. It is, for example, interesting to research if and how the COVID-19 effects for bicycle policies between cycling countries and cities such as Groningen (The Netherlands) and Copenhagen (Denmark) differ from COVID-19 effects for bicycle policies in countries and cities where cycling is still in its early stages like Paris (France).

Cycling is a theme which is booming on international level, the COVID-19 pandemic only increased the attention for cycling. However, in every country cycling is in a different stage and investments are done in different areas of cycling. While cycling in countries like France is still in its early stages, investments may be mainly done in physical cycling infrastructure, such as new cycling paths, whereas in other countries where physical cycling infrastructure is already further developed, investments may be done in other areas of cycling. Future research could thus contribute in an insight in the international differences of structural effects for the bicycle mobility as a result of the COVID-19 pandemic

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Appendix 1: General contact letter

The Dutch general contact letter, as sent to the respondents:

Geachte **respondent X**,

Voor mijn masterscriptie van mijn master Environmental and Infrastructure Planning aan de Rijksuniversiteit Groningen onderzoek ik hoe de coronapandemie een (structureel) effect kan hebben op de fietsmobiliteit in Groningen, en hoe de coronapandemie de transitie naar duurzame mobiliteit, zoals fietsmobiliteit, kan beïnvloeden. Om hier inzicht in te krijgen, wil ik de komende weken een aantal (digitale) interviews afnemen met verschillende respondenten binnen het vakgebied van fietsmobiliteit in Groningen.

Gezien uw functie bij (...) zal het mij daarom enorm helpen als ik u over dit onderwerp (digitaal) kan interviewen.

Alvast bedankt, ik zie uw reactie graag tegemoet!

Met vriendelijke groet,

Daan Spoor

The English translation of the general contact letter:

Dear **respondent X**,

For my master's thesis of my master Environmental and Infrastructure Planning at the University of Groningen, I am researching how the corona pandemic can have a (structural) effect on bicycle mobility in Groningen, and how the corona pandemic can influence the transition to sustainable mobility, such as bicycle mobility. To gain insight into this, I want to conduct a number of (digital) interviews with various respondents in the field of bicycle mobility in Groningen in the coming weeks.

Given your position at (...) it will therefore be of great help to me, if I can interview you about this subject (digitally).

Thank you in advance, I look forward to your response!

With kind regards,

Daan Spoor

Appendix 2: Interview guide experts

Subtopic	Question (as asked during the interview)	Question (English translation)
General question	Kunt u wat over uzelf vertellen, wat is uw expertise op het gebied van fietsmobiliteit?	Can you tell a bit about yourself, what is your expertise in the field of bicycle mobility?
Travel behaviour	<ol style="list-style-type: none"> 1. Kunt u mij vertellen op welke manier is het fietsgebruik tijdens de coronacrisis veranderd? <ul style="list-style-type: none"> • Zijn we meer of minder gaan fietsen? • Was er een verandering van recreatief gebruik van de fiets? • Was er een verandering van gebruik van de fiets voor woon-werkverkeer? 2. Is de verdeling van vervoersmiddelen veranderd gedurende de coronacrisis? 3. Welke factoren hebben invloed gehad op de verandering van de (fiets)mobiliteit door corona? <ul style="list-style-type: none"> • Hoe heeft thuiswerken het gebruik van de fiets beïnvloedt? • Heeft angst voor corona een rol gespeeld in het feit dat mensen meer zijn gaan fietsen in plaats van bijvoorbeeld het OV zijn gaan gebruiken? 4. Zal de coronacrisis ook op langere termijn gevolgen hebben voor mobiliteit, en in het bijzonder fietsmobiliteit? <ul style="list-style-type: none"> • Wat zijn deze lange termijngevolgen? • Wordt er dan meer of minder gefietst? 	<ol style="list-style-type: none"> 1. Can you tell me how bicycle use has changed during the corona pandemic? <ul style="list-style-type: none"> • Have we started cycling more or less? • Was there a change in recreational use of the bicycle? • Was there a change in use of the bicycle for commuting? 2. Has the distribution of means of transport changed during the corona pandemic? 3. Which factors have influenced the change in (bicycle) mobility due to the corona pandemic? <ul style="list-style-type: none"> • How has working from home influenced bicycle use? • Has fear of corona played a role in a change in bicycle use? 4. Will the corona crisis also have long-term consequences for mobility, and bicycle mobility in particular? <ul style="list-style-type: none"> • What are these long-term consequences? • Will there be more or less cycling?

	<p>5. Denkt u dat thuiswerken ook na de lockdown zal blijven?</p> <ul style="list-style-type: none"> • Wat zal dit betekenen voor de (fiets)mobiliteit? • Is het nodig om thuiswerken te blijven stimuleren om zo tot duurzamere mobiliteit te komen? <p>6. Heeft de coronacrisis invloed gehad op deelvervoer?</p>	<p>5. Do you think that working from home will continue after the lockdown?</p> <ul style="list-style-type: none"> • What will this mean for (bicycle)mobility? • Is it necessary to continue to encourage working from home in order to achieve more sustainable mobility? <p>6. Has the corona crisis affected sharing transport?</p>
Institutional	<p>7. Zijn er beleidsmatig bijvoorbeeld ook veranderingen doorgevoerd tijdens de coronacrisis op het gebied van (fiets)beleid?</p> <ul style="list-style-type: none"> • Op welke manier is dit gebeurt? • Zijn er ook nieuwe fietsprojecten gestart, of andere fietsprojecten versnelt vanwege corona? • Is er ook gebruik gemaakt van corona, door nu juist fietsinfra aan te pakken? • Zijn er door corona juist ook vernieuwende ideeën ontstaan? <p>8. Is er met beleid ook geprobeerd reizigers juist op de fiets te krijgen in plaats van met de auto of het OV specifiek tijdens corona?</p> <ul style="list-style-type: none"> • Zou dit moeten gebeuren? En op welke manier zou dit moeten gebeuren? <p>9. Is er op een andere manier geprobeerd tijdens de lockdowns duurzame mobiliteit zoals fietsen extra te stimuleren? En op welke manier gebeurde dit?</p>	<p>7. Have there been any policy changes as a result of the corona pandemic in the field of (cycling) policy?</p> <ul style="list-style-type: none"> • How did this happen? • Have new bicycle projects been started, or have other bicycle projects been accelerated because of corona? • Has corona also been used, by improving bicycle infrastructure in particular? • Have innovative ideas been created as a result of corona? <p>8. Has there been a policy of trying to get travellers on the bicycle instead of by car or public transport specifically during corona?</p> <ul style="list-style-type: none"> • Should this happen? And how should this be done? <p>9. Has there been another attempt to stimulate sustainable mobility such as cycling during the lockdowns? And how did this happen?</p>

	<p>10. Zijn er ook andere kansen die de coronacrisis heeft gegeven om duurzame mobiliteit zoals fietsen te stimuleren? En hoe zijn deze kansen aangegrepen?</p>	<p>10. Are there other opportunities that the corona crisis has provided to stimulate sustainable mobility, such as cycling? And how were these opportunities seized?</p>
Urban Environment	<p>11. Heeft corona op korte termijn tot veranderingen in het ruimtegebruik met betrekking tot mobiliteit in Groningen?</p> <p>12. Er is afgelopen zomer ook bepaald dat een groot deel van de binnenstad zou worden afgesloten voor fietsers, waarom is dit toen besloten?</p> <ul style="list-style-type: none"> • Zijn er toen meer van dit soort maatregelen genomen in Groningen? • Is het ook de bedoeling om een deel van deze maatregelen ook na corona te behouden? <p>13. Is de fysieke ruimte voor duurzame mobiliteitsmiddelen zoals de fiets verandert als gevolg van de coronacrisis?</p> <ul style="list-style-type: none"> • Is de coronacrisis ook gebruikt om fietsparkeerproblematiek op te lossen? 	<p>11. Did corona lead to changes in the use of space with regard to mobility in Groningen in the short-term?</p> <p>12. Last summer it was also decided that a large part of the city centre would be closed to cyclists, why was this decided back then?</p> <ul style="list-style-type: none"> • Were more these kind of measures taken in Groningen at the time? • Is it also the intention to retain some of these measures after corona? <p>13. Has the physical space for sustainable means of mobility such as the bicycle changed as a result of the corona crisis?</p> <ul style="list-style-type: none"> • Has the corona pandemic also been used to solve bicycle parking problems?
Long-term transition	<p>14. Ziet u de huidige crisis als een kans voor een verdere transitie naar duurzame mobiliteit?</p> <ul style="list-style-type: none"> • Ziet u de coronapandemie daarin als een omslag voor mobiliteitsbeleid? • Denkt u dat de coronacrisis voor een gedragsverandering kan zorgen? • Hoe zou de overheid volgens u de huidige crisis kunnen gebruiken om een transitie naar duurzamere mobiliteit te bevorderen? 	<p>14. Do you see the corona pandemic as an opportunity for a further transition to sustainable mobility?</p> <ul style="list-style-type: none"> • Do you see the corona pandemic as a turning point for mobility policy? • Do you think that the corona crisis can lead to a change in behaviour regarding mobility? • How do you think the government could use the current crisis to promote a transition to more sustainable mobility?

	<p>15. Zijn er ook bepaalde lessen getrokken uit de coronacrisis op gebied van mobiliteit?</p> <p>16. Hoe kan de veranderende mobiliteit als gevolg van corona de ruimtelijke omgeving op lange termijn beïnvloeden?</p> <ul style="list-style-type: none"> • Op welke manier gebeurt dit? • Zal de coronacrisis zorgen voor nieuw ruimtelijk beleid? 	<p>15. Did the corona pandemic learned us lessons for mobility policy?</p> <p>16. How can the changing mobility as a result of corona influence the spatial environment in the long-term?</p> <ul style="list-style-type: none"> • How does this happen? • Will the corona crisis lead to new spatial policy?
General question	17. Heeft u verder nog vragen of opmerkingen?	17. Do you have any further questions or comments?

Appendix 3: Interview guide bicycle users

Subtopic	Question (as asked during the interview)	Question (English translation)
Homeworking	1. Zit u door de coronapandemie veel thuis (bijvoorbeeld door thuiswerken of online onderwijs)? <ul style="list-style-type: none"> • Zo ja, heeft dit invloed gehad op uw fietsgedrag en op welke manier? 	1. Are you at home a lot due to the corona pandemic (for example, working from home or online education)? <ul style="list-style-type: none"> • If so, has this influenced your cycling behavior and in what way?
Safety feeling	2. Heeft u in het begin van corona zich ooit onveilig gevoeld vanwege eventueel risico op besmettingen op de fiets? <ul style="list-style-type: none"> • Zo ja, heeft dit invloed gehad op uw reisgedrag en op welke manier? 	2. Did you ever feel unsafe at the beginning of corona because of the risk of a COVID-19 infection on the bicycle? <ul style="list-style-type: none"> • If so, has this influenced your travel behavior and how?
Travel behaviour	3. Is uw eigen fietsgebruik veranderd tijdens de coronapandemie? <ul style="list-style-type: none"> • Op welke manier is uw fietsgebruik veranderd? • Bent u meer of minder gaan fietsen? 4. Bent u meer recreatief gaan fietsen tijdens de pandemie? <ul style="list-style-type: none"> • Waarom, en op welke manier gebeurde dit? 5. Was er bij u een verandering in het fietsgedrag in woon-werkverkeer? <ul style="list-style-type: none"> • Waarom, en op welke manier gebeurde dit? 	3. Has your own bicycle use changed during the corona pandemic? <ul style="list-style-type: none"> • How has your bicycle use changed? • Have you started cycling more or less 4. Have you started cycling more recreationally during the pandemic? <ul style="list-style-type: none"> • Why, and in what way did this happen? 5. Was there a change in your cycling behaviour when commuting? <ul style="list-style-type: none"> • Why, and in what way did this happen?

Road experience	6. Heeft u zelf op de fiets tijdens de lockdowns ook veranderingen ervaren op de weg? <ul style="list-style-type: none"> • Heeft u de weg drukker of rustiger ervaren? • Ervaarde u deze veranderingen positief of negatief? 	6. Did you also experience changes on the road while cycling during the lockdowns? <ul style="list-style-type: none"> • Did you experience the road busier or quieter? • Did you experience these changes positively or negatively?
Future	7. Verwacht u dat u (ook) na de pandemie meer zult thuiswerken? <ul style="list-style-type: none"> • Zo ja, denkt u dat dit permanente invloed zal hebben op uw (fiets)reisgedrag? 8. Verwacht u dat uw fietsreisgedrag na de pandemie blijvend gaat veranderen?	7. Do you expect to work from home (also) after the pandemic? <ul style="list-style-type: none"> • If so, do you think this will have a permanent influence on your (cycling) travel behaviour? 8. Do you expect your cycling behaviour to change permanently after the pandemic?
Algemeen	9. Heeft u verder nog vragen of opmerkingen?	9. Do you have any further questions or comments?

Appendix 4: Transcript interview respondent 1

Appendix 5: Transcript interview respondent 2 & respondent 3

Appendix 6: Transcript interview respondent 4

Appendix 7: Transcript interview respondent 5

Appendix 8: Transcript interview respondent 6

Appendix 9: Transcript interview respondent 7

Appendix 10: Transcript interview respondent 8

Appendix 11: Transcript interview respondent 9

Appendix 12: Transcript interview respondent 10 & respondent 11

Appendix 13: Transcript interview respondent 12

Appendix 14: Transcript interview respondent 13

The transcripts of the interviews are stored by the researcher and can be obtained by sending an email to dd.spoor@hotmail.com.