



## *CHILD-FRIENDLY NEIGHBOURHOODS*

*The influence of car-free neighbourhoods on child-friendliness and the potential benefits of the reclaimed space*

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## Summary

Due to the enormous growth of car-use in the last decades, many urban areas in the world are burdened with congestion, traffic, noise, pollution and safety issues. To decrease car-use, the concept of car-free zones and traffic calming measures is getting more and more the attention. However, it is still not really known what the influences of car-free neighbourhoods are on children and on child-friendly planning. Therefore, the central question of this research which will be answered is: *“To what extent could a car-free neighbourhood contribute to child-friendliness?”*

This explorative research is based on the two-step approach, in which the first step is an in-depth literature review about car-free neighbourhoods and child-friendliness, and the second step is the analyzation of survey results conducted in two car-free neighbourhoods and two car-present neighbourhoods in the Netherlands.

Based on the literature review, there are various advantages of car-free neighbourhoods regarding safety, health, social cohesion, and environment. Furthermore, the literature shows that children living in car-present neighbourhoods cannot play outside independently anymore compared to children from the 1970s. The result is that children stay indoors more often because of the growth in car-use.

The results of the survey show that the car-free neighbourhoods contribute to child-friendliness because of more street safety, health advantages and the opportunities for children to play outside. However, this research also shows that the child-friendliness of a neighbourhood not only depends on whether a neighbourhood is car-free or not. This is because the presence of greenery, playgrounds, and play equipment might even be more important than the implementation of a car-free neighbourhood to create a child-friendly environment. Residents from car-free neighbourhoods as well as residents from car-present neighbourhoods think that there is still room for improvement within the neighbourhood regarding child-friendliness. This means that a car-free neighbourhood is not by definition more child-friendly compared to a car-present neighbourhood, it also depends on the development opportunities in neighbourhoods for children regarding physical activity, active mobility, and social cohesion.

**Keywords:** *car-free neighbourhood, neighbourhood planning, child-friendliness, child-inclusiveness, reclaiming space, neighbourhood recreational space.*

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# Chapter 1. Introduction

## 1.1 Background

Due to the enormous growth of car-use in the last decades, many urban areas in the world are burdened with congestion, traffic, noise, pollution and safety issues (Nobis, 2003). These problems have an impact on the daily life of many people all around the world. The growth of car-use is not only on an urban scale a problem, but also on district-level and neighbourhood-level (Melia, 2006). To decrease car-use, the concept of car-free zones and traffic calming measures is getting more and more the attention (Da Silva Borges & Grando Goldner, 2015). There are already mobility policies within cities that provide car-free urban areas. However, there are not many neighbourhoods in cities or villages which are car-free, even though they are the ultimate expression of sustainable mobility (Da Silva Borges & Grando Goldner, 2015). Not only the increase of car-use influences adults, the influence of increased car-use on children could even be bigger. The car-related problems contribute to the decrease of wellbeing of children, since these problems decrease the physical activity, road safety, accessibility, and active transportation. And these aspects are vital to children's wellbeing (ARUP, 2017).

The child-friendly environment is important because child-friendly urban planning is an emerging field, due to the trend of global urbanisation and the growing attraction of cities for families with children (Krishnamurthy et al., 2018). Streets free from traffic danger can allow for more active travel and contribute to a greater sense of community (ARUP, 2017). Therefore it is important to create an environment which is more child-friendly, and less car-friendly.

## 1.2 Research Problem

### 1.2.1 Societal relevance

There is still a knowledge gap concerning the influence of car-free neighbourhoods on children and what the impact of car-free neighbourhoods is on child-friendly planning. A study of the KpVV (2008) shows that 46% of children in the Netherlands play on the street in front of their house which helps them to create their own identity. It is important for children to play outside on the street, since it enhances the opportunities for social interaction, which is essential to health and wellbeing (ARUP, 2017). Besides this, compared to previous generations, children spend less time playing outdoors and have lower participation rates in active transport. This has to do with safety on the street and child-friendliness of neighbourhoods since many studies have identified that a lack of neighbourhood safety is seen as a potential barrier to children's physical activity (Carver et al., 2007). Although there are improvements in safety on streets, traffic accidents are still one of the primary causes of death of children worldwide (Owen et al., 2020). Furthermore, physical activity of children is important, because regular participation in physical activity during the childhood reduces the risk of developing disease risk factors in adulthood and may prevent overweight and obesity (Boreham & Riddoch, 2001; Flynn et al., 2006). The significance of car-free neighbourhoods could be that safety and walkability in

neighbourhoods will increase, and that leads to the increase of children's independent mobility (Villanueva et al., 2014). Furthermore, rates of mental health problems among children are also on the rise, with the stresses of urban life and declining opportunities for play identified as contributing factors (ARUP, 2017).

### 1.2.2 Academic relevance

The impacts of environmental exposure on children's behaviour are already explored by children's geographers and epidemiologists, but child development research has largely ignored neighbourhood contexts (Ergler et al., 2017). Karsten and Van Vliet (2006) have identified that there is often a lack of understanding and recognition by planners on the importance of the local scale in the everyday lives of children. Children can interact effectively within the environment to perform independently at a level appropriate to their physical and cognitive capabilities, but the environment should be planned in such a way that it enables children to interact effectively (Kyttä, 2004). Due to the missing link between children's daily experiences and urban planning issues, it is important to conduct an explorative research to get an insight in the needs of children for child-friendly neighbourhood planning and whether a car-free neighbourhood could increase child-friendliness.

Therefore, this research investigates the influence of a car-free neighbourhood on the child-friendliness with the use of the two steps approach. It will give an insight in whether a car-free neighbourhood increases the child-friendliness of a neighbourhood or not. The central question of this research is:

*"To what extent could a car-free neighbourhood contribute to child-friendliness?"*

The sub-questions of this research will be:

- What are the potential advantages and disadvantages that a car-free neighbourhood have on child-friendly environments?
- Is there a difference in child-friendliness in car-free neighbourhoods compared to car-present neighbourhoods?
- What can be done with the reclaimed space to increase child-friendliness of a neighbourhood?
- To what extent could the reclaimed space support child-friendliness in a neighbourhood?

### 1.3 Structure

Within this thesis, chapter 2 continues with various concepts used within this research, the purpose of this research, and the conceptual model. This chapter also explains the relation between the various concepts and the importance of the concepts within this research. After that, chapter 3 clarifies the methodology. Three international case studies will be discussed as well as the collection of primary data with the use of a survey. Chapter 4 discusses the results of the literature review and chapter 5 includes an overview, analyzation and reflection of the results of the survey. Chapter 6 and chapter 7 provide an extensive reflection on the research, as well as limitations and recommendations. At the end of the report, the references and appendices are included.

## Chapter 2. Theoretical framework

### 2.1 Car-free neighbourhood

Because of the disadvantages of the growth in car-use, and the impact of the disadvantages on the daily life of people, sustainable planning is needed (Nobis, 2003). The concept of the car-free neighbourhood is a relatively new concept which is closely linked to sustainable planning and it has direct and indirect health benefits (Nieuwenhuijsen & Khreis, 2016). The car-free neighbourhood is a neighbourhood that relies primarily on walking, cycling or another mode of transport. Cars are not allowed inside these neighbourhoods. However, such car-free policy measures appear to mainly target private cars and exclude public cars such as police and hospital vehicles, as they are seen as necessary public needs (Nieuwenhuijsen & Khreis, 2016). One of the benefits of the car-free development is that the space could be used for other purposes than car infrastructure (Melia, 2006). Besides this, safety on the street in neighbourhoods is causally related to the free play of children and the parental perceptions, because street safety is related to children's level of independence and attitudes to play free and careless in the neighbourhood (Veitch et al., 2005). The car-related problems explained in the introduction contribute to the decrease of wellbeing of children, since these problems decrease the physical activity of children, as well as the road safety, accessibility, and active transportation (ARUP, 2017). There is an urgent need to rebalance and provide better and safer infrastructures for active and public transport modes, building a new culture for it on the long term. A car-free neighbourhood would provide for better town planning by removing the need to facilitate car mobility and ensuring that urban areas are planned around people and functionality (Nieuwenhuijsen & Khreis, 2016). Because of this, the concept of the car-free neighbourhood is closely related to the child-friendly environment, which will be discussed in the following section.

### 2.2 Child-friendly environment

A child-friendly environment is a city, town or area in which the voices, needs, priorities and rights of the children are an integral part of public policies, programmes and decisions (UNICEF, 2019; UN, 1990). It consists of a coherent and systematic approach to planning and designing cities that improves children's development, health, and access to opportunities (ARUP, 2017). The creation of the child-friendly environment results in an increase in active mobility and physical activity. Parental perceptions about the built environment could even impact children's autonomy (Villanueva et al., 2014) (Van Loon & Frank, 2011). Distance to destination is important as active travel behaviour of children is strongly linked to the environment (Oliver et al., 2016). So therefore, a car-free neighbourhood could encourage children to for example use the bicycle or walk to school which increases active mobility and independent mobility. Furthermore, the child-friendly environment is essential for children since this increases the opportunities to play outside which lead to the increase of social interaction (KpVV, 2008). The increase of social interaction is directly linked to mental health and the wellbeing of children (ARUP, 2017).

### 2.3 Space reclamation

Space reclamation is closely linked to the child-friendly environment and the car-free neighbourhood. That is because the ongoing work on child-friendly neighbourhoods explores and highlights the role of housing, transportation, community networks, play and green as important prerequisites for living in neighbourhoods with children (Krishnamurthy, 2019). It is necessary to look at the possibilities of the reclaimed space and what is done with the reclaimed space in already implemented car-free neighbourhoods. The implementation of play streets could be one of the solutions, because play streets offer significant opportunities for neighbourhoods and small communities to implement a health-benefiting recreational space for the children in the neighbourhood. Play streets are short road closures, to give children the opportunity to play outside on the street (Zieff et al., 2016). Other possible implementations are the addition of greenery, playgrounds, or playfields. These implementations increase the health and wellbeing of children, and are therefore important regarding the increase of child-friendliness in neighbourhoods (ARUP, 2017).

### 2.4 Research purpose

The purpose of this explorative research is to get an insight in the relationship between car-free neighbourhoods and the child-friendliness in neighbourhoods for primary school children. There is already a clear link and relationship between car-use and how it affects residents and what the effects of cars are on health. To narrow down the research, the focus will predominantly be on primary school children to discover the effects on the neighbourhood-scale. To add to this, the research will result in an insight on how to reclaim urban space, and how to develop it towards the needs of a child-friendly environment. The topic of this research can be defined as a complex planning situation, because the implementation of car-free neighbourhoods requires the communicative side of planning (De Roo, 2020).

## 2.5 Conceptual model

This model provides an overview of the factors and concepts which are of great importance within this research.

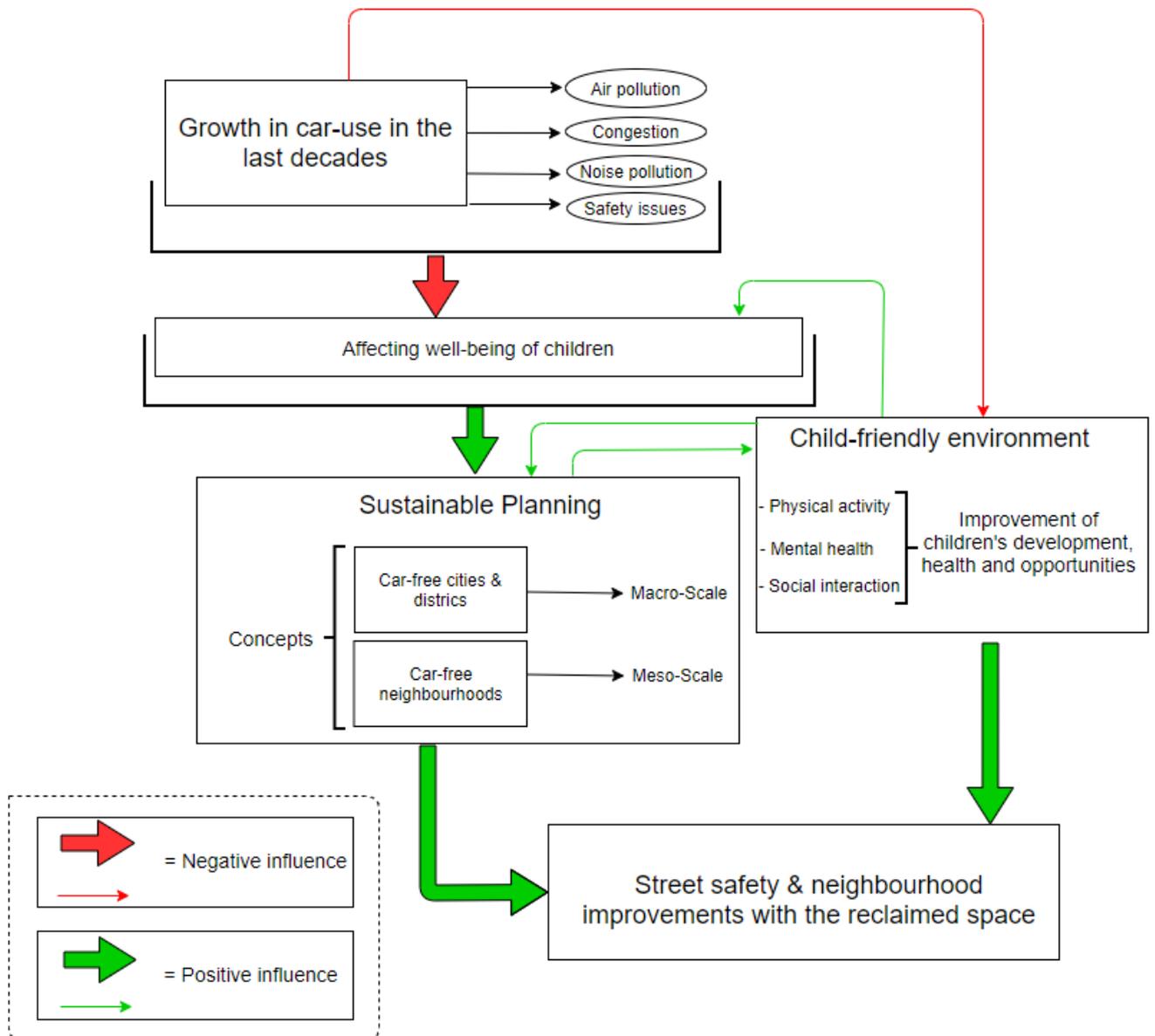


Figure 2.1: Conceptual Model

## 2.6 Hypotheses

It is assumed that the answer on the research question could portray that child-friendliness is positively affected by the implementation of car-free neighbourhoods. Children can play free on the street, without having to watch out for cars and the possible danger of that. These are the most likely expectations, since car-use cause in general congestion, noise, pollution, and safety issues (Nobis, 2003). Therefore, a logical expectation will be that when there is no car in the neighbourhood, the safety of children will increase. Most likely answers to the question related to reclaimed space, will be that people would like to see greener areas and more space to play for children since that increases the opportunities for children in neighbourhoods.

## Chapter 3. Methodology

### 3.1 Two steps approach

This research is based on the two steps approach. The reason for this is that the two steps approach will help to answer all of the questions in this research with the use of existing literature and the analysis of primary data. The literature review is the first step of the two steps approach and contains information about currently existing car-free neighbourhoods on an international scale. Furthermore, the literature review contains information about child-friendliness on neighbourhood level, and child-friendly possibilities with the reclaimed space when a neighbourhood will become car-free. Several search terms are used to find suitable articles about car-free neighbourhoods and child-friendliness. The key terms which are used to find the articles are *car-free neighbourhood*, *neighbourhood planning*, *environment*, *child-friendliness*, *child-inclusiveness*, *reclaiming space* and *neighbourhood recreational space*. With this, a deductive way of coding (appendix A) is used to gather as much useful information as possible.

### 3.2 International case studies

To investigate the implementation of car-free neighbourhoods within this research, three international cases are chosen which provide useful information. There are more international case studies, but the decisive factor to choose these three cases is that the cases provide the most comprehensive information about the environmental aspects, the general advantages and disadvantages, and the possibilities with the reclaimed space. The first international case is about a car-free neighbourhood in Vienna. This case will give an insight on the general advantages of car-free neighbourhoods in terms of sustainability and environment (Ornetzeder et al., 2008). The second international case is about the car-free district in Vauban, which will give insights in positive and negative influences of a car-free neighbourhood (Nobis, 2003). The difference between these case studies is that the case study of Vienna focuses more on the environmental impact of car-free neighbourhoods and Vauban focuses more on the general aspects of the car-free neighbourhood. The third international case is about the possible implementation of a car-free neighbourhood and the reclamation of the space in Florianópolis, Brazil (Da Silva Borges & Grando Goldner, 2015). The literature needed, is found with the use of the Groningen University library, as well as Google Scholar, SmartCat, Scopus and online books. However, with secondary data it is important to realize that the information collected by someone else, was for another purpose than the purpose of this research (Clifford et al., 2010).

### 3.3 Primary data collection

The second step of the two steps approach is the collection of primary data in four neighbourhoods in the Netherlands. Two of the neighbourhoods are already car-free, and two are car-present. The two car-free neighbourhoods are chosen since these neighbourhoods are

relatively similar to each other and because both neighbourhoods are located in cities. The neighbourhoods are compact, and the houses are built in the same period. Furthermore, the age distribution of the residents of both car-free neighbourhoods are relatively similar, as well as the presence of children. After identifying these two neighbourhoods, it was necessary to choose two car-present neighbourhoods which are very much similar to the car-free neighbourhoods and which are also located in cities. After an intensive research, two car-present neighbourhoods are found which are suitable for this research with similarities regarding age distribution, presence of children, and the 'age' of the neighbourhood. The use of these case studies is important since a case study helps the researcher to explore in-depth a process or concept (Williams, 2007).

The method to collect primary data is the use of a survey. That is because a survey is useful since it can be distributed quickly among the residents of the four neighbourhoods. This might result in a high response rate, which increases the confidence of this research. Another method which could be used was conducting interviews. However, due to the current COVID-19 pandemic it is not wise to get in direct contact with the interviewees. Another disadvantage of interviews is that it is a time consuming research method, compared to a survey. For these reasons, a balance has been made to see which method would be the most successful, and it is decided to use a survey because surveys deliver the most direct measure of the thoughts, opinions, and intentions of people, and that makes it one of the most valuable sources of data (Martin et al., 2014; Clifford et al., 2010).

The survey contains the same questions in the different neighbourhoods, since it is only possible to make a good comparison between the four neighbourhoods when using the same questions (Thomas, 2021). The survey will contain questions with a scale of agreement and open questions. The questions will be about the perception of car-free neighbourhoods, and whether people think this would increase child-friendliness or not.

To distribute the surveys, flyers (Appendix B) are created and put in the letter boxes of the residents. The flyers contain a QR-code and a link to the online survey. This method of distribution was the most appropriate, again because of the current COVID-19 pandemic. The surveys are addressed to parents of children and singles in the neighbourhoods, since adults would give more suitable answers to questions of a survey than children themselves.

The results of the survey will give an insight in the implementation possibilities and the child-friendliness of car-free neighbourhoods. Furthermore, surveys will help to get an understanding about advantages and disadvantages of the car-free and car-present neighbourhoods.

### 3.4 Data Analysis Scheme

	Information	Sources to collect data	Documentation
<b><u>Main RQ:</u> “To what extent could a car-free neighbourhood contribute to child-friendliness?”</b>	(Dis)Advantages car-free neighbourhood, child-friendliness of neighbourhoods, Perception of car-free neighbourhoods	Answers on the sub-questions, secondary data analysis, primary data collection with the use of surveys	Documentation in the thesis.
<b><u>Sub-Q1:</u> “What are the potential advantages and disadvantages that a car-free neighbourhood have on child-friendly environments?”</b>	(Dis)Advantages car-free neighbourhood, explanation child-friendly environments	Academic literature, (news)papers, documents	Download articles, (news) papers, documents on pc.
<b><u>Sub-Q2:</u> “Is there a difference in child-friendliness in car-free neighbourhoods compared to car-present neighbourhoods?”</b>	Differences in perceptions of car-free/car-present neighbourhoods, influence cars on child-friendliness	Primary data: Survey in car-present neighbourhoods and survey in car-free neighbourhoods	Data will be documented with Microsoft Word and Survio.
<b><u>Sub-Q3:</u> “What can be done with the reclaimed space to increase child-friendliness of a neighbourhood?”</b>	Possible implementation to increase child-friendliness in neighbourhoods when a neighbourhood is car-free	Academic literature, (news)papers, documents	Download articles, (news) papers, documents on pc.
<b><u>Sub-Q4:</u> “To what extent could the reclaimed space support child-friendliness in a neighbourhood?”</b>	Perceptions of implementation possibilities on how to increase child-friendliness in neighbourhoods	Primary data: Surveys in neighbourhoods to gather opinions about possible child-friendly implementations on neighbourhood-level	Data will be documented with Microsoft Word and Survio.

**Table 3.1:** *Data analysis scheme*

## Chapter 4. Secondary data analysis

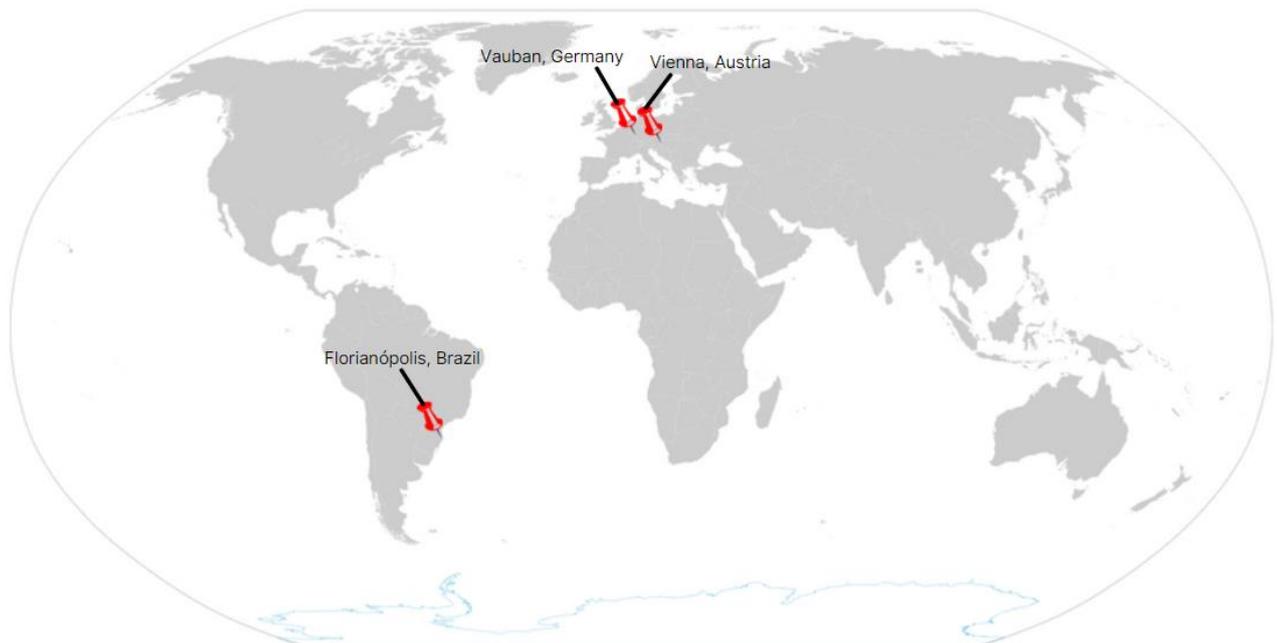
### 4.1 Car-free neighbourhoods (dis)advantages

This section will provide an understanding about the advantages and the disadvantages of car-free neighbourhoods and districts with the use of literature about car-use and its consequences, and three international case studies.

#### 4.1.1 General advantages

Car traffic causes around 1.3 million global deaths, and about 78 million injuries (Bhalla et al., 2014). A reduction in motorized traffic is expected to lead to a reduction in accidents (Green et al., 2014). This means that the implementation of car-free areas could have beneficial effects in terms of traffic accident decrease. Furthermore, it is known that car traffic contributes to a considerable proportion of air pollution in cities, and it contributes to noise pollution (Nieuwenhuijsen & Khreis, 2016). In addition, reduction of traffic related air pollution can be expected to lead to the reduction of mortality (Beelen et al., 2014). Besides this, recent health impact assessments have shown great potential health benefits of switching to active transportation through increased physical activity with the implementation of car-free neighbourhoods (Mueller et al., 2015). Increased physical activity has been associated with a reduction in several diseases (Rojas-Rueda et al., 2013). Car-free neighbourhoods do also increase social contacts and cohesion. Currie & Stanley (2008) state that public transport use can strengthen social capital by providing a safety net of transport options for groups and enabling social interaction with fellow users of the public transportation.

#### 4.1.2 Case studies Vienna, Vauban, and Florianópolis



**Figure 4.1:** *International case study locations: Florianópolis, Vauban & Vienna (Author, 2021)*

In Vienna, there is a car-free housing project to evaluate the environmental advantages and the results are interesting. The study of Ornetzeder et al. (2008) indicates that the car-free housing project has indeed lower CO<sub>2</sub> emissions measured per household. This is because of avoiding car-use and purchasing green electricity in the car-free settlement and it is shown that the emissions saved from not using the car are even higher than the emissions saved from using green electricity (Ornetzeder et al., 2008). So, this study has shown that there are significant environmental advantages when not using the car in implemented car-free settlements. The stabilisation of more sustainable living patterns is intricately linked to the social climate and infrastructure to facilitate behavioural change (Ornetzeder et al., 2008). This means that it is not easy to implement car-free settlements, since it is important that the residents are also active in changing their behaviour and are willing to get a sustainable lifestyle.

The Vauban district is one of the biggest car-reduced projects in Germany. The goal was to reduce the use of cars in the entire district to the benefit of all inhabitants (Nobis, 2003). The study of Nobis (2003) showed that people living in the district are highly satisfied with their mobility possibilities instead of using the car, which is also a requirement to make it successful. Residents of the Vauban districts are convinced that the increasing expansion of space used for activities instead of car-focused use of spaces exerts a greater influence of people's behaviour, which is an interesting advantage of this car-free district. This case study proves that it is well worth applying new mobility concepts like car-free living. However, the success of such projects depends not only on the traffic concept, but also on several other aspects such as attractiveness of the area and connection to the public transport (Nobis, 2003). This could be a disadvantage of car-free neighbourhoods, since not all areas or neighbourhoods can meet the requirements to implement a successful car-free district.

The city of Florianópolis is a medium-sized city in Brazil in which a lack of urban planning and public transport contributes to the increased rate of motorisation (Da Silva Borges & Grando Goldner, 2015). Although the car-free neighbourhood is not yet implemented in this city, the overview of implementation possibilities and the perception of residents are the decisive factor to use this case study, since it provides useful information for this research. The study of Da Silva Borges & Grando Goldner (2015) shows that the car-sharing system is an option which could be practised in neighbourhoods in Florianópolis. Although there are some limitations and difficulties about implementing a car-free neighbourhood, the residents are positive about the replacement of car infrastructures into greener areas and leisure activities which are advantages concerning health and social cohesion within car-free neighbourhoods.

#### 4.2 Influence of cars on child-friendly environments

It seems as if the cities and towns are less and less suitable for children. That is an unwanted development from the perspective of mobility, traffic, and social safety (KpVV, 2008). Besides this, there is the call for child-friendly cities since it is recognized that cities are home to an increasing proportion of the world's children, and these cities are largely unfriendly to children (Riggio, 2002). A safe and friendly environment can protect children and offering freedom of movement (KpVV, 2008). The municipalities and the government must continue to focus on creating and maintaining child-friendly neighbourhoods (Nji, 2021). An important indicator for child-friendly environments are the capacity, quality, proximity, of playgrounds because of the increase in traffic, adults feel uncomfortable to let their children play outside (Bouw & Karsten, 2004). Another important indicator is the proximity and accessibility of primary schools, and the safety of the public space (Karsten & Felder, 2016). Due to the decrease in the independent freedom of movement of children, the importance of the proximity and accessibility of play facilities has increased (Gaster, 1991). The safety of the public space has a major influence on the playing of children in the neighbourhood (Carver et al., 2007). Children living in car-present neighbourhoods cannot play outside independently anymore compared to children from the 1970s, because the increase in welfare in the last decades resulted in an increase in the use of cars (KpVV, 2008). Children especially struggle with (1) - speeding cars, because children have difficulties with estimating the speed of cars, (2) - too little view because of parked cars when children want to cross the street, and (3) - cars parked on the sidewalk. Because of this, children often must divert to the street to play outside (KpVV, 2008).

#### 4.3 Possible child-friendly implementations in car-free neighbourhoods

When a neighbourhood is going to be car-free, car-related spaces in the neighbourhood are not necessary anymore. The public space which is beneficial to the development of children is often beneficial to everybody: "a city friendly to children is a city friendly to all" (KpVV, 2008). Often, parents strongly believe that playing outdoors is important for their children's healthy development (SCP, 2005). But to play outdoors, safety of the children is necessary. Because of this, one possible implementation to increase the child-friendliness in neighbourhoods is to add playgrounds which could increase the opportunities for children to connect with neighbours

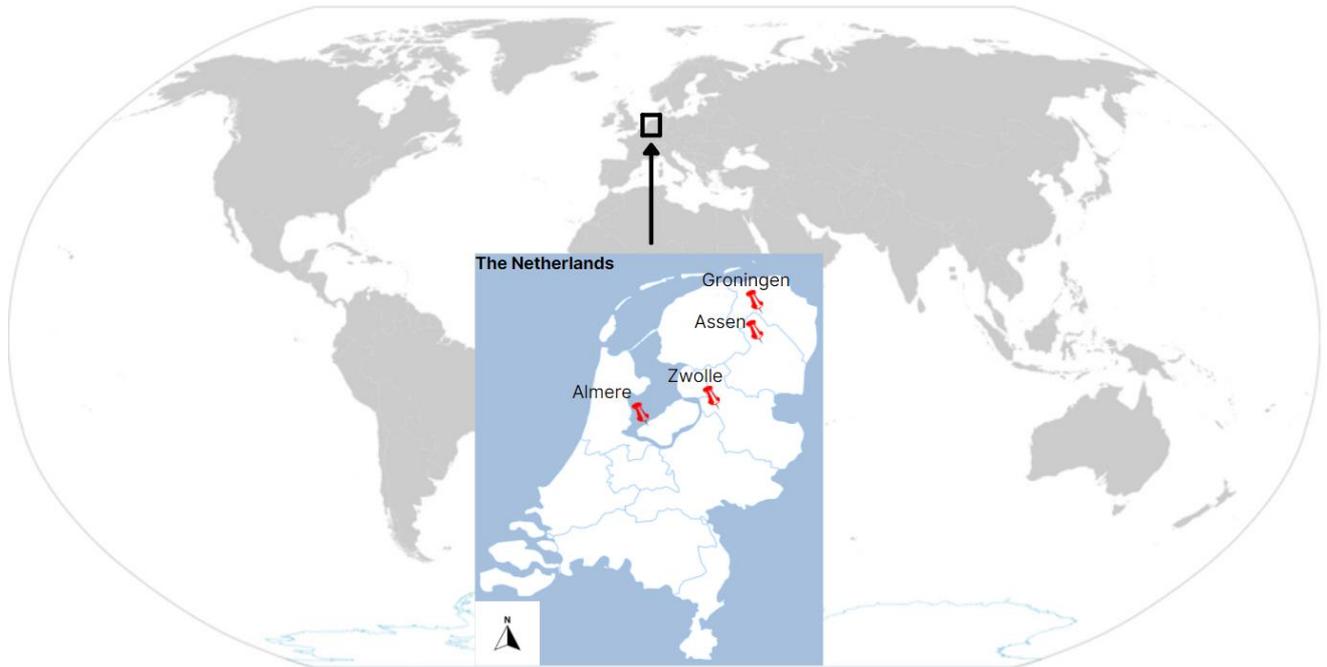
and other children (Krishnamurthy, 2019). Furthermore, implementations to promote the walkability of the neighbourhood have a positive effect on the social network development of children. Walkability in this sense include street connectivity and land use mix (Christian et al., 2017), this means that when a neighbourhood becomes car-free, implementation of walking paths should happen to increase physical activity of children. Another possible implementation are climbable objects. For children, climbing objects are not just only fun but at the same time it teaches children vital lessons such as risk assessment, focus and planning (Krishnamurthy, 2019). Besides this, an important possible implementation is nature. Children need nature, and nature needs children. Green space in neighbourhoods increases the physical and mental health benefits, including lower rates of obesity, depression, and stress (ARUP, 2017).

#### 4.4 Reflection

This chapter gave insights in the benefits of car-free neighbourhoods. It became clear that a reduction in cars lead to less accidents and that the decrease of cars in neighbourhoods lead to less air pollution and a reduction in mortality. Furthermore, car-free neighbourhoods do increase the social cohesion of a neighbourhood, and it increases the opportunities for physical activity which is directly linked to an increase in health. The international case studies gave an overview of the environmental benefits, implementation possibilities, and the advantages and disadvantages of car-free neighbourhoods. From this chapter, it became clear that there are in general more advantages of a car-free neighbourhood than disadvantages. Furthermore, the relation between child-friendly environments and cars is discussed. In car-present neighbourhoods, children struggle with the presence of cars. Several implementation possibilities are explained, to make a neighbourhood more child-friendly. These implementations have beneficial effects on physical and mental health, as well as social cohesion.

## Chapter 5. Primary data results & analysis

### 5.1 Dutch case studies



**Figure 5.1:** Survey locations: Almere, Assen, Groningen & Zwolle (Author, 2021)

#### 5.1.1 Description of the car-free neighbourhoods

The first car-free neighbourhood is 'De Buitenkans' in Almere which is one of the biggest ecological neighbourhoods of the Netherlands (De Buitenkans, 2021). The houses are built in 2007. The neighbourhood contains about 55 houses and the residents are adults with children, and some adults without children. Figure 5.2 provides an impression of the neighbourhood. The second Dutch case study is about the car-free neighbourhood 'Meanderhof' in Zwolle (Meanderhof, 2021). This neighbourhood is comparable with the neighbourhood in Almere since both neighbourhoods are car-free and relatively small. There are about 50 houses and the houses of 'Meanderhof' are built in 2008 and therefore the neighbourhood age of these two cases are remarkably similar. On the outskirts of both neighbourhoods is space to park the car, which is visible in figure 5.3. Cars are not allowed inside of the neighbourhood, which is also like 'De Buitenkans' in Almere. Photos of the car-free neighbourhoods can be found in Appendix E. The location of the cities is visible in figure 5.1.



Figure 5.2: *Impression of the neighbourhood 'De Buitenkans' in Almere (De buitenkans, 2021)*



Figure 5.3: *Impression of the neighbourhood 'Meanderhof' in Zwolle (Meanderhof, 2021)*

### 5.1.2 Description of the car-present neighbourhoods

The first car-present neighbourhoods used in this research is the neighbourhood 'Vreebergen' in Assen. This is, like the car-free neighbourhoods, a relatively small and compact neighbourhood with around 115 residents and the houses are built from 1990 up to 2000 (AlleCijfers, 2021a). Photos of this neighbourhood can be found in figure 5.4 and Appendix E. The second car-present neighbourhood is 'Tersluis' in Groningen. This neighbourhood contains around 200 houses, so more than the other three neighbourhoods in this research. However, the neighbourhood is relatively compact and is very much comparable to the other neighbourhoods, and therefore useful. Furthermore, an advantage is that there are many children in this area (AlleCijfers, 2021b). Photos of this neighbourhood can be found in Appendix E, and figure 5.5 provides an impression of the neighbourhood.



Figure 5.4: Impression of the neighbourhood 'Vreebergen' in Assen (Author, 2021)

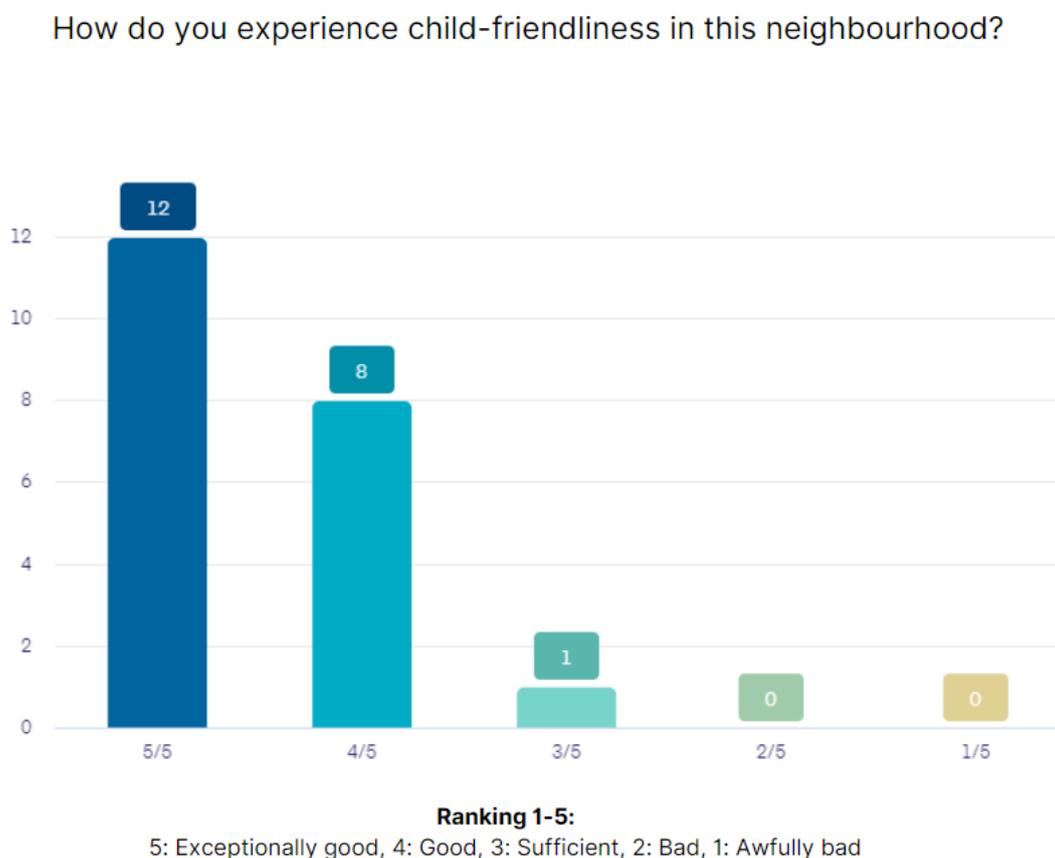


Figure 5.5: Impression of the neighbourhood 'Tersluis' in Groningen (Roderveld, 2021)

## 5.2 Survey results analysis car-free neighbourhoods

After distributing the flyers with the survey in the car-free neighbourhoods, 14 residents from Almere responded and 7 residents from Zwolle responded. In total, 21 residents responded, which is 20% response rate, since 105 flyers were distributed in the Dutch car-free neighbourhoods. Due to the low number of responses, the results are not representative for the whole car-free neighbourhoods. However, the answers given by the respondents are useful in this research. This section will show and explain the results of the survey with the use of graphs and pie charts. The graphs about gender, age, and family composition can be found in appendix C.

### 5.2.1 Experience of child-friendliness in car-free neighbourhoods



**Figure 5.6:** *Experience of child-friendliness in car-free neighbourhoods*

Residents from the car-free neighbourhoods in Almere and Zwolle are satisfied with the child-friendliness in their neighbourhoods. By far most of the respondents think that the child-friendliness in their neighbourhood is good or even exceptionally good. This is the result of the fact, according to the literature, that there are no cars in the neighbourhoods, which increases street safety for children.

5.2.2 Opportunities to play outside in car-free neighbourhoods

What is your opinion about the following statement:  
**"Children in this neighbourhood have plenty of opportunities to play outside"**

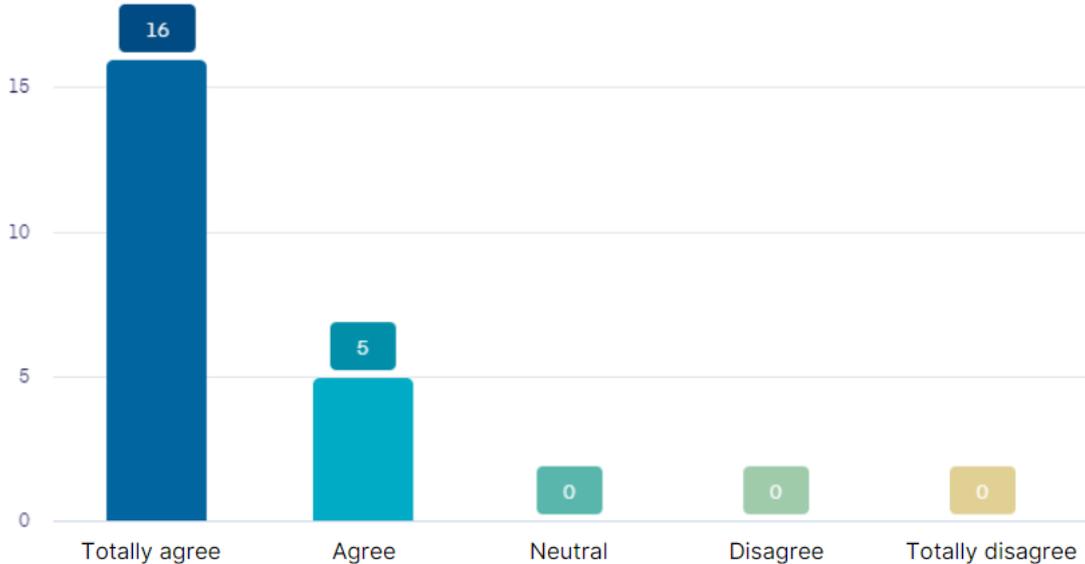


Figure 5.7: Opportunities to play outside in car-free neighbourhoods

In car-free neighbourhoods, the respondents believe that children have plenty of opportunities to play outside. By far most of the respondents totally agree with the statement shown in the graph above. The reason for this is that often the car-free neighbourhoods contain much greenery in the neighbourhood instead of car-related infrastructure, and children can play freely outside on the street without the possible danger for cars. This is in line with the existing literature, analysed in chapter 4. When walking in the neighbourhood in Almere, one person told me that the car-free neighbourhood in Almere is a bit too child-friendly, since the children just leave their bicycles and go-karts in the middle of the paths.

5.2.3 Physical health of children in car-free neighbourhoods

What is your opinion about the following statement:  
**"The physical health of children in this neighbourhood is positively influenced because this neighbourhood is car-free"**



**Figure 5.8:** *Influence car-free neighbourhood on physical health*

Most of the respondents of car-free neighbourhoods think that the physical health of children in the neighbourhoods is positively influenced due to the opportunities to play outside and have active mobility without worrying about traffic. One person disagrees with the statement in the graph above, however the reason to disagree with it is not clear. That is the disadvantage of questions with a scale of agreement, since it is not possible for respondents to elaborate on their answer.

5.2.4 Safety in car-free neighbourhoods

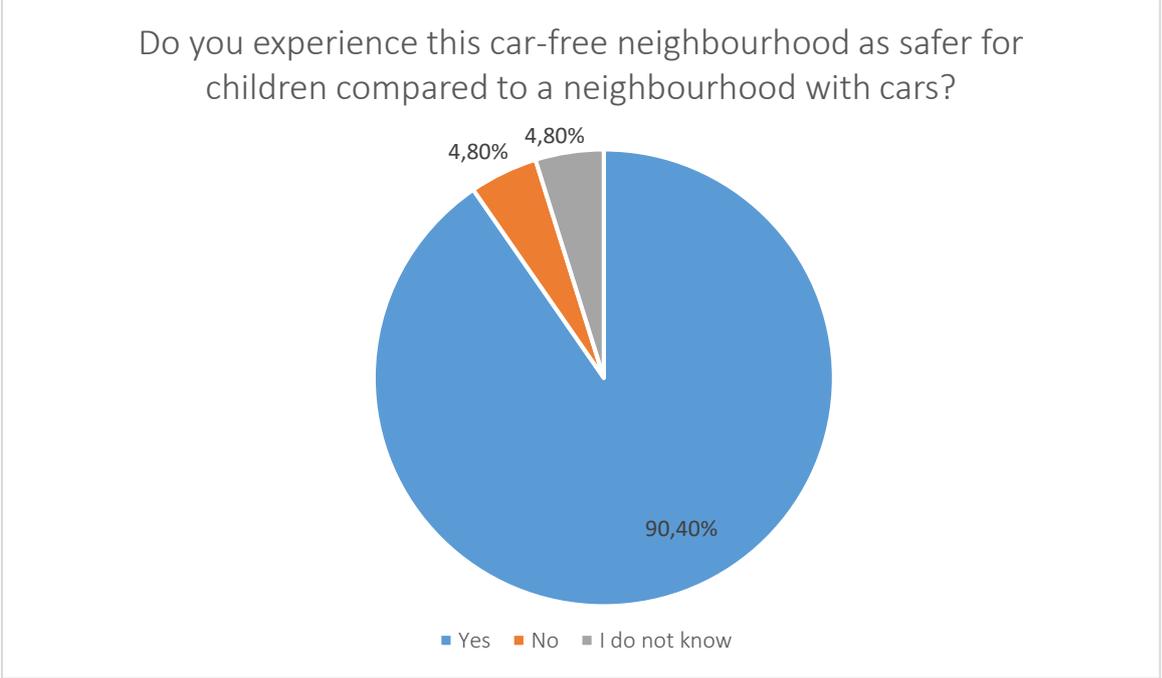


Figure 5.9: Experience of safety in car-free neighbourhood

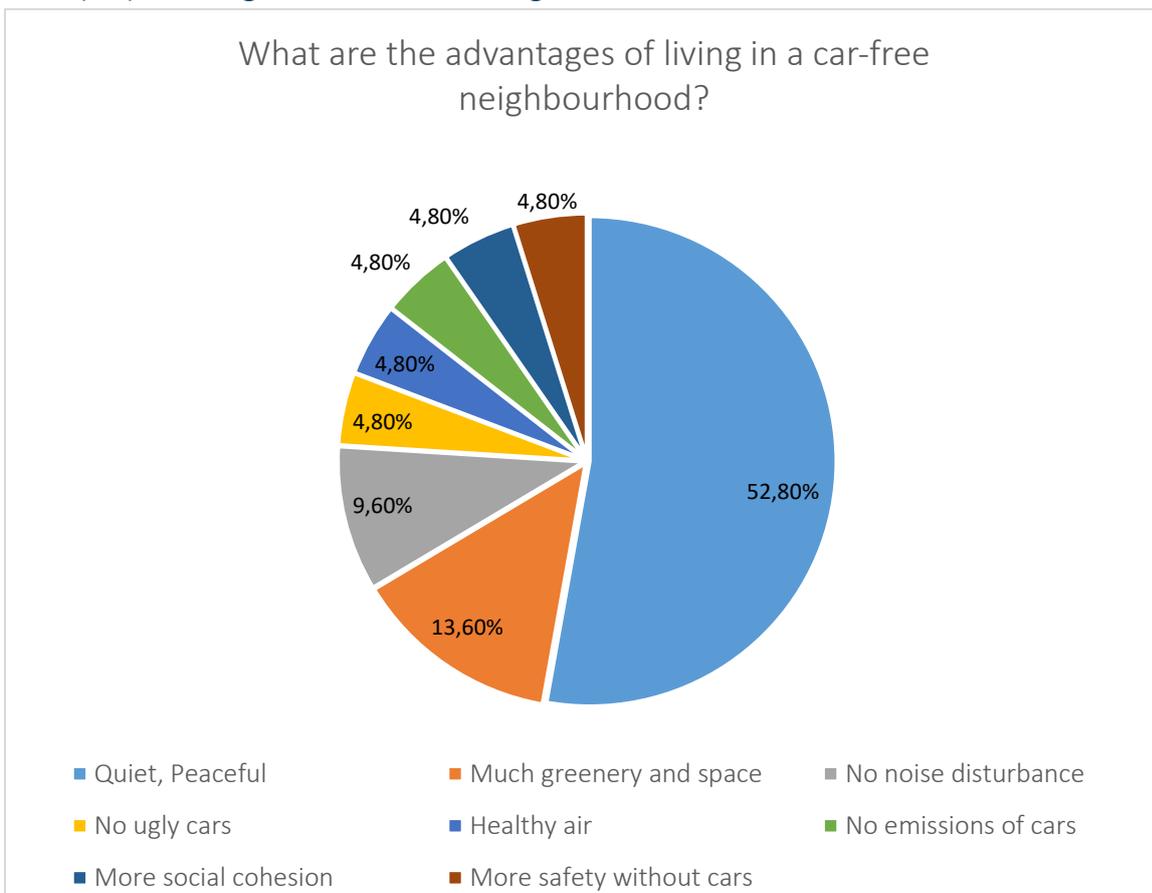
<p><b>Yes</b></p> <p><b>90,4% of respondents</b></p>	<ul style="list-style-type: none"> <li>- Freedom to play in this neighbourhood.</li> <li>- Less risk of accidents.</li> <li>- No worries about cars or being disturbed by cars.</li> <li>- More safe.</li> <li>- More space to explore, play, and meet each other without danger of cars.</li> <li>- No emissions of unhealthy gases.</li> <li>- Positive influence on physical health.</li> </ul>
<p><b>No</b></p> <p><b>4,8% of respondents</b></p>	<ul style="list-style-type: none"> <li>- In surrounding neighbourhoods with cars, people drive carefully and there is still a lot of greenery and space.</li> </ul>

I don't know	- No reason
4,8% of respondents	

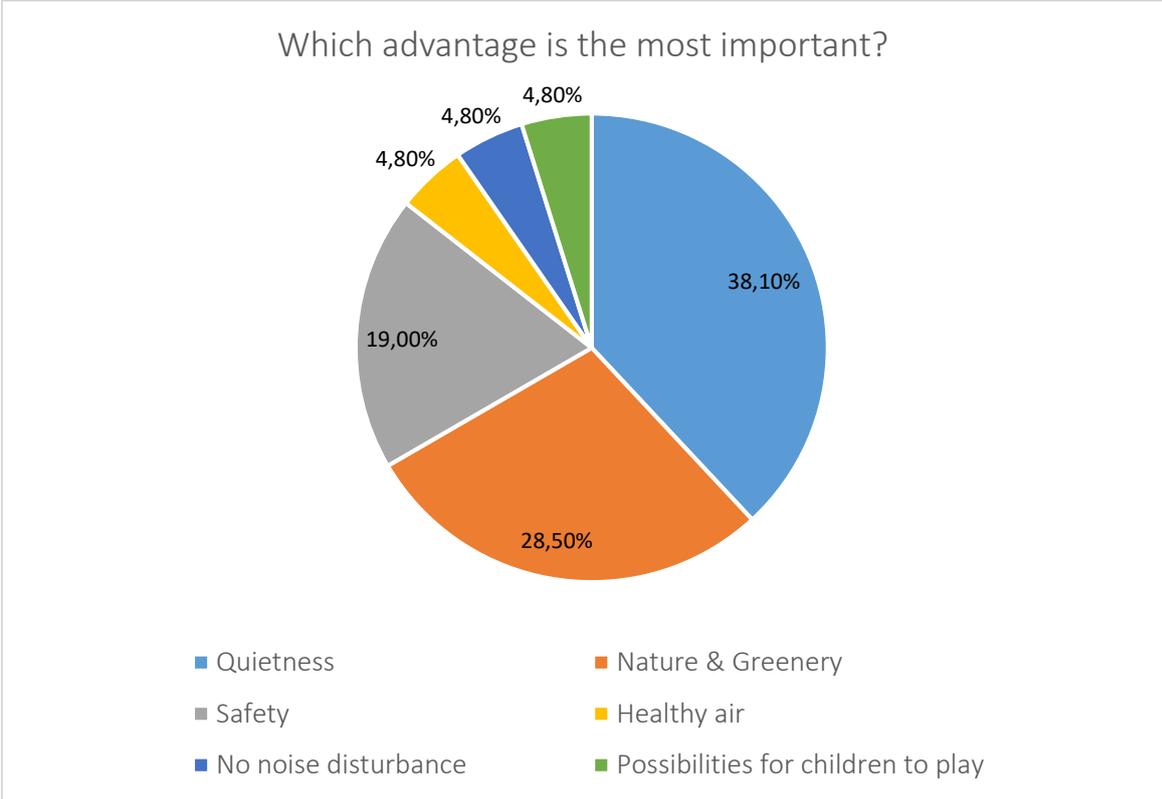
**Table 5.1:** *Safety experience car-free neighbourhood*

More than 90% of the respondents think that the car-free neighbourhood is safer for children compared to a car-present neighbourhood. The reason for this is that they think that a car-free neighbourhood increases the freedom of movement of children in the neighbourhood and there is less risks of accidents. Other reasons are that a car-free neighbourhood has a positive influence of physical health and that there are no emissions of unhealthy gases in a car-free neighbourhood. One person thinks that a car-free neighbourhood is not safer than a car-present neighbourhood since people drive carefully in neighbourhoods with children. From the observation of the table above, we can state that almost everyone thinks that a car-free neighbourhood is safer for children than a car-present neighbourhood.

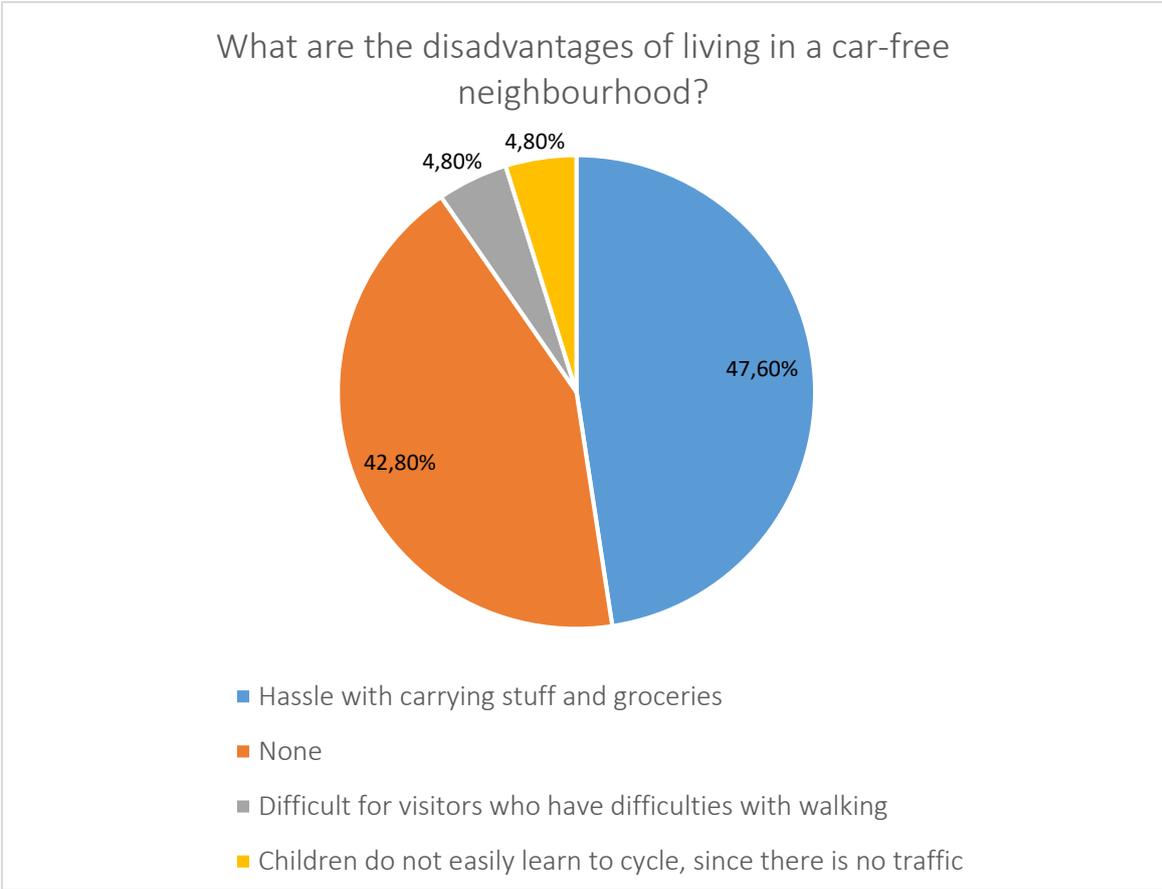
### 5.2.5 (Dis)advantages of the car-free neighbourhood



**Figure 5.10:** *Advantages of the car-free neighbourhood*



**Figure 5.11:** *Most important advantage of the car-free neighbourhood*



**Figure 5.12:** *Disadvantages of the car-free neighbourhood*

When asking residents from car-free neighbourhoods about the advantages and disadvantages of living in a neighbourhood without cars, the respondents stated that there are more advantages than disadvantages. Especially the quietness, space and greenery in car-free neighbourhoods are important advantages, as well as the safety within the neighbourhood without cars. Although the respondents think there are lots of advantages, there are also some disadvantages. Residents sometimes struggle with carrying heavy stuff and groceries, but one respondent mentioned that often there is a handcart available in the neighbourhood to make it much easier to walk with groceries to their houses. Another disadvantage which was mentioned, is that the development of children could be a bit behind, for example when learning to cycle. Children in car-free neighbourhoods do not learn to deal with cars and other traffic, and that is a disadvantage from growing up in a car-free neighbourhood about children’s development.

5.2.6 Child-friendliness in car-free neighbourhoods

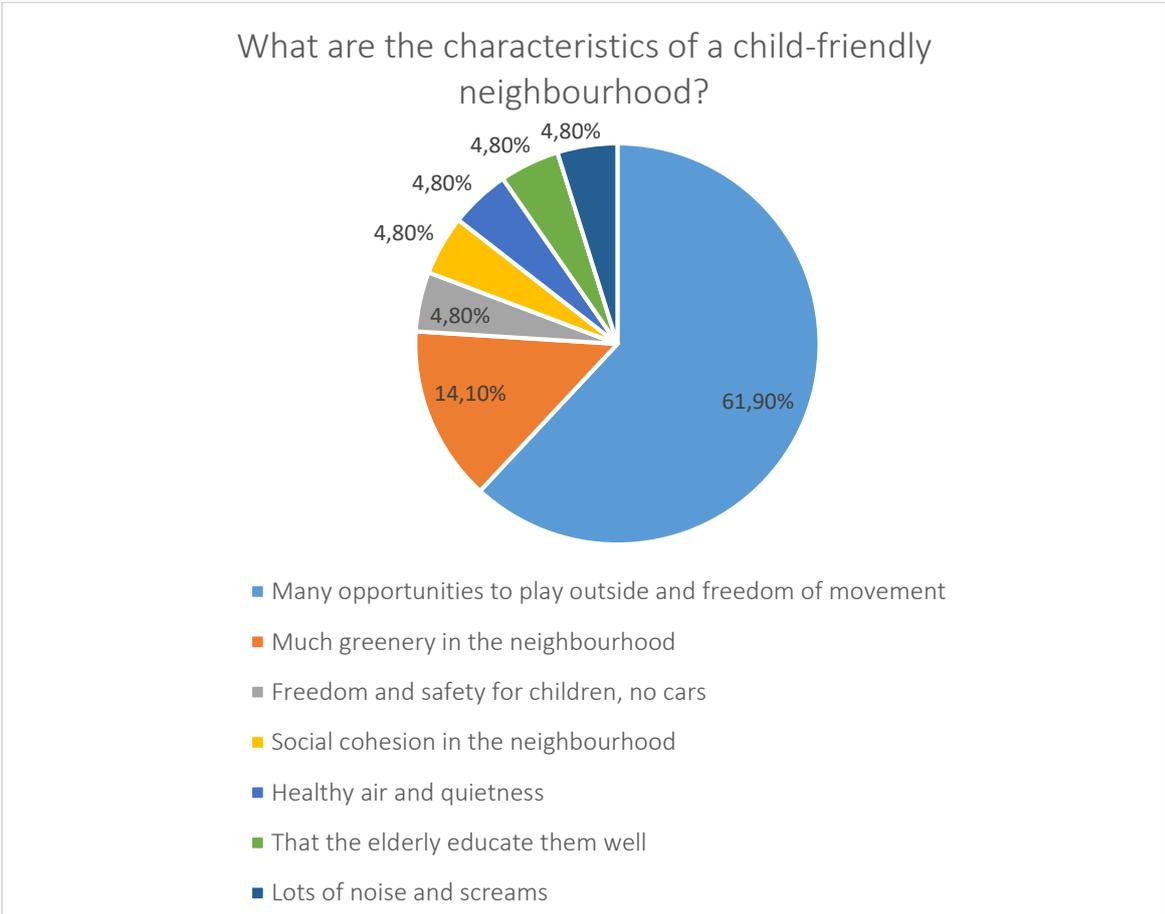
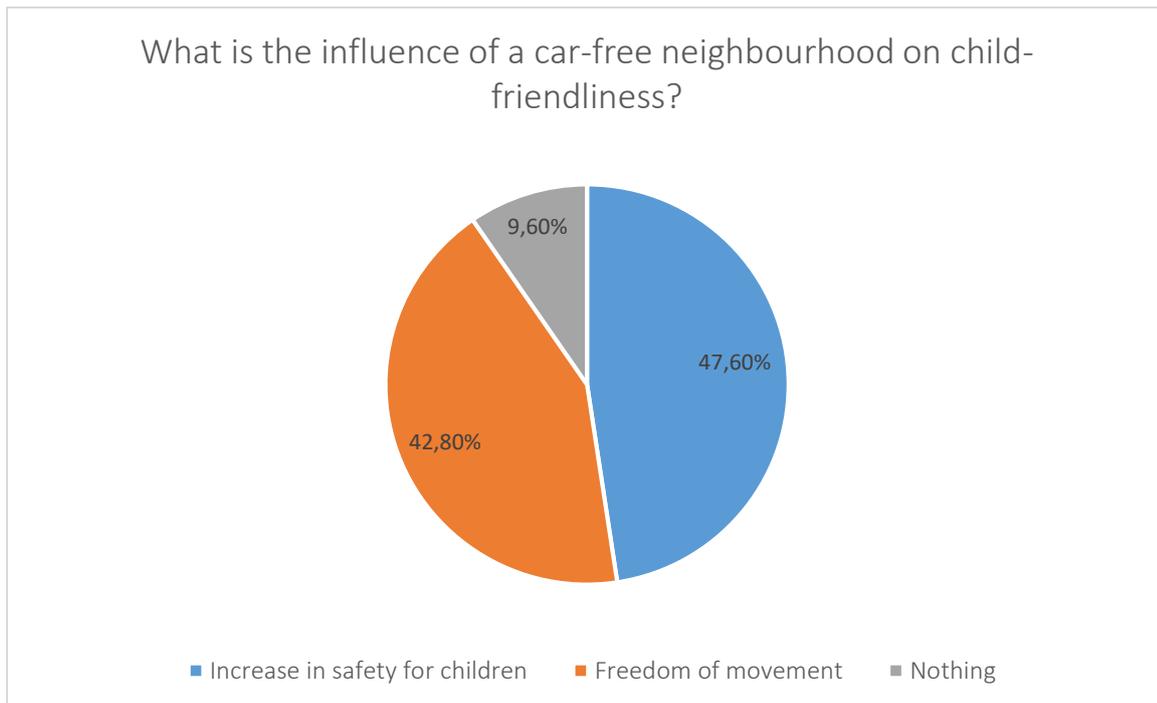
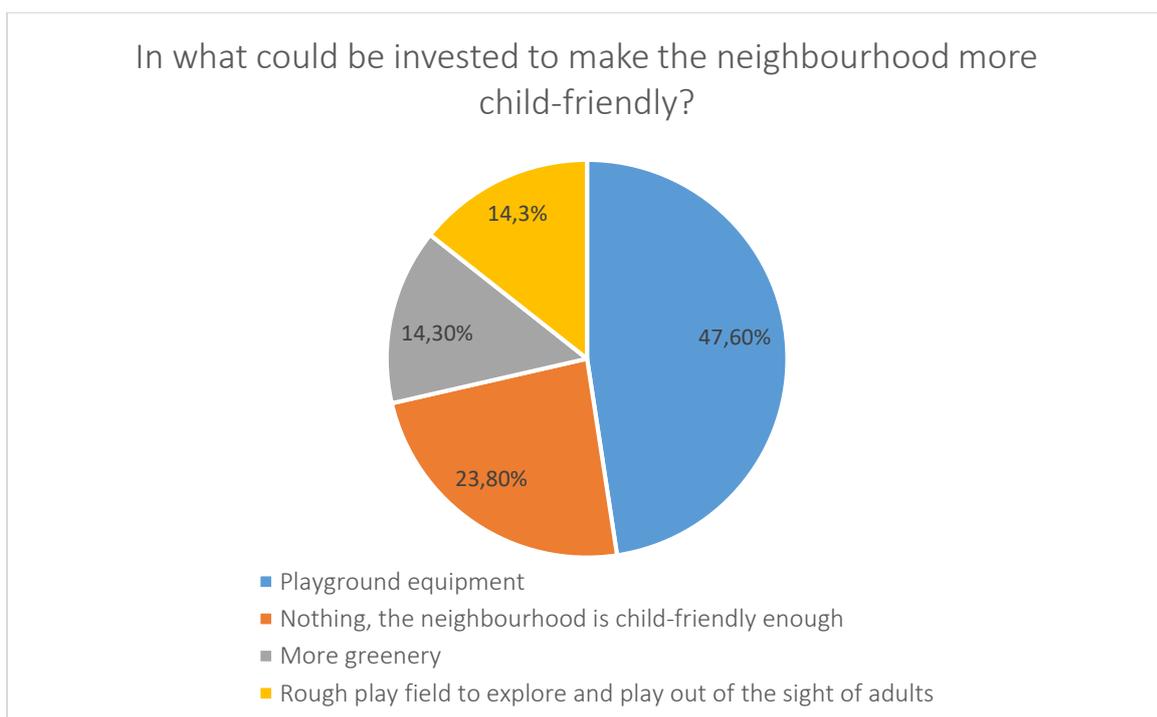


Figure 5.13: Characteristics of a child-friendly neighbourhood



**Figure 5.14:** *Influence of a car-free neighbourhood on child-friendliness*



**Figure 5.15:** *Possible investments to make the car-free neighbourhood more child-friendly*

There are many opportunities for children to play outside in car-free neighbourhoods. Furthermore, children have much freedom of movement since the car-free neighbourhoods are safer. This makes clear that living in a car-free neighbourhood as a child increases the opportunities to play freely outside and that the parents of these children do not have to look after their children every single time of the day.

### 5.3 Reflection car-free neighbourhoods

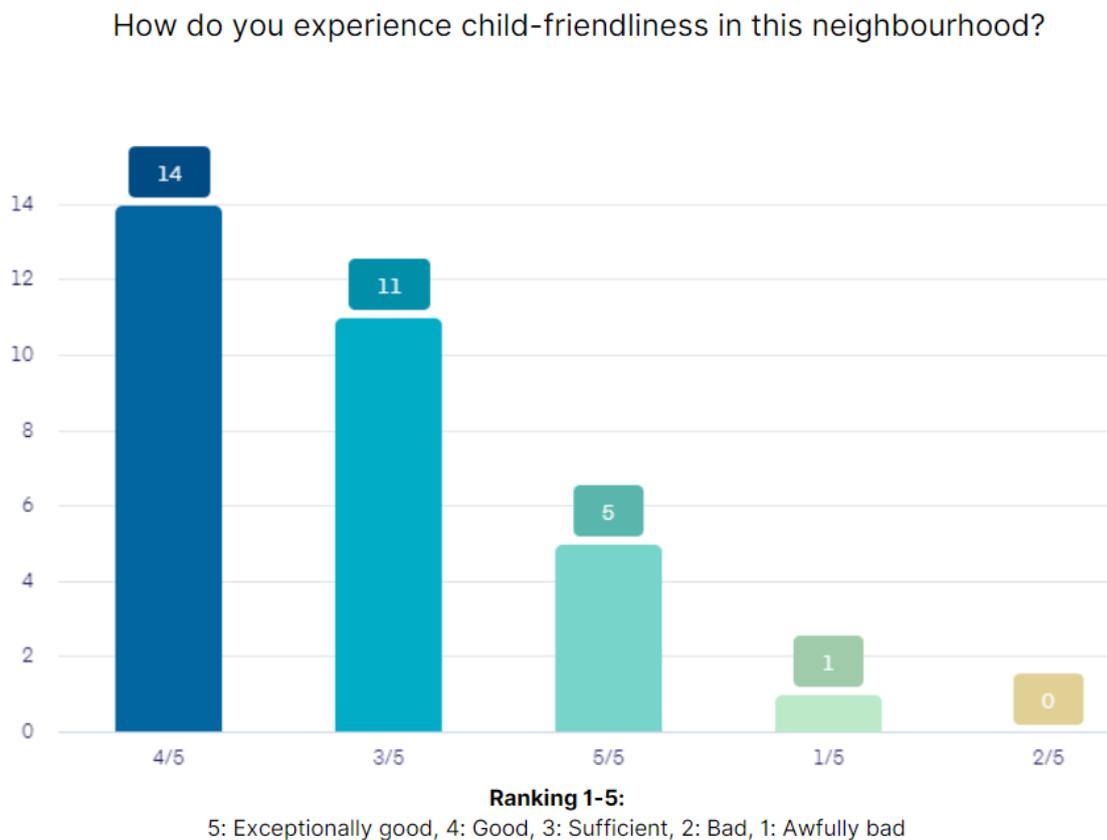
According to the respondents of the survey, street safety in car-free neighbourhoods is increased due to the lack of cars. The experience of child-friendliness in these neighbourhoods is on average exceptionally good, because children can play freely outside without the possible danger of cars. Furthermore, the opinion of respondents is that the physical health of children is positively influenced due to the lack cars. This is in line with the literature since it was already mentioned that the absence of cars would increase safety, opportunities to play outside for children, and health. People's opinion about the advantages of car-free neighbourhoods are in line with the existing literature and the three international cases. One resident told me that people often meet and help each other when necessary, which corresponds to the literature in which it is stated that social cohesion is often increased in car-free neighbourhoods.

However, not only the lack of cars is important to increase the child-friendliness of a neighbourhood. Although the residents from the car-free neighbourhoods think the neighbourhoods are very much child-friendly, there is still room for improvement. According to the survey results, investments could be made in playground equipment, more greenery, and a play field to make the car-free neighbourhoods even more child-friendly. This means that the implementation of a car-free neighbourhood not automatically means that the neighbourhood is child-friendly, and other factors such as play facilities do also have an important role in the child-friendliness of a neighbourhood.

## 5.4 Survey results analysis car-present neighbourhoods

After distributing flyers in car-present neighbourhoods, in total 31 residents responded. In the neighbourhood 'Tersluis' in Groningen, 21 people responded, and in the neighbourhood 'Vreebergen' in Assen, 10 people responded. The response rate is approximately 11%, since 280 flyers were distributed in the car-present neighbourhoods. The low number of responses results in the fact that these responses are not completely representative for the whole car-present neighbourhoods. This section will explain the results with the use of graphs and tables. The graphs about gender, age, and family composition can be found in appendix D.

### 5.4.1 Experience of child-friendliness in car-present neighbourhoods



**Figure 5.16:** Experience of child-friendliness in car-present neighbourhoods

When asking the residents of car-present neighbourhoods about the child-friendliness in the neighbourhoods, the responses are dispersed. Most of the respondents think the child-friendliness in their car-present neighbourhoods is good, but also many respondents think it is sufficient. Furthermore, one person thinks that the child-friendliness in the neighbourhood is awfully bad. The reason for this is the possible danger of cars in the neighbourhoods, but it could also be related to the few possibilities for children to play outside.

5.4.2 Opportunities to play outside in car-present neighbourhoods

What is your opinion about the following statement:  
**"Children in this neighbourhood have plenty of opportunities to play outside"**

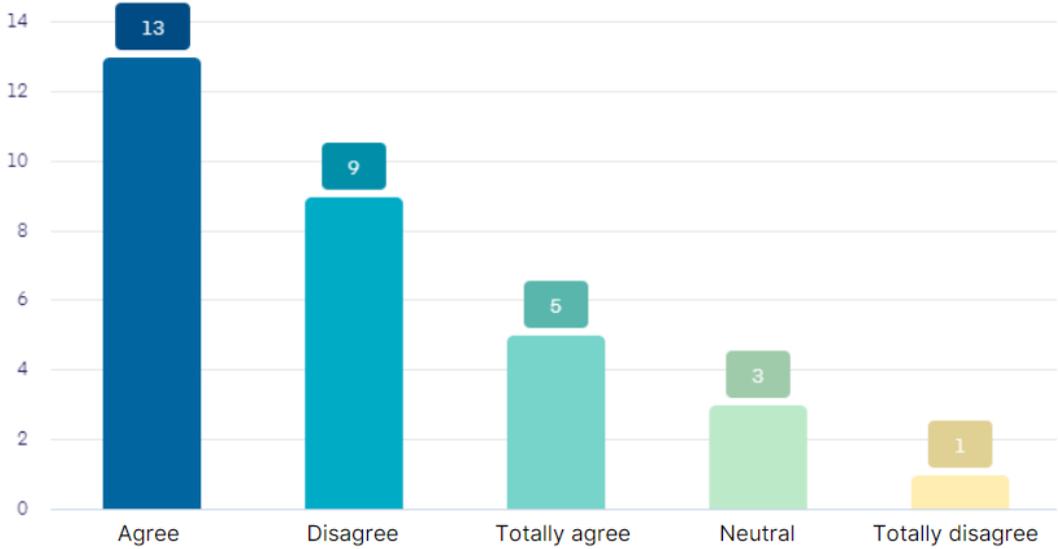


Figure 5.17: Opportunities to play outside in car-present neighbourhoods

The responses on the question about the opportunities for children to play outside were again dispersed. Most of the people do agree with the statement, however there are also people who disagree. From this result, it is not possible to state a clear conclusion about this statement in car-present neighbourhoods. However, according to the survey results, there are less opportunities for children to play outside in car-present neighbourhoods compared to car-free neighbourhoods.

5.4.3 Physical health of children in car-present neighbourhoods

What is your opinion about the following statement:  
**"The physical health of children in this neighbourhood is negatively influenced because this neighbourhood is car-present"**

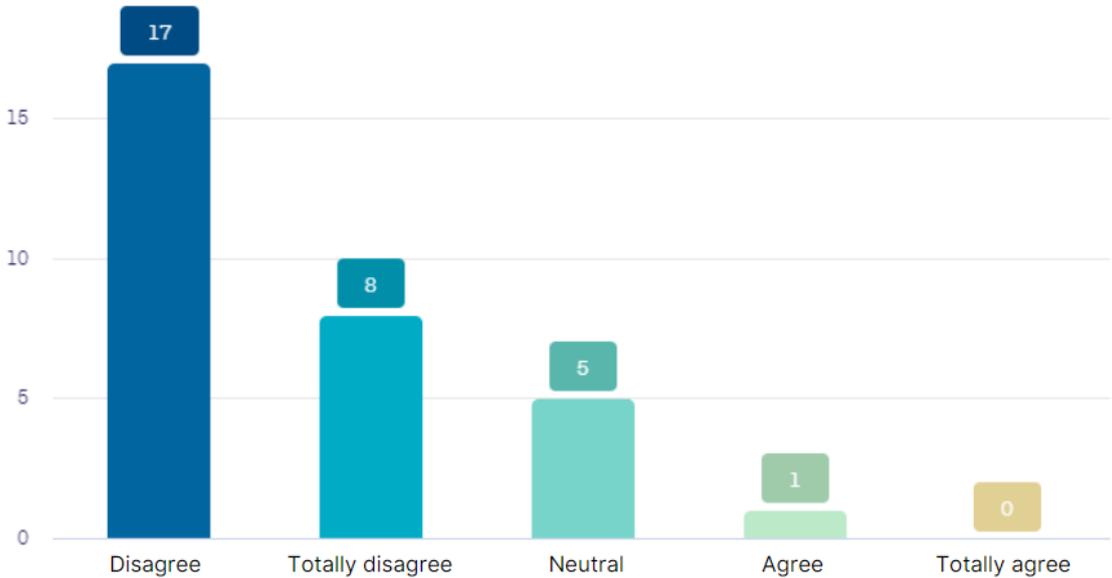


Figure 5.18: Influence car-present neighbourhood on physical health

The responses from residents of car-present neighbourhoods about the physical health of children in their neighbourhoods are clear. Most of the respondents think that the physical health of children is not negatively influenced because of the cars in the neighbourhood. The reason for this is that although there are cars in the neighbourhood and the possible danger of cars, children are still able to walk on the sidewalk and cycle on the streets and bike paths. This means that children do have the opportunities to make use of active mobility, and therefore the physical health is not negatively influenced by the cars in the neighbourhoods.

#### 5.4.4 (Dis)advantages of the car-free neighbourhood

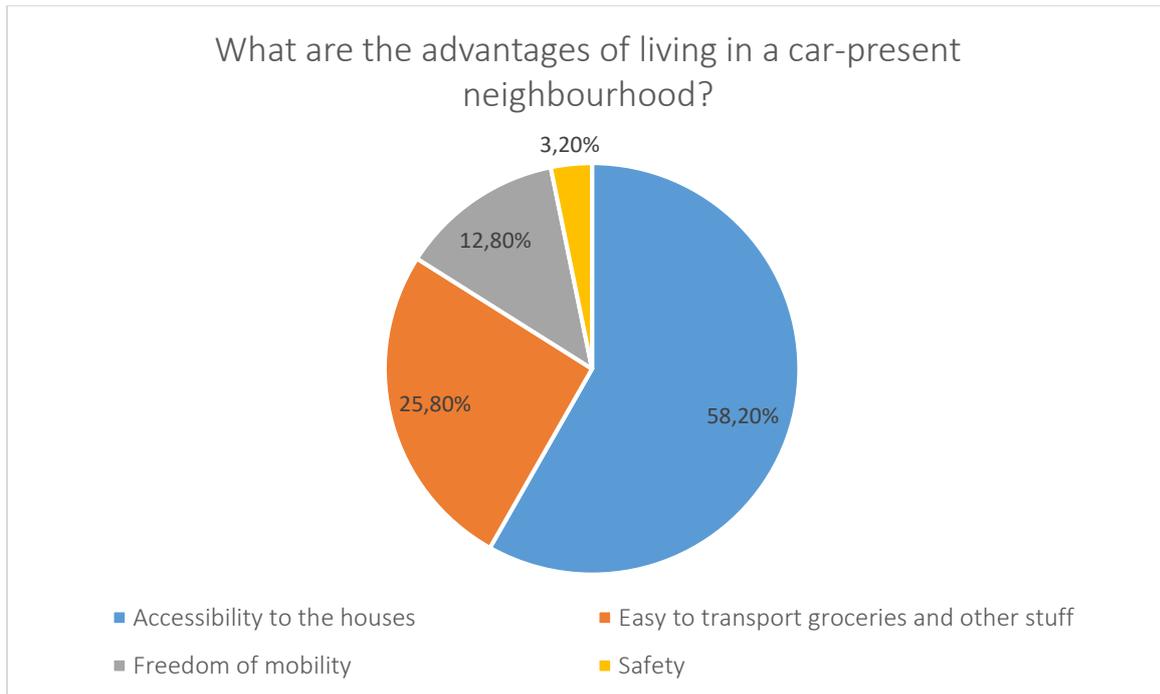


Figure 5.19: Advantages of the car-present neighbourhood

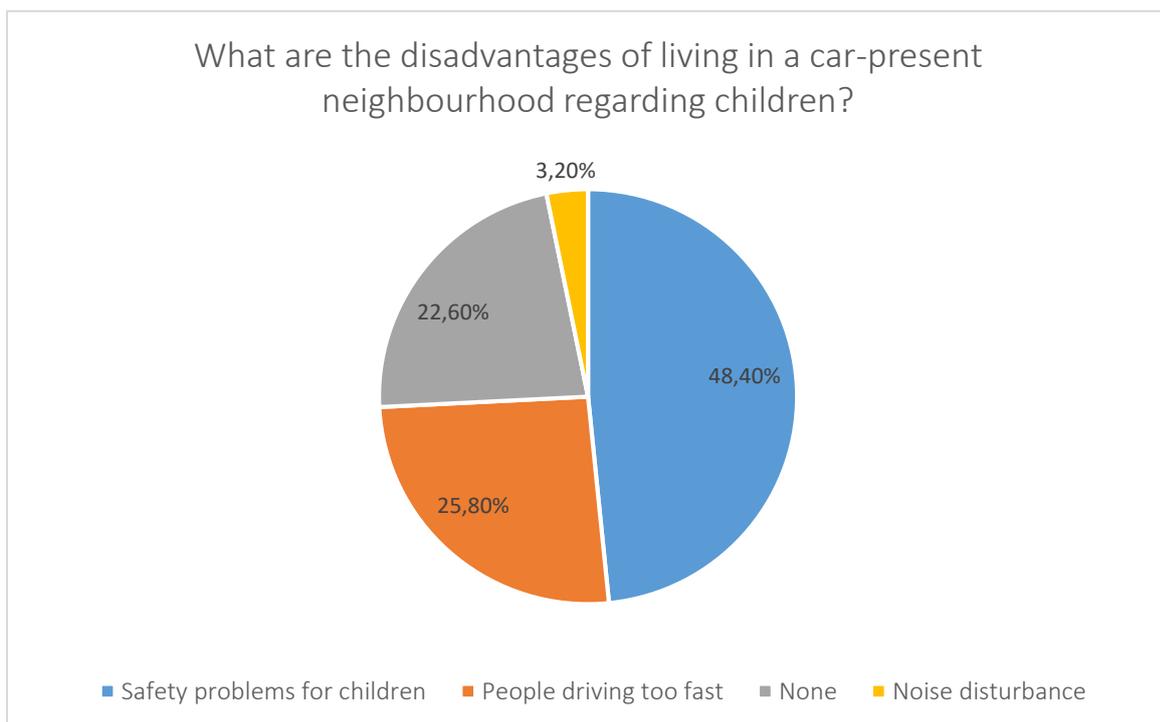


Figure 5.20: Disadvantages of the car-present neighbourhood

In the car-present neighbourhoods, the advantages are that the houses are easily accessible, that it is easy to transport groceries and other stuff from and to the houses, and the freedom of mobility, according to the respondents of the survey. However, one of the responses was that safety another advantage of the car-present neighbourhood is. This response is unexpected, since in general the cars in neighbourhoods cause problems regarding safety. That is also visible when looking at the responses about the disadvantages of car-present neighbourhoods, since almost half of the respondents think that safety issues are a disadvantage of the car-present neighbourhoods. Furthermore, disadvantages are that people drive too fast in the neighbourhood, and one person thinks that noise disturbance is also a disadvantage. Most of the responses are in line with already existing knowledge about the advantages and disadvantages of car-present neighbourhoods.

### 5.4.5 Experience of difficulties regarding cars

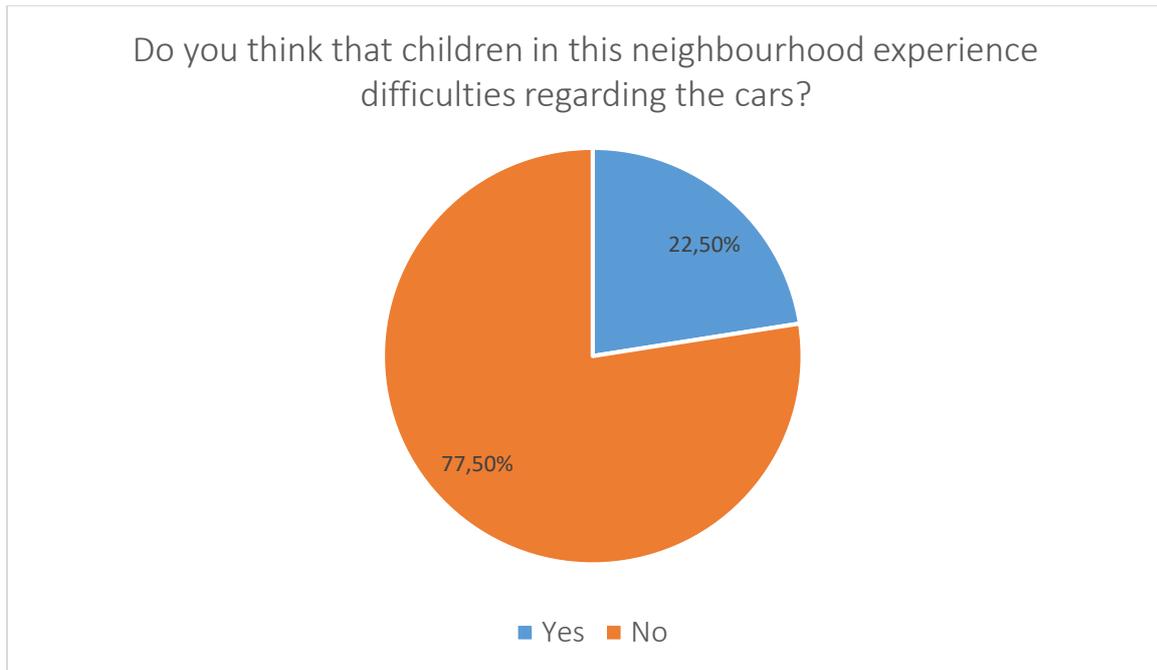


Figure 5.21: Experience of difficulties regarding the cars

<p><b>Yes</b></p> <p>22,5% of respondents</p>	<ul style="list-style-type: none"> <li>- Safety issues.</li> <li>- Especially places with schools and parks.</li> <li>- Lot of people who drive too fast.</li> <li>- High bushes, no overview for children and drivers.</li> </ul>
<p><b>No</b></p> <p>77,5% of respondents</p>	<ul style="list-style-type: none"> <li>- It could be educational for children and the right way to learn how to deal with cars and the possible danger.</li> <li>- Residents drive slowly since they take the children into account in the neighbourhood.</li> <li>- Not many cars in the neighbourhood.</li> <li>- Enough opportunities to play safely in the neighbourhood.</li> </ul>

Table 5.2: Experience of difficulties in car-present neighbourhoods

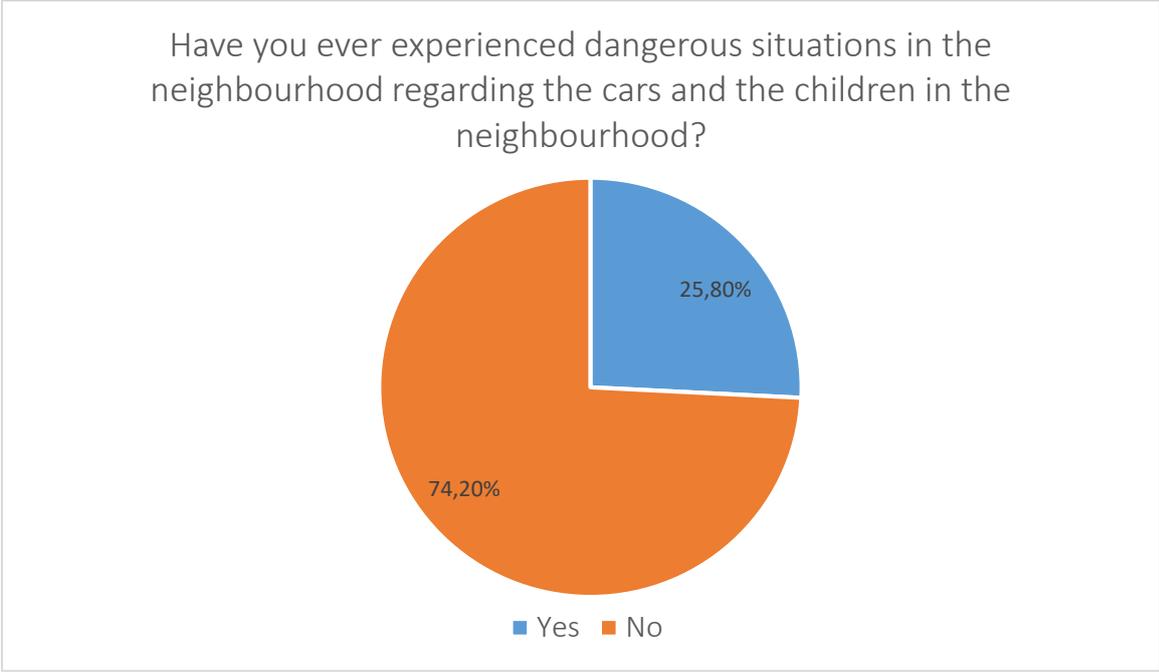


Figure 5.22: Experience of dangerous situations in car-present

<p><b>Yes</b></p> <p>25,8% of respondents</p>	<ul style="list-style-type: none"> <li>- Safety issues for children.</li> <li>- Children who did not watch for cars when crossing the road.</li> <li>- Lot of people who drive too fast.</li> <li>- Difficulties with traffic rules in the neighbourhood.</li> </ul>
<p><b>No</b></p> <p>74,2% of respondents</p>	<ul style="list-style-type: none"> <li>- Residents drive slowly since they take the children into account in the neighbourhood.</li> <li>- Not many cars in the neighbourhood.</li> </ul>

Table 5.3: Experience of dangerous situations in car-present neighbourhoods

As explained in the previous section about advantages and disadvantages of car-present neighbourhoods, one of the disadvantages according to the respondents is that there might be safety issues for children regarding the cars in the neighbourhood. However, when looking at the responses in the table above, about three-quarters of the respondents do not think that children experience difficulties with cars in the neighbourhood, and they did not experience dangerous situations with children and cars in the neighbourhoods. They state that people take the children into account and often the people drive relatively slowly. Furthermore, some respondents state that it could be educational for children to learn how to deal with cars and the possible danger. One respondent used an inspiring sentence to make clear that the children

do not experience difficulties in the neighbourhood regarding cars: “Cars are part of the society, if used responsibly”.

### 5.4.6 Child-friendliness in car-present neighbourhoods

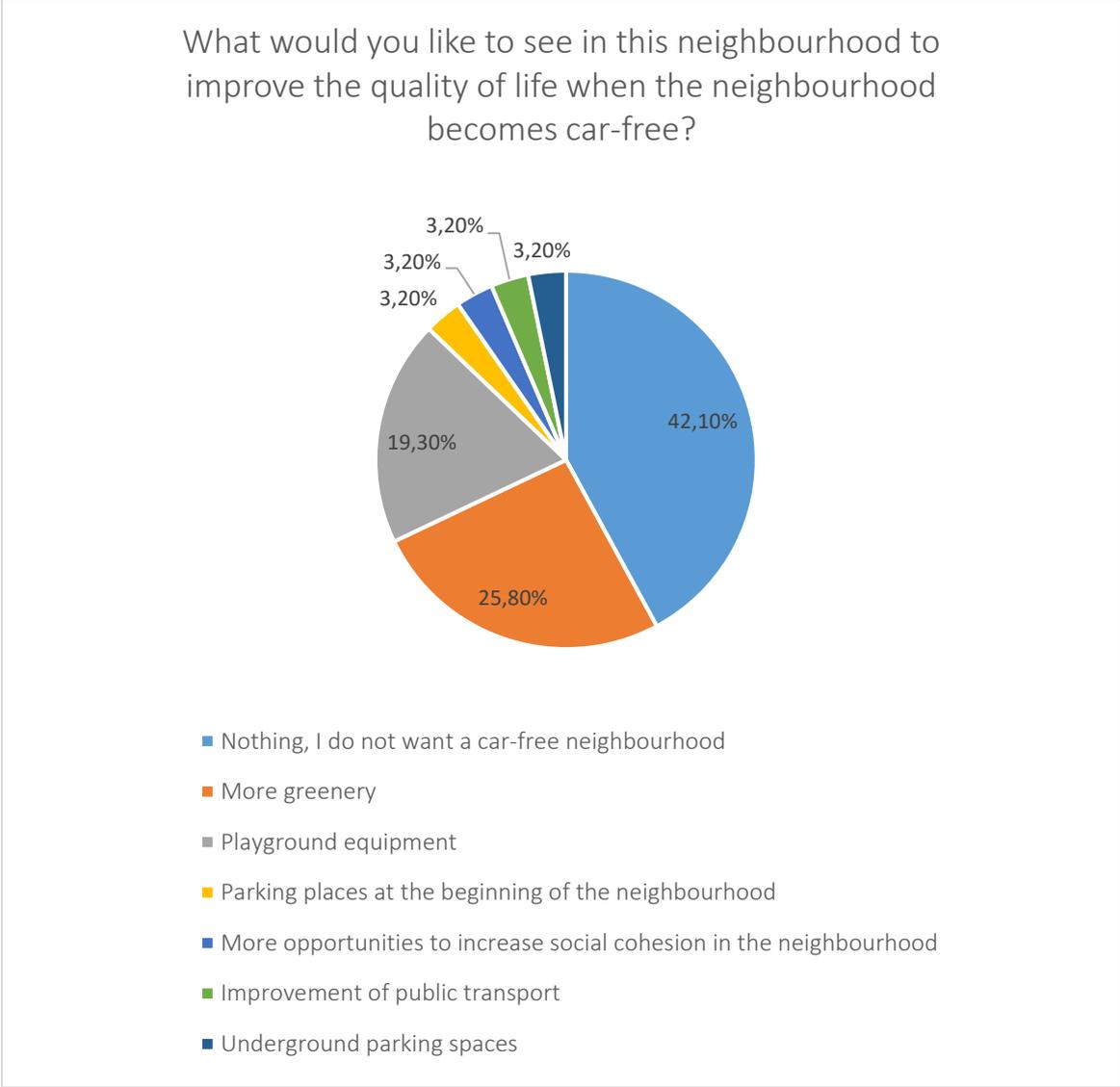


Figure 5.23: Possible investments to improve the neighbourhood when it becomes car-free

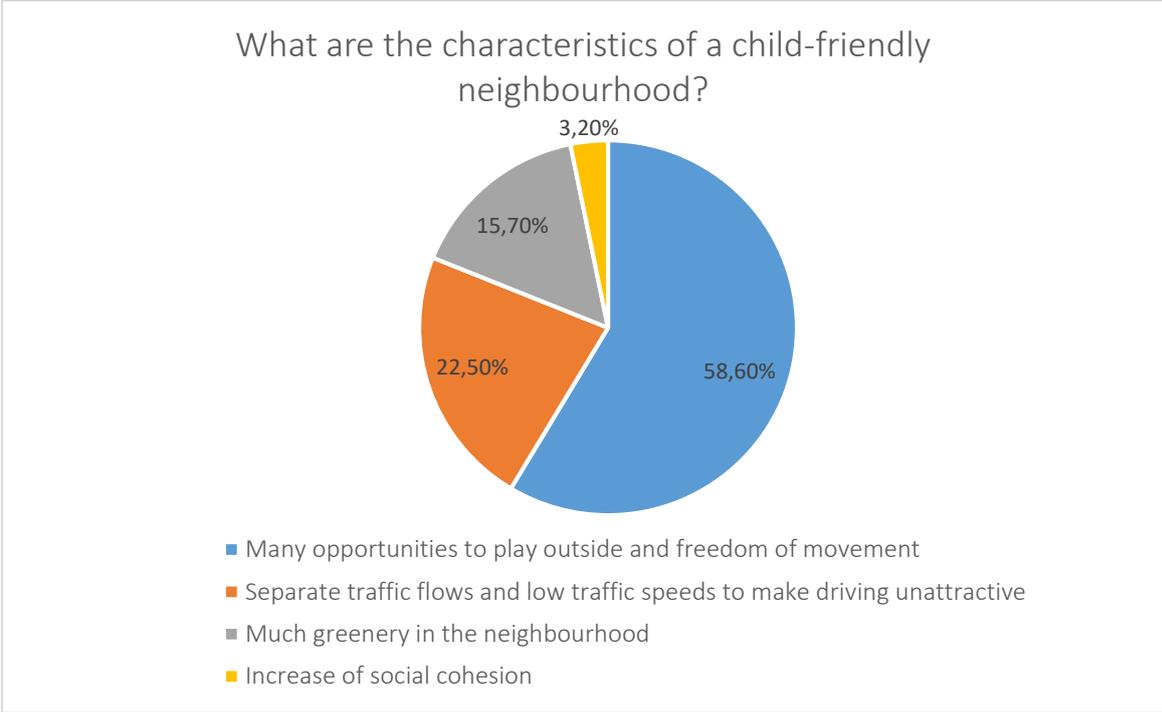


Figure 5.24: Characteristics of a child-friendly neighbourhood

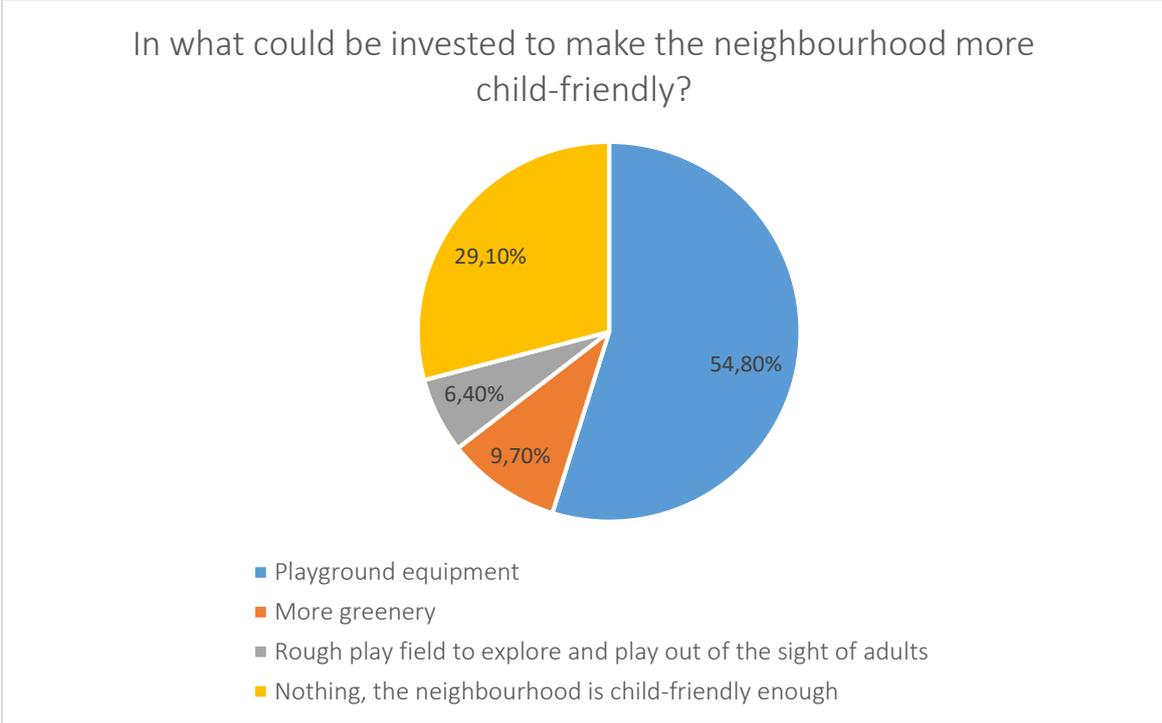
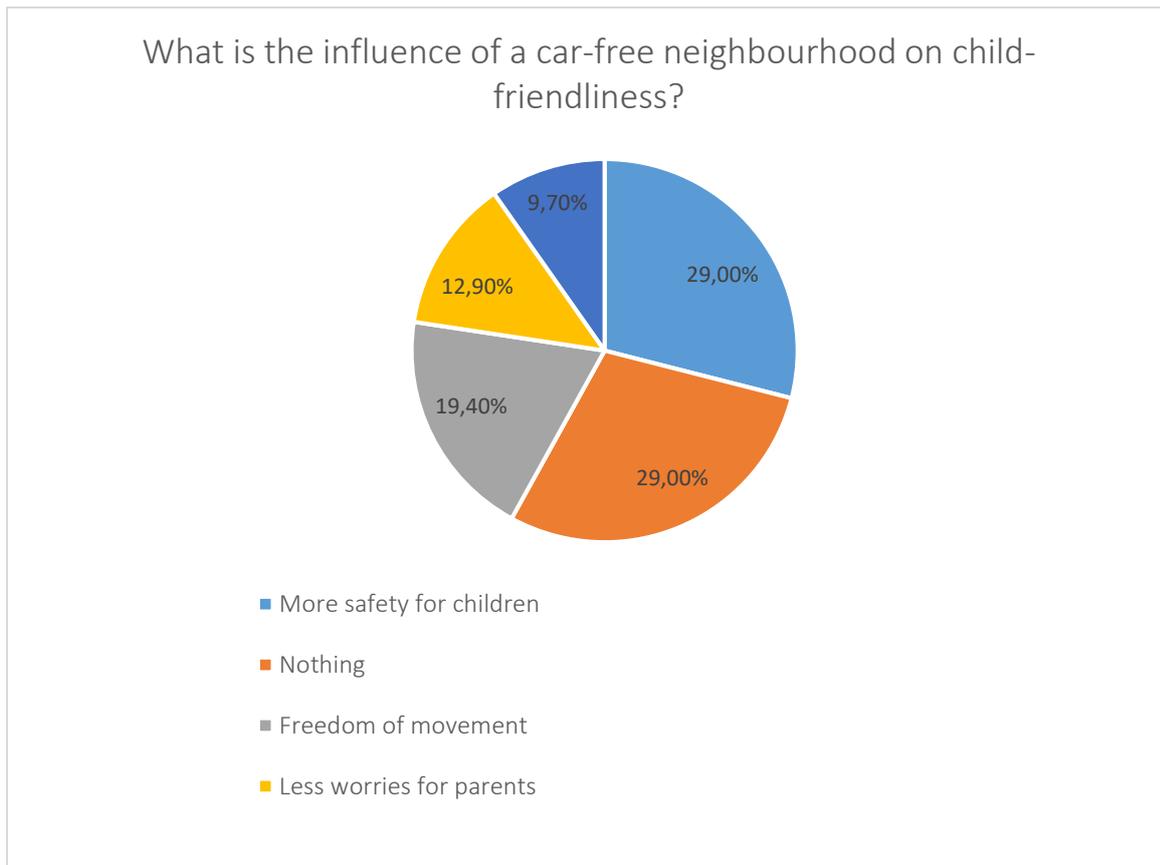


Figure 5.25: Possible investments to make the car-present neighbourhood more child-friendly



**Figure 5.26:** *The influence of a car-free neighbourhood on child-friendliness*

The survey responses show that there are still investments possible to make the neighbourhoods more child-friendly. It is stated that greenery, playgrounds, and play equipment are important factors to increase child-friendliness in a neighbourhood.

### 5.5 Reflection car-present neighbourhoods

The average of the ranking of the experience of child-friendliness in car-present neighbourhoods is 3,7. This average is lower than the average in car-free neighbourhoods, which is 4.5. Therefore, according to this result, it is possible to state that child-friendliness is higher in car-free neighbourhoods and this could be the result of the disadvantages of cars. This results strengthens the knowledge gained from the literature, since it is stated that the absence of cars increase child-friendliness. When looking at the opportunities for children to play outside, it is possible to say that, according to these survey results, the thoughts of the respondents are that children in car-free neighbourhoods have more opportunities to play freely outside compared to children in car-present neighbourhoods. The reason for this is that children in car-free neighbourhoods do not have to watch out for cars, and thus they are more able to play outside without worry according to the residents.

The physical health of children in car-present neighbourhoods is not negatively influenced because of the presence of cars, according to the residents of the car-present neighbourhoods. This is contrary to the literature since it is stated that the presence of cars decrease the opportunities of physical activity in neighbourhoods. An interesting remark which is made by

the respondents from the car-present neighbourhoods, is that the presence of cars could be educational for children to learn how to deal with cars and the possible danger.

When looking at the responses about child-friendliness in car-present neighbourhoods, interesting to see is that almost half of the respondents do not want their neighbourhood to be car-free. This is in line with the already existing knowledge about car-free neighbourhoods, namely that it is not easy to just implement a car-free neighbourhood, but that residents of such a neighbourhood are really convinced and motivated to live without cars in their neighbourhood. However, to make these neighbourhoods more child-friendly, people would like to see more greenery and playground equipment. This is relatively similar to the responses from residents of car-free neighbourhoods and the existing literature. According to the responses on the survey, the ideas and opinions about child-friendly investments in neighbourhoods are almost equal in both the car-free and car-present neighbourhoods. In both the car-free and car-present neighbourhoods, investments are possible to improve the child-friendliness of the neighbourhoods.

## Chapter 6. Conclusion

In this research, the central question was: *“To what extent could a car-free neighbourhood contribute to child-friendliness?”* This research is of importance because of the enormous growth in car-use in the last decades with the associated problems. These problems contribute to the decrease of wellbeing of children, since the problems decrease the physical activity of children, as well as the road safety, accessibility, active transportation, and social interaction. Based on already existing literature, it is clear that a reduction in cars lead to less accidents and the decrease of cars in neighbourhoods lead to less air pollution and a reduction in mortality. After an in-depth analysis of three international case studies, it was clear that car-free neighbourhoods are also beneficial to the environment, health and social cohesion within a neighbourhood. It increases the physical activity opportunities for children which is directly linked to an increase in health. The literature has furthermore shown that it cities and towns are less and less suitable for children because of the growing urbanization and the relation between child-friendly environments and cars became clear. In car-present neighbourhoods, children struggle with the presence of cars. Therefore, child-friendly neighbourhoods and implementations are necessary.

With the use of surveys in two car-free neighbourhoods and two car-present neighbourhoods in the Netherlands, this research compared child-friendliness in car-free neighbourhoods and car-present neighbourhoods. Opinions about the physical health of children in neighbourhoods are similar in both the car-free neighbourhoods and car-present neighbourhoods. However, there is a difference between the opinions regarding child-friendliness and safety. Most of the answers were in line with the existing literature and the information about the three international case studies. Furthermore, it is possible to say that children in car-free neighbourhoods have more opportunities to play freely outside compared to children in car-present neighbourhood which is also in line with already existing academic articles. Besides this, the survey responses made clear that there are still investments possible in both the car-free and car-present neighbourhoods to make the neighbourhoods more child-friendly. Investments could be made in playgrounds, play fields, or greenery, which are the necessary conditions to make a neighbourhood child-friendly. From this fact, it is possible to conclude that a car-free neighbourhood is not immediately child-friendly.

Although this research has shown that the absence of cars has beneficial influences on child-friendliness in neighbourhoods, the implementation of a car-free neighbourhood is not enough to create a child-friendly neighbourhood. It might even be that children do not learn to deal with traffic when growing up in a car-free neighbourhood, which might result in a developmental delay. Although this is only an assumption, it is interesting to do further research about the possible developmental delay of children living in car-free neighbourhoods. To increase child-friendliness, it is necessary to look beyond just banning cars in neighbourhoods. Further research can be done to get an insight in the possible combination of the presence of cars in neighbourhoods and the implementation of child-friendly facilities such as playgrounds and play fields.

## Chapter 7. Discussion

Although this research shows convincing results about the perception of car-free neighbourhoods and the effect on child-friendliness, there is room for improvement. Firstly, not many people responded on the flyer to fill in the survey. As said before, about 20% of the residents from car-free neighbourhoods have completed the survey, and about 10% of the residents from car-present neighbourhoods have completed the survey. This low number of respondents is not representative for the whole population of car-free neighbourhoods and car-present neighbourhoods. Because of this low number of responses, it is impossible to state that there is significant evidence found that car-free neighbourhoods contribute to child-friendliness. Additionally, the use of statistical programs such as SPSS was not suitable because of the low number of respondents. Despite this low number of respondents, it was decided to not visit the neighbourhoods again to talk directly to the residents, because of the current COVID-19 pandemic and the associated measures.

Besides this, the scale of agreement used in the surveys was not always useful. Some of the answers on these questions were surprising. Further explanation why respondents gave the surprising answers on the questions with the scale of agreement was not possible, and therefore the reason to give these unexpected answers was not always clear.

Furthermore, the neighbourhoods used in this research are in four different cities in the Netherlands. Although the neighbourhoods are very much comparable to each other, it might be that the perception of car-free neighbourhoods and car-present neighbourhoods differ among the residents of the different cities. However, it was decided to use these four neighbourhoods as four Dutch case studies, since the similarities between the different neighbourhoods outweigh the possible perception differences of residents from the four different cities.

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## Chapter 9. Appendices

### Appendix A: Examples of coding strategy

<p>Pedestrianization of the public realm and increased green space offer more opportunities for social interaction (Nieuwenhuijsen et al., 2014). Markovich and Lucas (2011) synthesised and critically evaluated the literatures pertaining to the social impacts and equity of transport, transport disadvantage as it pertains to different social groups, and the wider interactions between transport poverty and social exclusion. They found a range of issues suggesting that the social and distributional impacts of transport have historically been underestimated. Schwanen et al. (2015) provided a critical review of the progress in understanding the linkages between transport disadvantage and social exclusion. It follows earlier work in proposing social capital as a concept that mediates those linkages, and they suggested that there are various fairly complex pathways. Lucas (2012) contends that transport disadvantage results in inaccessibility of goods, services, decision-making, life chances, social network and social capital, which then leads to social exclusion. More specifically, Putnam (2000) argues that the increase over time in solo driving in the USA is one of the processes that has contributed to the diminishing of the country's social capital in the period 1945–2000; Urry (2007) considers active mobility the glue that holds together social networks; Currie and Stanley (2008) hold that public transport use can strengthen social capital by providing a safety net of transport options for (economically) disadvantaged groups, encouraging high-density living and enabling social interaction with fellow users during trips. People living on streets with high traffic volume have on average less than one quarter the number of friends and social interactions than people living on streets with low traffic volumes (Appleyard, 1982; Hart and Parkhurst, 2011).</p>	<p>Ambient particulate air pollution was twelfth in the ranking of the Global Burden of Disease estimates in 2010 (Forouzanfar et al., 2015), contributing to an estimated 3–4 million premature deaths and an average 9 months life expectancy reduction in Europe (WHO, 2015). Bhalla et al. (2014) estimated that air pollution from motor vehicles is the cause of 184,000 deaths globally, including 91,000 deaths from ischemic heart disease, 59,000 deaths from stroke, and 34,000 deaths from lower respiratory infections, chronic obstructive pulmonary disease, and lung cancer; Lelieveld et al. (2015), using more sophisticated source models estimated that traffic emissions are responsible for about one-fifth of mortality by ambient PM<sub>2.5</sub> and O<sub>3</sub> in Germany, the UK and the USA, while they globally account for about 5% of the 3.3 million annual premature deaths due to outdoor air pollution. Adding the health impacts of NO<sub>x</sub>, as was recently done in London, doubles these numbers (Walton et al., 2015). Of course, deaths are only the top of the pyramid and there is an extensive range of other health effects of traffic-related air pollution (Héroux et al., 2015).</p> <p>A number of studies have shown that a reduction in air pollution can lead to a reduction in mortality and morbidity (Pope et al., 2009; Giles et al., 2011), but the numbers of studies are small and there are no studies on car free cities. However there are many studies showing the effect of the exposure to mainly traffic related air pollution on mortality (Beelen et al., 2014), lung cancer (Raaschou-Nielsen et al., 2013), cardiovascular disease incidence (Cesaroni et al., 2014), decreased lung function in children (Gehring et al., 2013; Eeftens et al., 2014), reduced cognitive function in children (Sunyer et al., 2015), respiratory infections during early childhood (MacIntyre et al., 2014), and low birth weight (Pedersen et al., 2013). Furthermore evidence is emerging for a role of</p>
<p>Car traffic causes around 1.3 million global deaths, and some 78 million injuries (Bhalla et al., 2014). In 2011, more than 30,000 people died on the roads of the European Union, i.e. the equivalent of a medium town. For every death on Europe's roads there are an estimated 4 permanently disabling injuries such as damage to the brain or spinal cord, 8 serious injuries and 50 minor injuries (European Commission, 2016). Road traffic injuries rank as the eighth leading cause of death, and are furthermore not equally distributed. Low-income and middle-income countries, where investments in road safety campaigns, safe infrastructure and technologies are generally less, account for over 90% of the world's fatalities on the roads despite having only 48% of the world's registered vehicles (WHO, 2009; WHO, 2015). Furthermore, vulnerable road users are most adversely affected. Although there is a high variability between the different regions, the highest accident rates in cities are generally for motorbike commuters, followed by active transport modes commuters (pedestrians and cyclists), then public transport commuters and finally car commuters (Rojas-Rueda et al., 2012). Studies have shown that accident rates for active transport depend on the number of cyclists resulting in a rapid decline in accidents when the numbers of cyclists increase; the so called safety in numbers effects (Jacobsen, 2003).</p> <p>A reduction in motorized traffic is expected to lead to a reduction in accidents. For example, Green et al. (2014) examined monthly traffic accident counts, based on counts reported to the police in central London before and after the congestion charge compared to several suitable controls and found a substantial and robust decline in accidents associated with the advent of the congestion charge in London. The effect of congestion charging was in the order of a reduction of 34 accidents per month when compared to other cities.</p>	<p> <b>Top left:</b> Coding example social cohesion related to transport</p> <p> <b>Top right:</b> Coding example air-pollution and health risks due to motor vehicles</p> <p> <b>Bottom left:</b> Coding example road accidents related to motor vehicles</p>

#### ANTWOORD

Meer natuur, je ziet je buren meer omdat je loopt naar de parkeerplaats, meer ruimte omdat er geen pp zijn, geen geluidsoverlast, het ziet er mooier uit, veiliger voor kinderen, meer veilige vrije bewegingsvrijheid voor kinderen, je loopt regelmatig een stukje met de klike of naar de auto. Je bent je meer bewust van de natuur omdat je er steeds doorheen loopt. Zorgt na een drukke werkdag als ik uit de auto stap voor even een korte korte rustige wandeling.

meer reuring en contacten op straat

Men rijdt minder hard, het is rustiger, veiliger en kinderen krijgen de tijd zelf beter op te letten

Minder blik, dus mooier om naar te kijken, Meer groen. Minder lawaai.

Geen blik voor de deur, Geen herrie van auto's

Mooi uitzicht, Rust.

- = Greenery
- = Social cohesion
- = Available space
- = quiet, peaceful
- = Safety
- = Appearance

#### Translation of text:

More nature, you see your neighbours more often since you walk to the parking places, more space because there are no parking places, no noise nuisance, it looks nicer, safer for children, more safe freedom of movement for children, you regularly walk a bit with the bin or to the car. You are more aware of nature because you keep walking through it. After a busy day at work, when I get out of the car, it provides me a short, quiet walk.

More commotion and contacts in the street.

People drive less fast, it is quieter, safer and children get the time to pay more attention themselves.

Less cars, so more beautiful to look at. More greenery, less noise.

No cars in front of the door. No noise nuisance from cars.

Nice view. Peaceful.

## Appendix B: Flyer used to spread the survey

### *Flyer car-present neighbourhood*



university of  
 groningen

faculty of spatial sciences



Beste bewoner,

Mijn naam is Jorn Kremers en ik ben derdejaars student aan de Rijksuniversiteit Groningen. Ik doe de bacheloropleiding 'Spatial Planning & Design'. Op dit moment ben ik bezig met mijn scriptie om de opleiding af te ronden. De scriptie gaat over de invloed van autovrije wijken op de kindvriendelijkheid in een wijk voor kinderen tot en met 12 jaar (Basisschoolkinderen). Om dit onderzoek zo goed mogelijk uit te voeren, kan ik uw hulp goed gebruiken.

Ik wil u als bewoner van deze wijk graag een aantal vragen stellen met betrekking tot kindvriendelijkheid en de mogelijkheden voor het verbeteren van kindvriendelijkheid wanneer een wijk autovrij wordt. Via de QR-code of de link op deze flyer komt u terecht bij een online enquête. De enquête is volledig anoniem en de resultaten worden uitsluitend gebruikt voor dit onderzoek, daarnaast zullen de resultaten niet gedeeld worden met derden. U helpt mij enorm met het invullen van deze enquête.

Ik hoop u voldoende geïnformeerd te hebben. Mocht u vragen hebben, dan kunt u mij bereiken via dit e-mail adres: [j.kremers@student.rug.nl](mailto:j.kremers@student.rug.nl)

Mocht u meer willen weten over de achtergrond van het onderzoek, dan kunt u contact opnemen met mijn supervisor (Femke Niekerk) via dit e-mail adres: [f.niekerk@rug.nl](mailto:f.niekerk@rug.nl)

Alvast bedankt.

Link: <https://www.surveio.com/survey/d/U5X3A3Y9T7S7C3T9Q>

## Flyer car-free neighbourhood



university of  
 groningen

faculty of spatial sciences



Beste bewoner,

Mijn naam is Jorn Kremers en ik ben derdejaars student aan de Rijksuniversiteit Groningen. Ik doe de bacheloropleiding 'Spatial Planning & Design'. Op dit moment ben ik bezig met mijn scriptie om de opleiding af te ronden. De scriptie gaat over de invloed van autovrije wijken op de kindvriendelijkheid in een wijk voor kinderen tot en met 12 jaar (Basisschoolkinderen). Om dit onderzoek zo goed mogelijk uit te voeren, kan ik uw hulp goed gebruiken.

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Alvast bedankt.

Link: <https://www.surveio.com/survey/d/M9K7R1N9M1F2O9Y2E>

### Text on the flyer translated to English:

Dear resident,

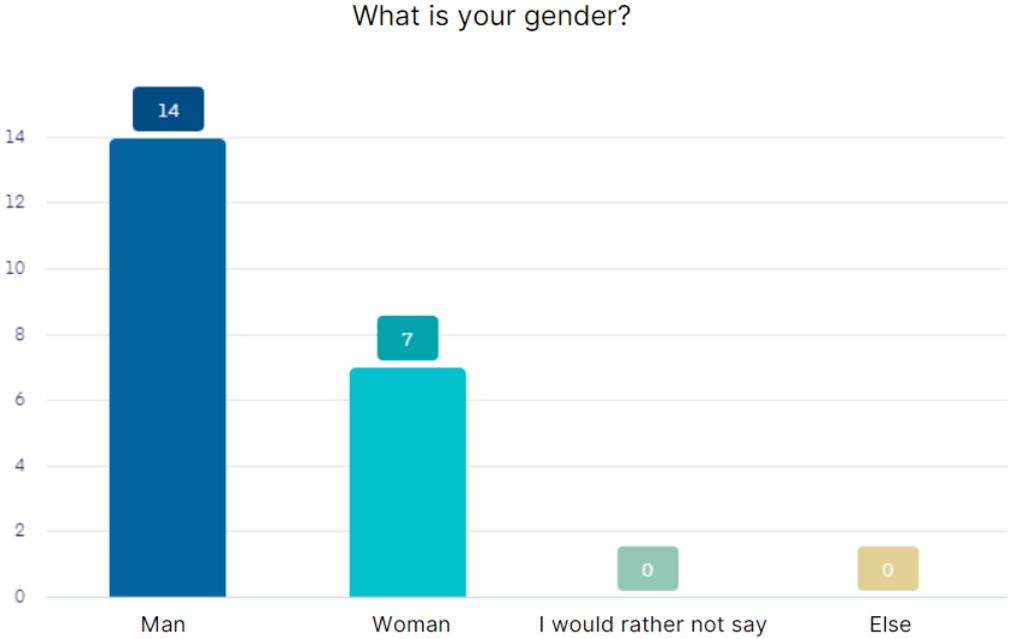
My name is Jorn Kremers and I am a third-year student at the University of Groningen. I am doing the bachelor's degree program 'Spatial Planning & Design'. At the moment, I am working on my thesis to complete the bachelor program. The thesis is about the influence of car-free neighbourhoods on child-friendliness for children up to and including 12 years old (primary school children). I can very much use your help to carry out this research.

As a resident of this neighbourhood, I would like to ask you a number of questions regarding child-friendliness and the possibilities for improving child-friendliness when a neighbourhood becomes car-free. The survey is completely anonymous and the results are used exclusively for this research. In addition, the results will not be shared with third parties. You will help me a lot with completing this survey.

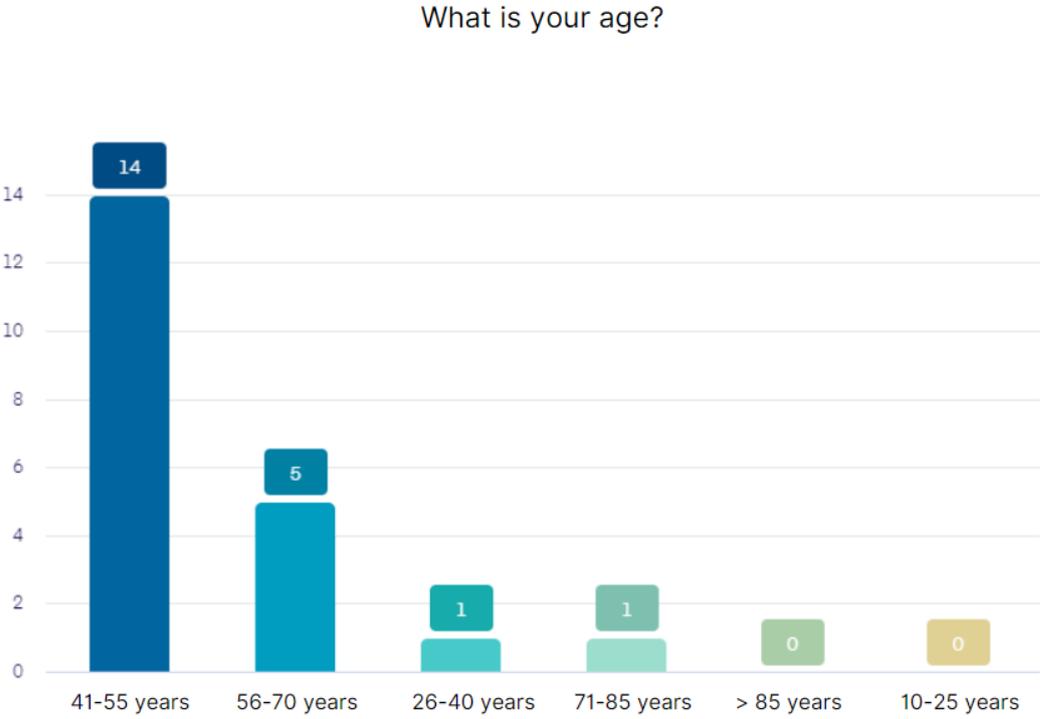
Thanks in advance.

Appendix C: Respondents survey car-free neighbourhoods demographics

Gender

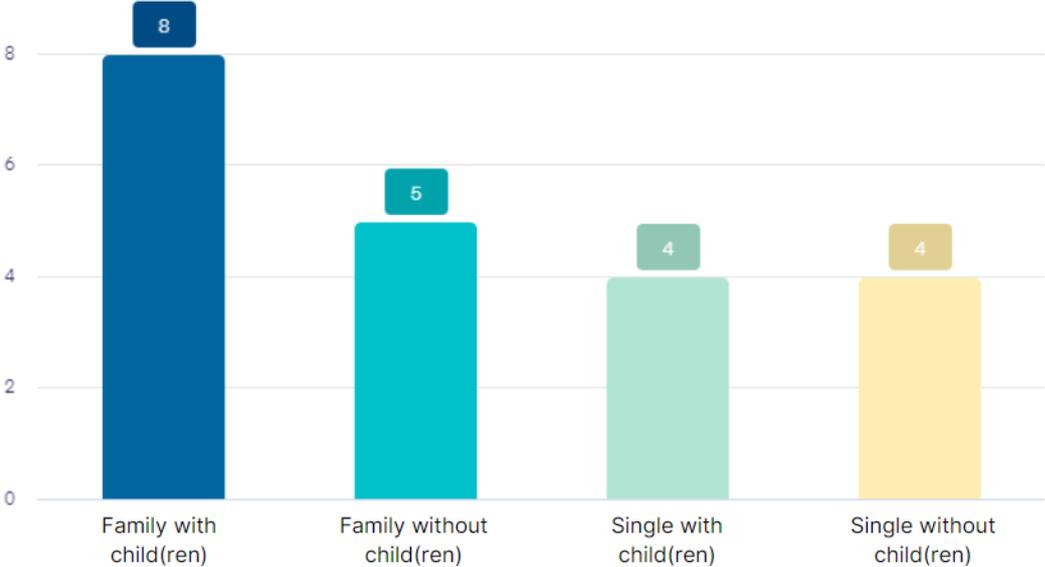


Age



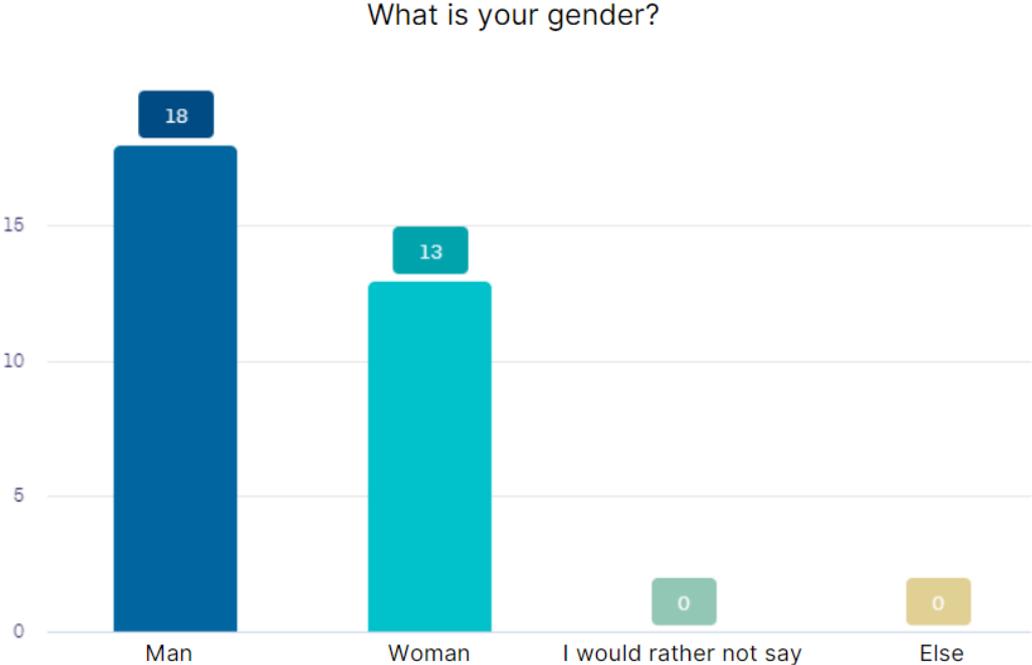
Family composition

What is your family composition?

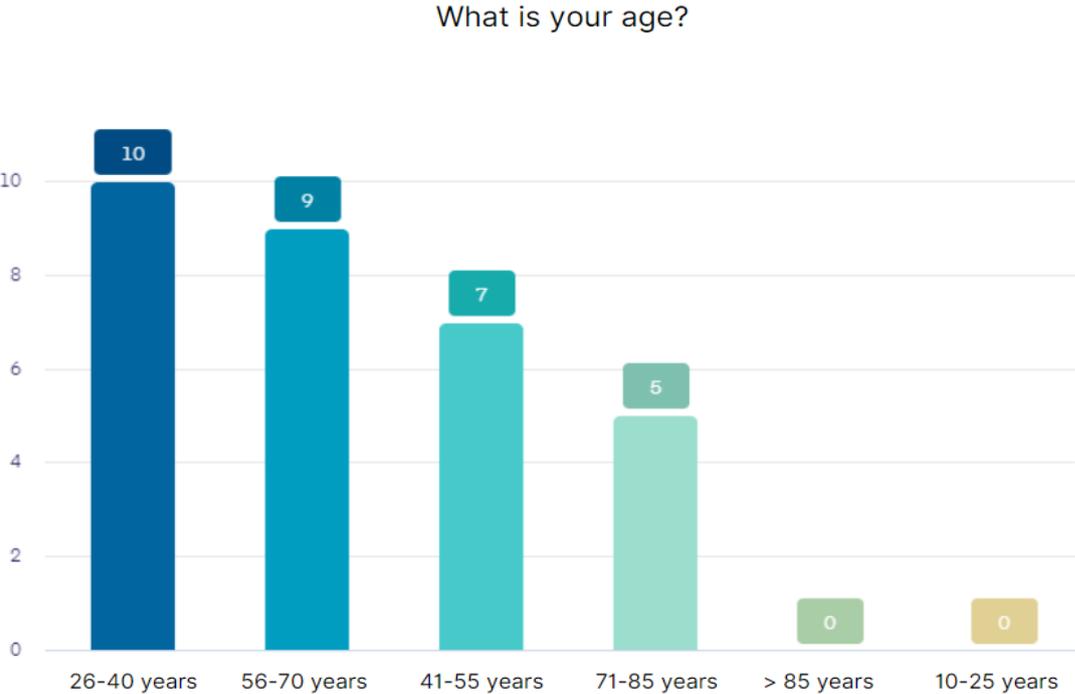


Appendix D: Respondents survey car-present neighbourhoods demographics

Gender

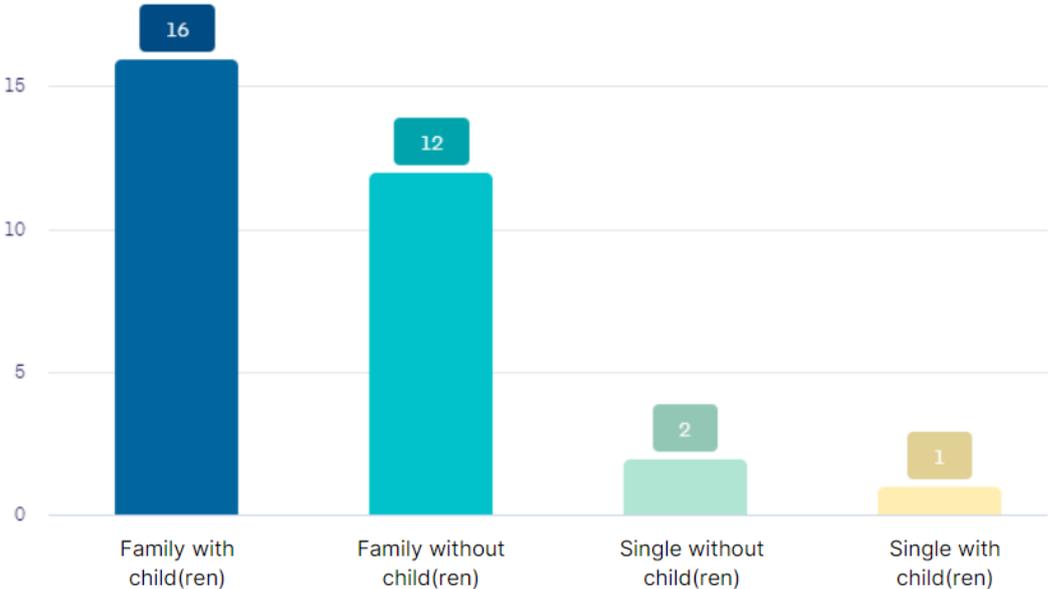


Age



Family composition

What is your family composition?



## Appendix E: Photos Dutch neighbourhoods

### *Vreebergen, Assen*



The neighbourhood 'Vreebergen' in Assen is a car-present neighbourhood. The pictures above are taken during the distribution of the flyers with the survey in the neighbourhood. It is visible that there is already quite some greenery in the neighbourhood with grass, shrubs, and trees. There is also a football field for children. However, this field is in bad condition and therefore not used that often according to a resident of the neighbourhood. Furthermore, the neighbourhood is built for cars with driveways near the houses and many streets. There is also no playground with play equipment, and therefore it might be useful to invest in these things to increase child-friendliness in this neighbourhood.

*Tersluis, Groningen*



The neighbourhood 'Tersluis' in Groningen is a car-present neighbourhood, and the pictures are taken during the distribution of the flyers. This neighbourhood is relatively 'new', compared to the other neighbourhoods used in this research. This neighbourhood does not contain much greenery, and none trees or playgrounds at all for children. Driveways are directly in front of the houses and the neighbourhood contains many streets. The child-friendliness in this neighbourhood is extremely poor, since it is not safe for children to play on the streets and because of the lack of greenery and play fields.

*De Buitenkans, Almere*



The neighbourhood 'De Buitenkans' in Almere is one of the car-free neighbourhoods used in this research. Again, these pictures are taken during the distribution of the flyers in the neighbourhood. According to a resident of this neighbourhood, children can play freely outside without worries. This neighbourhood contains much greenery and narrow streets. Cars are parked at the beginning of the neighbourhood on a big parking place, and this is just a small part of the whole neighbourhood. Therefore, children do not have to watch out for cars and other traffic. The presence of greenery and the absence of cars increases the child-friendliness of this neighbourhood. However, there is no playground for children and thus it might be useful to invest in this to increase the child-friendliness of this neighbourhood even more.

## *Meanderhof, Zwolle*



The neighbourhood 'Meanderhof' in Zwolle is a small car-free neighbourhood, used in this research. As with the other neighbourhoods, the pictures are taken during the distribution of the flyers with the survey. Like the car-free neighbourhood in Almere is that the car-free neighbourhood in Zwolle also have a parking place at the beginning of the neighbourhood. Furthermore, this neighbourhood contains much greenery and even an 'insect hotel'. There is no playground for children, and it is not intended for children to play in the greenery in the neighbourhood. The lack of cars in this neighbourhood could increase child-friendliness, however it might be useful to invest in playgrounds, play fields, or play equipment to make this neighbourhood even more child-friendly.