



How to make car-free neighbourhoods work

The factors that contribute to the success of a car-free neighbourhood

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After completing this research, I begin a new period of my life where I can bring all the knowledge I have gained in recent years into practice. I hope you will enjoy reading my thesis as much as I enjoyed writing it.

Thijs Oost

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Abstract

Cars and their associated infrastructure, like roads and parking, have far-reaching consequences on urban life. They take up much of the space in cities, but we could put this space to better use. By reducing the number of cars in neighbourhoods, we could add more green to stimulate active forms of mobility, like walking, cycling and public transport. This change is not only good for climate adaptation, reducing the urban heat island effect and increasing drainage, but also beneficial for the health of residents. There is already a great deal of literature on car-free cities but little existing literature on car-free residential areas. As a result, car-free neighbourhoods receive little attention from policymakers and are little applied in practice. It is therefore not very clear what makes a car-free neighbourhood successful. Therefore, this research aimed to identify the factors contributing to a car-free neighbourhood's success. The main research question was: *What factors contribute to the success of a car-free neighbourhood?*

This research combined the top-down perspective of local governments with the bottom-up perspective of residents. This research approach has not yet been applied frequently to car-free neighbourhoods but could provide valuable information. This research used a qualitative research method, a comparative case study, to answer the research questions. Interviews were conducted with residents of three car-free neighbourhoods in the Netherlands, combined with interviews with local governments.

The findings show that most residents are positive about the concept of car-free neighbourhoods. However, local authorities argue that the location of a neighbourhood determines whether the concept of a car-free neighbourhood is a good idea to apply. The identified factors contributing to a car-free neighbourhood's success are greenery, a reduced number of parking spaces, enough alternatives to the car, involvement of residents from the start, clear agreements between residents and local governments, and a location close to a city's centre. Recommended subjects for future research are (1) the intended target groups of car-free neighbourhoods by local governments, (2) different car-free neighbourhoods in the Netherlands or car-free neighbourhoods outside of the Netherlands, and (3) the impact of the COVID-19 pandemic on people's decision to live in a car-free neighbourhood.

Key words: car-free, neighbourhood, resident, government, city, parking.

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1. Introduction

1.1 Background

People like to live in city centres (Molenda & Sieg, 2013). It enables convenient access to shopping and leisure activities, but living downtown also can result in parking difficulties. Many - mainly European - inner cities were built and grew at a time when car ownership and use were not nearly as common as today. In some places, streets are narrow or unsuitable for combining a road, cycle lane or footpath, and a tram line or bus lane. Some houses outside the city centre have a driveway where people have their own parking space. However, in many urban areas, parking permits are used to manage urban parking (ibid). These parking spaces can be above ground, such as along the road, or below ground, such as a parking garage. However, parking has far-reaching consequences on urban life (Ostermeijer et al., 2019). The land is scarce, and the opportunity cost of parking is high. Nevertheless, cities devote a substantial amount of space to parking which may induce excess vehicle demand (ibid).

A study by Guo (2013a) in the New York City region showed that free residential street parking increases private car ownership by nearly 9 per cent. This study is supported by Rogers et al. (2016), who state that overbuilding residential parking leads to increased car ownership, increased car travel distance, and congestion.

The availability of parking spaces affects people's travel mode choices, increasing single-occupancy vehicle use and decreasing the use of active modes, like walking, cycling or public transport (Rogers et al., 2016). The easier the car is to use, the more inclined people are to use it (Guo, 2013b). When cars are parked directly in front of people's homes, people are more likely to use their car than other modes of transport. The opposite is also true: when they have parked their car further away from home, or in a parking garage, people are more inclined to use a bicycle or public transport. There is a relationship between how easy it is to use the car and the amount of car use.

1.1.1 The opportunity cost of parking

Cars and the roads and parking spaces they require take up much of the space in cities (Nieuwenhuijsen & Khreis, 2016). The opportunity cost of parking is high (Ostermeijer et al., 2019) because parked cars take up a considerable amount of space which could be used differently by adding greenery, wider pavements and bicycle lanes, or separated bus or tram lanes (Rogers et al., 2016). Opportunity cost is “the anticipated value of ‘that which might be’ if choice were made differently” (Buchanan, 1991, p.520). In addition, parking spaces can cause greater separation of buildings because of the extra space they take, increasing the distance between destinations (Rogers et al., 2016; Cervero et al., 2010). This separation, in turn, can increase car ownership, car use, and the demand for more parking spaces (ibid). An abundance of parking spaces can degrade natural landscapes through urban sprawl, increase petrified surfaces, thus contribute to the urban heat island effect, and contribute to greenhouse gas emissions (Rogers et al., 2016).

Reducing the number of cars, the associated infrastructure, and parking spaces can provide more space for greenery and green networks in cities, leading to various health benefits (Nieuwenhuijsen, 2016). These benefits occur because more green space can contribute to higher levels of active and physical mobility (Mueller et al., 2017), such as walking, cycling and public transport (Nieuwenhuijsen & Khreis, 2016). For example, cyclists prefer to cycle through green areas (Wahlgren & Schantz, 2014). Partly because of this, green space is associated with several beneficial health effects (Lee & Maheswaran, 2010), including a reduction in mortality and a longer life span (Mitchell & Popham, 2008), reduced risk of cardiovascular disease (Pereira et al., 2012), and better mental health (Gascon et al., 2015).

Moreover, more greenery also contributes to reducing the urban heat island effect. The relationship between hardening - concrete and asphalt - and warming was already described in 1973 (Oke, 1973). The high density of buildings and roads can create so-called urban heat islands, defined as built-up areas that are warmer than nearby rural areas (ibid). This effect is mainly observed in places where open, wooded or green areas have been removed to build concrete and asphalt (Nieuwenhuijsen, 2016). The strength of this effect depends on population density, vegetation, urban design and the albedo effect, among other factors. This effect can increase the temperature in cities by up to 3 to 5 degrees Celsius compared to nearby rural areas (ibid). As a result of climate change and increasing urbanisation, temperatures in cities are likely to rise further in the coming years (IPCC, 2021). In addition, increasing precipitation due to climate change will also confront urban areas

with the challenge of drainage. More green space in cities can lower the temperature and improve the absorption and drainage of precipitation (ibid).

1.2 The introduction of car-free neighbourhoods

Reducing the number of parking spaces in cities and exchanging them for green spaces has many advantages, especially in residential areas where people spend a lot of time (Ornetzeder et al., 2008). Moreover, car-free residential areas can provide for healthier people and better climate adaptation (Nieuwenhuijsen, 2016). However, car-free neighbourhoods have received little attention from policymakers (Guo, 2013c) and have been the subject of little research (Marsden, 2006). Besides, the change to a car-free neighbourhood does not always have to come from 'above' by planners and policymakers of local governments. Mobility is also shaped from 'below' by the people who move through the streets and neighbourhoods (Jensen, 2013). So far, few studies have combined the perspectives of 'top down' and 'bottom up' (Freitag et al., 2014). That is why this study combines the perspectives of local governments and residents to gain new insights into the success and failure of car-free neighbourhoods.

Despite their many benefits, car-free neighbourhoods are still quite rare in cities. The concept is relatively new - the first car-free neighbourhood was opened in 1992 in Germany - and the implementation of these neighbourhoods is not always and everywhere without problems (Da Silva Borges & Grando Goldner, 2015; Morris et al., 2009). The question is whether residents favour car-free neighbourhoods and whether local governments know what is needed to make a car-free neighbourhood successful. What factors contribute to the success of a car-free neighbourhood? That is the research question this thesis tries to answer. Three car-free neighbourhoods in the Netherlands have been compared to answer this question. Interviews were conducted with residents of these neighbourhoods and policymakers of local governments. This chapter continues with a short description of the cases that have been studied.

1.2.1 Westerpark, Breda

Westerpark is a neighbourhood in the city of Breda, in the province of Noord-Brabant. This neighbourhood, built in the late 1990s, was the first step by the local government of Breda towards sustainable urban development (Gemeente Breda, 2013). This neighbourhood is located outside the city centre of Breda, about 2.7 kilometres (Google Maps, 2022). Westerpark was car-free since its design but is no longer entirely car-free. Parking is only possible at the edge of the neighbourhood and is free. When the neighbourhood was built,

enough residents were willing to forego the luxury of a car parked directly in front of their homes (Schapendonk, 2020). However, problems arose when the first residents of Westerpark moved out of the neighbourhood and new, less enthusiastic residents moved in. These new residents did want to be able to park their cars in front of their homes. The result was that after a few years, Westerpark turned into "a battlefield of motorists looking for a parking space" (Schapendonk, 2022). In response, the local government re-added parking spaces at the edges of the neighbourhood, making the roads very narrow in some areas. Although pedestrians are allowed in the neighbourhoods, cyclists must get off their bikes in some places.

1.2.2 Assendorp, Zwolle

Assendorp is a neighbourhood in the city of Zwolle, in the province of Overijssel. Assendorp is a neighbourhood with small streets and pre-war houses (Zwolle.nl, n.d.). This neighbourhood is located close to the city centre of Zwolle, about 1 kilometre (Google Maps, 2022). Assendorp was not designed as car-free but is now partly car-free. In this neighbourhood, the residents have started an initiative to reduce the number of cars in the neighbourhood (50 Tinten Groen Assendorp, n.d.). In cooperation with the local government, a car park has been provided at the neighbourhood's edge. About 40 per cent of the residents park their car here now, voluntarily. A so-called 'Mobipunt' has been opened, which offers various facilities besides free parking. For instance, there are charging points for electric cars, bicycle racks, and a shared car. In the future, they would like to open two more 'Mobipunten' and add services like charging points for electric bikes and parcel lockers. In addition, if two households choose not to park their car in front of their house, but at the Mobipunt, the residents can remove one parking space and fill it with, for example, greenery. In this way, the residents get something back for their efforts. Cars, pedestrians and bicycles are all allowed in the neighbourhood.

1.2.3 Ebbingekwartier, Groningen

The Ebbingekwartier is a neighbourhood in the city of Groningen, in the province of Groningen. This neighbourhood is car-free, except for the edges (Gemeente Groningen, 2012), and was completed in mid-2013. This neighbourhood is located close to the city centre of Groningen, about 600 metres (Google Maps, 2022). The Ebbingekwartier has been car-free since its design, except for the edges, and is still car-free today. Residents must park their cars in a parking garage under the neighbourhood. There have been complaints in the past about the high parking fees (RTV Noord, 2013). The neighbourhood has remained the same since completion. Cars were not allowed in the neighbourhood,

which is still the case. The residents do not seem to experience this as a problem because there is no mention in the media of dissatisfied residents, which is the case with Westerpark in Breda. Both pedestrians and cyclists are allowed in the neighbourhood.

1.3 Research aim and research questions

Looking at the neighbourhoods of Westerpark, Assendorp and the Ebbingekwartier, car-free neighbourhoods are in some cities successful and in other cities less successful. This thesis aims to gain insight into the success of car-free neighbourhoods by studying and comparing the three different neighbourhoods.

1.3.1 Main research question

A better understanding of the factors contributing to the success or failure of existing car-free neighbourhoods can help local governments learn from the past and improve future car-free neighbourhoods. Therefore, this research aims to identify the factors contributing to a car-free neighbourhood's success. The main research question is therefore defined as follows:

What factors contribute to the success of a car-free neighbourhood?

'Success', in the context of car-free neighbourhoods, is viewed from the perspective of the residents living in the neighbourhood and the local government of the city where the neighbourhood is located. When cars are banned or reduced in a neighbourhood, the neighbourhood should improve in some way since removing cars opens many possibilities. For the local government of Groningen, the Ebbingekwartier is a successful neighbourhood if the quality of the neighbourhood - quieter, cleaner and safer - is increased by the car-free aspect (Gemeente Groningen, 2012). For the local government of Breda, Westerpark is successful if fewer cars result in more greenery (Gemeente Breda, 2013). For the inhabitants of Assendorp - as the neighbourhood becomes car-free through a citizens' initiative and not mainly through the local government - their neighbourhood is successful if fewer cars ensure more space for greenery, safety, and emergency vehicles (50 Tinten Groen Assendorp, n.d.). Taken together, 'success', in the context of car-free neighbourhoods, is, in this thesis, defined as a quieter, safer and greener neighbourhood, according to the opinion of the residents and the local government, after the reduction or removal of cars.

Factors versus success

For the sake of clarity, it is crucial to make a distinction between the 'factors' and 'success'. 'Success', as described above, refers to when you can call a car-free neighbourhood

successful. This 'success' is defined based on what local governments consider a successful neighbourhood, described in zoning plans. 'Success' is not about what is needed to make a car-free neighbourhood successful; this is what the 'factors' are about. The 'factors' are about what elements are needed in a car-free neighbourhood to make it successful. This paragraph only defines a successful car-free neighbourhood, but what 'factors' are needed to make a car-free neighbourhood successful is the subject of this thesis. These 'factors' can only be identified at the end of this thesis after discussing and analysing the results. Thus, the definition of 'success' was formulated in advance based on government documents; the 'factors' were later identified based on data collection and analysis. The main research question of this thesis is not "What is a successful car-free neighbourhood?" but "What factors contribute to the success of a car-free neighbourhood?".

Car-free

Car-free, in this study, was operationalised as 'few to no cars'. In Dutch, the term '*autoluw*' is used, which means 'with relatively few cars', but therefore does not mean that there are no cars at all. For lack of a better word in the English language, 'car-free' is therefore used with the meaning 'few to no cars', although this word suggests 'no cars at all'.

1.3.2 Secondary research questions

Subsequently, the secondary research questions that contribute to answering the main research question are defined as follows:

1. How does the view on the concept of car-free neighbourhoods differ between local governments and residents?
2. When is a car-free neighbourhood considered successful by local governments and residents?
3. Has residents' view of their car-free neighbourhood changed since they started living there?

1.4 Structure

This thesis continues in chapter 2 by discussing relevant theory for this research. Chapter 3 explains the methodology: how the cases were selected, how the data collection was carried out and how the data was analysed. Chapter 4 discusses the cases and the results of the analysis. Chapter 5 summarises the most important findings, compares the findings with the theory from chapter 2 and answers the secondary research questions of this study. Finally, chapter 6 concludes with a summary of the main findings from Chapter 5 and answers the main research question of this study.

2. Theoretical Framework

2.1 Should we want car-free developments?

2.1.1 Advantages of car-free developments

A car-free neighbourhood has several advantages, as also described in the introduction. One of the most apparent advantages is that with fewer cars, more space becomes available for other uses. If there is less infrastructure for cars, such as roads and parking spaces, this space can be used for greenery, footpaths, cycle paths and public transport (Rogers et al., 2016). This infrastructure can contribute to more walking, cycling and public transport use by making people less dependent on the car, leading to health benefits through more physical activity (Nieuwenhuijsen, 2016; Mueller et al., 2017). Moreover, a decrease in parking spaces and an increase in infrastructure for walking, cycling and public transport can lead to less car ownership (Cervero et al., 2010). This infrastructure focused on active forms of mobility further reduces the need for car infrastructure. In addition, road accidents involving cars still cause fatalities every year (Doheim et al., 2016). Therefore, a reduction in cars can lead to fewer traffic deaths.

Moreover, cars cause a lot of noise pollution, which decreases when the number of cars also decreases (Wahlgren & Schantz, 2014). Finally, fewer cars are also better for the environment because there are fewer emissions (Doheim et al., 2020). Therefore, fewer cars in cities are advantageous for the climate and climate adaptation, as well as for the health of inhabitants (Amoly et al., 2014; Nieuwenhuijsen & Khreis, 2016).

2.1.2 Disadvantages of car-free developments

Despite their drawbacks, cars are an affordable and comfortable means of transport (Doheim et al., 2020). Moreover, cars give people freedom, independence, and the ability to go wherever they want (Masouimi, 2019). Cars give people convenience, rapidity, comfort and flexibility (ibid). When cars are taken away in cities, some freedom and independence are also taken away from people. In some cities, cars are banned, but no reasonable alternatives exist (Stojanovski, 2019). Also, banning cars is not convenient for people with difficulty walking (Morris et al., 2009). They may not be able to walk or cycle far enough to reach public transport and therefore depend on the car. Car-free developments should take this into account. The same applies to accessibility for emergency services and

delivery services (Baehler, 2019). Delivery services can switch to smaller vehicles or delivery bicycles. However, transporting people in a cargo bike instead of an ambulance seems undesirable, to say the least. Therefore, vehicles cannot just be banned from cities and neighbourhoods. There must be exceptions and alternatives. Finally, transporting large objects, for example, when moving, becomes more complex (ibid). Shop owners are worried that if they sell large products in a car-free area, people will no longer come to shop there because they cannot transport the products they have bought by car (Doheim et al., 2020).

2.2 The scale of car-free developments

2.2.1 Car-free cities

Transforming cities into car-free areas is becoming increasingly important and is, fortunately, a trend increasingly being implemented in cities worldwide (Doheim et al., 2020). These cities add green to their city centre and reduce congestion. Some cities have experimented first. In Mexico City, for example, car-free Sundays were introduced as a test. People could dance, jog and cycle on all streets (Mendex, 2014). This initiative by the local government of Mexico City was well received by the residents and was implemented every Sunday in the following years. People held salsa classes in the streets, urban theatre and music, and political campaigns were held on the streets. In Mexico City, removing the car on Sundays was possible because the local government simultaneously invested in building robust cycling infrastructure, promoting cycling culture, and integrating cycling into the primary transport system (Doheim et al., 2020). Over time, these investments resulted in a 40 per cent reduction in car use for short distances. The policy has proven successful not only in reducing car traffic on Sundays but during the whole week, although not all neighbourhoods are yet connected to the new mobility network.

2.2.2 Car-free neighbourhoods

While most cities worldwide usually only consider car-free city centres, European cities also create car-free residential areas (Kushner, 2005). Not to prohibit cars on certain days, but 24/7. The aim is to design neighbourhoods so that mainly people who make little to no use of their cars will live here. Parking spaces, for example, are changed into places for greenery and recreation. These developments are frequently accompanied by forms of Shared Mobility (ibid). One or more shared cars are made available to the neighbourhood's residents at a lower fee than commercial car-sharing companies. However, it usually turns out that shared cars are hardly used in areas with efficient public transport (ibid). Another

disadvantage is that implementing car-free neighbourhoods is not easy and frequently meets with criticism from residents (Da Silva Borges & Grando Goldner, 2015; Morris et al., 2009).

2.3 How does a car-free neighbourhood become successful?

Car-free neighbourhoods, therefore, have many advantages, both in terms of the climate and the health of inhabitants. However, also several disadvantages must be considered when implementing this concept. The concept can be applied to a city or city centres, but it also has advantages on the scale of neighbourhoods. Discussing examples from both practice and theory can help identify what is needed to implement a car-free neighbourhood successfully.

2.3.1 Knowledge from practice

Some European cities that successfully reduced the number of cars are Paris, London, Bologna, Madrid, Oslo, and Copenhagen. Doheim et al. (2020) compared these cities in terms of how they deal with reducing cars in neighbourhoods. These cities have redesigned urban areas to encourage walking and cycling so that people – hopefully – change their mobility choices. For example, the number of car lanes is being reduced, and that space is used for wider footpaths, cycling lanes and green spaces. Investments are being made in building cycle networks, cycle parking and cycle sheds near public transport facilities. The local government of London has ensured that in some neighbourhoods, only disabled people are allowed to park their cars, and other residents must park their cars at a distance (Morris et al., 2009).

Some cities, compared by Doheim et al. (2020), differ in support of their residents. Reducing the number of cars may seem positive and successful on paper, but if it causes dissatisfied residents, the local government must deal with it. Paris has faced criticism and public resistance to the new measures (ibid). For example, people were fined when they were unaware they were driving in a prohibited area. In Madrid, the traffic restrictions also met much criticism from residents, especially local shop owners, arguing: ‘no cars, no customers, no business’. In some of the other cities studied, London, Bologna, Oslo and Copenhagen, the car reduction measures were implemented much smoother, and there was more support from the residents (ibid). The measures ultimately did not differ much from those in Paris and Madrid.

2.3.2 Knowledge from literature

When removing cars from a neighbourhood, it is vital to provide enough alternatives to these cars (Doheim et al., 2020). Alternatives for the car include public transport, walking, cycling and Shared Mobility (Katzev, 2003). Besides, it helps to slowly implement changes such as banning cars (Doheim et al., 2020). Car use is a habit for many people, and slowly implementing changes gives people time to adjust their habits to the new situation. However, it may still happen that residents disagree with the changes. What you should have done then is to involve the residents in policymaking right from the start, or at least involve them in future decisions (ibid). Residents should be involved before making final decisions (Bongardt et al., 2013). When residents are well informed and involved, and measures are applied slowly to allow people to get used to the new situation, the chances of them supporting the measures are much higher.

Location

Besides car ownership, the location of a neighbourhood is the most crucial factor that influences modal choice (Baehler, 2019). Car ownership is generally lower in compact neighbourhoods with good local accessibility and neighbourhoods located close to a city centre (van Acker et al., 2014; Da Silva Borges & Grando Goldner, 2015). This lower car ownership might be because parking in neighbourhoods close to a city centre is more expensive in some cities, also for residents (Doheim et al., 2020), and higher parking costs can lead to lower car ownership (Ostermeijer et al., 2019). However, what probably plays a more significant role is that the car becomes less needed when a neighbourhood is close to a city centre (Kushner, 2005). If the city centre and other facilities can be reached on foot or by bicycle within about ten minutes, the car can be used less (ibid).

Change

If done correctly, car-free neighbourhoods can be implemented with little change in regulations or physical infrastructure. However, when developing a car-free neighbourhood, it is essential to realise that developing car-free neighbourhoods is an ongoing process (Sareen et al., 2021). The development of car-free neighbourhoods takes place in a constantly changing context. The importance of time must be recognised because local governments must respond to neighbourhood changes (ibid). Local governments can provide information or make changes in physical infrastructure, for example, to influence change. A new car-free district cannot simply be built, or an existing district made car-free without doing something about it in the future. The risk then is that people will move away en masse.

The extent to which neighbourhoods shape relocation decisions has not yet been well researched (Clark & Coulter, 2015). For example, it is unclear how exactly a neighbourhood plays a role in relocation decisions. Furthermore, it is still less known how different aspects of neighbourhood change are related to mobility decisions (ibid). However, it has been clear for many years that people move to adapt their living conditions to their changing needs and preferences (Clark & Dieleman, 2017). People choose to live in a neighbourhood based on the choice of a particular home, specific neighbourhood characteristics or expectations about the neighbourhood (Feijten & van Ham, 2009). So, for example, people may choose to live in a car-free neighbourhood because they expect it to be pleasant. However, when a neighbourhood changes in such a way that the characteristics of the neighbourhood no longer match the preferred characteristics, this can lead to residential stress (Lee et al., 1994). After living there for a while, people can also discover that their expectations were wrong and that living in the neighbourhood is less pleasant than expected. For example, perhaps people thought it would be nice to live in a car-free neighbourhood, but there was less public transport available than hoped or the distance to the centre was further than expected. This residential stress can lead to moving intentions and plans. Actual moving takes place when there are no restrictions or limitations that prevent moving (ibid). For instance, another house must be available, and enough money must be available to move.

2.4 The relationship between car-free neighbourhoods, Shared Mobility, and car ownership

Usually, when people move, they choose a neighbourhood that matches their housing preferences and reflects their travel behaviour (Handy et al., 2005; Bhat & Guo, 2007; Mokhtarian & Cao, 2008). For example, people who move into a compact neighbourhood with facilities nearby may choose to walk, not only because the built environment encourages this, but mainly because their preference for walking led them to live in this neighbourhood (van Acker et al., 2014). The same self-selection process also occurs in car ownership and mobility choices (van Wee et al., 2002). Therefore, when policies aimed at reducing car use and car ownership are applied to people with a car preference, the policy alone is unlikely to be effective because mobility and mobility choices are directly related to the characteristics of the spatial environment (Meurs & Haaijers, 2001).

Therefore, it is crucial that car alternatives, and the associated infrastructure, are available in and around the neighbourhood. However, regular car users commonly have little

knowledge about alternative transport modes. Consequently, it is also essential to provide them with information about the advantages of, for example, walking, cycling and public transport (Horeni et al., 2007), in addition to the physical presence of alternatives. This information may cause avid car users to discover comfortable alternatives to the car (Kushner, 2005) and may lead them to use their car less.

If people then start using their cars less over time, the presence of Shared Mobility, like car-sharing, might eventually cause them to sell their cars (Martin et al., 2010). In addition, fewer parking spaces can also stimulate car-sharing in car-free neighbourhoods and reduce car ownership (Johansson et al., 2019). However, these shared cars must be available to the residents of a neighbourhood, as shared cars are not always evenly distributed across a city (Brown, 2017). Moreover, many shared car users are highly educated and earn more than average. As a result, car-sharing networks are mainly rolled out in neighbourhoods with higher incomes and less in neighbourhoods with lower incomes (ibid).

2.5 The relationship between effort and mobility choices

Identifying the factors influencing people's behaviour is challenging because it depends on many different aspects (Wahlgren & Schantz, 2014). For example, someone may choose not to cycle because there is already good public transport or because the destination is too far to cycle. Other reasons for choosing not to cycle could be that it is raining or someone simply does not feel like it (ibid). A lack of alternatives to the car can also prevent people from choosing an active form of mobility such as walking, cycling or public transport (Stojanovski, 2019). The layout of a residential area can also contribute to people's mobility choices. A neighbourhood can be arranged so that active forms of mobility are increased (ibid). For example, shorter walking distances and good cycling infrastructure can stimulate people to leave their cars home (Masoumi, 2019). Of course, the distance of a journey plays a role - above a certain number of kilometres, few people take the bicycle - and whether it is raining, for example (Reck et al., 2022). What also plays a vital role in mobility choices is 'access distance'. Access distance is the physical and mental distance to a form of mobility (ibid). For example, someone is more likely to take the car if it is parked in front of the door and the bicycle is still parked in the locked shed. Access distance is also relative to the total travel distance. For instance, if the car is parked in the garage and the bicycle is already parked in front of the house, someone might be more likely to use the bicycle for a short distance. However, if the journey had been longer, that person might still take the car because the extra effort outweighs the comfort or convenience of a longer journey (Reck et al., 2022; Masoumi, 2019).

This access distance works both ways. If you want people to use public transport more, you can, for example, bring the bus stops closer to their homes. However, it also works the other way: if you want people to use their cars less, you can move their cars further away from their homes by letting people park at a distance. This way, you encourage car use and make other mobility more attractive. This parking can be enforced, for instance, by providing a car park at the edge of a neighbourhood for residents and by using cameras with automatic number plate recognition to limit motorised traffic other than parcel delivery services and emergency services (Aldred et al., 2016; Doheim et al., 2020).

2.6 Research gap

The existing literature on car-free developments focuses mainly on car-free cities, which is why car-free cities receive the attention of policymakers (Guo, 2013c). However, little research has been done on car-free residential areas, meaning these also receive less attention from policymakers (Marsden, 2006). As a result, the car-free concept is still too little applied to residential areas (Da Silva Borges & Granda Goldner, 2016; Morris et al., 2009). Nevertheless, it can contribute to residential areas' climate adaptation and positively affect residents' health. In addition, no literature could be found on changing cases, which is the focus of this case study, as seen in the case selection (3.1.1).

Moreover, most of the literature on car-free residential areas focuses on the top-down perspective of planners and policymakers rather than the bottom-up perspective of residents themselves (Jensen, 2013). Little literature combines these top-down and bottom-up perspectives (Freytag et al., 2014). Finally, little literature on car-free developments focuses on the Netherlands, but insights from the Netherlands could be helpful in this topic due to the distinct cycling culture in this country (Haustein et al., 2020). Therefore, this thesis focuses on a gap in the literature on car-free neighbourhoods in the Netherlands, viewed from the perspective of both policymakers and residents, as too little research has been done in this area. This knowledge can help make future car-free neighbourhoods in the Netherlands and beyond more successful; quieter, safer, and greener. This thesis, therefore, tries to answer the following question: "What factors contribute to the success of a car-free neighbourhood?".

2.7 Conceptual model

The presence of alternatives to the car can lead to more use of these alternatives (Doheim et al., 2020). Alternatives to the car, such as walking, cycling, and public transport, are used more if a neighbourhood has more green space (Mueller et al., 2017; Nieuwenhuijsen & Khreis, 2016; Wahlgren & Schantz, 2014). Moreover, the location of a neighbourhood also plays a significant role, as the location of a neighbourhood is one of the most critical factors influencing mobility choices (Baehler, 2019). The location of a neighbourhood is of the most crucial factors influencing mobility choices. If a neighbourhood is closer to a city centre, people are less likely to take their car but choose an alternative (van Acker et al., 2014; Da Silva Borges & Grando Goldner, 2015). A location close to a city centre can even lead to people getting rid of their cars altogether, thus reducing car ownership in a neighbourhood (ibid). Finally, the physical presence of good infrastructure for walking and cycling is also needed to encourage these forms of mobility (Doheim et al., 2020).

All these influences on mobility choices are essential because a car-free neighbourhood is most successful if cars are used less or not at all. After all, neighbourhoods can be greener (Rogers et al., 2016). More green ensures lower temperatures and better climate adaptation through improved drainage, for example, and more active forms of mobility that benefit people's health (Nieuwenhuijsen, 2016). Besides mobility choices, the support of residents is also vital for the success of a car-free neighbourhood (Doheim et al., 2020). The support of residents is increased by involving residents in policy and decision-making (ibid) and informing them about car alternatives (Horeni et al., 2007), which influences their mobility choices.

When people's modal choices are more focused on alternatives to the car and support the changes in a neighbourhood, the chances of a successful car-free neighbourhood developing over time should be much higher (Figure 1). It is essential to add that 'Mobility choices' and 'Residents' support' are factors that can lead to the success of a car-free neighbourhood. Therefore, these are not definitions of success as described in 1.3.1. A successful car-free neighbourhood is a quieter, safer and greener neighbourhood, according to the opinion of the residents and the local government, after the reduction or removal of cars.

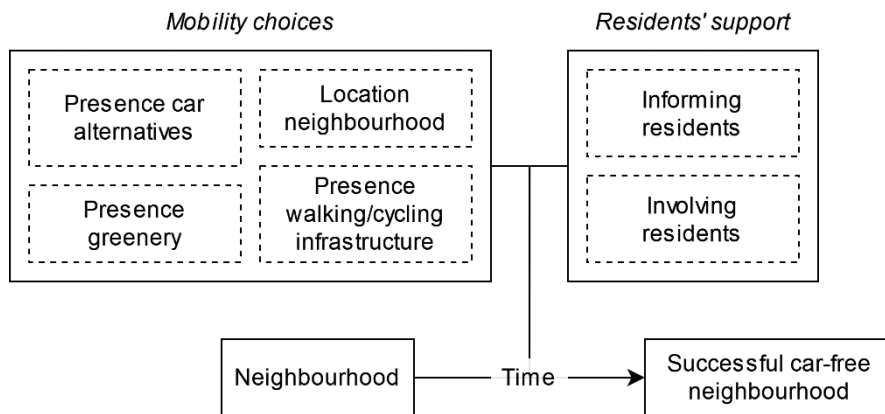


Figure 1. *Conceptual model.*

Summarised, the presence of car alternatives, the presence of greenery, the location of a neighbourhood and the presence of walking/cycling infrastructure influence mobility choices. Likewise, informing and involving residents influences their support. Mobility choices and resident support can, over time, create a successful car-free neighbourhood that is quieter, safer, and greener.

3. Methodology

3.1 Research design

This thesis uses a qualitative research method to answer the research question (*What factors contribute to the success of a car-free neighbourhood?*). This thesis used a comparative case study. A case study is appropriate for this study because it aims to understand the cases in-depth and in its natural setting while recognising the case's complexity in its context (Punch, 2014). Furthermore, a case study can help gain new ideas and insights (Yin, 2008), and a case study is suitable for small-scale in-depth research (Taylor, 2016). This method suits this research because it aims to explore which factors should be present for a car-free neighbourhood to be successful, also examining the context of those neighbourhoods.

A case study uses only a selection and cannot be fully representative of all car-free neighbourhoods. For this research, three cases were chosen that all had a different starting point or finishing point to gain insight into the success or failure of car-free neighbourhoods that have followed different paths. They differ in whether the neighbourhood was car-free from the start and whether it still is a successful car-free neighbourhood today. By comparing these three different paths, it is, to a certain extent, possible to make analytical generalisations by comparing the results of the comparative case study with the theories discussed in the literature on the subject (Yin, 1994; Taylor, 2016).

A qualitative research design with interviews was chosen instead of a quantitative research design with, for example, surveys because there is no possibility for further questioning. Moreover, a case study is about obtaining in-depth information and less about collecting large amounts of less in-depth information.

This research aims to gain insight into the success of car-free neighbourhoods by studying and comparing three different neighbourhoods.

3.1.1 Case selection

The case selection was made based on three distinct types of car-free neighbourhoods. These neighbourhoods are the cases of the case study. From all three types of neighbourhoods, an attempt was made to select one that met the selection criteria and could represent this type of neighbourhood. Only neighbourhoods realised as car-free were included in the case selection for types A and B. Neighbourhoods for which the local

government had the idea of making them car-free, but which were not realised car-free in the end, have not been included in the selection. This decision was made because this research emphasises the success of car-free neighbourhoods, and determining whether a non-car-free neighbourhood is successfully car-free is impossible. By comparing these cases, insight is gained into the path of these neighbourhoods, and it becomes possible to determine why one car-free neighbourhood remained successfully car-free and why this is not true for another neighbourhood. This knowledge can help both local governments and residents to create successful car-free neighbourhoods in the future.

A case can be selected, among others, because it is usual or ordinary (Taylor, 2016). The cases in this study were chosen because they are representative examples within their type of car-free neighbourhood. The Ebbingekwartier in Groningen was selected because it is a typical example of an entirely car-free neighbourhood (Gemeente Groningen, 2012). The parking garage in the neighbourhood might be unique, but the entirely car-free streets make it a genuinely car-free neighbourhood. This case was selected to see whether this example is considered successful and could perhaps also be applied to other car-free neighbourhoods in the future. Westerpark in the city of Breda has been selected because it shows that the concept of a car-free neighbourhood does not necessarily work everywhere. Because this neighbourhood was already built in the 1990s, it provides historical insight into which factors and developments can lead to a car-free neighbourhood not being regarded as successful (Schapendonk, 2020). Assendorp in the city of Zwolle was selected because it was not the local government that introduced the car-free concept top-down, but the residents took action bottom-up (50 Tinten Groen Assendorp, n.d.). This case shows that changes in a city or neighbourhood do not always have to come from above but also can be initiated by the residents themselves.

The three distinct types of car-free neighbourhoods are:

- A. car-free neighbourhood that has been car-free since its design and is still car-free today;
- B. car-free neighbourhood that was car-free since its design, but is no longer (entirely) car-free;
- C. neighbourhood that was not designed as car-free, but is now (partly) car-free.

A neighbourhood in the Netherlands has been selected for each type of car-free neighbourhood. The Netherlands is very suitable for a study on this subject, mainly because The Netherlands has a distinct cycling culture (Haustein et al., 2020). There is much cycling,

policies support cycling, and there is a highly developed cycling infrastructure. Different age groups and genders are well represented among cyclists (Aldred et al., 2016), which is not the case in most countries without a pronounced cycling culture (Heesch et al., 2012; Heinen et al., 2010). Cycling is seen as a mainstream activity, whereas in other countries, it can be considered strange or 'uncool' (Pooley et al., 2013; Underwood et al., 2014). The Netherlands is the leading cycling country in Europe: the Netherlands is the country where people cycle the most and where the longest distances are covered (European Commission, 2013). This strong cycling orientation is reflected in very dense cycling infrastructure. In addition, cycling on the road is possible if there are no cycle lanes, although separate cycling lanes are the norm in cities (Haustein et al., 2020). Cycling is used as much as driving up to a distance of 7.5 kilometres (KiM, 2018; CBS, 2016). The bicycle is seen as an alternative to the car, up to a certain distance. This is why this study was only conducted in the Netherlands. A car-free neighbourhood is only possible if there are alternatives to the car and if people also see these options as alternatives. This is the case in the Netherlands as people consider the bike an alternative for the car up to 7.5 kilometres, which is why the context of the Netherlands was considered suitable for research into car-free neighbourhoods.

Table 1 shows which neighbourhood has been chosen for each type of neighbourhood and in which city and province this neighbourhood is located.

Table 1. *Case selection.*

Type	Neighbourhood	City, province	Car-free by design	Currently car-free
A	Ebbingekwartier	Groningen, Groningen	Yes	Yes
B	Westerpark	Breda, Noord-Brabant	Yes	No
C	Assendorp	Zwolle, Overijssel	No	Yes

Some other neighbourhoods that were considered as cases in this research are in the city of Amsterdam, Utrecht and The Hague. In Amsterdam, it concerns the area around the 'Munttoren', an old city gate in Amsterdam (Kruyswijk, 2016). Bicycle lanes have been changed into footpaths here. A road was also made virtually car-free to make room for cyclists and pedestrians. The case was considered unsuitable because it is not a residential area but an area in the centre of Amsterdam with mainly amenities like shops, restaurants, bars and major thoroughfares, which you will not find in an average residential area. This

research does focus on residential areas to see how residents experience these car-free neighbourhoods and examines when they are considered successful. The fact that these types of cases are not included in the selection means that the results and conclusions can only be applied to neighbourhoods and not no areas whose function is not primarily residential. The neighbourhood considered as a case in Utrecht is the Merwede, a planned neighbourhood with room for over 12,000 people, where pedestrians and cyclists have a significant role (Merwede.nl, n.d.). The construction of this neighbourhood will not start until mid-2022, so it is not yet possible to interview existing residents. A final area that was considered as a case are the neighbourhoods Geuzen- and Statenkwartier, and Duinoord in The Hague (Scheveningen-thehague.nl, 2021). In these neighbourhoods, the local government of The Hague is conducting a trial with remote parking to see if residents are prepared to park further away from home so that the number of cars parked on the street is reduced. However, this trial was still in progress when this thesis was written and had not yet been completed, so this case could not be used to gain insights. This case has also not been included in this research because it only focuses on remote parking of cars. This aspect is only one part of car-free neighbourhoods - other essential aspects are adding car alternatives and, for example, greenery - which made this case unsuitable for inclusion in the case study.

These are currently the more prominent car-free neighbourhoods in the Netherlands. However, there may be different areas such as city centres or smaller areas like parts of residential areas in the Netherlands that are partially car-free. Unfortunately, these are probably less documented, which made them difficult to find or not at all findable during the selection process.

3.2 Data collection

3.2.1 Semi-structured interviews

An interview is an effective way to gain insight into people's perceptions and the meaning they attach to certain things (Punch, 2014). In addition, it provides insight into people's definitions and their construction of reality. Moreover, it is one of the most powerful ways to understand others. There are many different types of interviews. Fontana & Frey (1994) use the following classifications: structured, semi-structured, and unstructured. Interviews are a flexible instrument for data collection as they can be adapted to various research questions. The chosen interview type should be attuned to, among others, the strategy and objective of the research and the research questions. This choice is important because different

interview types have their strengths and weaknesses and their own goals. Semi-structured interviews have a pre-prepared list of questions, but during the interview, the order of these questions can be changed (Clifford et al., 2016). In addition, questions can be added during the interview to elaborate on the given answers. Semi-structured interviews have the flexibility to develop the conversation in unforeseen directions (Lunghurst, 2016).

To better understand the success of car-free neighbourhoods, semi-structured interviews were conducted with inhabitants of car-free neighbourhoods and employees of the local governments of the cities where the neighbourhoods are located. The interviews had a pre-prepared list of questions. However, during the interview, the order of the questions in some interviews changed when a respondent had already answered the following question. Follow-up questions allowed the collection of more relevant information contributing to the research objective. Residents of car-free neighbourhoods were asked several additional questions, as some questions related to living in the car-free neighbourhood itself. In addition, a list of success criteria was not drawn up in advance to be presented to respondents, as this could have a steering effect and thus influence the study results. Therefore, relevant persons - residents and policymakers - were interviewed with open questions without much guidance to get a better, honest and open picture of their opinions, perspectives and ideas. This form of data collection provides a more unrestrained starting point than, for example, presenting a list of success criteria for a car-free neighbourhood in a survey.

By asking questions about car-free neighbourhoods, an attempt was made to gain insight into how people think about car-free neighbourhoods. The second aim was to determine whether people consider a particular car-free neighbourhood successful and what factors they think should be present to make a car-free neighbourhood successful. The interview questions (Appendix A) were prepared using the conceptual model (Figure 1), after which the deductive codes were drawn up (Appendix B). During the interviews, the respondents attempted to determine whether these factors contributing to a car-free neighbourhood's success are also experienced as such. The success factors were not explicitly mentioned, but open questions were asked to see if the respondents mentioned the factors from the conceptual model and deductive codes themselves. In this way, it was possible to see whether the success factors mentioned in theory are also experienced as success factors by the residents and local governments.

Interviews were conducted with residents because the overall aim of this research is to improve future car-free neighbourhoods. Residents are the people who live in car-free neighbourhoods, so the input of residents of existing car-free neighbourhoods was considered valuable for this research. In addition, neighbourhoods are in most cases planned and realised by local governments. Therefore, in addition to interviews with residents, it was decided to conduct interviews with local government employees. Their view of the car-free neighbourhoods provides valuable insights into how local governments view existing and future car-free neighbourhoods, which can help improve them.

A fully structured interview was not chosen because the possibility of further questioning based on given answers would be lost and the gathering of unforeseen but valuable information. Unstructured interviews were not chosen because they were not intended to investigate, for example, people's behaviour or their symbolic and cultural significance, which is the purpose of unstructured interviews (Punch, 2014).

3.2.2 Respondents

Table 2 gives an overview of the people interviewed. In total, nine interviews were conducted. In every neighbourhood, two residents were interviewed. For Groningen and Breda, an interview was conducted with one local government employee. For Zwolle, a mobility agent was interviewed. The task of a mobility agent is to solve complex cases, for example, between local authorities and residents, in the mobility domain. The local government of Zwolle recommended that communication about the neighbourhood should be done with him because he is the intermediary between the local government and the residents of Assendorp. The residents of the Ebbingekwartier and Westerpark were approached by ringing the doorbell at random houses to see who wanted to participate in the study. In Assendorp, residents were approached through the mobility agent. He asked the residents for their cooperation, after which two residents indicated that they were willing to give an interview. Nine interviews were conducted between 18 May 2022 and 17 June 2022. Some interviews were conducted physically, face-to-face (interviews 1, 4, 5 and 7), while others took place online (interviews 2, 3, 6 and 9) using the software *Google Meet* or *Microsoft Teams* or via email (interview 8).

Table 2. *Interviews.*

Interview	Neighbourhood, city	Respondent	Date	Transcribed interview
1	Assendorp, Zwolle	Resident	08-06-2022	Yes
2		Resident	13-06-2022	Yes
3		Mobility agent	18-05-2022	Yes
4	Ebbingekwartier, Groningen	Two residents	15-06-2022	Yes
5		Resident	17-06-2022	Yes
6		Local government	02-06-2022	No ¹
7	Westerpark, Breda	Resident	31-05-2022	Yes
8		Resident	08-06-2022	No ²
9		Local government	16-06-2022	Yes

1) Interview conducted by telephone due to technical problems respondent. Notes were typed during the interview. After the interview, these notes were sent to the respondent, checked, and confirmed.

2) The interview was conducted by email because after the first promise to video call, the respondent later decided against it and wanted to do the interview by e-mail only.

3.3 Data analysis

After the interviews had been conducted and recorded, the interviews were listened back to and transcribed. The software *Atlas.ti* was used to analyse the transcriptions and code the interviews.

A combination of deductive and inductive coding was used to analyse the interviews. Before coding, deductive codes were defined. The predefined codes could help to inform and guide thinking from the start. In addition, this method made it easier to find theoretical connections (Lewins & Silver, 2007). The transcripts when then read during an open coding process to create inductive coding. Hence, the inductive codes are based on the interview transcripts (Given, 2008). The transcripts were examined for information that did not yet appear in the deductive codes and for similar terminology mentioned by the respondents. Subsequently, the deductive and inductive codes were applied within the same coding process. Then selective coding was carried out, where the inductive findings were combined to form the final codebook. Finally, for some analyses, the codes were grouped. The final codebook and groups can be found in Appendix B.

3.4 Ethics

As can be seen in the interview guides in Appendix A, each interview started with a brief introduction and an explanation of the research. Next, the respondent was asked for permission to record the interview. Subsequently, the respondent was made aware that the interviews would be anonymous and that they could stop participating at any moment without explanation. After that, the respondent was asked to introduce him-/herself. Employees of the local governments were also asked to explain their relation to the car-free neighbourhood, for example, their involvement in the neighbourhood in the past and present. The interviews were recorded using the default recording app on an Android phone, passcode protected. The recordings were sent to *Microsoft Onedrive*, which is also password-protected, as is the laptop on which the recordings were transcribed. The information obtained from the interviews is used only for this study. The transcripts and recordings will be deleted when this study fully concludes with an assessment.

4. Results

4.1 Case study

4.1.1 Ebbingekwartier, Groningen

The Ebbingekwartier is part of a larger neighbourhood, 'Hortusbuurt-Ebbingekwartier' (AlleCijfers.nl, 2022a). In 2021, this neighbourhood had 5,595 inhabitants, but this is for the entire neighbourhood. Because of this, it is impossible to say precisely how many people live in the car-free area, Ebbingekwartier. In total, this neighbourhood has a surface area of 45 hectares - the smallest neighbourhood of the cases - and the average density of addresses is 6,663 addresses per square kilometre. This means that this neighbourhood has the highest address density of all the cases. 4,175 households are living in Hortusbuurt-Ebbingekwartier. 25% of the dwellings are owner-occupied, 32% are rented from housing corporations, 42% are other types of rent, and the remainder is other. The dwellings in the Ebbingekwartier were mainly built between 2010-2020 (Kadaster, 2022), making it the newest neighbourhood of all the cases. The average income per inhabitant in Hortusbuurt-Ebbingekwartier is €24,900, the lowest of all cases, and most of the inhabitants are between 15-45 years old. This neighbourhood has the youngest population of all the cases.

4.1.2 Assendorp, Zwolle

Assendorp had 13.010 inhabitants in 2021, making it the case with the most inhabitants (AlleCijfers.nl, 2022b). This neighbourhood has a total surface area of 314 hectares - the biggest neighbourhood of the cases - and the average density of addresses is 2,739 addresses per square kilometre. There are 7,255 households in Assendorp. 48% of the dwellings are owner-occupied, 33% are rented from housing corporations, 18% are other rentals, and the rest are other. The dwellings in Assendorp were mainly built between 1925 and 1950 (Kadaster, 2022), making it the oldest neighbourhood of all. The average income per inhabitant is €28,300, most residents are between 25-65 years old.

4.1.3 Westerpark, Breda

Westerpark had 3,490 inhabitants in 2021, making it the case with the fewest inhabitants (AlleCijfers.nl, 2022). The neighbourhood has a total surface area of 66 hectares and an average density of 1,911 addresses per square kilometre. This gives the neighbourhood the lowest address density of all the cases. 1,400 households are living in Westerpark. 73% of

the dwellings are owner-occupied, 19% are rented from housing corporations, and 8% are other types of rent. The dwellings in Westerpark were mainly built between 1990 and 2000 (Kadaster, 2022). The average income per inhabitant in Westerpark is €30,300, the highest of all cases, and most residents are between 25-65 years old.

4.2 Interviews

4.2.1 How does the view on the concept of car-free neighbourhoods differ between local governments and residents?

During the interviews, both the residents of car-free neighbourhoods and the employees of the local governments of the cities where the neighbourhoods are located were asked about their opinion on the concept of a car-free neighbourhood. The respondents' answers are displayed in Table 3. In addition, they were asked about their opinion on the concept of 'car-free neighbourhoods' (rows 1 and 2) and whether they consider 'their' neighbourhood to be successfully car-free (rows 3 and 4). A successful car-free neighbourhood is a quieter, safer and greener neighbourhood, according to the opinion of the residents and the local government, after the reduction or removal of cars. Someone can be positive about the concept of car-free neighbourhoods but experience his/her neighbourhood as unsuccessful, for example, because the implementation of the concept is flawed.

Table 3. View on car-free neighbourhoods per respondents group.

	Residents	Local governments
<i>Positive about car-free neighbourhoods</i>	5/6	1/3
<i>No one-sided opinion on car-free neighbourhoods</i>	1/6	2/3
<i>Finds neighbourhood successfully car-free</i>	2/6	1/3
<i>Does not find neighbourhood successfully car-free</i>	4/6	2/3

At the top of the table are the groups 'Residents' and 'Local governments'. Below is how many of these groups agreed with the statement. For example, 5 out of 6 residents are positive about car-free neighbourhoods, and 1 out of 3 local governments are positive about car-free neighbourhoods. The answer option "Negative about car-free neighbourhoods" is not shown because no respondent gave this answer.

Residents

A resident from Assendorp in the city of Zwolle said she views a car-free neighbourhood as follows:

"You cannot go anywhere faster than 30 km/h, and cars are a guest. Because that is what Zwolle is pretty good at, by the way: bicycle streets. The whole street is a cycle path, and cars are guests, so you must get along with the cyclists (Figure 2). So: stay behind them, and I am totally fine with that because I am a motorist now and then, and I am a cyclist now and then. So I do see it from both sides."

– Resident Assendorp, Zwolle

She views car-free neighbourhoods as neighbourhoods where only local traffic drives and parks. She favours remote parking to reduce the amount of traffic in the neighbourhood. This preference is also mentioned by Rogers et al. (2016), who state that car-free neighbourhoods work best when the number of cars is reduced. However, she is less in favour of a neighbourhood where cars are banned entirely, as delivery and emergency services should still be able to move through the neighbourhood – something that is also mentioned by Aldred et al. (2016) and Doheim et al. (2020) – as well as people who move large objects and those who have difficulty walking.



Figure 2. *Bicycle street where cars are a guest and must stay behind cyclists in Assendorp, Zwolle.*

Local governments

When asked what the local government of Groningen thinks of car-free neighbourhoods, the answer was that it depends on where the neighbourhood is located that determines whether a car-free neighbourhood is helpful. The closer to the city centre, the higher the traffic pressure on the neighbourhood, the more suitable a car-free neighbourhood can be, something that was also discovered by Baehler (2019). Therefore, based on the location of a neighbourhood and its character, consideration must be given to how a neighbourhood should be organised. The focus should not be on banning a particular modality but on the quality of the public space and the quality of the living environment. If it turns out that the quality of the living environment in a neighbourhood will improve by banning cars, this can be a good idea for that neighbourhood. However, this is not necessarily the case for every neighbourhood.

The local government of Breda is also not unanimously positive or negative about car-free neighbourhoods. They too emphasise that it depends on where a neighbourhood is located:

*"I think you must know where such a neighbourhood is located.
Westerpark is too far from the centre and far from public transport."*

– Local government of Breda

A car-free neighbourhood works poorly if it is far from the city centre and has no suitable alternatives to the car such as public transport. It might only work if the residents do not own a car, which was the approach for developing the Westerpark neighbourhood in Breda.

In Table 4, the respondent's answers to the same questions as Table 3 are again displayed. Only now, not per respondent group but neighbourhood. From this table, it can be deduced that the residents and local government of the Ebbingekwartier in Groningen consider the neighbourhood to be a successful car-free neighbourhood. On the other hand, in Zwolle, nobody considers Assendorp to be a successful car-free neighbourhood. The same goes for Westerpark in Breda. Furthermore, the number of respondents who think positively of car-free neighbourhoods is evenly distributed across the neighbourhoods.

Table 4. *View on car-free neighbourhoods per neighbourhood.*

	Ebbingekwartier, Groningen	Westerpark, Breda	Assendorp, Zwolle
<i>Finds neighbourhood successfully car-free</i>	3/3	0/3	0/3
<i>Does not find neighbourhood successfully car-free</i>	0/3	3/3	3/3
<i>Positive about car-free neighbourhoods</i>	2/3	2/3	2/3
<i>No one-sided opinion on car-free neighbourhoods</i>	1/3	1/3	1/3

Ebbingekwartier, Groningen

The residents of the Ebbingekwartier in Groningen who were interviewed for this study have a positive view of car-free neighbourhoods (Table 5), partly because it is so quiet in terms of traffic. This calmness is especially pleasant with small children, who can play outside on the street instead of in the garden at the back of the house. However, the number of illegal mopeds and motorbikes on the cycling path is experienced as annoying because they drive fast and cause noise pollution.

Table 5. *View on car-free neighbourhoods Ebbingekwartier, Groningen.*

	Residents Ebbingekwartier	Local government Groningen
<i>Positive about car-free neighbourhoods</i>	2/2	0/1
<i>No one-sided opinion on car-free neighbourhoods</i>	0/2	1/1
<i>Finds neighbourhood successfully car-free</i>	2/2	1/1

In addition, various facilities, such as shops and health care institutions, are within walking distance of the neighbourhood. Kushner (2005) also mentions access to facilities as one of the elements promoting active modes of mobility. However, the cost of parking the car in the parking garage is experienced as high. Furthermore, the residents would like to see more greenery in the neighbourhood, making cycling and walking more pleasant (Figure 3). Indeed, theory shows that people are more willing to walk, cycle and use public transport if there is more green in a neighbourhood (Mueller et al., 2017; Nieuwenhuijsen & Khreis, 2016; Wahlgren & Schantz, 2014).

The local government of Groningen sees the neighbourhood as a hugely successful car-free neighbourhood but also acknowledges that there is little greenery in the neighbourhood and much paving. As a result, the temperature in the neighbourhood could rise in the summer, which is a perfect example of the urban heat island effect as described by Rogers et al. (2016). The local government also recognises that the parking garage makes it a unique neighbourhood that cost-effectively cannot be developed everywhere.



Figure 3. *Greenery is not present everywhere in the Ebbingekwartier, Groningen.*

Assendorp, Zwolle

The residents of Assendorp in Zwolle who were interviewed for this study are more divided about car-free neighbourhoods (Table 6). However, one is a great advocate of a car-free neighbourhood:

"I am very much in favour of a car-free neighbourhood. I think that a neighbourhood should be safe and liveable on all sides. In my opinion, this does not include having to deal with cars on your doorstep, and everywhere you go."

– Resident Assendorp, Zwolle

However, he does not yet consider the neighbourhood where he now lives to be a successful car-free neighbourhood. Many cars are parked at the door because not everyone parks his or her car at the Mobipunt. In addition, the accessibility for pedestrians and the disabled in, for example, wheelchairs is not up to standards. The sidewalks are too narrow, and bikes are parked on these sidewalks, blocking access for pedestrians. There is also not much greenery in the neighbourhood, although this is slowly being added now, which would benefit the cyclability and walkability of the neighbourhood. Finally, he feels there should be exceptions for people who have difficulty walking, for instance, by allowing them to be picked up at the door by car. This exception has also been applied in London (Morris et al., 2009).

Table 6. View on car-free neighbourhoods Assendorp, Zwolle.

	Residents Assendorp	Mobility Assendorp	agent
<i>Positive about car-free neighbourhoods</i>	1/2	1/1	
<i>No one-sided opinion on car-free neighbourhoods</i>	1/2	0/1	
<i>Does not find neighbourhood successfully car-free</i>	2/2	1/1	

The other resident in Assendorp agrees on the latter point. In her opinion, a residential area where cars are never allowed is not desirable. However, she would like to see the role of the car changed, for walking and cycling to become the most important modes of transport in her neighbourhood.

The mobility agent who was interviewed is a great advocate of car-free neighbourhoods. He believes that cars have been made far too necessary and that too much space is devoted to cars in residential areas:

“It is as clear as day that we have made the car far too important with each other. It is bizarre how we have adapted our infrastructure to the car. (...) It is crazy that all those cars stand still ninety per cent of the time. In a few hundred years, the people who live then will laugh their heads off at how we have dealt with these cars now.”

– Mobility agent Assendorp, Zwolle

To him, a solution where residents park their cars at the neighbourhood's edge seems the most desirable. This solution would motivate people to use their cars less or encourage less car ownership. However, according to him, Assendorp is still far from being a successful car-free neighbourhood in its current state. Moreover, the changes are taking place too slowly because the cooperation between the parties involved is slow.

Westerpark, Breda

In Breda, both residents interviewed are positive about the concept of a car-free neighbourhood (Table 7). Car-free neighbourhoods are seen as ideal for families. However, they doubt the feasibility because they agree that people will continue to own a car. This feasibility can be questioned if people use their car as a habit and there are no good car alternatives in or close to the neighbourhood (van Wee et al., 2002). Consequently, there must be a place for these cars to park, for example, at the neighbourhood's edge, although an excess of parking spaces can also lead to increased car ownership (Guo, 2013a).

Table 7. *View on car-free neighbourhoods Westerpark, Breda.*

	Residents Westerpark	Municipality of Breda
<i>Positive about car-free neighbourhoods</i>	2/2	0/1
<i>No one-sided opinion on car-free neighbourhoods</i>	0/2	1/1
<i>Does not find neighbourhood successfully car-free</i>	2/2	1/1

The residents do not consider Westerpark a successful car-free neighbourhood because there are many parking problems, and the local government does not stick to the original plan for the neighbourhood. The original plan was that fewer parking spaces would be needed because people who do not own cars would start living there. This assumption was not necessarily strange since most people choose a neighbourhood that matches their housing preferences and reflects their travel behaviour when moving (Handy et al., 2005; Bhat & Guo, 2007; Mokhtarian & Cao, 2008). However, this was not the case in Breda; some even own two or more cars. The local government is now trying to add more parking spaces to the neighbourhood on existing roads, which makes roads narrower and makes passing each other more complicated (Figure 4). A solution is being sought in the implementation of one-way traffic.



Figure 4. *Parking spaces added later on the existing road in Westerpark, Breda.*

The local government of Breda acknowledges that Westerpark is not a successful car-free neighbourhood and states that there are traffic problems. In addition, the neighbourhood is too far from the city centre and public transport. The local government also said that as a local government, they could not enforce that only people who do not own a car will live in a particular neighbourhood. The local government is now building extra parking spaces because people continue to own and buy cars. According to them, the concept of a car-free neighbourhood cannot be reconciled with a lot of car ownership. The local government also observes that residents demand enough parking spaces, but the local government does not consider providing sufficient parking spaces an obvious task for them.

Comparison with theory

Similarities between theory and the data are that most respondents are positive about the concept of car-free neighbourhoods and recognise the benefits that are also mentioned in theory, such as more space for walking, cycling and greenery (Doheim et al., 2020), with benefits for heat, noise pollution and safety (Wahlgren & Schantz, 2014). For the local governments, the location of the neighbourhood also plays a role, which is also stated by theory for the success of a car-free neighbourhood (Bahler, 2019; van Acker et al., 2014; Da Silva Borges & Grando Goldner, 2015). Besides, residents and local governments believe that emergency services and people with mobility problems should still be able to drive through a neighbourhood, which is also mentioned by Aldred et al. (2016) and Doheim et al. (2020). In addition, both local governments and residents recognise that greenery can contribute to more successful car-free neighbourhoods and lower temperatures, which is also acknowledged by several studies (Mueller et al., 2017; Nieuwenhuijsen & Khreis, 2016; Wahlgren & Schantz, 2014; Rogers et al., 2016), yet this knowledge is little applied in the cases.

The difference between the theory and the data is that it is striking that the local government of Breda indicates that a car-free neighbourhood does not work well if this neighbourhood is located far from the city centre. This observation is also something Bahler (2019), van Acker et al. (2014) and Da Silva Borges & Grando Golder (2015) found in their studies. Nevertheless, the local government built Westerpark anyway. It may be that this realisation came only after the neighbourhood was built. Furthermore, they acknowledge that a car-free neighbourhood does not work well if no good public transport is available, which is the case for Westerpark and mentioned by Doheim et al. (2020). However, in hindsight, they could still improve this for Westerpark. Furthermore, the local government of Breda assumed that mainly people without a car would live in Westerpark. Several studies also recognised this (Handy et al., 2005; Bhat & Guo, 2007; Mokhtarian & Cao, 2008). Nevertheless, it turned out that people with a car, or even owning several cars, would move to Westerpark.

What may have gone wrong here is that residents initially chose Westerpark because they assumed that living in a car-free neighbourhood would be pleasant. People move to a neighbourhood based on neighbourhood characteristics and expectations about the neighbourhood (Feijten & van Ham, 2009). However, it may be that the residents found out - after living there for a while - that the neighbourhood is located far from the centre and public transport. When a residential area is perceived more negatively than expected,

causing the area to no longer match people's preferences, this can lead to residential stress (Lee et al., 1994). This may have been the cause of residents moving in at the beginning of Westerpark because people move when their needs and preferences are not met in their neighbourhood. However, this does not explain why people who did want to keep their cars moved in afterwards. One would expect people to move to a neighbourhood that meets their preferences (Feijten & van Ham, 2009), but this is not the case for the new residents of Westerpark.

4.2.2 When is a car-free neighbourhood considered successful by local governments and residents?

The diagram below (Figure 5) shows the factors that residents and local governments think are needed to create a successful car-free neighbourhood on the right-hand side. On the left are the residents and the local government, which shows which factors were mentioned by which group of respondents, and which factors overlap.

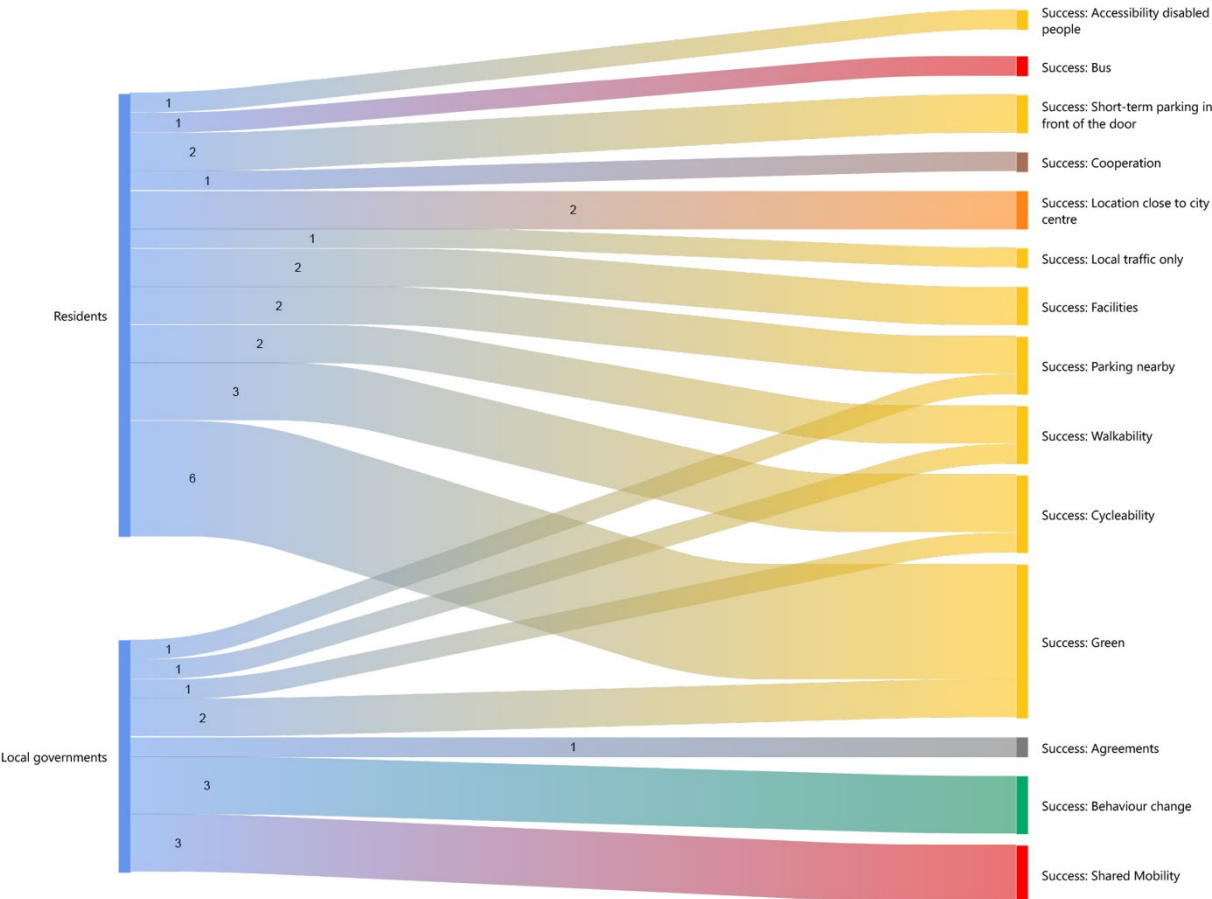


Figure 5. Sankey diagram, success factors.

These factors were mentioned in response to the question: "How would you describe a successful car-free neighbourhood?". Therefore, some factors may have been mentioned at

other times in the interview. However, this diagram only looks at the factors people mentioned when they were explicitly asked about factors for success. An overview of all factors can be found in Appendix C. The first thing to notice is that "Green" is mentioned by most respondents, both by residents and local governments. This seems to indicate that more green space is associated with a successful car-free neighbourhood, as it makes walking and cycling through the neighbourhood more pleasant, which is true according to Mueller et al. (2017), Nieuwenhuijsen & Khreis (2016) and Wahlgren & Schantz (2014). In addition, "Cyclability" is frequently mentioned, which is related to "Green". During the interviews, cycling is explicitly mentioned together with green three times. It is mentioned that cyclists should be able to move more comfortably through the neighbourhood, with shade and shelter from green, and without too many traffic lights. One resident also mentioned that cars drive slower in areas with more greenery, which makes walking and cycling safer.

A second observation is that both "Behaviour change" and "Shared Mobility" are mentioned by both local governments and the mobility agent for the success of a car-free neighbourhood. However, no resident does mention both factors as success factors. Behavioural change is explicitly mentioned together with cycling twice. A resident mentioned that when his car is parked at a distance, the temptation to use the car is reduced, and he will cycle more often. The local authorities also have this attitude: cycling should be attractive and easy, and it should take a little more effort to use the car. This difference in barrier to a mode of transport causes a change in people's mobility behaviour. This change is confirmed in studies by Reck et al. (2022) and Masoumi (2019). Parking at a distance works in the Ebbingekwartier and Assendorp because they are close to the city centre and people can use available car alternatives. However, parking at a distance in Breda does not work well because the distance to the city centre is longer and alternatives to the car are not as well accessible. In addition, remote parking only works if people are willing to walk to their car and create a new habit. The same applies to the situation where residents cannot park their car in front of their home. People will have to get used to the fact that they will have to walk when transporting large objects, instead of the car being parked in front of the door. Shared Mobility is mentioned by local governments and the mobility agent as an alternative to the car, for example, the train. However, it is admitted that when the shared car is parked in the same place as the other remotely parked cars, residents still must walk to use it. However, the availability of Shared Mobility will hopefully lead to a decrease in car ownership, which is to be expected according to Martin et al. (2010) and Johansson et al. (2019).

Comparison per group per type of respondent

This overview becomes more revealing when these factors are grouped (Figure 6). How the factors were grouped is shown in Appendix B.

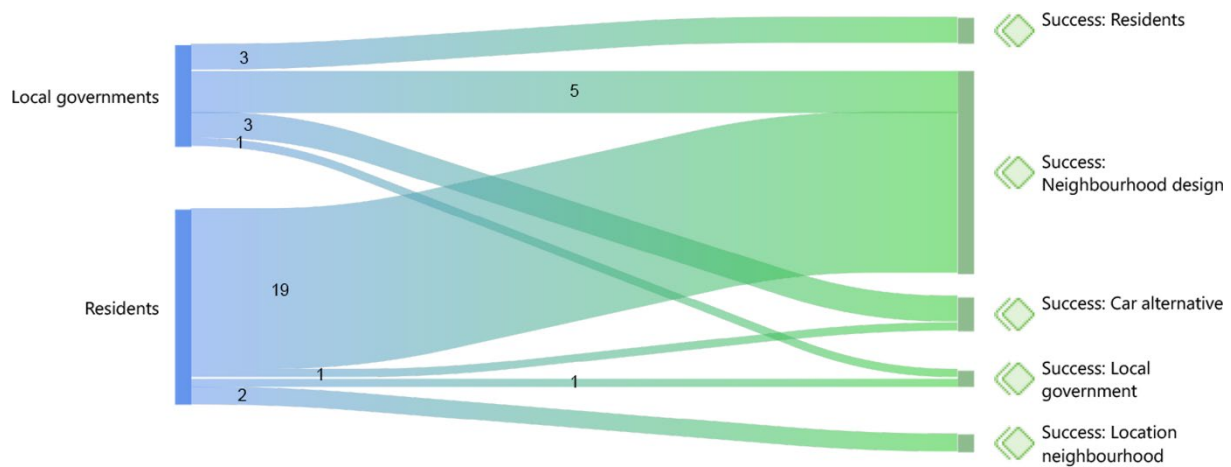


Figure 6. Sankey Diagram per type of respondent, success factors grouped.

What is striking now is the emphasis on success factors related to the neighbourhood's design. Admittedly, this is also the largest group in terms of factors. However, it still indicates that factors related to the neighbourhood's design are mainly associated with a successful car-free neighbourhood. These include, amongst others, the amount of greenery, the parking location, the ability to get to the front of houses by car, and the presence of facilities in the neighbourhood.

A group of factors that only the local governments mention is the group "Residents". This group is mainly about behavioural change. As mentioned before, local governments believe that people's behaviour must change to make a car-free neighbourhood successful, as stated by Doheim et al. (2020). The mindset of people must change; people should be more inclined to take their bicycles and be prepared to walk a long way to their cars if they want to use them. In addition, they must learn to live with the fact that if they must move heavy, large objects, their car cannot be parked in front of their homes. In addition, only residents mention the neighbourhood's location as a success factor. The local authorities mentioned this elsewhere during the interview, but not specifically as a success factor. For example, a neighbourhood on the outskirts of a city where it is difficult to get to because there is no train station or bus transport does not work well as a car-free neighbourhood. However, when a neighbourhood is close to the city centre, the centre can be reached on foot or by bike. This shorter distance makes people less likely to use their cars.

Residents and local governments mentioned factors are the presence of alternatives to the car and the “Local government” group. The bus and Shared Mobility are mentioned as an alternative to the car. In the group “Local government”, the factors “Agreements” and “Cooperation” are included. During the interviews, it was emphasised that for a car-free neighbourhood to be successful, there must be clear agreements and cooperation between the residents and the local government. It must be agreed on what is allowed and what is forbidden in advance.

Comparison per group per neighbourhood

Figure 7 shows the same Sankey diagram as Figure 6, but now not per type of respondent but per neighbourhood.

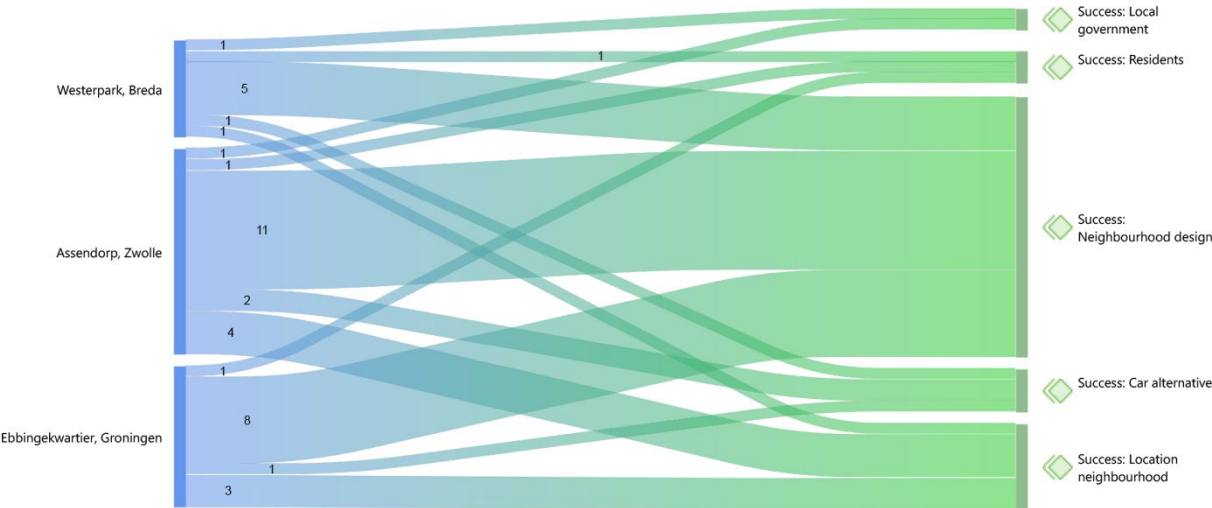


Figure 7. Sankey Diagram per neighbourhood, success factors grouped.

The first thing to notice in this diagram is that factors related to 'neighbourhood design' are mentioned most frequently in Assendorp, Zwolle. This could be because this neighbourhood is 'community-led', which means that the neighbourhood has fewer cars due to citizen initiatives and not because of the neighbourhood design, which would be 'design-led'. Therefore, this neighbourhood differs the most in design from the other car-free neighbourhoods in this study. As a result, in Assendorp, factors related to the neighbourhood design are frequently mentioned because this is where the most benefits can be achieved.

What is also striking is that success factors related to the neighbourhood's location are mentioned most in Assendorp, Zwolle, and the Ebbingekwartier, Groningen, and least in Westerpark, Breda. This is surprising, considering that Westerpark is the district furthest

from the centre of all the cases. The district's location is thus mentioned the least in Westerpark as a success factor for a car-free district compared to the other two districts.

The groups of factors 'Local government', 'Residents' and 'Car alternatives' do not or hardly differ between the cases. These factors are mentioned more or less equally in each district for a successful low-traffic district.

Comparison to theory

Both residents and local authorities mention that more green space can lead to more active forms of mobility such as walking, cycling and public transport, which is supported by Nieuwenhuijsen & Khreis (2016). For example, cyclists prefer cycling through green areas (Wahlgren & Schantz, 2014). Furthermore, it is mentioned in the interviews and literature that the distance to mobility makes choices change. This 'access distance', both physical and mental, can cause people to choose the easiest and closest mobility option (Reck et al., 2022; Masoumi, 2019).

Where the results of the interviews and theory disagree, however, is on whether more shared cars and fewer parking spaces lead to less car ownership. The interview with the local government of Breda shows that they assumed that fewer parking spaces would result in less car ownership, mainly because the neighbourhood would attract people without a car. This expectation is also stated by Martin et al. (2016) and Johansson et al. (2019). However, this no longer appears to be the case in Breda. Previously, mainly people without a car went to live in Westerpark, but the neighbourhood now attracts people with one or more cars. Because the neighbourhood is not designed for this, this causes problems. However, it must be said that Breda may have fewer parking spaces but no Shared Mobility options. The absence of carsharing may cause people to keep their cars. Local governments also mention that people's habits must change so they will eventually use their cars less. Doheim et al. (2020) argue that this is also a task for local governments. They should inform residents of the advantages of alternatives to the car so that people are encouraged to use them.

4.2.3 Has residents' view of their car-free neighbourhood changed since they started living there?

Most residents interviewed for this study have lived in their neighbourhood since 2018, i.e., for four years, with outliers upwards (Table 8). Two-thirds of residents say their view of their neighbourhood has changed, one third say their view of their neighbourhood is unchanged.

Table 8. Overview of how long residents have been living in their neighbourhood.

Interview	Neighbourhood	Living in the neighbourhood since	Living in the neighbourhood for how long
1	Assendorp, Zwolle	2012	10 years
2		2018	4 years
4	Ebbingekwartier,	2015	7 years
5	Groningen	2018	4 years
7	Westerpark, Breda	2018	4 years
8		1998	24 years

Opinion changed, positively

Both residents of Assendorp in the city of Zwolle have positively changed their opinion. One resident says the local government now supports the residents better than ten years ago. For instance, the local government has provided more green areas, bicycle lanes and a bicycle roundabout; the neighbourhood has become much more bicycle friendly. The other resident mentioned that the involvement of the residents, and their will to make things happen together, is more potent than he had anticipated four years ago. This involvement happens in a relaxed way; nobody is obliged to participate. One of the residents of the Ebbingekwartier in the city of Groningen experiences the concept of a car-free neighbourhood as more pleasant than expected four years ago, partly because the car is still parked nearby in the parking garage.

Opinion unchanged

The other two residents of the Ebbingekwartier have not changed their opinion in the seven years they have lived there. However, they are disappointed that so many mopeds and motorbikes drive fast along the cycling lane while they are not allowed to do so. According to them, this causes danger for children playing outside. The opinion of one of the residents of Westerpark in the city of Breda also remains unchanged. Living in a car-free neighbourhood was expected to be pleasant four years ago and has proven to be so. This resident also mentions that they are not planning to live here for ten years. So, if they do not like trivial things, the thought that they will not be living here for very long helps. This resident had chosen Westerpark because it is a more modern, trendier, and greener neighbourhood than the one they lived in before. They did not move here because of the car-free design.

Opinion changed, negatively

For the other resident of Westerpark, their opinion has changed for the worse. When they started living there 24 years ago, just after the construction of the neighbourhood, it was first seen as a nice neighbourhood. However, according to them, the local government does not stick to the original plan for the neighbourhood, because of which the neighbourhood has now partly failed.

Comparison

Figure 8 compares the success factors mentioned by residents in two groups. The first group consists of three residents whose opinion of the neighbourhood had changed between when they moved in and now. The second group consists of three residents whose opinion has remained unchanged.

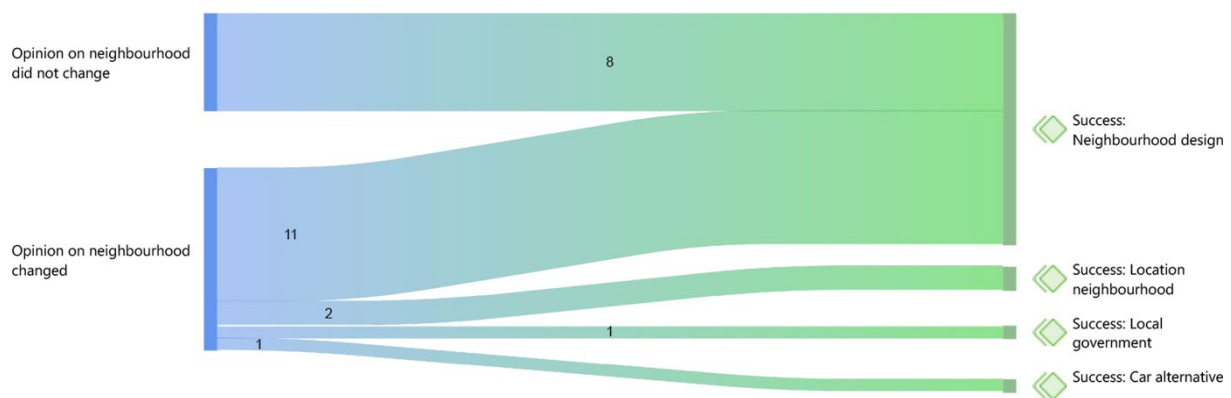


Figure 8. Sankey diagram, opinion on the neighbourhood.

What is striking is that people whose opinion of their neighbourhood has remained unchanged only mention the design of a neighbourhood as a factor for a successful car-free neighbourhood. The other group of people, whose opinion has changed, also mention factors related to the location of the neighbourhood, the local government, and the presence of car alternatives as factors for a successful car-free neighbourhood. In case of the location, people chose their neighbourhood specifically because it was close to the city centre so they could walk or cycle to the centre, which is needed for a successful car-free neighbourhood in their opinion. In the case of the local government, a resident discovered while living in the neighbourhood that the involvement of the local government and residents was higher than he had expected beforehand, which changed his opinion on the neighbourhood for the better. In his opinion, this involvement and collaboration are needed for a car-free neighbourhood to be successful. Finally, in the case of car alternatives, buses are mentioned as a success factor for neighbourhoods located further from a city centre.

5. Discussion

5.1 How does the view on the concept of car-free neighbourhoods differ between local governments and residents?

No one among the residents or local authorities views car-free neighbourhoods negatively. Nevertheless, not everyone is explicitly positive and convinced by the concept of a car-free neighbourhood, but relatively neutral. That might be one of the reasons why car-free neighbourhoods are not being applied everywhere. However, most of the residents interviewed for this study are positive about the concept of a car-free neighbourhood. They are now happily living in a car-free neighbourhood or would like to live in an entirely car-free neighbourhood. However, there are, among some respondents, doubts about the feasibility. Residents like neighbourhoods with less car traffic, but a neighbourhood where it is no longer possible to drive their car in front of their house is seen as less pleasant. Especially when moving house or for people with small children, it is convenient to be able to park the car shortly before their homes. Local governments, however, see this differently and would rather see neighbourhoods completely free of cars and all cars parked at a distance so that it is no longer possible to drive a car in front of a house. Local governments are also critical of car-free neighbourhoods. They like the concept itself, but according to them, it is the location that determines whether a car-free neighbourhood can become successful. The further away a neighbourhood is from a city centre, the less suitable the car-free concept for that neighbourhood. In addition, banning cars should not be an end in itself. The goal must be a high-quality living environment; in some neighbourhoods, this could entail fewer cars. Another difference is that residents require the local government to provide enough parking spaces, but local governments find this less of a given. The local government will provide parking spaces, but not a surplus of parking spaces because that would be a waste of space.

Residents and local governments agree that greenery can contribute to car-free neighbourhoods because it makes walking and cycling more pleasant. This is also supported by literature (Mueller et al., 2017; Nieuwenhuijsen & Khreis, 2016; Wahlgren & Schantz, 2014). In addition, agreements must be made about which forms of mobility are permitted.

For example, are cyclists allowed to use the sidewalk? Moreover, are scooters and motorbikes allowed on the cycling lane? According to both residents and local governments, this must be clear to everyone and should be enforced. They also both agree that, for the time being, most people will still own a car. Shared Mobility might persuade some people to get rid of their cars (Martin et al., 2010; Johansson et al., 2019), but most will keep theirs, according to the interviews. A surplus of cars is not advantageous for a car-free neighbourhood either. When many residents own two or more cars, they occupy a lot of space. For example, space that cannot be used for greenery, cycling lanes or sidewalks. What residents and local governments also agree on in every neighbourhood is whether the neighbourhood is seen as a successful car-free neighbourhood or not. When residents see the neighbourhood as successful, so does the local government, and vice versa.

Generally, people are positive about car-free neighbourhoods and recognise the benefits mentioned in the literature (Doheim et al., 2020; Wahlgren & Schantz, 2014). The location of a neighbourhood is seen as necessary for a car-free neighbourhood by Bahler (2019), van Acker et al. (2014), and Da Silva Borges & Grando Goldner (2015). Nevertheless, the local government of Breda built a car-free neighbourhood far away from the centre. They assumed and hoped that people without cars would start living here, as van Acker et al. (2014) predicted. However, this has not been the case: people with one or more cars have started living in Westerpark. The interviews show that residents do not specifically choose a neighbourhood because of its car-restricted character, while this is to be expected according to Kushner (2005). People keep their cars in all investigated neighbourhoods partly because Shared Mobility does not yet meet their needs for flexibility and convenience. In addition, Westerpark does not have good public transport or Shared Mobility, which is necessary for a car-free neighbourhood, according to Doheim et al. (2020). Fewer parking spaces can lead to less car ownership, but only in combination with car sharing, according to Johansson et al. (2019). Westerpark does not have car-sharing options. The local government of Breda has taken the cars out of Westerpark without bringing back alternatives, making this neighbourhood an unsuccessful car-free neighbourhood.

5.2 When is a car-free neighbourhood considered successful by local governments and residents?

Residents and local governments agree that greenery contributes to the success of a car-free neighbourhood. More greenery makes it more pleasant to cycle and walk through the neighbourhood. Therefore, this greenery makes people more inclined to walk or cycle and use their cars less often. A car-free neighbourhood is therefore considered more successful if there is much greenery since this is also stated in the literature (Nieuwenhuijsen, 2016; Mueller et al., 2017; Nieuwenhuijsen & Khreis, 2016; Wahlgren & Schantz, 2014; Lee & Maheswaran, 2010).

When considering a successful car-free neighbourhood, local governments think of behavioural change and Shared Mobility, whereas residents do not mention these as success factors. Literature also mentions Shared Mobility as one of the success factors for a car-free neighbourhood (Martin et al., 2010). Residents do admit that if their car is parked at a distance and it is quicker to take the bike, they are less inclined to walk to their car and therefore use their bike, as also found by Guo (2013b) and Reck et al. (2022). When this becomes a habit, there is indeed a behavioural change in the modality choice of residents. In addition, local governments hope that the presence of Shared Mobility will lead to less car ownership, but in practice, it turns out that most residents prefer to keep their cars for now. Therefore, local governments may see car-free neighbourhoods more as a place where people go to live without a car, while residents see a car-free neighbourhood as a place where there are fewer or no cars but where the car can still be parked nearby. A car-free neighbourhood is therefore seen as more successful if parking facilities are available at a distance.

Residents regard the location of a car-free neighbourhood as a crucial factor in its success, as does literature (Baehler, 2019; van Acker et al., 2014; Da Silva Borges & Grando Goldner, 2015). The local governments do not explicitly mention the location as a success factor. However, they indicate that the car-free neighbourhood concept cannot simply be applied to every neighbourhood. According to them, the priority in a neighbourhood must always be a high-quality living environment. If the character of the neighbourhood and its location indicate that the car-free neighbourhood and its location indicate that the car-free neighbourhood concept increases this quality, it can be applied. Here the view of residents and local governments on car-free neighbourhoods differs. Whereas residents almost all regard the concept of a car-free neighbourhood as positive, the local governments are

somewhat more critical. A car-free neighbourhood is not a good idea everywhere and should not be applied indiscriminately.

Residents and local governments agree that there must be good agreements between the residents and the local government. For example, agreements about which forms of modality are allowed must be made together. In addition, there must be good cooperation so that solutions can be sought together. For example, when residents move house, they need to know whether it is possible and allowed to park their car in front of their house temporarily or not. Moreover, this may only be possible in contact with the local government. The agreements must be clear to both parties to avoid ambiguity and frustration. This is also stated by Doheim et al. (2020) and Bongardt et al. (2013).

Both residents and municipalities recognise that more greenery can contribute to more active forms of mobility, which is also supported by literature (Nieuwenhuijsen & Khreis, 2016; Wahlgren & Schantz, 2014). For example, Assendorp in Zwolle is turning parking spaces into greenery, which can stimulate more active mobility, lower temperatures and better drainage (Kushner, 2005). However, the Westerpark and Ebbingekwartier neighbourhoods do not have much green space. This lack of green makes the Ebbingekwartier a hot neighbourhood in summer, but its favourable location to the city centre means much cycling and walking in the neighbourhood. However, Westerpark has little green space and is further away from the city centre, which makes people more inclined to take the car. A shortage of parking spaces can reduce car ownership, but only in combination with the presence of alternatives to the car, which are lacking in Westerpark.

In Westerpark, the original residents who owned few or no cars, the neighbourhood's target group according to the local government, moved out. People who own one or more cars then moved into this car-free neighbourhood. The first question is why the original residents left. It could be that they thought in advance that living in this neighbourhood would be pleasant, which is why they moved there. Perhaps the residents found out after a while that the neighbourhood was quite far from the centre and that public transport was not nearby, so they chose to move because the neighbourhood no longer met their expectations. People move when a neighbourhood no longer meets their expectations (Clark & Dieleman, 2017). The second question is why people moved into a car-free neighbourhood. People usually go live in a neighbourhood that meets their expectations (Feijten & van Ham, 2009). This question remains partially unanswered. The interviews with residents have shown that people do not usually move to a low-traffic neighbourhood specifically for its low-traffic character. Other characteristics of a neighbourhood are generally the deciding factor. It may

be that the neighbourhood did meet their wishes in other respects, which is why they went to live here.

The local government of Breda could have responded to the wishes of the original inhabitants. Instead, the local government built the neighbourhood and then failed to improve things like public transport. However, developing car-free neighbourhoods is an ongoing process in an ever-changing context (Sareen et al., 2021). Therefore, the local government could have responded to the unfulfilled expectations of the residents by engaging in a dialogue with them and looking at how their wishes could have been met. In this way, Westerpark might have been a more successful car-free neighbourhood.

This outflow of inhabitants did not occur in the other cases, the Ebbingekwartier in Groningen and Assendorp in Zwolle. These neighbourhoods have good access to public transport and are closer to the city centre than Westerpark. The Ebbingekwartier is also a very new neighbourhood, which means that many of the original residents probably still live there. In Assendorp, the residents started an initiative to reduce the number of cars in their neighbourhood. Why this is happening in Assendorp and not in Westerpark is unclear. It could have something to do with the fact that the residents in Westerpark do not want to reinforce the car-free concept due to the lack of public transport and the distant location from the centre. The interviews in Assendorp show that this is a close community of residents who together want to make the neighbourhood more liveable by reducing the number of cars so that the neighbourhood becomes quieter, safer and greener. This fact may explain the different attitudes of the residents in Assendorp compared to Westerpark, where there is not such a close community.

In Assendorp, success factors related to the neighbourhood's design are mentioned most frequently. This observation is not surprising because this neighbourhood was not built as a car-free neighbourhood by design and therefore deviates most from the concept of a low-traffic district in terms of design. For example, there is little greenery, few or no cycle paths in the neighbourhood and cars can still be parked outside the door in most places. What is more surprising, however, is that success factors related to the neighbourhood's location are mentioned the least in Breda, even though this neighbourhood is located furthest from the centre of all cases. This observation could be explained by the fact that many inhabitants of Westerpark own one or more cars. This may explain why the distance to the city centre is seen as less important because the car can easily be used for this purpose. As a result, the location of a neighbourhood might be seen as less important for the success of a car-free neighbourhood.

5.3 Has residents' view of their car-free neighbourhood changed since they started living there?

Half of the residents now have a more positive view of their neighbourhood than when they moved in. Parking the car at a distance does not appear to be experienced as an inconvenience. Some residents have not changed their opinion about car-free neighbourhoods but are disappointed that not all road users abide by the rules. For example, scooters and motorbikes drive fast in the bike lane, where they are not allowed. Only one resident has become more pessimistic about the neighbourhood they live in. This is also the resident who has lived in this neighbourhood the longest of all respondents. The idea of the neighbourhood, a neighbourhood in which people would live without owning a car, was not feasible from the outset. Now, two decades later, the neighbourhood is facing parking issues.

When the group of residents who have changed their minds about their neighbourhood is compared to the group of residents who have not changed their minds, it turns out that residents who have not changed their minds only think about factors related to the design of a neighbourhood for a successful car-free neighbourhood. Residents who have changed their mind about their neighbourhood, however, do not only think about the design of a neighbourhood for the success of a car-free neighbourhood but also look at other factors such as the location, the local government, and the presence of alternatives to the car.

A difference between these groups is that the group of residents whose opinion of their neighbourhood has not changed only cite factors related to the design of a neighbourhood for the success of a car-free neighbourhood. However, the group of residents whose opinion has changed also cites factors related to the location of the neighbourhood, the local government, and the presence of alternatives to the car. Therefore, it could be that residents who have not changed their minds base their opinion only on aspects related to the design of a neighbourhood. At the same time, residents who have changed their minds base their opinion on other aspects, thus also considering them necessary for a successful neighbourhood.

6. Conclusion

6.1 Conclusion

This thesis aims to gain insight into the success of car-free neighbourhoods by studying and comparing three different neighbourhoods and identifying the factors that contribute to the success of a car-free neighbourhood. A better understanding of the factors contributing to the success or failure of existing car-free neighbourhoods can help local governments learn from the past and improve future car-free neighbourhoods. Therefore, this research aimed to identify the factors contributing to a car-free neighbourhood's success. The main research question was therefore defined as follows:

What factors contribute to the success of a car-free neighbourhood?

Cars and the associated infrastructure like roads and parking have far-reaching consequences on urban life (Ostermeijer et al., 2019). They take up much of the space in cities (Nieuwenhuijsen & Khreis, 2016), but we could put this space to better use (Rogers et al., 2016). We could provide for more space for greenery in cities, leading to more active and physical mobility such as walking, cycling and public transport (Mueller et al., 2017), leading to various health benefits (Nieuwenhuijsen, 2016). In addition to health benefits, more greenery improves climate adaptation by improving drainage and reducing the urban heat island effect (Oke, 1973; IPCC, 2021). Car-free neighbourhoods can help improve residents' health and climate adaptation in neighbourhoods. However, implementing car-free neighbourhoods is not easy and regularly meets with criticism from residents (Da Silva Borges & Grandó Goldner, 2015; Morris et al., 2009). It is essential to involve residents in policymaking right from the start before making final decisions (Bongardt et al., 2013) to increase support from the residents. However, while developing a car-free neighbourhood, it is essential to realise that developing them is an ongoing process that requires adapting to a constantly changing context (Sareen et al., 2021). Finally, it is crucial that when cars are removed from neighbourhoods, there are enough alternatives for residents to be still able to move around (Doheim et al., 2020; Stojanovski, 2019), as is the location of the neighbourhood because the location of a neighbourhood is one of the most crucial factors that influences modal choice (Baehler, 2019).

This thesis focused on a gap in the literature on car-free neighbourhoods in the Netherlands. Little research has been done on car-free neighbourhoods, which is why they have received little attention from policymakers and are still too little applied in practice. Furthermore, most literature focuses on the top-down perspective of planners and policymakers rather than the bottom-up perspective of residents. That is why this research viewed car-free neighbourhoods from the perspective of both policymakers and residents.

Based on the literature studied and data collected, this thesis showed that:

- car-free neighbourhoods can have many benefits in terms of climate adaptation by providing more space for green and in terms of the health of residents by encouraging active forms of mobility;
- several factors influence the success of car-free neighbourhoods, and can be used by local governments to improve existing neighbourhoods.

This chapter continues by answering the secondary and main research questions.

6.1.1 How does the view on the concept of car-free neighbourhoods differ between local governments and residents?

Both residents and local governments have a positive view of the concept of car-free neighbourhoods. Both recognize the various advantages that a car-free neighbourhood has. However, local governments especially acknowledge that the concept cannot be applied everywhere because it depends on the location. Residents like car-free neighbourhoods because they are perceived as safer and quieter. For local governments, car-free neighbourhoods help to increase the quality of life in a neighbourhood. Both residents and local governments regard car-free neighbourhoods as neighbourhoods with less motorised traffic, but parking somewhere other than in front of the houses is still possible. Although, in theory, car-free neighbourhoods are mainly intended for people who do not own a car (Acker et al., 2014), it turns out that people who live in car-free neighbourhoods usually own cars.

The original residents of Westerpark, who owned few cars, left the neighbourhood. This may have happened because, after moving, they found out that the neighbourhood was too far from the city centre and that public transport was not nearby. People move when a neighbourhood no longer meets their wishes and expectations (Clark & Dieleman, 2017). The municipality could have responded to this wish by engaging with residents and listening to their wishes since developing car-free neighbourhoods is an ongoing process

(Sareen et al., 2021). However, it is unclear why residents with one or more cars subsequently moved into Westerpark. One would expect that people with a preference for the car would not go and live in a car-free neighbourhood because people usually go live in neighbourhoods that meet their wishes and expectations (Feijten & van Ham, 2009), but this was the case in Westerpark.

In summary, while most residents are positive about the concept of car-free neighbourhoods, local authorities need to know where car-free developments occur. After all, a car-free neighbourhood does not work in every location and is therefore not always a positive development that benefits a neighbourhood's liveability.

6.1.2 When is a car-free neighbourhood considered successful by local governments and residents?

According to residents and local governments, car-free neighbourhoods are successful if they have much greenery, which is also stated in the literature. Green ensures that people will walk, cycle and use public transport more (Mueller et al., 2017; Nieuwenhuijsen & Khreis, 2016; Wahlgren & Schantz, 2014). Local governments consider a car-free neighbourhood successful if forms of Shared Mobility are present, like carsharing, but residents consider this less important. A car-free neighbourhood is successful for residents and local authorities if fewer cars drive through the streets. However, for example, parking should still be possible at the edge of a neighbourhood. Both groups also consider a car-free neighbourhood successful if it is close to the city centre, so walking and cycling become more attractive than other modes of transport. Finally, a car-free neighbourhood is seen as successful by both residents and local authorities if there are good agreements between residents and the local authority about what is and is not permitted in the neighbourhood.

Concluded, residents and local authorities do not differ much in their opinions about when they consider a car-free neighbourhood successful. The only difference is that local governments consider Shared Mobility, such as shared cars, important, but residents see this as less important.

6.1.3 Has residents' view of their car-free neighbourhood changed since they started living there?

Half of the interviewees had changed their opinion of their neighbourhood between when they started living there and now. The changed opinion is usually more positive, because, for example, parking at a distance is not experienced as annoying as thought. However, in

one case where the opinion has become more negative, this is because the local government no longer sticks to the original plan of the neighbourhood, because of which the neighbourhood is now experienced as an unsuccessful car-free neighbourhood.

In summary, residents' opinions of the neighbourhood they live in are usually more positive than when they first moved in, but half of the respondents had not changed their minds.

6.2 What factors contribute to the success of a car-free neighbourhood?

Several factors are essential for the success of a car-free neighbourhood. These factors must be used simultaneously and side by side because sometimes one factor does not work without the other or because they reinforce each other. For example, the neighbourhood must have greenery to reduce the urban heat island effect (Rogers et al., 2016), improve drainage (Nieuwenhuijsen, 2016), and encourage active forms of mobility such as walking, cycling, and public transport (Wahlgren & Schantz, 2014). In addition, the number of parking spaces in a neighbourhood can be reduced if alternatives to the car are available. Fewer parking spaces can contribute to lower car ownership, but only if alternatives such as good public transport and shared cars are available and if residents are aware of these alternatives (Doheim et al., 2020). In addition, residents should be involved from the start of any changes in the neighbourhood so that they are prepared for changes and agree with them (Bongardt et al., 2013). The changes, rules and agreements must be clear to the local government and all residents of a car-free neighbourhood.

Moreover, the location affects the success of a car-free neighbourhood (Baehler, 2019), especially if there is little green space and a lack of alternatives to the car and if the area is far from the city's centre. If these factors are all present in a car-free neighbourhood, the chances of it being a successful car-free neighbourhood are much higher. Finally, local governments must realise that car-free neighbourhoods are in a constantly changing context. It is therefore essential to keep listening to the changing wishes of residents to keep the neighbourhood successful over time.

Concluding, the factors that contribute to the success of a car-free neighbourhood are: greenery, a reduced number of parking spaces, enough alternatives to the car, involvement of residents from the start, clear agreements between residents and local governments, and a location close to a city's centre (Figure 9).

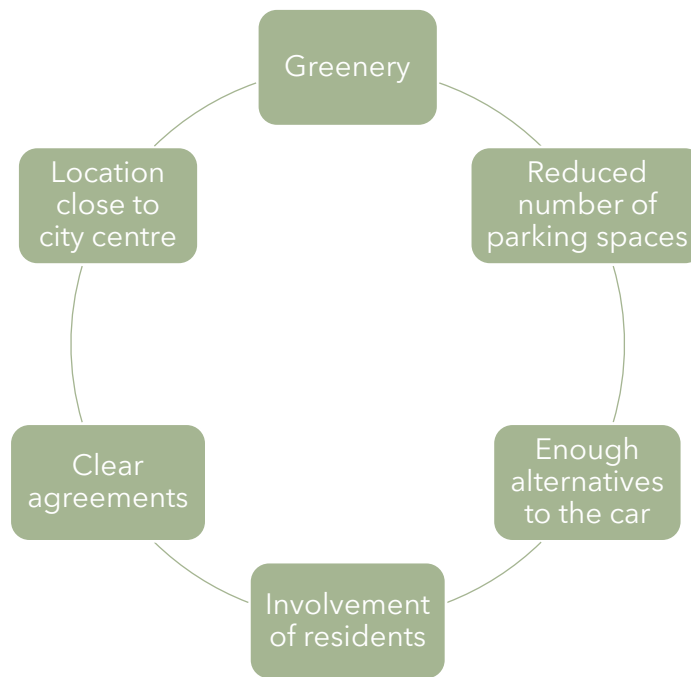


Figure 9. Factors that contribute to the success of a car-free neighbourhood.

6.3 Reflection

6.3.1 Limitations

Some remarks can be made about the limitations of this thesis. For example, striking things are found about the fact that car-free neighbourhoods are intended for people who do not own a car, but people who own one or more cars move in here. Unfortunately, given the time and resources that the researcher had, it was not possible to delve further into this. More insights into this could contribute further to the results of this study and thus contribute even more to the success of car-free neighbourhoods.

In addition, only two policy staff members appointed by the local governments of Groningen and Breda, and a mobility agent appointed by the local government of Zwolle, were interviewed. Interviews with neighbourhood architects or agencies that deal with public transport could have further contributed to the results of this study. It could have provided new insights to identify more success factors for car-free neighbourhoods. Six residents were also interviewed. These in-depth interviews provided many insights, but more interviews or the addition of surveys among a larger group of residents could have provided even more information that could have contributed to the success of this research.

6.3.2 Methods

During the contact with local governments, they were slow to respond to contact requests via the standard contact form on their websites. As a result, it took a very long time until

interviews with policy staff were scheduled. Unfortunately, this made the data collection take longer than planned and made it impossible to talk to more people involved within the timeframe of this research.

In addition, finding willing residents was also tricky. Many residents were not at home or did not want to cooperate with an interview. The selection of respondents was tried to be as random as possible. However, it is possible that only people who are positive about car-free neighbourhoods said yes to an interview when they heard this would be the subject of the discussion. The result that many residents are optimistic about car-free neighbourhoods may be a form of self-selection.

6.3.3 Suggestions for future research

Suggestions for future research can be based on the findings and limitations of this study. Firstly, it is suggested to conduct more research into how car-free neighbourhoods are aimed at people without cars but also attract people who own one or more cars and would like to use them. In addition, insight into people's moving preferences could contribute to future car-free neighbourhoods or improve existing car-free neighbourhoods.

Secondly, it is suggested to conduct a similar study in other cities in the Netherlands to investigate whether a study there yields comparable results or new insights, or in cities outside of the Netherlands to investigate whether the same success factors are true for countries with less distinct cycling cultures.

Thirdly, people must be in the office less often since the COVID-19 pandemic. Therefore, their commuting effort decreases on a weekly basis since they can stay at home and work from there on some days. It is generally assumed that corona measures, such as being more at home, can impact people's relocation behaviour (CBS, 2021). People would have a greater need for space in and around the home. The expectation that working from home will also be more common after the pandemic, could also result in people who work moving further away from their work. Therefore, car-free neighbourhoods could become more interesting, because the living quality is higher than an average neighbourhood. After all, a successful car-free neighbourhood is quieter, safer and greener. Future research into the relationship between people's housing preferences during and after the pandemic and car-free neighbourhoods could provide interesting insights.

7. References

- 50 Tinten Groen Assendorp. (n.d.). *Meer groen en ruimte in de wijk*. Retrieved June 2, 2022, from <https://50tintengroenassendorp.nl/vervoer/>
- Acker, van, V., Mokhtarian, P., & Witlox, F. (2014). Car availability explained by the structural relationships between lifestyles, residential location, and underlying residential and travel attitudes. *Transport Policy*(35), 88-99.
- Aldred, R., Woodcock, J., & Goodman, A. (2016). Does more cycling mean more diversity in cycling? *Transport Reviews*, 36(1), 28-44.
- AlleCijfers.nl. (2022). *Statistieken buurt Westerpark*. Retrieved August 4, 2022, from <https://allecijfers.nl/buurt/westerpark-breda/>
- AlleCijfers.nl. (2022a). *Statistieken Hortusbuurt-Ebbingekwartier*. Retrieved August 4, 2022, from <https://allecijfers.nl/buurt/hortusbuurt-ebbingekwartier-groningen/>
- AlleCijfers.nl. (2022b). *Statistieken wijk Assendorp*. Retrieved August 4, 2022, from <https://allecijfers.nl/wijk/wijk-13-assendorp-zwolle/>
- Amoly, E., Dadvand, P., Forns, J., López-Vicente, M., Basagaña, X., Julvez, J., & Sunyer, J. (2014). Green and blue spaces and behavioral development in Barcelona schoolchildren: The BREATH project. *Environmental Health Perspectives*, 122(12), 1351-1358.
- Baehler, D. (2019). *Living in a car-free housing development. Motivations and mobility practices of residents in nine developments in Switzerland and Germany [PhD thesis, Université de Lausanne]*. Retrieved from https://serval.unil.ch/en/notice/serval:BIB_2053C99A97BC
- Bhat, C., & Guo, J. (2007). A comprehensive analysis of built environment characteristics on household residential choice and auto ownership levels. *Transportation Research Part B*, 41(5), 506-526.
- Bongardt, D., Creutzig, F., Hüging, H., Sakamoto, K., Bakker, S., Gota, S., & Böhler-Baedeker, S. (2013). *Low-carbon land transport: policy handbook*. Oxfordshire: Routledge.
- Brown, A. (2017). Car-less or car-free? Socioeconomic and mobility differences among zero-car households. *Transportation Policy*(60), 152-159.

- Buchanan, J. (1991). Opportunity Cost. In J. Eatwell, M. Milgate, & P. Newman (Eds.), *The World of Economics* (pp. 520-525). London: Palgrave Macmillan.
- CBS. (2016). *Onderzoek Verplaatsingen in Nederland (OVIN)*. Den Haag: Centraal Bureau voor de Statistiek.
- CBS. (2021). *Meer verhuizingen naar regio's buiten de Randstad*. Retrieved August 17, 2022, from <https://www.cbs.nl/nl-nl/nieuws/2021/08/meer-verhuizingen-naar-regio-s-buiten-de-randstad>
- Cervero, R., Adkins, A., & Sullivan, C. (2010). Are Suburban TODs Over-Parked? *Journal of Public Transportation*, 13(2), 47-70.
- Clark, W. A., & Dieleman, F. M. (2017). *Households and Housing: Choice and Outcomes in the Housing Market* (1st ed.). Oxfordshire: Routledge.
- Clark, W., & Coulter, R. (2015). Who wants to move? The role of neighbourhood change. *Environment and Planning A*, 47(12), 2683-2709.
- Clifford, N., Cope, M., Gillespie, T., & French, S. (2016). *Key Methods in Geography* (3rd ed.). London: Sage.
- Da Silva Borges, B., & Grando Goldner, L. (2015). Implementation of car-free neighbourhoods in medium-sized cities in Brazil, a case study in Florianópolis, Santa Catarina. *International Journal of Urban Sustainable Development*, 7(2), 183-195.
- Doheim, R., Farag, A., & Badawi, S. (2020). Success Measures for Transforming Into Car-Free Cities: Recommendations for Implementation. In R. M. Doheim, A. A. Farag, & S. Badawi (Eds.), *Humanizing Cities Through Car-Free City Development and Transformation* (pp. 232-268). Lancashire: University of Central Lancashire.
- European Commission. (2013). Eurobarometer 79.4, May-June 2013. Brussels: TNS OPINION.
- Feijten, P., & Ham, v. M. (2009). Neighbourhood Change... Reason to Leave? *Urban Studies*, 46(10), 2103-2122.
- Fontana, A., & Frey, J. (1994). Interviewing: The art of science. In N. Denzin, & Y. Lincoln (Eds.), *Handbook of Qualitative Research* (pp. 361-376). Thousand Oaks: SAGE.

- Freytag, T., Gössling, S., & Mössner, S. (2014). Living the green city: Freiburg's Solarsiedlung between narratives and practices of sustainable urban development. *The International Journal of Justice and Sustainability*, 19(6), 644-659.
- Gascon, M., Triguero-Mas, M., Martínez, D., Dadvand, P., Forn, J., & Plasència, A. (2015). Mental health benefits of long-term exposure to residential green and blue spaces: a systematic review. *International Journal of Environmental Research and Public Health*(12), 4354-4379.
- Gemeente Breda. (2013). Bestemmingsplan Meerzicht-Westerpark.
- Gemeente Groningen. (2012). Bestemmingsplan Ebbingekwartier.
- Given, L. (2008). *The sage encyclopedia of qualitative research methods*. Thousand Oaks: SAGE Publications Inc.
- Google Maps. (2022). *Google Maps*. Retrieved July 28, 2022, from <https://www.google.com/maps>
- Guo, Z. (2013a). Residential street parking and car ownership: a study of households with off-street parking in the New York City region. *Journal of the American Planning Association*, 79(1), 32-48.
- Guo, Z. (2013b). Home parking convenience, household car usage, and implications to residential parking policies. *Transport Policy*(29), 97-106.
- Guo, Z. (2013c). Does residential parking supply affect household car ownership? *Journal of Transport Geography*(26), 18-28.
- Handy, S., Cao, X., & Mokhtarian, P. (2005). Correlation or causality between the built environment and travel behavior? Evidence from Northern California. *Transportation Research Part D*, 10(6), 427-444.
- Haustein, S., Kroesen, M., & Mulalic, I. (2020). Cycling culture and socialisation: modelling the effect of immigrant origin on cycling in Denmark and the Netherlands. *Transportation*(47), 1689-1709.
- Heesch, K., Sahlqvist, S., & Garrard, J. (2012). Gender differences in recreational and transport cycling: a cross-sectional mixed-methods comparison of cycling patterns, motivators, and constraints. *International Journal of Behavioral Nutrition and Physical Activity*, 9(106), 1-12.

- Heinen, E., Wee, van, M., & Maat, K. (2010). Commuting by bicycle: an overview of the literature. *Transport Reviews*, 30(1), 59-96.
- Horeni, O., Garling, T., Loukopoulos, P., & Fujii, S. (2007). An experimental simulation of adaptations to increased car-use costs. *Transportation Research Part F*(4), 300-320.
- IPCC. (2021). *Climate Change 2021: The Physical Science Basis*. Cambridge, United Kingdom; New York, NY, USA: Cambridge University Press.
- Jensen, O. (2013). *Staging Mobilities*. London: Routledge.
- Johansson, F., Hendriksson, G., & Envall, P. (2019). Moving to a Private-Car-Restricted and Mobility-Served Neighborhoods: The Unspectacular Workings of a Progressive Mobility Plan. *Sustainability*, 11(6208), 1-19.
- Kadaster. (2022). *Basisregistratie Adressen en Gebouwen - BAG*. Retrieved August 4, 2022, from <https://www.kadaster.nl/zakelijk/registraties/basisregistraties/bag>
- Kamruzzaman, M., Baker, D., Washington, S., & Turrell, G. (2013). Residential dissonance and mode choice. *Journal of Transport Geography*(33), 12-28.
- Katzev, R. (2003). Car Sharing: A New Approach to Urban Transportation Problems. *Analyses of Social Issues and Public Policy*, 3(1), 65-86.
- KiM. (2018). *Fietsfeiten*. Den Haag: Kennisinstituut voor Mobiliteitsbeleid.
- Kruyswijk, M. (2016, November 8). Even wennen: het verkeer rond de Munt staat niet meer te stinken. *Het Parool*.
- Kushner, J. (2005). Car-Free Housing Developments: Towards Sustainable Smart Growth and Urban Regeneration Thorough Car-Free Zoning, Car-Free Redevelopment, Pedestrian Improvement Districts, and New Urbanism. *Journal of Environmental Law*, 23(1), 1-26.
- Lee, A., & Maheswaran, R. (2010). The health benefits of urban green spaces: a review of the evidence. *Journal of Public Health*(33), 212-2022.
- Lee, B., Oropesa, R., & Kanan, J. (1994). Neighborhood context and residential-mobility. *Demography*, 31(2), 249-270.
- Lewins, A., & Silver, C. (2007). Coding Schemes, Coding Frames. In *Using Software in Qualitative Research* (pp. 92-117). London: SAGE.

- Lunghurst, R. (2016). Semi-structured interviews and focus groups. In N. Clifford, M. Cope, T. Gillespie, & S. French (Eds.), *Key Methods in Geography* (pp. 143-157). London: SAGE.
- Marsden, G. (2006). The evidence base for parking policies: a review. *Transport Policy*, 13(6), 447-457.
- Martin, E., Shaheen, S., & Lidicker, J. (2010). Impact of carsharing on household vehicle holdings: Results from North American shared-use vehicle survey. *Transportation Research Record*, 2143(1), 150-158.
- Masoumi, H. (2019). A Discrete Choice Analysis of Transport Mode Choice Causality and Perceived Barriers of Sustainable Mobility in the MENA Region. *Transport Policy*(79), 37-53.
- Mendex, G. (2014). *Beyond Move in Mexico City: Integrating sustainable mobility into the everyday*. Retrieved August 2, 2022, from <https://thecityfix.com/blog/beyond-move-mexico-city-integrating-sustainable-mobility-ecobici-biking-gisela-mendez/>
- Merwede.nl. (n.d.). *Ontdek verrassend stadsleven*. Retrieved June 27, 2022, from <https://merwede.nl/>
- Meurs, H., & Haaijers, R. (2001). Spatial structure and mobility. *Transportation Research Part D*(6), 429-446.
- Mitchell, R., & Popham, F. (2008). Effect of exposure to natural environment on health inequalities: an observational population study. *Lancet*, 372(9650), 1655-1660.
- Mokhtarian, P., & Cao, X. (2008). Examining the impacts of residential self-selection on travel behavior: a focus on methodologies. *Transportation Research Part B*, 42(3), 204-228.
- Molenda, I., & Sieg, G. (2013). Residential parking in vibrant city districts. *Economics of Transportation*, 2(4), 131-139.
- Morris, D., Enoch, M., Pitfield, D., & Ison, S. (2009). Car-free development through UK community travel plans. *Urban Design and Planning*, 162(1), 19-27.
- Mueller, N., Rojas-Rueda, D., Basagaña, X., Cirach, M., Cole-Hunter, T., & Davand, P. (2017). Urban and transport planning related exposures and mortality: A health impact assessment for cities. *Environmental Health Perspectives*, 125(1), 89-96.

- Nieuwenhuijsen, M. (2016). Urban and transport planning, environmental exposures and health-new concepts, methods and tools to improve health in cities. *Environmental Health*, 15(38), 161-171.
- Nieuwenhuijsen, M., & Khreis, H. (2016). Car free cities: pathway to healthy urban living. *Environment International*(94), 251-262.
- Oke, T. (1973). City size and the urban heat island. *Atmospheric Environment*(7), 769-779.
- Ornetzeder, M., Hertwich, E., Hubacek, K., Kortytarova, K., & Haas, W. (2008). The environmental effect of car-free housing: A case in Vienna. *Ecological Economics*, 65(3), 516-530.
- Ostermeijer, F., Koster, H., & Ommeren, van, J. (2019). Residential parking costs and car ownership: implications for parking policy and automated vehicles. *Regional Science and Urban Economics*(77), 276-288.
- Overheid.nl. (2021). *Nota parkeernormen 2021*. Retrieved May 12, 2022, from <https://lokaleregelgeving.overheid.nl/CVDR663962/1>
- Pereira, G., Foster, S., Martin, K., Christian, H., Boruff, B., & Knuiman, M. (2012). The association between neighborhood greenness and cardiovascular disease: an observational study. *BMC Public Health*, 12(466), 1-9.
- Pooley, C., Horton, D., Scheldeman, G., Mullen, C., Jones, T., Tight, M., . . . Chisholm, A. (2013). Policies for promoting walking and cycling in England: a view from the street. *Transport Policy*(27), 66-72.
- Punch, K. (2014). *Introduction to Social Research* (3rd ed.). London: Sage.
- Reck, D., Martin, H., & Axhausen, K. (2022). Mode choice, substitution patterns and environmental impacts of shared and personal micro-mobility. *Transportation Research Part D*(102), 1-18.
- Rogers, J., Emerine, D., Haas, P., Jackson, D., Kaufmann, P., Rybeck, R., & Westrom, R. (2016). Estimating parking utilization in multifamily residential buildings in Washington, D.C. *Transportation Research Record: Journal of the Transportation Research Board*, 2568(1), 72-82.
- RTV Noord. (2013, June 2). Bewoners Ebbingekwartier kwaad over parkeerbeleid . *RTV Noord*.

Sareen, S., Remme, D., Wågsæther, K., & Haarstad, H. (2021). A matter of time: Explicating temporality in science and technology studies and Bergen's car-free zone development. *Energy Research & Social Science* 78(78), 1-8.

Schapendonk, N. (2020). *Een autoluwe wijk in Breda: 'Duur, maar kwaliteit en leefbaarheid zijn ook wat waard'*. Retrieved June 2, 2022, from <https://www.bndestem.nl/breda/een-autoluwe-wijk-in-breda-duur-maar-kwaliteit-en-leefbaarheid-zijn-ook-wat-waard~a9fd667a/>

Scheveningen-thehague.nl. (2021). *Gemeente start proef met parkeren op afstand*. Retrieved June 27, 2022, from <https://scheveningen-thehague.nl/gemeente-start-proef-met-parkeren-op-afstand/>

Stojanovski, T. (2019). Urban Form and Mobility Choices: Informing about Sustainable Travel Alternatives, Carbon Emissions and Energy Use from Transportation in Swedish Neighbourhoods. *Sustainability*, 11(2), 1-28.

Taylor, L. (2016). Key Methods in Geography. In N. Clifford, T. Cope, T. Gillespie, & S. French (Eds.), *Case Study Methodology* (pp. 581-596). London: Sage Publications.

Underwood, S., Handy, S., Paterniti, D., & Lee, A. (2014). Why do teens abandon cycling? A retrospective look at attitudes and behaviors. *Journal of Transport & Health*, 1(1), 17-24.

Wahlgren, L., & Schantz, P. (2014). Exploring bike ability in a suburban metropolitan area using the Active Commuting Route Environment Scale (ACRES). *International Journal of Environmental Research and Public Health*, 11(8), 8276-8300.

Wee, van, B., Holwerda, H., & Baren, van, R. (2002). Preferences for modes, residential location and travel behaviour: the relevance for land-use impacts on mobility. *European Journal of Transport and Infrastructure Research*, 2(4), 305-316.

Yin, R. (1994). Discovering the future of the case study: method in evaluation research. *Evaluation Practice*, 15(3), 283-290.

Yin, R. (2008). *Case study research: Design and methods* (4th ed.). Thousand Oaks: Sage Publications Inc.

Zwolle.nl. (n.d.). *Assendorp: Gezellige, hartelijke wijk*. Retrieved July 28, 2022, from <https://www.zwolle.nl/assendorp>

8. Appendices

- Appendix A: Interview guide
- Appendix B: Final codebook
- Appendix C: Sankey diagram all codes

Appendix A: Interview guide

A1. Interview questions inhabitants

0. Introduction, explanation research and ask for permission to record interview. Make aware that interviews are anonymous, and that they can stop participating at any moment without explanation. Ask interviewee to introduce him-/herself.
1. Car-free neighbourhoods, in my research, are neighbourhoods with relatively little motorised traffic, with, for example, a parking garage or a parking space at the edge of the neighbourhood, but in any case, with few to no parking spaces directly in front of the houses. What is your opinion on car-free neighbourhoods?
2. When did you start living in this neighbourhood, and why did you choose this neighbourhood?
 - a. Where did you live before?
 - b. Why did you move?
 - c. How does your present living situation differ from what you lived in?
3. Has your opinion on this neighbourhood changed since you moved here?
4. Would you like to live in a car-free neighbourhood / Would you like to live in a non-car-free neighbourhood?
5. How would you describe a successful car-free neighbourhood?
 - a. Which factors do you think have to be present to make a car-free neighbourhood successful?
 - b. What are your expectations and wishes of a car-free neighbourhood?
6. Do you consider [name neighbourhood] to be a successful car-free neighbourhood, and why?
 - a. What do you think are the advantages and disadvantages of this neighbourhood?
7. If you could change anything in [name neighbourhood], what would that be?
 - a. If you could add or remove anything, what would it be?
8. Which means of transport do you use to travel the greatest distance?
 - a. How do you like it?

At the end of each interview, the respondent was asked if they would like to receive a summary of the results.

A2. Interview questions local governments

0. Introduction, explanation research and ask for permission to record interview. Make aware that interviews are anonymous, and that they can stop participating at any moment without explanation. Ask interviewee to introduce him-/herself, and his/her connection to the neighbourhood.
1. Car-free neighbourhoods, in my research, are neighbourhoods with relatively little motorised traffic, with, for example, a parking garage or a parking space at the edge of the neighbourhood, but in any case, with few to no parking spaces directly in front of the houses. What is your opinion on car-free neighbourhoods?
2. How would you describe a successful car-free neighbourhood?
 - a. Which factors do you think have to be present to make a car-free neighbourhood successful?
 - b. What are your expectations and wishes of a car-free neighbourhood?
3. Do you consider [name neighbourhood] to be a successful car-free neighbourhood, and why?
 - a. What do you think are the advantages and disadvantages of this neighbourhood?
4. If you could change anything in [name neighbourhood], what would that be?
 - a. If you could add or remove anything, what would it be?

At the end of each interview, the respondent was asked if they would like to receive a summary of the results.

Appendix B: Final codebook

Group	Code	Deductive/inductive	Description
Car alternative	Bus	Deductive	Mention of bus or bus stops as an alternative to the car (Katzev, 2003).
	Cycling	Deductive	Mention of cycling as an alternative to the car (Katzev, 2003).
	Public transport	Deductive	Mention of public transport as an alternative to the car (Katzev, 2003).
	Shared Mobility	Deductive	Mention of Shared Mobility, like carsharing, as an alternative to the car (Katzev, 2003).
	Train	Deductive	Mention of trains or train stations as an alternative to the car (Katzev, 2003).
	Walking	Deductive	Mention of walking as an alternative to the car (Katzev, 2003).
Local government	Agreements	Inductive	Mention of agreements between residents and the local government.
	Conservative government	local Inductive	Mention of a government that is not open to change and does not support its resident much with their car-free neighbourhood.
	Cooperation	Inductive	Mention of cooperation between residents and the local government.

	Progressive government	local	Inductive	Mention of a government that is open to change and does support its residents with their car-free neighbourhood.
Location neighbourhood	Location close to city centre		Deductive	Mention of location car-free neighbourhood close to the city centre (Baehler, 2019).
	Location further from city centre		Deductive	Mention of location of car-free neighbourhood further from the city centre (Baehler, 2019).
Neighbourhood design	Compact		Deductive	Mention of a compact neighbourhoods, buildings close to each other (van Acker et al., 2014; Da Silva Borges & Grando Goldner, 2015).
	Cyclability		Deductive	Mention of elements that make cycling easier or more pleasant (Nieuwenhuijsen & Khreis, 2016).
	Emergency vehicles		Inductive	Mention of access of emergency vehicles into the car-free neighbourhood.
	Facilities		Deductive	Mention of facilities in the car-free neighbourhood (Kushner, 2005).
	Green		Inductive	Mention of green, parks, playgrounds, etc.
	Local traffic only		Inductive	Mention of local traffic only, not a thoroughfare.
	Not only local traffic		Inductive	Mention of not only local traffic, but a thoroughfare.
	Parking nearby		Deductive	Mention of parking spaces close to people their homes (Reck et al., 2022).

	Prohibited modalities	Inductive	Mention of modalities on road sections where they are not allowed.
	Short-term parking in front of home	Inductive	Mention of short-term parking in front of homes.
	Walkability	Deductive	Mention of elements that make walking easier or more pleasant (Nieuwenhuijsen & Khreis, 2016).
Opinion on car-free neighbourhoods' concept	Negative	Deductive	Mention of negative opinion about car-free neighbourhoods (Doheim et al., 2020).
	Positive	Deductive	Mention of positive opinion about car-free neighbourhoods (Doheim et al., 2020).
Opinion on whether neighbourhood is successfully car-free	Agree	Deductive	Mention of agreeing that the neighbourhood is a successful car-free neighbourhood (Doheim et al., 2020).
	Disagree	Deductive	Mention of disagreeing that the neighbourhood is a successful car-free neighbourhood (Doheim et al., 2020).
Residents	Behaviour change	Inductive	Mention of behaviour change of residents.
	Engaging residents	Inductive	Mention of active, engaging residents.
	Less car ownership	Deductive	Mention of less car ownership residents (van Wee et al., 2002).
	Not less car ownership	Deductive	Mention of not less car ownership residents (van Wee et al., 2002).

	Reason for living in this neighbourhood not related to car-free aspect	Deductive	Mention of reason for living in this neighbourhood not related to the fact that it is a car-free neighbourhood (Handy et al., 2005; Bhat & Guo, 2007; Mokhtarian & Cao, 2008).
	Reason for living in this neighbourhood related to car-free aspect	Deductive	Mention of reason for living in this neighbourhood related to the fact that it is a car-free neighbourhood (Handy et al., 2005; Bhat & Guo, 2007; Mokhtarian & Cao, 2008).

Appendix C: Sankey diagram all codes

