HOW THE BUILT ENVIRONMENT AFFECTS TRAVEL BEHAVIOUR

A Comparative Analysis of Three Neighbourhoods in Groningen, the Netherlands

Colophon

Title: How the Built Environment Affects Travel Behaviour: A Comparative Analysis of Three Neighbourhoods in Groningen, the Netherlands
Author: Cas Smeets
Student number: S4139399
Contact: c.m.smeets@student.rug.nl

Program: Spatial Planning and Design
Degree: Bachelor of Science
University: University of Groningen
Faculty: Spatial Sciences

Supervisor: Dr. S. Ramezani
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Abstract

Cities are expanding rapidly, creating unsustainable car dependency. The need for a modal shift towards sustainable modes of transport is growing. A solution can be found in the built environment, which is known to affect travel behaviour. However, there is a dissensus among scholars which features of the built environment affect travel behaviour and to what extent they do so. This research explores which sociodemographic characteristics of the population and objective- and subjective features of the built environment have an influence on travel behaviour in the context of the Dutch city of Groningen. A quantitative survey was conducted to analyse travel behaviour patterns in three different neighbourhoods with different characteristics. Statistical analysis shows that the relative position of the neighbourhood has an effect on time travelled by foot and by bike, while the use of the car is not affected. Furthermore, the results show that women walk more on average than men and that factors that increase the pleasantness of walking and cycling decrease car use. New developments and redevelopments of neighbourhoods should therefore consider the needs and desires of the inhabitants of the neighbourhood to ascertain desired healthier travel behaviour.

Keywords: travel behaviour, modal shift, active travel, built environment, perceived built environment, sociodemographic characteristics.

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1. Introduction

1.1 Background

Currently, many cities around the world are expanding by building low density suburbs at the fringes of the city. These suburbs are often built on arable land, damaging natural systems (ITDP, 2017). Furthermore, the sprawling suburbs generate demand for travel by private car which new road building cannot keep up with. Cities are experiencing heavy traffic congestion, polluting the air with emissions and accelerating climate change. The increasing patterns of car dependency are an unsustainable solution to housing the growing world population in cities (ITDP, 2017). Therefore, travel demand should be moderated in a way (Ewing and Cervero, 2001).

Prolonged sitting, including during long commutes in a car as a result of car-oriented design, is negatively associated with health outcomes (Owen et al., 2010). Increasing physical activity levels can improve physical health conditions, emotion, sense of recognition, whole life quality, anxiety neurosis (Ohmatsu et al., 2014), and reduce pressure (Kario et al., 2001; Vancampfort et al., 2014) and depression (Dunn et al., 2001). A modal shift from traveling by car to traveling using active transport modes, which includes walking and cycling, therefore reduces health risks and improves overall well-being. In addition, stimulating active transport reduces pollution, energy use and increases social interaction (De Vos et al., 2019; Rissel and Rissel, 2009). Walking and cycling have received attention as a form of increasing physical activity for of a number of reasons. Firstly, no special skills or facilities are required, making walking and cycling suitable for all age groups. Secondly, people can choose their own preferred intensity of walking and cycling. Lastly, people, especially those from low income groups, are able to break out of their inactive lifestyles by walking and cycling (Brownson et al., 2000).

As stated above, an individual's physical activity level has extensive effects on health and well-being. Therefore, it is essential to determine the factors that influence one's level of physical activity. In addition to human factors, which include personal and social factors, nature and the built environment characteristics have also been proven to affect physical activity levels (Dahlgren and Whitehead, 1991; Kahn et al., 2002; Leslie et al., 1999). One way the built environment has an influence on physical activity is through travel mode choice (Ferdous et al., 2011; Handy et al., 2006; Yang et al., 2011; Yin, 2013). This choice is made based on built environment features like land use, walk and bike network facilities, and aesthetics, in addition to sociodemographic factors (Iacono et al., 2010; Liu et al., 2014; Millward et al., 2013). Perceptions of these built environment features are shown to have greater influence on travel behaviour than objective measures, which makes perceptual assessment essential in design related factors (Smith, 2008). Therefore, urban design and urban planning are critical factors in reducing car dependency and creating more vibrant and healthy cities (Cervero, 2002; Chen et al., 2008; Ding et al., 2017).

There is, however, a dissensus among scholars in the extent to which different built environment variables affect mode choice behaviour (Ding et al., 2017; Ewing and Cervero, 2010). Different contexts, modelling approaches, geographical scale, and the nonlinear effects of built environment features could be ascribed explaining factors for this dissensus (Cheng et al., 2020; Ding et al., 2018, 2017). Some studies (e.g. Cervero and Kockelman, 1997; Frank and Pivo, 1994; Meurs and Haaijer, 2001; Newman and Kenworthy, 1989) show that travel behaviour is influenced by various features of the built environment, while others (e.g. Bagley and Mokhtarian, 2002; Boarnet and Sarmiento, 1998; Kitamura et al., 1997) established lesser effects or found virtually no effect on travel behaviour. How these theories and concepts translate into behaviour in the Dutch context has been studied only scarcely.

The city of Groningen, situated in the north of the Netherlands, has developed as a dense, compact city and aims to retain this status when accommodating a projected growth of 40,000 inhabitants by 2040 (Groninger Internet Courant, 2021). An extensive public transport system provides high frequency, high quality public transport within the city and outgoing to regional destinations. Additionally, the city

discourages car use through implementing coherent policy packages. The traffic circulation plan, for example, discourages the use of cars within the inner city by introducing one-way roads that force people to travel using the ring road when travelling from one district to another (Aanpak Ring Zuid, 2021). Additionally, paid parking within large parts of the city is combined with excellent public transport to encourage people to park at 'park and rides' at the fringes of the city. Different neighbourhoods in the city were built in different times, which makes each neighbourhood unique with its own spatial features that were popular at the time it was built. A comparative research allows for the exploration of the influence of these large and more small-scale features between the different neighbourhoods.

1.2 Research Problem

To reduce the impact of transportation on the climate and to increase health, active transport modes should be promoted. The built environment plays an important role in this. Therefore, this study aims to explore the relationship between the built environment and travel behaviour with a focus on active transport in the Dutch setting of the city of Groningen. To achieve this, the following research question will be answered:

- How do sociodemographic characteristics and objective- and perceived built environment affect travel behaviour in the city of Groningen?

To answer the main research question, the following subquestions are proposed:

- Which objective factors of the built environment influence travel behaviour?
- Which sociodemographic characteristics influence travel behaviour?
- Which perceived factors of the built environment on the neighbourhood scale influence travel behaviour?
- How does travel behaviour differ between studied neighbourhoods?

1.3 Reading Guide

The relevance of this research has been discussed in this chapter. The following chapter will discuss relevant theories and concepts. Subsequently, chapter three explains the methodology used for the data collection of this research. The results of this data collection are found in chapter four along with how it relates to existing scientific literature and a discussion. Chapter five includes the answers to the research questions, conclusions, policy implications, limitations to this research, and suggestions for future research.

2. Theoretical Framework

2.1 Travel Mode Choice

The factors that have an influence on one's mode choice can be classified into four categories: 1) socioeconomic and demographic characteristics e.g. age, gender, employment status, and car ownership; 2) trip and travel mode characteristics; 3) spatial and built environment aspects; and 4) attitudinal and psychological factors (Buehler, 2011; De Witte et al., 2013; Eldeeb et al., 2021, 2015; Foth et al., 2014; Mahmoud, 2012). This research expands on the aspect of the spatial and built environment and researches this relationship in a new setting, while also considering the socio-demographic factors.

Some socio-demographic factors are found to be more influential than others when choosing a travel mode. Car ownership, for example, is one of the most significant factors influencing mode choice (Aziz et al., 2018; Limtanakool et al., 2006; Mahmoud and Hine, 2013; Nurul Habib et al., 2009; Srinivasan et al., 2020; Yu et al., 2019). Another example is that people with a lower level of education are more likely to travel by public transport, while a higher level of education results in more travel by car (Dieleman et al., 2002). Additionally, socio-demographic factors are hypothesised to affect perceptions of the built environment and travel behaviour (Ma and Cao, 2019).

Features of the built environment affect travel mode choice, as this is where travel takes place (Eldeeb et al., 2021). The built environment can be considered at regional scale or a local neighbourhood scale. The factor of the built environment with the largest influence on travel mode choice is found at the regional scale, namely the relative location of a residence within the overall urban structure (Ewing and Cervero, 2010; Næss, 2012; Næss et al., 2019; Stevens, 2017). City centres with concentrated land uses tend to lead to higher use of active modes of transport than suburban areas where land uses are more scattered (Schwanen et al., 2001). Similarly, walking and biking traffic volumes are shown to decrease with distance from the city centre (Martín and Páez, 2019; Nkeki and Asikhia, 2019; Scott and Ciuro, 2019; Yang et al., 2017). In addition to increased travel times and decreased accessibility, density of the neighbourhood plays an important role in this. An increase in distance from the city centre generally leads to lower neighbourhood densities (Mouratidis et al., 2019). Areas with higher densities engender higher shares of trips by active transport modes (Frank et al., 2004; Inoue et al., 2010, 2009; Witten et al., 2012).

Furthermore, mixed land use is considered crucial in promoting walking and cycling (Bedimo-Rung et al., 2005; Giles-Corti and Donovan, 2002a; Inoue et al., 2011; Paydar and Ramezani, 2010; Pikora et al., 2003; Rowe, 2011; Saelens and Handy, 2008; Suminski et al., 2005; Tu and Lin, 2008; Van Cauwenberg et al., 2012; Yun, 2019; Zapata-Diomedi and Veerman, 2016). Mixed land use can increase both 'walking for leisure' and 'walking for errands' (Sallis et al., 2004), as it provides a variety of destinations that are of interest to people, such as parks or public spaces (Addy et al., 2004; Giles-Corti and Donovan, 2002b). Furthermore, recreation facilities like movie theatres or shops are located closer to residential areas (Brownell et al., 1980). Access to these destinations is associated with increased levels of active travel (Cervero, 1996; Cervero and Duncan, 2003; Frank et al., 2005; Kamruzzaman et al., 2016; Maria Kockelman, 1997). Often, higher density residential areas have a higher mix of functions, which might be a contributing factor to lower levels of walking and cycling activity in lower density residential areas (Cervero and Kockelman, 1997).

The transportation infrastructure, which includes the road network, sidewalks, bike lanes and parking availability, also plays an import role in mode choice (Cheng et al., 2019; Ferrer and Ruiz, 2018; Santos et al., 2013). Factors that improve street connectivity for active modes of travel, e.g. the presence of sidewalks, ease of street crossing, sidewalk quality and the presence of benches, are proven to increase active travel (Giles-Corti and Donovan, 2002a; Leslie and Cerin, 2008; Pikora et al., 2003; Saelens et al., 2003; Van Cauwenberg et al., 2012; Yun, 2019). Additionally, multiple options for alternative routes

and a well-connected street network improve proximity of destinations and the efficiency of travel patterns (Oakes et al., 2007).

Furthermore, the attractiveness of places can influence travel behaviour too. Appealing landscapes have been proven to have a positive influence on outdoor walking and cycling activities (Huang, 2006). As aesthetic qualities of a place are difficult to measure, they are often described in other research. Examples of aesthetic qualities are the design of buildings and its windows and position of the doors, landscaping and the shade provided by trees, the availability of benches, and street lighting (Handy et al., 2002). Greenery is one of the most studied aesthetic qualities of a place. McCormack and Shiell (2011) found that greenery plays a role in increasing the perceived walkability of residential neighbourhoods, while the absence of greenery may lead to feelings of discomfort and prevent people from walking. Furthermore, greenery plays an important role in reducing air and noise pollution (Wang et al., 2016), both of which are significant deterrents to walking and cycling (Winters et al., 2011).

Lastly, both safety in traffic and general safety are found to be influential when regarding mode choice. Walking and cycling is significantly lower when people deem the environment insecure (Wang et al., 2016). Additionally, feelings of unsafety may tempt people to choose faster modes like cycling over walking (Rodríguez and Joo, 2004). Thus, in addition to the actual crime rate, the perception of the environment also has an influence on mode choice. This is further elaborated upon in the next section.

2.2 Perceived Built Environment

Evaluating the built environment can be done objectively and subjectively. Objective evaluations are based on statistics and datasets, whereas subjective evaluations are based on assessments of the built environment by respondents. People are found to make decisions that satisfy their needs instead of providing full utility. These decisions are based on the often limited information available to them, which is known as the theory of bounded rationality (Simon, 1957). The information available may not completely correspond with the real world, creating a mismatch between the perceived and objective environment. It is important to stress that subjective assessments of the built environment are not estimations of the factual characteristics of a place, but evaluation of it. Resultingly, evaluations of a neighbourhood may differ between its residents based on their preferences and needs (Ettema and Schekkerman, 2016). Additionally, Ewing and Handy (2009) argue that the perceived built environment acts a mediator between the objective built environment and travel behaviour. This is based on the assumption that different people might form different mental maps of the same area, which results in different travel behaviour. Similarly, Ma et al. (2014) found that the perceived environment plays the role of full mediator between the objective environment and cycling behaviour.

2.3 Conceptual Model and Hypotheses

An overview of the relations between different factors is given in the conceptual model (Figure 1). Based on the relations described above, the following hypotheses are proposed:

1. A higher building density will lead to more active transport.
2. Having a driver's license and access to a car leads to significantly more time spent travelling by car.
3. Features of the built environment that increase attractiveness are associated with increased active transport.
4. Perceived safety contributes to increased active travel.

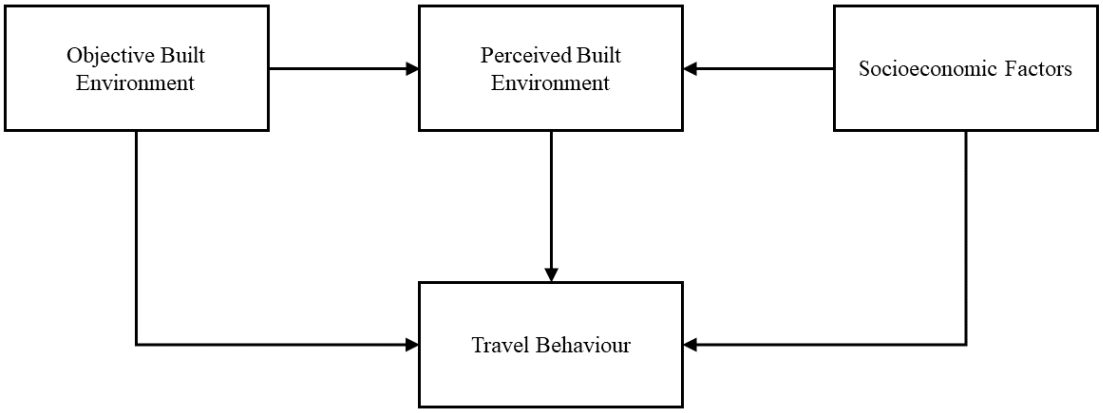

Figure 1: Conceptual model.

3. Methodology

First, a literature review has been conducted to provide relevant information on the relationships that exist between the variables. Subsequently, these relationships are explored for the specific context of the city of Groningen through an online survey. This approach allows for the identification of patterns between travel behaviour and the sociodemographic characteristics and the perceived built environment at the scale of the population. The survey therefore enables the comparison of these relationships between the populations of the studied neighbourhoods, whereas qualitative methods are applied to understand motives of individual behaviour through small scale intense research (McEvoy and Richards, 2006).

3.1 Study Area

This study compares how the built environment of three different neighbourhoods affects travel behaviour in the city of Groningen, the Netherlands. The chosen neighbourhoods comprise of Oosterpoortbuurt, Vinkhuizen, and Lewenborg, which are delineated in red in Figure 2. This selection has been made based on the respective spatial characteristics (Table 1) described in the above sections.

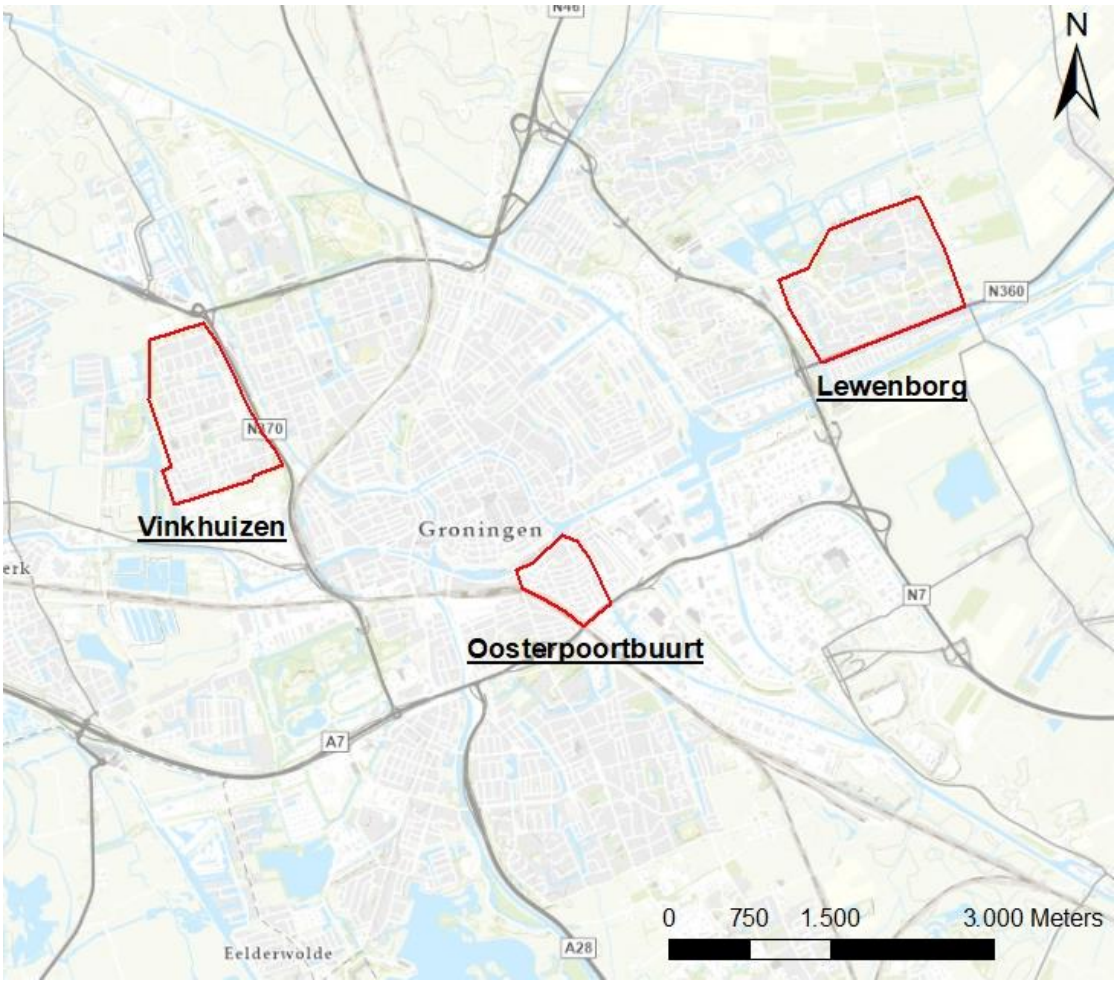

Figure 2: Map of study areas.

Neighbourhood	Distance to city centre	Built up area / total area	Units / total area
Oosterpoortbuurt	1.04 km	36.4 %	7.50 * 10^-3 units / m^2
Vinkhuizen	2.84 km	18.9 %	4.16 * 10^-3 units / m^2
Lewenborg	4.24 km	17.4 %	2.77 * 10^-3 units / m^2

Table 1: Neighbourhood characteristics.

The Oosterpoortbuurt is located closest to the city centre and has the highest density in built up area and functional units. Not many parking spaces are available and paid parking is implemented in the entire neighbourhood. Driving a car is also discouraged by narrow one-way streets and low maximum speeds. The housing typology most commonly found is row housing. Not as much greenery is present in the streets as in Vinkhuizen or Lewenborg.

Secondly, Vinkhuizen is located further from the city centre and has a lower density than Oosterpoortbuurt. The neighbourhood consists of wider streets with on-street parking freely available. The two main housing typologies found here are row housing and flats. This results in the presence of much open green spaces.

Lastly, Lewenborg is located furthest from the city centre and has the lowest density. This neighbourhood consists mostly of row housing with much green spaces and trees in between. Most houses have private driveways to park their cars in front of their homes.

3.2 Data Collection

3.2.1 Literature review

The literature review was conducted to investigate which factors of the built environment have been proven to have an effect on travel behaviour in the international context. Additionally, it helped to identify relevant spatial characteristics which are investigated in the survey.

3.2.2 Survey

A quantitative approach has been used in this research to gain insight into the behaviour of the population. Surveys allow for descriptive research of the population by obtaining information on its characteristics, behaviours, and attitudes (McLafferty, 2010). The online survey tool Qualtrics was used to collect primary data on the population. The University of Groningen provided access to Qualtrics. The survey was available in English and Dutch and contained questions on the socio-demographic characteristics and travel behaviour of the respondents, and how they perceived the built environment of their neighbourhood. Questions on the socio-demographic characteristics included a question on whether respondents work from home, as this might be a result of the COVID-19 pandemic which could influence the data. Additionally, respondents could indicate their travel behaviour through time travelled (in minutes) with different modes in the past seven days. The perceived influence of different built environment characteristics was investigated through statements about the neighbourhood to which the respondents could agree or disagree on a 5-point Likert scale. An overview of the questions with their respective answer possibilities is given in Appendix A.

Participants were recruited by distribution of pamphlets to letterboxes in the three neighbourhoods. This pamphlet contained an introduction to this research, an invitation to fill out the survey which included a link and QR-code that led to the survey, a statement of anonymity, and the contact details of the researcher in case the respondents had any questions or remarks. A copy of this pamphlet is included in Appendix B. These pamphlets were distributed to letterboxes at random addresses in the three neighbourhoods, including all types of housing typologies present in the neighbourhood. As this sampling method results in low response rates, this process repeated multiple days until a minimum of 30 responses per neighbourhood were acquired.

3.3 Data Analysis

The data gathered through the survey allows for the analysis of two relationships, namely between socio-demographic characteristics and travel behaviour, and built environment characteristics and travel behaviour for the three different neighbourhoods. The statistical analysis is conducted using SPSS. The data allows for analysis of these relationships at the level of three neighbourhoods combined and for comparison between the three neighbourhoods. First, the data is analysed for the three neighbourhoods combined to see what patterns are present for the city of Groningen. For the analyses of the relationships between the sociodemographic characteristics and the travel behaviour, the Spearman correlation test is used. This test determines whether there is a positive or negative correlation and the strength of this correlation between the two variables. The variables of the sociodemographic characteristics are nominal and are therefore recoded into dummy variables in SPSS. For the relationship between travel behaviour and the perceived built environment, the data gathered on the perceived built environment can be treated as continuous ratio data. This allows the Pearson correlation test to be used to investigate this relationship. Additionally, these relationships are analysed for the different neighbourhoods separately. SPSS includes a 'split file' tool which allows the data to be analysed separately for each neighbourhood based on the answer to the question 'In which neighbourhood do you currently live?'. After the data was organised into three categories for the different neighbourhoods, the tests were repeated. Finally, a comparison of travel behaviour per mode was conducted between the three neighbourhoods by means of ANOVA tests.

3.4 Ethical Considerations

Several considerations were taken into account in order to act ethically during this research. Firstly, the respondents were informed by the pamphlet about the purpose of the survey and this research. Additionally, the pamphlet explains that the results are fully anonymous and that the data gathered in the survey will solely be used for this research. The respondents voluntarily filled out the survey in private. The beginning of the survey included a statement that informed the respondents that they could quit the survey at any time if they felt uncomfortable filling out the rest of the survey.

The data gathered has not been tampered with and no fraud is committed during the research. The gathered data and results will also not be used to harm any of the participants in any way.

4. Results

4.1 Descriptive Statistics

A total of 125 responses was collected using Qualtrics during the period between 14-04-2022 and 13-05-2022. A distribution of the responses per neighbourhood is shown in Figure 3. Each neighbourhood meets the minimum of 30 respondents for the data set to be considered large and are therefore assumed to be normally distributed.

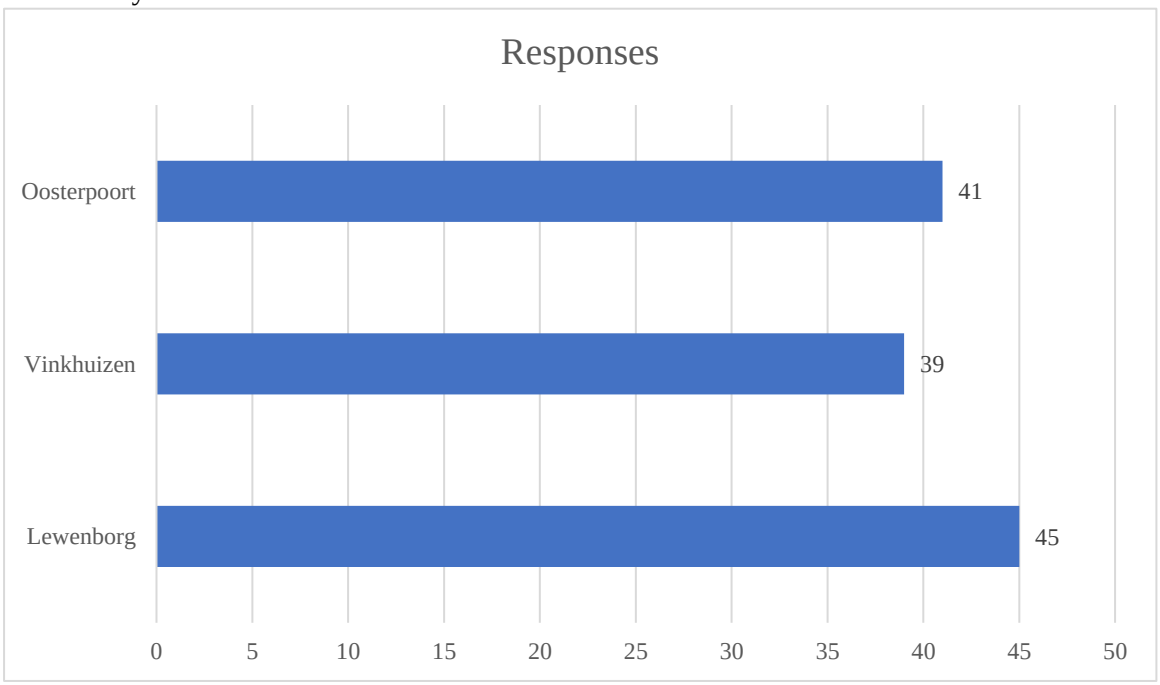

Figure 3: Distribution of responses.

The distribution of the age categories of the respondents for the total dataset is shown in Figure 4. From this we can see that the majority of respondents are in the categories of 25-44 and 45-64 years of age. This distribution changes somewhat when looking at the figures for the three separate neighbourhoods, shown in Figures 5-7. The distribution of the Oosterpoortbuurt shows the sample consists of younger respondents whereas Vinkhuizen and Lewenborg have a similar sample that consists of older respondents.

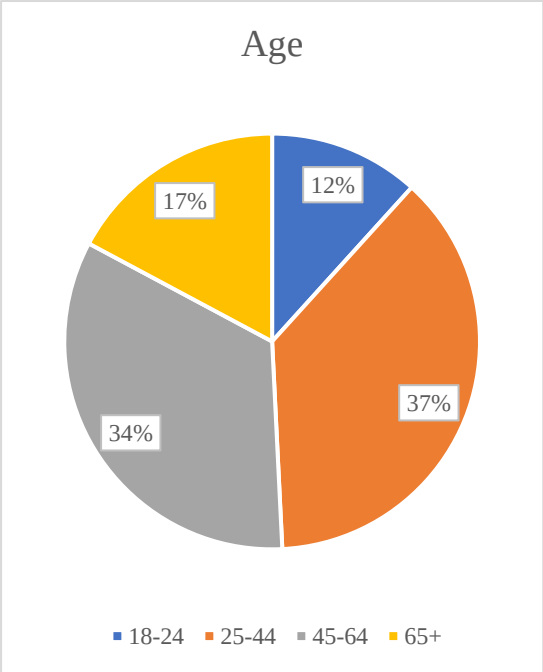

Figure 4: Age distribution of the studied neighbourhoods combined.

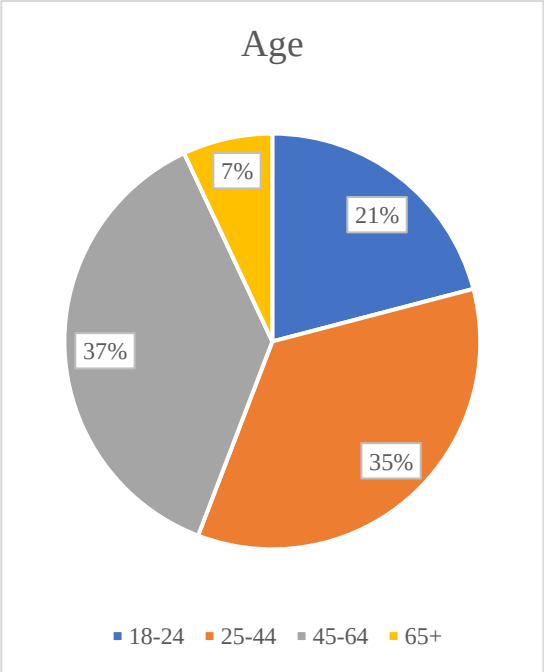

Figure 5: Age distribution of Oosterpoortbuurt.

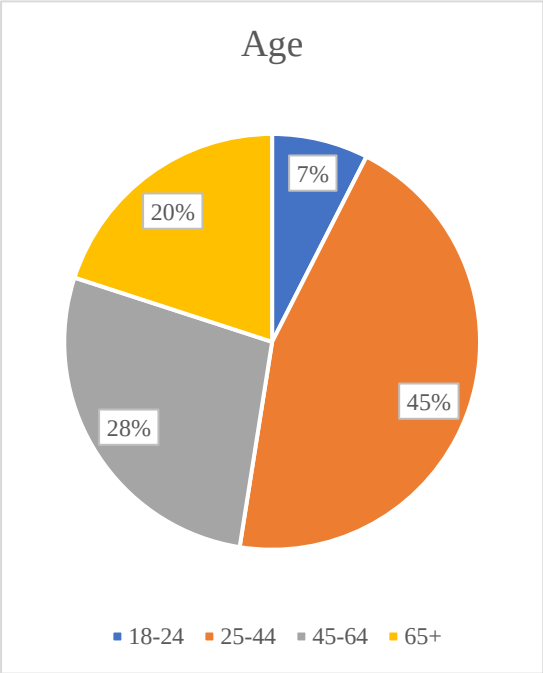

Figure 6: Age distribution of Vinkhuizen.

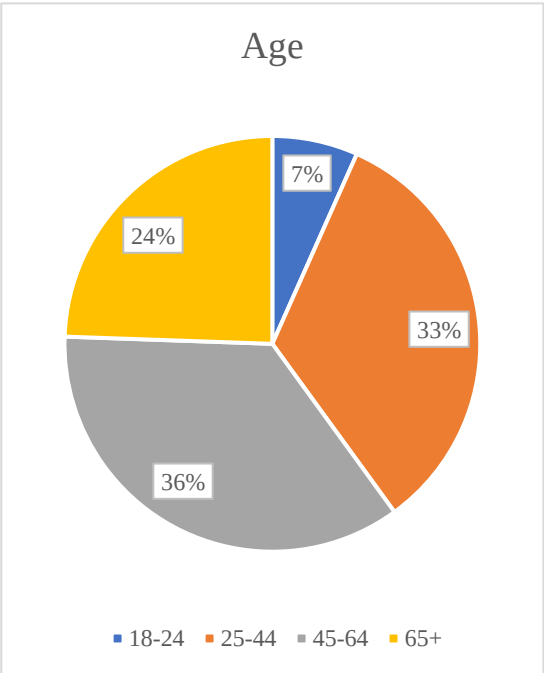

Figure 7: Age distribution of Lewenborg.

Gender distributions also differ between the neighbourhoods. In total, more respondents were female than male (Figure 8). This holds true for Oosterpoortbuurt and Vinkhuizen, while more men than women reacted to the survey in Lewenborg (Figures 9-11).

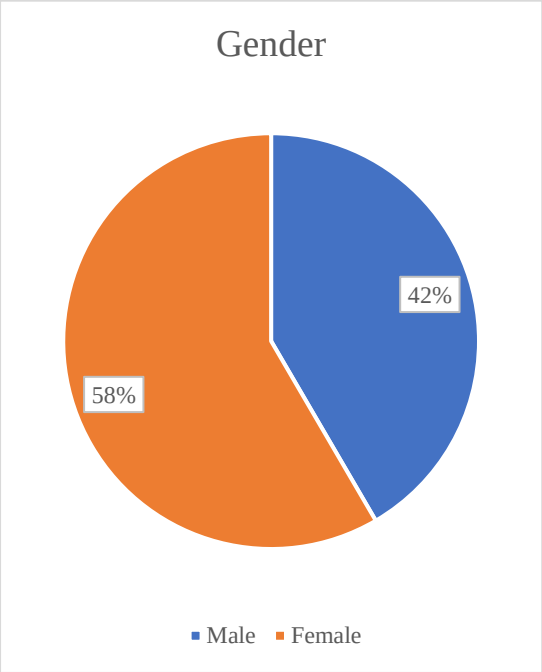

Figure 8: Gender distribution of the studied neighbourhoods combined.

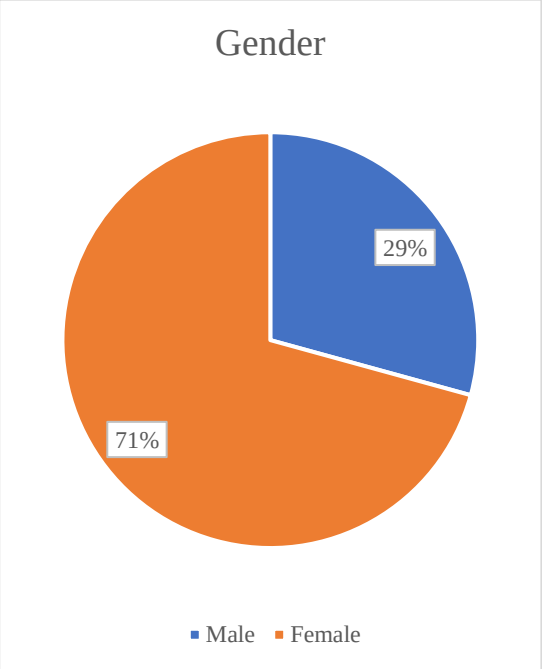

Figure 9: Gender distribution of Oosterpoortbuurt.

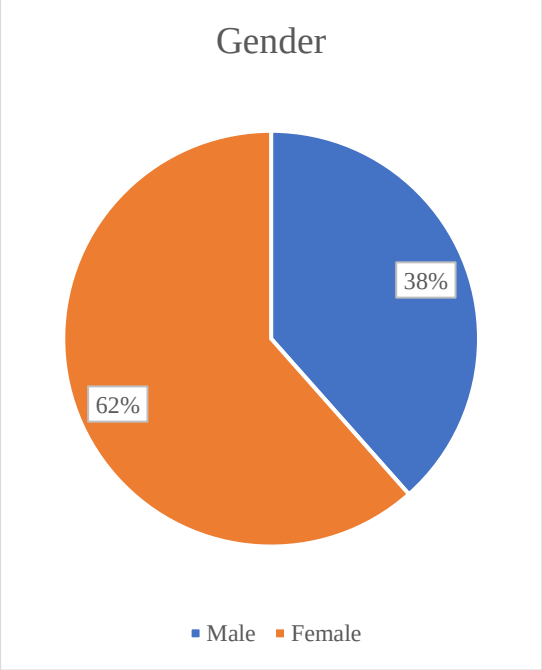

Figure 10: Gender distribution of Vinkhuizen.

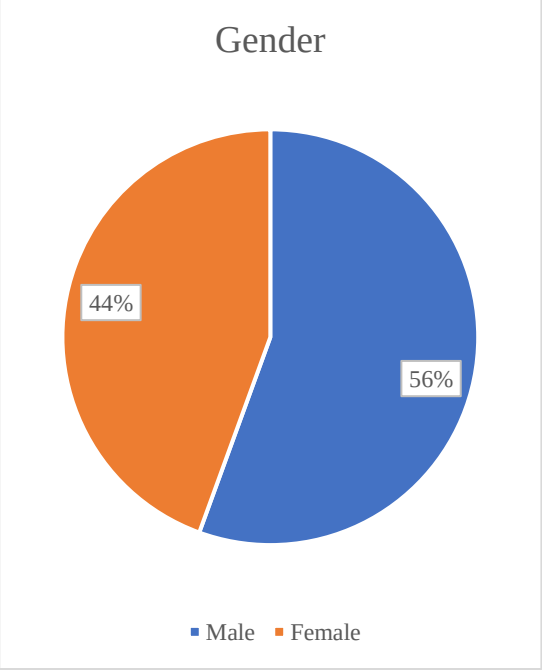

Figure 11: Gender distribution of Lewenborg.

4.2 Objective Factors and Travel Behaviour

The comparisons of travel behaviour between the three neighbourhoods for each travel mode in Appendix C reveal that none of the travel modes showed a significant difference in travel behaviour between the neighbourhoods. Although the tests were not significant, mean travel times per mode still show differences between the studied neighbourhoods. Oosterpoortbuurt residents walk more on average than residents of Vinkhuizen or Lewenborg. This is in line with theories from Frank et al. (2004), Inoue et al. (2010), Martín and Páez (2019), Nkeki and Asikhia (2019), Schwanen et al. (2001), Scott and Ciuro (2019), Witten et al. (2012), and Yang et al. (2017), which indicate that residents are more encouraged to travel by means of active transport closer to the city centre and in higher density areas. However, this does not hold true for cycling, where the residents of the Oosterpoortbuurt show the lowest activity. A reason for this could be that distances to destinations are shorter and therefore total travel time by bike is shorter for residents of the Oosterpoortbuurt compared to other neighbourhoods. For travel by car, the average travel times per neighbourhood are very similar, indicating that car travel behaviour is not influenced by the position of the neighbourhood for the city of Groningen. This is in contrast with findings from Ewing and Cervero (2010), Næss (2012), Næss et al. (2019), and Stevens (2017) that find that relative position of an area in the urban fabric significantly affects time spent travelling by car in American and Nordic contexts. An explanation could be that Groningen is a smaller city and that the difference in distance from the neighbourhoods to the city centre is relatively small compared to the cities studied in the literature. Additionally, the southern ring road of the city of Groningen was under construction during the period the survey was conducted, affecting all car travel in the city. This may have prevented people from travelling by car, resulting in them choosing other modes of transport instead. Lastly, travel times for public transport show the largest differences of all transport modes between the studied neighbourhoods. Lewenborg shows the highest mean travel time for public transport, which could be explained by high frequency bus connection to the city centre. Oosterpoortbuurt has slightly lower average travel times for public transport. An explaining factor could be that the neighbourhood is located close to the main station of the city of Groningen, which offers public transport in many directions. The fact that the neighbourhood is located so close to the station reduces the need to travel to the main station by public transport to make a transfer, reducing overall travel time. Vinkhuizen sees an especially low average travel time for public transport. This could indicate that the neighbourhood is not well connected to the rest of the city by public transport routes.

4.3 Sociodemographic Characteristics and Travel Behaviour

4.3.1 Three Neighbourhoods Combined

Several significant correlations between sociodemographic characteristics and travel behaviour can be found when the data of the three neighbourhoods are combined. These relationships are shown in Table 2 with the respective strengths of the relationships and p-values. Correlation coefficients < 0.3 are considered weak relationships, 0.3 - 0.5 as moderate, 0.5 – 0.7 as strong, and 0.7 – 0.9 as very strong.

Interestingly, the analysis shows that there is correlation between gender and time travelled by foot. This means that, according to this sample, women walk more on average than men in the three neighbourhoods. Pollard and Wagnild (2017) also found that women walk more than men, but this difference diminishes with increasing age until no consistent gender difference remains. Surprisingly, the sample of this research includes many older people, which makes the relationship present in this research remarkable. Furthermore, the level of education is shown to have an influence on travel behaviour in this sample. Having a bachelor's degree is negatively correlated with time spent in the car, while it has a positive influence on time travelled with public transport. This is in contrast with findings from Dieleman et al. (2002) who find that higher education results in more time travelled by car. Finally, an increase in age is negatively correlated with time spent in public transport. This is in line with findings from Currie and Delbosc (2010) who find that the elderly are more car dependent than the younger generations.

Variables	Spearman's Rho	Strength	p-value
Being female & Time travelled by foot	+0.187	Weak	0.041
'Other' household composition (compared to survey options for household composition) & Time travelled by car	-0.225	Weak	0.013
Bachelor's degree & Time travelled by car	-0.314	Moderate	0.000
Full time job & Time travelled by car	+0.198	Weak	0.030
Sometimes working from home & Time travelled by car	+0.256	Weak	0.005
Age & Time travelled by public transport	-0.232	Weak	0.020
Couple without children & Time travelled by public transport	-0.214	Weak	0.033
Bachelor's degree & Time travelled by public transport	+0.234	Weak	0.019
PhD degree & Time travelled by public transport	+0.200	Weak	0.046

Table 2: Correlation between sociodemographic characteristics and travel behaviour for the studied neighbourhoods.

4.3.2 Three Neighbourhoods Separately

The significant correlations that were found on the level of the individual neighbourhoods are included in Appendix D. These results show that only some of the relationships that were found to be significant when looking at the neighbourhoods combined still hold when looking at the neighbourhoods separately. Additionally, new relationships between variables are found to be significant at the level of the individual neighbourhoods.

When the Oosterpoortbuurt is considered separately, surprising relationships are found. Having a driver's license and having access to a car are both found to result in less time actually travelled by car. These relationships could be caused by some limitations in the research methodology. For example, the question on how much time is spent travelling by car does not distinguish between time driving as the driver or time being driven around. Additionally, these relationships could be a result of the limited sample size, which means that they do not hold when the sample size is increased.

The relationship found for Vinkhuizen where having a bachelor's degree increases time travelled by car is remarkable as this contrasts with the negative relationship between these variables found for the three combined neighbourhoods. For Vinkhuizen, having bachelor's degree also has an influence on time travelled by public transport. This means that, for Vinkhuizen, having a bachelor's degree results in more travel overall. Another remarkable relationship is the very strong correlation that exists between having access to a car and time travelled by public transport. People that have access to a car thus are more likely to choose to travel by public transport, even though mean time travelled by public transport is the lowest of the three studied neighbourhoods.

Noteworthy relationships for Lewenborg are that having an MBO degree is correlated with an increase in time travelled by car, whereas an HBO degree results in less time travelled by car. This trend is similar to the trend present at the level of the three neighbourhoods where higher education correlates with more time spent travelling by public transport.

4.4 Perceived Built Environment and Travel Behaviour

4.4.1 Three Neighbourhoods Combined

An overview of the significant relationships between the factors of the perceived built environment and travel behaviour for the three neighbourhoods combined is shown in Table 3. Factors concerning accessibility correlate positively with time travelled by foot, which is in line with findings from Cheng et al. (2019), Ferrer and Ruiz (2018), and Santos et al. (2013). Additionally, feelings of unsafety are negatively associated with time travelled by foot, as is illustrated by Wang et al. (2016). However, the analysis shows that feelings of unsafety are positively correlated with time travelled by bike. This increase in time spent travelling by bike could be a conscious or unconscious mode choice based on the perceived safety. When people deem an area along their travel unsafe, they could choose a faster mode

Variables	Pearson's r	Strength	p-value
Parking is difficult at local shopping areas & Time travelled by foot	+0.219	Weak	0.016
There are many places to go within walking distance at my home & Time travelled by foot	+0.277	Weak	0.002
There are many places to go within cycling distance at my home & Time travelled by foot	+0.182	Weak	0.047
My neighbourhood is well accessible by foot & Time travelled by foot	+0.195	Weak	0.033
My neighbourhood is well accessible by bike & Time travelled by foot	+0.191	Weak	0.037
The city centre is well accessible by foot & Time travelled by foot	+0.272	Weak	0.003
There are many interesting things to look at while walking or cycling in my neighbourhood & Time travelled by foot	+0.198	Weak	0.031
I see and speak to other people when I am walking in my neighbourhood & Time travelled by foot	+0.191	Weak	0.039
There is a high crime rate in my neighbourhood & Time travelled by foot	-0.210	Weak	0.023
The crime rate in my neighbourhood makes it unsafe to go on walks at night & Time travelled by foot	-0.205	Weak	0.026
Houses in my neighbourhood are well maintained & Time travelled by bike	-0.301	Moderate	0.001
The crime rate in my neighbourhood makes it unsafe to go on walks during the day & Time travelled by bike	+0.219	Weak	0.017
The crime rate makes it unsafe to go on walks at night & Time travelled by bike	+0.186	Weak	0.043
Sidewalks are separated from the road/traffic by parked cars in my neighbourhood & Time travelled by car	-0.229	Weak	0.012
It is safe to ride a bike in or near my neighbourhood & Time travelled by car	-0.344	Moderate	0.000
My neighbourhood is generally free from vandalism & Time travelled by car	-0.206	Weak	0.025
My neighbourhood is quiet & Time travelled by car	-0.204	Weak	0.026
The crime rate in my neighbourhood makes it unsafe to go on walks at night & Time travelled by car	+0.193	Weak	0.036
Sidewalks are separated from the road/traffic by parked cars in my neighbourhood & Time travelled by public transport	+0.227	Weak	0.024
There is a grass/dirt strip that separates the streets from the sidewalks in my neighbourhood & Time travelled by public transport	+0.228	Weak	0.023
The speed of traffic on most nearby streets is usually slow & Time travelled by public transport	+0.200	Weak	0.048

Table 3: Correlation between the perceived built environment and travel behaviour for the studied neighbourhoods combined.

of transportation (Rodríguez and Joo, 2004). Furthermore, factors that improve the quality of the environment of a neighbourhood are found to increase active travel and decrease time spent in travelling by car, which is in line with findings from Wang et al. (2016). The effect of greenery mentioned by McCormack and Shiell (2011), however, is not found to be significant in the results for this sample. One of the resulting effects of greenery is quietness. This influence is found to reduce time travelled by car for this sample, which might indirectly indicate an influence of greenery in the neighbourhood.

Public transport usage also increases as a result of an increase in attractiveness and safety. This may be caused by the improved walkability resulting from these factors. Improved walkability makes the journey to transport stops easier and more comfortable and thus increases time spent travelling with public transport (Frank et al., 2005).

4.4.2 Three Neighbourhoods Separately

The relationships between the perceived built environment and travel behaviour at the level of the separate studied neighbourhoods are also included in Appendix D. Whereas the strengths of the relationships were mostly weak for the three neighbourhoods combined, they are all moderate or strong when looking at the neighbourhoods separately.

Oosterpoortbuurt shows a similar trend in relationships to the one that is present for the three studied neighbourhood combined. The statements 'There are many places to go within walking distance at my home' and 'Stores are within easy cycling distance at my home' both correlate positively with active travel. These statements show how a mix of land uses can lead to active travel, which is in line with results from Zapata-Diomedi and Veerman (2016). Additionally, the statements 'Houses in my neighbourhood are well maintained' and 'My neighbourhood is generally free from vandalism' are correlated with reduced time spent travelling by car. Both statements contribute to a more attractive neighbourhood, which can lead to more active travel (Huang, 2006).

The relationships found in Vinkhuizen are again similar in trend to the studied neighbourhoods combined. Here, the statements 'Sidewalks are separated from the road/traffic by parked cars in my neighbourhood' and 'It is safe to ride a bike in or near my neighbourhood' both correlate with a reduction in time spent travelling by car. This illustrates how increased traffic safety can lead to people opting for other modes of travel than the car, as is in line with Wang et al. (2016).

For Lewenborg, the statements 'The crime rate in my neighbourhood makes it unsafe to go on walks during the day' and 'The crime rate in my neighbourhood makes it unsafe to go on walks at night' correlate with an increased time spent travelling by car. This shows that the perceived general safety in the neighbourhood affects active travel behaviour negatively, which is in accordance with results from Wang et al. (2016).

5. Conclusions

The aim of this research was to investigate the relationship between sociodemographic characteristics of the population, objective and perceived features of the built environment, and travel behaviour in the setting of the city of Groningen. The main research question can be answered by answering the subquestions. Answers to the subquestion '*Which objective factors of the built environment influence travel behaviour?*' include relative location of the neighbourhood within the urban fabric and density of the neighbourhood. This was also evident to some degree in this research, as findings show that the relative position of the neighbourhood within the urban fabric and the related density of the neighbourhood have an influence on time spent walking and cycling, while time spent commuting in the car is not affected. This could be a result of the development of Groningen as a compact city, minimising the distance from any neighbourhood to the city centre. Higher density and being located closer to the city centre resulted in more walking but less cycling, which confirms and opposes the first hypothesis. Generally less time is spent commuting with public transport than with other modes. These results simultaneously include the answer to the subquestion '*How does travel behaviour differ between studied neighbourhoods?*'.

The subquestion '*Which sociodemographic characteristics influence travel behaviour?*' has varying answers when looking at the three neighbourhoods combined or separately. When looking at the three neighbourhoods combined, women are found to walk more than men. Men thus have different needs than women. To achieve a more equal gender distribution of active travel, policy should consider the different needs for men and women when designing new developments. Additionally, the hypothesis '*Having a driver's license and access to a car leads to significantly more time spent travelling by car*' proved to be false. Finally, a relationship is found where time spent travelling with public transport decreases with age. So, the current public transport network apparently meets the needs of the older generations insufficiently. The desires of this age group should be considered in order to promote a modal shift to more sustainable modes of transport.

Similarly, significant relationships found between the perceived built environment and travel behaviour also differ between the combined neighbourhoods and the neighbourhoods separately. Factors that improve perceived attractiveness and safety were found to encourage active travel, which answers the subquestion '*Which perceived factors of the built environment on the neighbourhood scale influence travel behaviour?*'. Most factors that improve the 'walkability' or 'cyclability' of a place are found to be associated with a decrease in car use, which indirectly confirms the third hypothesis. There are some exceptions to this, which could be a result of different needs and desires of the inhabitants of the different neighbourhoods (Ettema and Schekkerman, 2016). In order to benefit from the positive effects of a modal shift towards sustainable modes of transport, specific features of the built environment should be promoted through policy. High density development and mix of land uses stimulate travel by active modes. In addition, features that increase the attractiveness of a neighbourhood should be promoted to expand the share of active transport. Traffic safety and general safety from crime also play an important role in the promotion of active modes, which is in accordance with the fourth hypothesis. When (re)developing an area, these features should be considered in the design in order to encourage healthy lifestyles.

5.1 Limitations and Future Research Suggestions

This research looked at the differences and similarities between three neighbourhoods in the city of Groningen. These neighbourhoods were chosen based on their differing characteristics, but may not be representative for other neighbourhoods with similar characteristics within the city of Groningen or elsewhere. This could be because of the sampling technique, which results in responses only from people willing to respond to a pamphlet delivered to their door. Therefore, other people that are part of the target group are not reached. Furthermore, these people may not be representative of other neighbourhoods in the city or other cities with similar characteristics. Although the research

methodology allows for the analysis of behavioural patterns for the population, it does explain what specific causes exist for the found relationships.

Future research could follow up on this research by analysing which attitudinal and psychological factors influence travel behaviour by conducting qualitative research (e.g. interviews), as these also have an influence on travel behaviour. This could unveil specific reasoning for behaviour or reveal indirect effects of the built environment that were not captured by the statements in this research. It is essential to further explore this research subject in order to move towards more sustainable and healthy mobility.

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Appendix A: Survey Design

Q#	Question	Measurement level	Answer options
Sociodemographic characteristics			
Q1	What is your gender?	Nominal	Male Female Other
Q2	What is your age?	Ordinal	18-24 25-44 45-64 65+
Q3	What is your household composition?	Nominal	Single Single parent Couple w/o children Couple with children Other
Q4	What is your level of education?	Nominal	No qualification Primary Secondary MBO HBO University Other
Q5	What is your working status?	Nominal	No job Full-time job Part-time job Other
Q6	Do you work from home?	Nominal	Yes, all the time Yes, some of the time No Not applicable
Q7	What is your housing situation?	Nominal	Rented Owned
Q8	In which neighbourhood do you currently live?	Nominal	Oosterpoortbuurt Vinkhuizen Zuid Lewenborg Zuid Other
Q9	Do you have a driver's license?	Binary	Yes No
Q10	Do you have access to a car?	Binary	Yes No
Travel behaviour			
Q11	What is your main mode of transportation?	Nominal	Walking Cycling Car Public transport
Q12	How much time in minutes did you spend traveling by foot in the last 7 days?	Ratio	Time spent traveling by foot in minutes

Q13	How much time in minutes did you spend traveling by bike in the last 7 days?	Ratio	Time spent traveling by bike in minutes
Q14	How much time in minutes did you spend traveling by car in the last 7 days?	Ratio	Time spent traveling by car in minutes
Q15	How much time in minutes did you spend traveling by public transport in the last 7 days?	Ratio	Time spent traveling by public transport in minutes
Mix of land uses			
Q16	I can do most of my shopping at local stores.	Ordinal	1: Strongly disagree 2: Disagree 3: Neutral 4: Agree 5: Strongly agree
Q17	Stores are within easy walking distance at my home.		
Q18	Stores are within easy cycling distance at my home.		
Q19	Parking is difficult in local shopping areas.		
Q20	There are many places to go within walking distance at my home.		
Q21	There are many places to go within cycling distance at my home.		
Accessibility and infrastructure			
Q22	My neighbourhood is well accessible by foot.	Ordinal	1: Strongly disagree 2: Disagree 3: Neutral 4: Agree 5: Strongly agree
Q23	My neighbourhood is well accessible by bike.		
Q24	My neighbourhood is well accessible by car.		
Q25	The streets in my neighbourhood do not have many cul-de-sacs.		
Q26	The distance between intersections in my neighbourhood is short.		
Q27	There are many alternative routes for getting from place to place in my neighbourhood.		
Q28	There are sidewalks on most of the streets in my neighbourhood.		
Q29	The sidewalks in my neighbourhood are well maintained.		
Q30	The width of the sidewalks is generally suitable for walking.		
Q31	There are easily-accessible bicycle or pedestrian trails in or near my neighbourhood.		
Q32	Sidewalks are separated from the road/traffic by parked cars in my neighbourhood.		
Q33	There is a grass/dirt strip that separates the streets from the sidewalks in my neighbourhood.		

Q34	It is safe to ride a bike in or near my neighbourhood.		
Q35	The city centre is well accessible by foot.		
Q36	The city centre is well accessible by bike.		
Attractiveness			
Q37	There are trees along the streets in my neighbourhood.	Ordinal	1: Strongly disagree 2: Disagree 3: Neutral 4: Agree 5: Strongly agree
Q38	Trees give shade for the sidewalks in my neighbourhood.		
Q39	There are many interesting things to look at while walking or cycling in my neighbourhood.		
Q40	My neighbourhood is generally free from litter.		
Q41	My neighbourhood is generally free from vandalism.		
Q42	There are many attractive natural sights in my neighbourhood.		
Q43	My neighbourhood is quiet.		
Q44	Houses in my neighbourhood are well maintained.		
Traffic safety			
Q45	There is so much traffic along the street I live on that it makes it difficult or unpleasant to walk in my neighbourhood.	Ordinal	1: Strongly disagree 2: Disagree 3: Neutral 4: Agree 5: Strongly agree
Q46	There is so much traffic along nearby streets that it makes it difficult or unpleasant to walk in my neighbourhood.		
Q47	The speed of traffic on the street I live on is usually slow.		
Q48	The speed of traffic on most nearby streets is usually slow.		
Q49	Most drivers exceed the posted limits while driving in my neighbourhood.		
Q50	Pedestrians and cyclists on the streets in my neighbourhood can be easily seen by people from their homes.		
Q51	The crosswalks in my neighbourhood help pedestrians cross busy streets in a safe manner.		
Q52	There are a lot of exhaust fumes in my neighbourhood.		
Crime safety			
Q53	I see and speak to other people when I am walking in my neighbourhood.	Ordinal	1: Strongly disagree 2: Disagree 3: Neutral 4: Agree 5: Strongly agree
Q54	My neighbourhood is well lit at night.		
Q55	There is a high crime rate in my neighbourhood.		

Q56	The crime rate in my neighbourhood makes it unsafe to go on walks during the day.		
Q57	The crime rate in my neighbourhood makes it unsafe to go on walks at night.		
Q58	Children can play safely.		

Adopted from Cerin et al., 2006; Ettema & Schekkerman, 2016; Paydar et al., 2020.

Appendix B: Pamphlet

DE WIJK EN REISGEDRAG

Voor mijn bachelor project doe ik onderzoek naar het verband tussen verschillende kenmerken van de wijk en het reisgedrag van de bewoners. Ik zal kijken naar hoe de kenmerken van drie verschillende wijken in Groningen het reisgedrag beïnvloeden. Kunt u mij hierbij helpen door een enquête in te vullen? Deze duurt ongeveer 5 minuten. U kunt de enquête in het Nederlands of Engels invullen.

Bij voorbaat dank.

De enquête:

U kunt de QR-code scannen met uw telefoon scannen of de link overnemen om bij mijn enquête te komen:
https://rug.eu.qualtrics.com/jfe/form/SV_4T7qOHvihv2vSEm

Alle antwoorden zijn anoniem en zullen alleen voor dit bachelor project worden gebruikt. Bij vragen over de enquête of mijn onderzoek kunt u een email sturen naar c.m.smeets@student.rug.nl.

Appendix C: Output Tables SPSS

Descriptives

Time_by_foot

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Oosterpoortbuurt	42	178,69	143,106	22,082	134,10	223,29	0	510
Vinkhuizen	39	115,23	214,626	34,368	45,66	184,80	0	1260
Lewenborg	41	118,37	116,750	18,233	81,51	155,22	0	570
Total	122	138,13	163,659	14,817	108,80	167,47	0	1260

Table a: Descriptive statistics for 'Time travelled by foot'.

ANOVA

Time_by_foot

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	105562,490	2	52781,245	2,003	0,139
Within Groups	3135327,411	119	26347,289		
Total	3240889,902	121			

Table b: ANOVA results for 'Time travelled by foot'.

Descriptives

Time_by_bike

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Oosterpoortbuurt	42	137,98	120,841	18,646	100,32	175,63	0	420
Vinkhuizen	39	204,49	214,064	34,278	135,10	273,88	0	1000
Lewenborg	41	172,20	144,871	22,625	126,47	217,92	0	600
Total	122	170,74	164,369	14,881	141,28	200,20	0	1000

Table c: Descriptive statistics for 'Time travelled by bike'.

ANOVA

Time_by_bike

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	89588,448	2	44794,224	1,677	0,191
Within Groups	3179495,159	119	26718,447		
Total	3269083,607	121			

Table d: ANOVA results for 'Time travelled by bike'.

Descriptives

Time_by_car

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Oosterpoortbuurt	42	124,64	152,025	23,458	77,27	172,02	0	600
Vinkhuizen	39	135,90	215,198	34,459	66,14	205,66	0	1050
Lewenborg	41	114,12	138,679	21,658	70,35	157,89	0	600
Total	122	124,70	169,738	15,367	94,28	155,13	0	1050

Table e: Descriptive statistics for 'Time travelled by car'.

ANOVA

Time_by_car

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9477,754	2	4738,877	0,162	0,850
Within Groups	3476641,623	119	29215,476		
Total	3486119,377	121			

Table f: ANOVA results for 'Time travelled by car'.

Descriptives

Time_by_public_transport

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Oosterpoortbuurt	33	44,97	92,723	16,141	12,09	77,85	0	300
Vinkhuizen	30	24,67	80,418	14,682	-5,36	54,70	0	420
Lewenborg	39	58,54	174,947	28,014	1,83	115,25	0	1000
Total	102	44,19	127,629	12,637	19,12	69,25	0	1000

Table g: Descriptive statistics for 'Time travelled by public transport'.

ANOVA

Time_by_public_transport

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	19484,132	2	9742,066	0,593	0,554
Within Groups	1625713,329	99	16421,347		
Total	1645197,461	101			

Table h: ANOVA results for 'Time travelled by public transport'.

Appendix D: Significant Correlations per Neighbourhood

Variables	Spearman's Rho	Strength	p-value
Having a driver's license & Time travelled by foot	+0.340	Moderate	0.032
Having a driver's license & Time travelled by car	-0.397	Moderate	0.011
Having access to a car & Time travelled by car	-0.560	Strong	0.000
Couple without children & Time travelled by car	+0.346	Moderate	0.029
No job & Time travelled by car	-0.339	Moderate	0.032
Full time job & Time travelled by car	+0.339	Moderate	0.032
Sometimes working from home & Time travelled by car	+0.443	Moderate	0.004
PhD degree & Time travelled by public transport	+0.357	Moderate	0.049

Table i: Correlation between sociodemographic characteristics and travel behaviour for Oosterpoortbuurt.

Variables	Spearman's Rho	Strength	p-value
Bachelor's degree & Time travelled by car	+0.344	Moderate	0.032
Age & Time travelled by public transport	-0.594	Strong	0.001
Having access to a car & Time travelled by public transport	+0.823	Very strong	0.000
Other household composition & Time travelled by public transport	+0.441	Moderate	0.015
Bachelor's degree & Time travelled by public transport	+0.803	Very strong	0.000

Table j: Correlation between sociodemographic characteristics and travel behaviour for Vinkhuizen.

Variables	Spearman's Rho	Strength	p-value
Master's degree & Time travelled by bike	-0.314	Moderate	0.045
MBO degree & Time travelled by car	+0.351	Moderate	0.024
HBO degree & Time travelled by car	-0.360	Moderate	0.021
Couple with children & Time travelled by public transport	+0.380	Moderate	0.017

Table k: Correlation between sociodemographic characteristics and travel behaviour for Lewenborg.

Variables	Pearson's r	Strength	p-value
There are many places to go within walking distance at my home & Time travelled by foot	+0.340	Moderate	0.032
There are sidewalks on most of the streets in my neighbourhood & Time travelled by foot	+0.319	Moderate	0.045
I see and speak to other people when I am walking in my neighbourhood & Time travelled by foot	+0.337	Moderate	0.034
Stores are within easy cycling distance at my home & Time travelled by bike	+0.365	Moderate	0.021
The speed of traffic on the street I live on is usually slow & Time travelled by bike	+0.342	Moderate	0.031
The speed of traffic on most nearby streets is usually slow & Time travelled by bike	+0.341	Moderate	0.031
My neighbourhood is well lit at night & Time travelled by bike	+0.330	Moderate	0.038
It is safe to ride a bike in or near my neighbourhood & Time travelled by car	-0.509	Strong	0.001
The city centre is well accessible by bike & Time travelled by car	-0.329	Moderate	0.038
My neighbourhood is generally free from vandalism & Time travelled by car	-0.424	Moderate	0.006
My neighbourhood is quiet & Time travelled by car	-0.355	Moderate	0.024
Houses in my neighbourhood are well maintained & Time travelled by car	-0.336	Moderate	0.034
The speed of traffic on the street I live on is usually slow & Time travelled by car	-0.368	Moderate	0.020
The crime rate in my neighbourhood makes it unsafe to go on walks at night & Time travelled by car	+0.459	Moderate	0.003

Table l: Correlation between the perceived built environment and travel behaviour for Oosterpoortbuurt.

Variables	Pearson's r	Strength	p-value
There are many places to go within cycling distance at my home & Time travelled by foot	+0.347	Moderate	0.030
My neighbourhood is well accessible by bike & Time travelled by foot	+0.338	Moderate	0.038
There are many interesting things to look at while walking or cycling in my neighbourhood & Time travelled by foot	+0.364	Moderate	0.025
Pedestrians and cyclists on the streets in my neighbourhood can be easily seen by people from their homes & Time travelled by foot	+0.380	Moderate	0.020
Stores are within easy walking distance at my home & Time travelled by bike	+0.353	Moderate	0.027
The sidewalks in my neighbourhood are well maintained & Time travelled by bike	-0.395	Moderate	0.014
Houses in my neighbourhood are well maintained & Time travelled by bike	-0.464	Moderate	0.003
Sidewalks are separated from the road/traffic by parked cars in my neighbourhood & Time travelled by car	-0.441	Moderate	0.006
It is safe to ride a bike in or near my neighbourhood & Time travelled by car	-0.332	Moderate	0.042
There are many places to go within walking distance at my home & Time travelled by public transport	-0.462	Moderate	0.010
There are many alternative routes for getting from place to place in my neighbourhood & Time travelled by public transport	-0.421	Moderate	0.023
I see and speak to other people when I am walking in my neighbourhood & Time travelled by public transport	-0.408	Moderate	0.031

Table m: Correlation between the perceived built environment and travel behaviour for Vinkhuizen.

Variables	Pearson's r	Strength	p-value
Parking is difficult in local shopping areas & Time travelled by foot	+0.488	Moderate	0.001
There are easily-accessible bicycle or pedestrian trails in or near my neighbourhood & Time travelled by foot	-0.432	Moderate	0.005
The city centre is well accessible by foot & Time travelled by foot	+0.358	Moderate	0.022
Trees give shade for the sidewalks in my neighbourhood & Time travelled by bike	+0.374	Moderate	0.016
Cycle paths are separated from the road/traffic by parked cars in my neighbourhood & Time travelled by car	-0.367	Moderate	0.018
My neighbourhood is generally free from vandalism & Time travelled by car	-0.386	Moderate	0.013
The speed of traffic on most nearby streets is usually slow & Time travelled by car	+0.355	Moderate	0.023
There are a lot of exhaust fumes in my neighbourhood & Time travelled by car	+0.466	Moderate	0.002
The crime rate in my neighbourhood makes it unsafe to go on walks during the day & Time travelled by car	+0.324	Moderate	0.039
The crime rate in my neighbourhood makes it unsafe to go on walks at night & Time travelled by car	+0.345	Moderate	0.027
Sidewalks are separated from the road/traffic by parked cars in my neighbourhood & Time travelled by public transport	+0.326	Moderate	0.043
There is a grass/dirt strip that separates the streets from the sidewalks in my neighbourhood & Time travelled by public transport	+0.319	Moderate	0.048
Cycle paths separated from the road/traffic by parked cars in my neighbourhood & Time travelled by public transport	+0.360	Moderate	0.024
The city centre is well accessible by foot & Time travelled by public transport	+0.346	Moderate	0.031
Children can play safely & Time travelled by public transport	+0.405	Moderate	0.010

Table n: Correlation between the perceived built environment and travel behaviour for Lewenborg.