The decline of social interactions:

The correlation between the built environment and social interactions

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Cover page:	A living street in Utrecht on which people are interacting with each other

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Abbreviation

MOT = Mode of transport

Abstract

In the past decades, the number of social interactions between neighbours has gone down. Due to housing shortages and climate adaptation, the urban environment has and will change, creating new urban spaces. Several studies have been done on the correlations between the built environment and social cohesion. However, these studies are not focused on unplanned social interactions on the street. Therefore, this study aims to create a better understanding of the correlations between the built environment and unplanned social interactions on the street, focusing on the quantity and meaningfulness of social interactions. This is done by answering the following research question: What is the correlation between the built environment and unplanned social interactions of adults on the street on a neighbourhood level in Groningen? This study starts with a literature review regarding land use and urban design in relation to social interactions. Furthermore, correlations between socio-demographic variables and perceived safety in relation to social interactions are reviewed. This study used quantitative online surveys (n = 221) distributed in 6 different neighbourhoods in Groningen. The questionnaire asked questions regarding the perceived built environment; one open question was asked about improvements in the built environment to stimulate more social interactions. The data was analysed through a correlation and content analysis. The results from the data analysis show that the most important variables to stimulate more social interactions are the presence/usage of greenery, usage of street furniture, lower-density neighbourhoods, access to sports and recreational facilities, the enjoyment of walking and most importantly, the perceived safety. Furthermore, respondents most frequently mentioned that they want more street furniture in their neighbourhood to stimulate more social interactions. It is advised to create lower-density neighbourhoods with a high presence of green combined with qualitative street furniture and sports and recreational facilities. Most importantly, is to create safe neighbourhoods. However, this study did not research how to create safe neighbourhoods.

Keywords: Social interactions, urban design, land use, perceived safety, meaningful interactions

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1. Introduction

1.1 Societal Relevance

Cities and countries always evolve and adapt to new problems and opportunities (Allen, 2012). New challenges will arise with an increasing population in the Netherlands in the coming decades, which will put pressure on our urban space (NOS, 2024). One challenge is the housing shortage, which leads to a demand for densification in Dutch cities to adapt to the demand for new houses (Deelstra, 2022). This is also the case in Groningen, where an estimated population increase of 14% will occur in 2035 (GIC, 2022). Densification is partly done by urban renewal projects. Urban renewal projects focus besides densification on the liveability, mixed-use and quality of public space (Gemeente Groningen, 2021). Overall, cities and neighbourhoods are changing in the Netherlands, and they have to adapt to these new challenges (Deelstra, 2022). With a changing urban environment, the urban space of citizens will also change. These changes may affect social dynamics among citizens.

According to Putnam (2000), social interactions and social capital have decreased over the past decades. This is mostly due to generational differences and technological innovations. Social interactions are very important for the well-being of individuals and should therefore be stimulated (Sun et al., 2020). Social interactions happen at different levels and situations, with the streets and neighbourhoods being important places for social interactions. There are different variables that impact social interactions on the streets and neighbourhoods; one of them is the built environment (Shehayeb & Eid, 2007).

Social interactions frequently happen in a neighbourhood and are important for the well-being of individuals. Therefore, it is important to understand which elements of a neighbourhood influence social interactions positively, especially in a time in which urban spaces are changing and social interactions are in decline. Policymakers and designers need to understand better the dynamics between the built environment and social interactions in renewed and newly built neighbourhoods. Therefore, better and more social interactions could be stimulated through urban design and planning, which would benefit the well-being of people. With more stress on our urban space and a decline in social interactions, more knowledge regarding the correlation between the built environment and social interactions can help shape urban design and increase social interactions on the street and, thus, the overall well-being of citizens.

1.2 Academic Relevance

Several studies have been done on how the built environment affects social cohesion in neighbourhoods (Dempsey, 2008 & Bjornstrom et al., 2013). However, few studies have been done on how the built environment affects social interactions within neighbourhoods. Dempsey (2008) & Bjornstrom et al. (2013) mention social interactions within their studies, although their main focus is on social cohesion. Their studies reference social interactions as part of social cohesion, but the main focus is not just on social interactions. However, multiple studies focus on spatial interventions on a street level and their effects on social interactions, most notably the

book ‘Life Between Buildings’ by Jan Gehl (2011). These studies focus on a small scale, not a neighbourhood level. Moreover, these studies are more theoretical, and there is a lack of empirical studies on the relationship between the built environment and social interactions.

Social interactions are not necessarily positive; according to Dempsey (2008), social interactions can have a positive as well as a negative impact on people at the neighbourhood level. Not all social interactions are desired. Van den Berg et al. (2017) focus on how walkability and mobility affect the quality of social interactions on a neighbourhood level. However, it is uncommon in the literature that there is a focus on the qualitative aspect of social interactions. Therefore, it is interesting to understand which variables stimulate more meaningful social interactions. Someone can have a high quantity of social interactions on a neighbourhood level, although this does not mean these social interactions are meaningful to a person.

The academic relevance of this study is that it gives new insights into how different factors of the built environment influence the quantity and meaningfulness of social interactions on a neighbourhood level. As the built environment plays a role in people’s daily activities and interactions, it is important to understand better how the built environment affects social interactions (Sun et al., 2020). This research elaborates on the existing literature of Dempsey (2008) and Dempsey et al. (2012). These studies are not solely focused on the relationship between the built environment and social interactions on a neighbourhood level. They focus on the relationship between the built environment and social cohesion (Dempsey, 2008) and the built environment and social sustainability (Dempsey et al., 2012). However, they mention a correlation between factors in the built environment and social interactions within their study. With a focus on accessibility, maintenance, density and social interactions (Dempsey, 2008), and density and social interactions (Dempsey et al., 2012). Both studies from Dempsey (2008) and Dempsey et al. (2012) mention characteristics of the built environment and social interactions. Although they do not focus on the perception of residents, they focus on what they think is the most important contributor of the built environment towards social interaction. Based on the existing literature, there is still a research gap regarding the correlation between the built environment and social interactions, especially meaningful social interactions. Furthermore, no research has been done about the built environment and social interactions in the city of Groningen. Lastly, most research that has been done is based on the researchers' perceptions of the built environment and not on the perceptions of its residents. This research will help with solving this research gap.

Besides the correlation between the built environment and social interaction, this research focuses on residents' perspectives on how social interactions can be stimulated based on the built environment. This is done to understand better what residents of a neighbourhood miss in their neighbourhood and what could improve the frequency of social interactions on the street. Furthermore, the perceived safety will be researched in relation to social interactions. This variable is interesting for this research because perceived safety affects social interactions and is related to the built environment (Dempsey, 2008). The built environment affects the perceived safety in a neighbourhood (Jacobs, 1961). The perceived safety simultaneously affects how often social interactions take place on the streets (Dempsey, 2008).

This research focuses on unplanned social interactions in neighbourhoods on the street because social interactions on the streets are often based on unplanned interactions in the literature. This is the opposite of planned social interactions in which you agree to meet someone and interact with them (Kim & Kaplan, 2004). Lastly, this research focuses on residents' perspectives towards the built environment and social interactions. Therefore, the built environment's characteristics are based on its residents' subjective perceptions.

1.3 Aim and Research Questions

This study aims to create a better understanding of the correlation between the built environment and the quantity and meaningfulness of unplanned social interactions on the street at the neighbourhood level in Groningen. Based on this research aim the following research questions are formulated.

The main research question of this study is:

- *What is the correlation between the built environment and unplanned social interactions of adults on the street on a neighbourhood level in Groningen?*

This research question will be answered based on several subquestions. The sub-questions of this study are:

- *What is the correlation between land use factors and the quantity and meaningfulness of unplanned social interactions on the street in neighbourhoods?*
- *What is the correlation between urban design and the quantity and meaningfulness of unplanned social interactions on the street in neighbourhoods?*
- *What is the correlation between the perceived safety and the quantity and meaningfulness of unplanned social interactions on the street in neighbourhoods?*
- *What is the perspective of residents on factors in the built environment that would stimulate more unplanned social interactions?*

1.4 Structure

This research will start with a literature review. The literature review begins with a section about social interactions in general and their benefits. Furthermore, the literature review discusses land use, urban design, safety and sociodemographic variables in relation to social interactions. The literature review will end with a conceptual model. After the literature review, a methodology section will discuss the research approach, data collection, recruitment process, ethics, data preparation and data analysis. After the methodology, the results section starts with descriptive statistics regarding the responses, after which the secondary research questions will be individually answered and discussed in the results sections. In the end, there is a conclusion based on the results, in which the research questions will be answered, policy recommendations will be stated, and future research and limitations will be discussed.

2. Literature Review

2.1 Social Interactions

A social interaction is how two or more people interact with each other when they meet or see each other. It refers to all types of interaction between two or more people/groups (Easthope & McNamara, 2013). Social interactions could be verbal, such as talking to each other or greeting other people, or non-verbal, such as waving or nodding towards each other (Studysmarter, 2024). Furthermore, social interactions can be divided into formal or informal social interactions, as well as planned or unplanned interactions and intentional or unintentional social interactions (Kim & Kaplan, 2004). Over time, casual unintentional interactions with neighbours can help create a sense of trust within a neighbourhood (Leyden, 2003). Studies in psychology have shown that the quality of social interactions is more important than the quantity of social interactions related to subjective well-being (Pinquart & Sörensen, 2000). Qualitative social interaction is referred to as meaningful social interaction in this research. According to Van den Berg et al. (2017), prearranged social interactions are defined as more important to individuals than spontaneous interactions. So meaningful, prearranged social interactions have the biggest impact on individual well-being. However, this study focuses on unplanned social interactions instead of planned social interactions because the literature regarding the built environment and social interactions focuses on unplanned social interactions.

As mentioned before, social interactions can be qualitative and meaningful for people, which creates strong ties between people. However, frequent quantitative interactions are nonetheless important to people. Social networks and interactions can consist of weak ties and strong ties between people; weak social networks can be just as important for social opportunities as strong ties (Granovetter, 1973). With weak social ties, people gain network opportunities with people outside of their network. It is, therefore, important for people to have weak social ties because it offers social opportunities outside of their network. These weak social ties can be created by frequent social interactions on a neighbourhood level. Furthermore, frequent informal interactions with neighbours help create a space of safety and trust within a neighbourhood.

Social connectedness is important for the well-being of individuals. During stressful periods, social interactions and connections with neighbours can help increase the overall well-being (Glover et al., 2023). A study by Fiorillo & Sabatini (2011) showed that social isolation harms a person's health; this social isolation can be created by a lack of social interactions. Furthermore, they mention that a high quantity of social interactions is correlated with cohesion within a community, which can stimulate a feeling of belonging and trust. On the other hand, social interactions can be viewed as negative due to disturbance, avoidance or a lack of interest (Skjaeveland, 1996). Some people see social interactions as a threat or something undesired (Easthope & McNamara, 2013). But overall, social interactions are perceived as something positive towards people (Glover et al., 2023).

There should be opportunities to meet in public spaces to create social interactions. No social interaction will exist without opportunities to meet or encounter other people (Shehayeb & Eid., 2007). Overall, people desire more social interactions but find it hard to get into situations that stimulate social interactions (Easthope & McNamara, 2013). Places designed to facilitate social interactions will increase the frequency of social interactions. Therefore, the built environment plays an important role in the stimulation of unplanned social interactions in public spaces.

2.1.1 Measurement of Social Interactions

There are different ways to measure the frequency and meaningfulness of social interactions. First of all, social interactions could be measured by observations in which different socially active behaviours can be observed and indicated (Chen et al., 2023). Researchers observe individuals or groups of people in public spaces and observe how they interact with each other. Besides observational approaches, surveys are used to assess social interactions between people. These surveys ask questions about social interactions (Easthope & McNamara, 2013). Next to surveys, qualitative interviews can be used to research social interactions. With in-depth interviews, the researcher is able to dive deeper into the relationship and meaning of social interactions. Lastly, diaries can be used to collect data on social interactions (van den Berg et al., 2017). This method lets the participants write down their social interactions in a diary. They write down the type of interaction, with whom it took place, and where it took place. The researcher, in the end, evaluates and analyses the notes of the participants.

2.2 Land Use and Social Interaction

2.2.1 Density

There is no clear definition of a high-density neighbourhood. While high density means something different in different cities and countries (Jenks & Dempsey, 2005). Density is generally a measure of the number of people or dwellings in a given area (Cheng, 2009). Density can be measured in different ways, such as residential density or building density. With residential density, the number of dwellings, people or habitable rooms per hectare or square km is measured. For building density, the floor area ratio, plot area or the ratio of open space compared to built space is measured (Dempsey et al., 2012). While there is no universal definition of high or low density, the definition of high and low density is based on a city's specific context. Density can be seen as ‘actual’ and ‘perceived’ density. Actual density is the measured density in a given area, and perceived density is an individual's perception of the number of people in a given area. A person can, therefore, perceive a place as overcrowded due to a high perceived density while the actual density is not high (Dempsey et al., 2012).

According to Dempsey (2008), the density of the built environment has a weak negative correlation with social interactions and feelings of trust. This could be a result of the fact that in higher-density neighbourhoods, there is less social cohesion, and people know each other less, which eventually can lead to fewer social interactions (Brueckner & Largey, 2008). This is in contradiction with the notion that compact cities lead to more intentional and unintentional

social interactions. According to Nurul (2015), a compact city eventually leads to a safer city while there are more social interactions. Nurul (2015) also states that there is a threshold from which density leads to overcrowding. This could harm social sustainability, interactions, and, eventually, safety in a neighbourhood when the density gets too high. Other studies have also shown that density could subsequently lead to more social interactions. Neighbourhoods with a higher density are more vibrant than lower-density neighbourhoods (Mouratidas & Poorting, 2020). This is caused because more people are on the streets in higher-density neighbourhoods, creating a form of high urban vitality. Neighbourhoods with a high urban vitality are more likely to create spaces where social interactions occur (Brown & Lombard, 2014).

Although there seem to be more social interactions in denser neighbourhoods, this does not have to mean that these social interactions lead to strong local ties and more social cohesion (Mouratidas & Poorting, 2020). These interactions could be more impersonal and less meaningful towards a person. A high quantity of social interactions does not have to mean that all these interactions are meaningful towards a person. According to Rapoport (1975), a high density could create an overload of sensory experiences. This eventually leads to discomfort for the perceiver and the likelihood of interactions with other people. Furthermore, according to Dempsey et al. (2012), negative social interactions increase when density increases. The dwelling types with the most negative social interactions are flats, which are often correlated with high-density areas. Also, the reported crime rates happen to be higher in high-density neighbourhoods, which harms the amount of social interactions (Dempsey et al., 2012).

In high-density neighbourhoods, there could be high urban vitality and frequent interactions between neighbours, but this does not have to mean that these social interactions are very meaningful to a person. The literature provides different statements on how high-density neighbourhoods affect social interactions. Furthermore, high density is defined differently at different places; therefore, it is hard to conclude how density affects social interactions (Dempsey, 2012). However, according to Mouratidas & Poorting (2020), the frequency of meaningful interactions decreases, and negative interactions increase when the density gets higher.

2.2.2 Mixed-Use

A mixed-use neighbourhood is when there are different uses and facilities in a neighbourhood, such as residential spaces, working, leisure, and shops. Mixed-use neighbourhoods are frequently referred to as good qualitative neighbourhoods; with mixed-use neighbourhoods, residents have higher accessibility to different services (Dempsey, 2008). A higher accessibility to different services, created by a mixed-use, does lead to more opportunities for social interactions (Barton, 2003). These social interactions are partly created by the way people move themselves in these neighbourhoods. People living in higher mixed-use neighbourhoods are more likely to walk towards different services and are, therefore, better capable of interacting with other residents when walking (Frank et al., 2004).
Furthermore, cafés, bars, shops, and other amenities are places where people can interact with each other (Denison, 2021). Compared to a mixed-use neighbourhood, a residential neighbourhood experiences fewer social interactions between neighbours (Nurul, 2015). All

these claims are in line with the findings of Jane Jacobs (1961), who states that mixed-use neighbourhoods are good for social activities and encounters on the street. According to Jacobs, more people on the streets positively impact the neighbourhood and the vibrant life on the streets.

So, according to the literature, accessibility to amenities and facilities helps stimulate social interaction. Although accessibility is not bounded towards a neighbourhood, people from one neighbourhood can access services of other neighbourhoods. This can lead to neighbourhoods with high mixed-use, attracting a lot of residents from other neighbourhoods with lower mixed-use (Mazumdar et al., 2018). With this notion, there could be a lot of interactions in a neighbourhood, although these interactions are between people from different neighbourhoods. This could eventually lead to a lower amount of social interactions and cohesion between people within a neighbourhood**.**

Often, when a neighbourhood has a high mixed-use, this is combined with a high density to attract customers to the facilities (Jacobs, 1961). Neighbourhoods that have a higher density and mixed-use are more vibrant than those in lower-density and mixed-use neighbourhoods (Mouratidas & Poorting, 2020). This is because more people are on the streets in higher-density and mixed-use neighbourhoods, creating a form of high urban vitality. High urban vitality stimulates social interactions while more people encounter each other on the streets (Brown & Lombard, 2014). Furthermore, in denser and higher mixed-use neighbourhoods, the walking activity of residents is higher than in low-density and low-mixed-use neighbourhoods (Sallis et al., 2016). This can lead to more encounters and interactions between people on the street (Lund, 2002). Later on, the relation between walkability and social interactions is discussed in more detail.

Overall, a combination of high mixed-use and density stimulates more social interactions on the street. However, this is measured in the quantity of social interactions and not in the quality and meaningfulness of these social interactions towards people. Next, urban design in relation to social interactions is discussed.

2.3 Urban Design and Social Interactions

Urban design also affects social interactions on the street. This study divides urban design into two elements: public open spaces and walkability. Public open spaces focus on the quality of public spaces, greenery, and street furniture. Walkability focuses on how walkable a neighbourhood is and which design elements of the built environment influence this walkability.

2.3.1 Public Spaces

People walk, sit, meet, and interact with each other on public streets. Jacobs (1961) described this as the street ballet, in which the public streets form a place for interaction and activities. Public spaces and their quality are somewhat subjective and harder to define as people have different opinions on what a good public space is. However, some attributes of public spaces have a positive impact on interactions. According to Jacobs, a neighbourhood should have small

building blocks so there are more routes to walk and opportunities to meet. If people's movement paths cross, there are more opportunities for exposure and interactions between people (Shehayeb & Eid, 2007). Furthermore, the quality of public spaces and seating areas is important. Public spaces that are more attractive to people positively impact social interactions because people are more willing to use a public space when they identify it as attractive (Dempsey, 2008). When a public space is of bad quality, this does not invite people to come and stay at this given spot. The maintenance of public spaces contributes to a sense of community and a space to interact with others (Dempsey, 2008). Overall, the quality of a neighbourhood, public areas, and facilities are all important attributes that stimulate social interaction (Dempsey et al., 2012). The quality and maintenance of public spaces can be seen as subjective because people view the quality of public spaces differently.

Besides the quality of public spaces, leisure activities and facilities play an important role in social interactions. With more leisure opportunities in public spaces, there are more opportunities for people to meet and interact. When these leisure activities are hidden from the public space, this will not benefit social interactions (Shehayeb & Eid, 2007). For example, an outdoor gym would benefit social interactions between people who participate in a given activity (working out) and people who pass through this place compared to a 'hidden' indoor gym. Furthermore, social activities in a neighbourhood are important factors for social interaction; walking the dog, children playing at a playground, and sports activities help stimulate social interactions (Dempsey et al., 2012). These activities are made possible by the design of public outdoor facilities in the neighbourhood.

According to Shehayeb & Eidl (2007), two important factors in creating social interaction on the streets are meeting opportunities and control opportunities. Meeting opportunities are places in which people can come together and meet others, such as public parks, squares or street furniture. Good meeting opportunities are stimulated by qualitative public spaces**.** This is also in line with Gehl (2011), who looked into how good public places invite people to come and stay, which stimulates meeting opportunities. The control opportunity is the opportunity to interact with others. This creates a space in which people are not forced to interact with others when not desired. When people are not forced to interact with others but have the opportunity to, they are more likely to interact with others (Montgomery, 2013). This can be created by multiple pathways in a park, entrances to a square and the opportunity to take different routes from one place to the other. Therefore, a person has more control over interacting with others (Montgomery, 2013). This means that people are not being forced to interact, which could deter people from using a public space. According to Montgomery (2013), people want a feeling of anonymity and the opportunity to withdraw from social interactions. When the meeting and control opportunities are favourable, people tend to go to public spaces more frequently and interact with others.

2.3.2 Street Furniture

Street furniture can be found in public spaces. Meeting opportunities can be created with street furniture like chairs, benches, and tables. Good public spaces invite people to sit, look, stay and interact with each other. Whyte (1980) observed that certain public spaces were used a lot, and others were empty. He stated that good seating areas are the most important factor for people to use public places. When there is more street furniture in public spaces, more people are likely to use it, although the quality is very important (Wan, 2008). Overall, the quality of street furniture is an important indicator of how it will be used; Street furniture that is of bad quality creates a lower incentive for people to use it (Dempsey et al., 2012). Street furniture does not necessarily have to be benches or chairs; it could also be the edges of buildings or grass fields to sit on. With good seating, people are more tempted to sit and stay at a given location; the longer people stay in an area, the more opportunities there are for people to interact (Gehl, 2011). When there is overall good public seating and places to stay, there is more liveliness on the streets, which can stimulate social interactions (Mehta & Bosson, 2021). Furthermore, people attract people; when people stay in a given area, more people will eventually join this place (Whyte, 1980). When more people stay in an area longer, there are more opportunities to interact with others.

The type of street furniture can also influence the use of it. Loo & Zan (2023) stated that moveable street furniture stimulates more social interaction than static furniture. Moveable street furniture provides more opportunities for the user to decide where and with whom to place it. Furthermore, it attracts people because it has a 'play' element, and when people pass by, it draws their attention. Lastly, the sun, trees, water(front), and opportunities to eat food play a role if people want to sit and stay at a given location (Loo & Zan, 2023).

2.3.3 Green Spaces

Besides street furniture, green spaces have an impact on the frequency of social interactions. Sugiyama et al. (2008) stated that a highly perceived green neighbourhood stimulates walking behaviour. This simultaneously can encourage more social interactions while walking (Lund, 2002). Other studies complement the claim that green urban spaces do stimulate social interactions (Krellenberg et al., 2014). When people perceive a neighbourhood as greener, they are more likely to participate in social activities (Shackleton & Blair, 2013). A high presence of greenery in a neighbourhood is created by trees, parks, grass fields and other green attributes. Public parks are especially a good stimulus for more social interactions.

Public parks are a great way for people to take part in physical activities and encounter people. Therefore, people are more likely to have social interactions in public parks (Cao & Kang, 2019). Several attributes of a park can influence its use and how people interact with each other. The biggest attribute towards social interaction within a park is the perceived quality of the park (Chen et al., 2023). The quality of a park is, by most studies, indicated by the amount of facilities that support activities, such as sports courts and playgrounds (Chen et al., 2020). Furthermore, basic amenities such as bathrooms, picnic tables, benches and overall seating areas help improve the quality of a public park (McCormack et al., 2010). Lastly, the aesthetic qualities of a park, like a waterfront, green space, and tree canopies, are important features for the quality of a

park. So, if these attributes are present within a park, it is often seen as a qualitative park and thus, social interactions are stimulated.

A study by Peters et al. (2010) has shown that parks are a good place for people to meet new people and interact, even for people who have trouble interacting with new people. An individual's use of a public park is not completely based on the proximity towards a park (Kabisch & Haase, 2013). When the quality of a public park is perceived as good, people are willing to commute a longer distance to reach this park. This means that a good qualitative park attracts visitors from different neighbourhoods. Therefore, social interactions within a park are not necessarily correlated with social interactions between people from one neighbourhood. Overall, public parks do stimulate physical activities and walking within a park (Cohen et al., 2007). This walking behaviour in public parks eventually positively affects social interactions. The correlation between walkability and social interactions will be explained in the next part.

2.3.4 Walkability

A walkable neighbourhood is defined as a neighbourhood that encourages and supports walking (Lee & Talen, 2014). Different variables of the built environment affect walkability. Walkability is stimulated when facilities and amenities are close to a person's home, within walking distance (Owen et al., 2007). Gehl (2011) states a facility should be within 500 meters to be walkable for a pedestrian. A neighbourhood which has these facilities and amenities within walking distance is frequently a neighbourhood with a high density and mixed-use. However, respondents from a study from Brookfield (2017) mentioned they are more likely to walk in their neighbourhood when it is of lower density. The study supports the claim that amenities and facilities should be within walking distance to create a walkable neighbourhood, although preferable within a lower-density neighbourhood. Furthermore, the amount of green has been mentioned as a positive stimulus for walking. This statement is complemented by the study of Sugiyama et al. (2008), who states that when people perceive a neighbourhood as greener, they are more likely to walk within their neighbourhood and interact with neighbours.
Next to this, the quality of the pedestrian paths is associated with walking behaviour; if pedestrian paths are safe and well maintained, this positively affects walking behaviour (Lund, 2002).

The traffic on the street also affects how people interact. Gehl (2011) mentions that the slower people move, the more opportunities there are to interact with their surroundings and people. When there is less street traffic, there is also more room for pedestrians to walk and interact with others (Gehl, 2011; Lund, 2002). Street design and policies can stimulate people to use a bike or go on foot instead of a car. With a better bicycle infrastructure, people are more likely to cycle to their destinations instead of using a car (Buehler & Dill, 2016). Furthermore, street interventions in which there is less room for a car and more room for pedestrians are good for creating spaces in which room is given to pedestrians and cyclists. This can help to enable social interactions between people (Schlossberg et al., 2018). Cars are the opposite of walking and cycling; people go too fast in a car to interact well with their surroundings. Talen (2002) complements this claim with the notion that streets with frequent slow traffic, like cyclists and pedestrians, foster social interactions, especially when there are local meeting points for people

to meet. Furthermore, people who live on busy streets with lots of traffic and strangers walking by experience a lower amount of social interactions and barely know their neighbours (Hart & Parkhurst, 2011). Also, the frequency of negative social interactions is higher when there is more street traffic.

Walking can help with a feeling of 'neighbouring', which is described as engagement in authentic social interactions by Glover (2021). Neighbouring-created walking can help to prevent social isolation for individuals. People are more involved in neighbourhood activities when there is a higher walkability in a neighbourhood (Leyden, 2003). According to Lund (2002), the frequency of walking is positively associated with the amount of unplanned social interactions with other neighbours. When people walk a particular path frequently, they encounter similar people and places, and this can lead to public familiarity. Public familiarity means that people get used to seeing certain people they might not know, which gives them opportunities for greater social interactions (Rietveld et al., 2019). When people experience frequent informal interactions with neighbours while walking, this can eventually open up greater opportunities for favours and more meaningful interactions (Rosenblum, 2016). These informal interactions while walking also create a feeling of trust among neighbours. Neighbours are, in this essence, not necessarily people who live in the same neighbourhood but people who frequently encounter each other in their own defined neighbourhood (Glover et al., 2023). Next to informal interactions, Van den Berg et al. (2017) showed that frequently walking in a neighbourhood is positively related to the quality of social interactions. So, people experience more meaningful social interactions when they walk more frequently. Besides meaningful interactions, a higher frequency of walking makes people more satisfied with their social lives (Weijs-Perrée et al., 2015). Complementary to walking, cycling positively affects social interactions as walking does (Van den Berg et al., 2017).

2.4 Safety and Social Interactions

People who perceive a neighbourhood as safe are more active within their neighbourhood. This correlation depends on an individual's perception towards safety. Research from De Nadai et al. (2016) showed that different age groups within a neighbourhood look at subjective safety differently. Some perceive a particular neighbourhood as safe, while others perceive it as unsafe. When streets are perceived as unsafe, people are less likely to use the streets more frequently (Dempsey et al., 2012). It is also the other way around; when people use a street less frequently, it is perceived as less safe (Jacobs, 1961). This can harm the number of social interactions and, as a consequence, create a feeling of isolation. When people have a positive perceived safety towards their neighbourhood, they are willing to interact and participate in social activities on the street. A positive perceived safety is a prerequisite in a neighbourhood for any social activities that take place (Dempsey, 2008).

According to Jacobs (1961), safe streets are predominantly created by eyes upon the streets and a frequent stream of users on the streets. Windows facing the street help create 'eyes upon the streets' and make the neighbourhood feel safer (De Nadai et al., 2016). A steady stream of users can be created by higher density and mixed-use. However, Dempsey et al. (2012) stated that crime levels are higher in high-density neighbourhoods. Furthermore, Bjornstrom & Ralston

(2014) argue that a higher mixed use can lead to a larger number of strangers and traffic in their neighbourhood, creating unsafe feelings. Furthermore, when a neighbourhood has low maintenance of its buildings and streets, this can develop acts of crime. This is known as the broken window theory, where, in this case, 'broken windows' lead to an act of crime (Kelling & Wilson, 1982). When people see more trash and degraded spaces, they are more likely to behave in a way that creates trash and degradation. Besides, when there is more crime in a neighbourhood, people are less likely to go into the street and interact with others. Therefore, a well-maintained neighbourhood is important for a positive perception of safety, which can stimulate activities and interactions on the street. Another important attribute to safety on the streets is the presence of good street lightning. When there is good street lighting, this is expected to decrease crimes and increase feelings of safety (Johansson et al., 2011). At last, when a neighbourhood has more green space, residents perceive this neighbourhood as safer compared to neighbourhoods with less green (De Nadai et al., 2016).

2.5 Socio-demographics and Social Interactions

Next to built environment characteristics, other variables influence the quantity and meaningfulness of social interactions. According to Van den Berg et al. (2017), elderly and ethnic minorities have fewer social interactions with their neighbours. This could be explained by a language barrier or fewer social contacts. This indicates that neighbourhoods that account for a higher percentage of elders and people from ethnic minorities experience less social interactions. Elderly people have significantly fewer social contacts than young and middle-aged people, predominantly attributed to life course factors (Cornwell, 2011). Therefore, retired people are expected to experience fewer social interactions on the street. Furthermore, ethnic heterogeneity within a neighbourhood seems to have no impact on the frequency of social interactions and cohesion (Tolsma et al., 2009). This might be in contradiction with the claims of Van den Berg et al. (2017), although Van den Berg (2017) focuses on individuals and Toslma et al. (2009) on the whole neighbourhood.

Besides demographic characteristics, socioeconomic characteristics could play a role in the frequency of social interactions. However, there are different claims on whether income affects social interactions. According to Bianchi & Vohs (2016), people with a higher income have fewer social contacts and interactions with their neighbours than those with a lower income. This study was done in the United States. In contradiction, Tolsma et al. (2009) state that neighbourhoods with a higher mean income in the Netherlands have, on average, more social connections and interactions with their neighbours compared to lower-income neighbourhoods. This is because households with a higher income have more freedom in the neighbourhood in which they live. If they do not like a neighbourhood due to, for example, crime, they have the economic means to relocate to a different neighbourhood.

Another factor for social interactions is free time. People prioritising free time over earning large sums of money experience more social interactions (Whillans & Dunn, 2019). When people have more free time, they can spend this time socialising and interacting with others. Furthermore, people who own a dog are more likely to encounter unplanned social interactions while walking

(McNicholas & Colic, 2000). Dog owners report more social interactions with strangers when they walk somewhere; dogs are great catalysts for social interactions. According to McNicholas & Colic (2000), these social interactions through dog ownership can increase the overall well-being of dog owners. Besides the presence of dogs in a household, the presence of children influences the frequency of social interactions. People who have children experience more social interactions within their neighbourhoods due to the new social opportunities that are created by having children (Dempsey et al., 2012). For example, parents interact with other parents on the playground when their children are playing outside, which creates opportunities for new social interactions.

Lastly, the most used mode of transport of an individual has an effect on social interactions between neighbours. As Putnam (2000) mentioned, with the rise of the automobile, people were spending more time alone in their car commuting. This has a negative effect on social capital and interaction between people. Van den Berg et al. (2017) explain that commuting by bike or foot positively impacts the frequency and quality of social interactions. Boniface et al. (2015) state that public transport stimulates more social interaction compared to car use. With public transport, people sit next to each other and often face other people, which stimulates interaction between people. So, if people use walking or cycling as their most used mode of transport, they are most likely to experience more social interactions. People who use the car as their most used mode of transport are expected to experience the least amount of social interactions on the street.

2.6 Conceptual Model

Figure 2 shows the conceptual model, which is derived from the literature. The model shows that four main components affect social interaction.
To start with, the land use variables density and mixed-use. Both variables can be measured objectively in a neighbourhood and compared to other neighbourhoods. Furthermore, both density and mixed-use can be interpreted subjectively, as Dempsey et al. (2012) stated. Therefore, density and mixed-use are also placed in the box of subjective built environment. Both density and mixed-use have an effect on social interactions (Dempsey, 2008; Nurul, 2015; Barton, 2003). Although, there is no clear consensus on how density affects social interactions because density is defined differently in different places (Dempsey, 2012). Most literature suggests an increase in social interactions when density increases, although Dempsey (2008) contradicts these claims. With a higher density and mixed-use, there is expected to be a higher urban vitality on the street, leading to more encounters between people and social interactions (Brown & Lombard, 2014). However, in areas with a higher density, these social interactions create fewer ties between neighbours and are expected to be less meaningful (Mouratidas & Poorting, 2020). The literature shows that neighbourhoods with a higher mixed-use do experience more social interactions between people in this neighbourhood (Nurul, 2015). So, neighbourhoods with a higher mixed-use are expected to have more unplanned social interactions on the street. There are no studies done on how the mixed-use affects the meaningfulness of social interactions. Lastly, there is no clear expectation of how density affects the frequency of social interactions, although most literature suggests an increase in social

interactions when density increases. Furthermore, it is expected that there will be more meaningful social interactions in lower-density neighbourhoods (Mouratidas & Poorting, 2020).

With regard to urban design, the amount of greenery and street furniture can be objectively measured. Furthermore, the variables, walkability, quality of public space, greenery, and street furniture, are placed in the box of the subjective built environment. All these variables can be interpreted subjectively by each individual. As can be seen in Figure 2, the objective built environment also affects the subjective built environment. The objective variables density and mixed-use affect how people perceive subjective variables. Furthermore, the objective quantity of greenery and street furniture affects the subjective perception of green space and street furniture; when there is more green or street furniture, it is likely that people will perceive that there is enough green and street furniture. Besides, the amount of green also affects a neighbourhood's walkability (Sugiyama et al., 2008).
All the design variables do influence the frequency of social interaction within a neighbourhood. The presence of street furniture and high-quality public spaces stimulate people to use the public space and interact with each other (Dempsey, 2008; Mehta & Bosson, 2021). The walkability in a neighbourhood is positively correlated with unplanned social interactions (Lund, 2002). Berg et al. (2017) mention that the frequency of walking positively affects meaningful social interactions on the street. Furthermore, the presence of green stimulates walking behaviour and participation in social activities on the street, which eventually leads to more social interactions. So, the presence of street furniture, qualitative public spaces, greenery, and high walkability is expected to be positively correlated with the frequency of social interactions. Furthermore, there is no literature about the effect of green, street furniture and the quality of public spaces towards meaningful social interactions. Therefore, there is no hypothesis regarding this correlation. However, a neighbourhood's walkability is expected to stimulate meaningful social interactions.

Several built environment variables directly or indirectly affect the safety in a neighbourhood. As De Nadai et al.(2016) state, eyes on the streets create safety; this is stimulated by a higher density and mixed-use because more people are on the street. Furthermore, a better quality of public space and green stimulates the perceived safety in a neighbourhood (De Nadai et al., 2016; Kelling & Wilson, 1982). Safety in a neighbourhood is positively correlated with the frequency of social interactions (Dempsey, 2008; De Nadai et al., 2016). People are more on the streets and participate in activities on the streets when there is a higher perceived safety. So, it is expected that when a neighbourhood has a higher perceived safety, there are more frequent social interactions on the street. No studies with regard to the built environment, perceived safety and meaningful social interactions have been conducted. Therefore, there is no hypothesis with regard to these correlations.

Besides the built environment, socio-demographic characteristics affect the frequency of social interaction. Age, free time, mode of transport, the presence of children in a household and dog ownership all affect the frequency of social interactions (Cornwell, 2011; Dempsey et al., 2012; McNicholas & Colic, 2000; Whillians & Dunn, 2019). It is expected that elderly people have fewer social interactions than younger adults (Van den Ber et al., 2017). Furthermore, the presence of children or a dog in a household is expected to positively correlate with social

interactions on the street (Dempsey et al., 2012; McNicholas & Colic, 2000). Furthermore, people with more free time are expected to interact more socially with others on the street because they have more time to socialise with neighbours (Whillans & Dunn, 2019). Lastly, the mode of transport that is used by individuals plays a role in the frequency of social interactions. When people use walking or cycling the most as their mode of transport, they experience the most and meaningful social interaction on the street (Van den Berg et al., 2017). So, it is expected that elderly people and people who use cars or public transport the most as their most used mode of transport experience the least social interactions on the streets. Furthermore, the presence of a dog or children in the household is expected to stimulate more social interactions. Lastly, people with the most free time are expected to experience more social interactions. With regard to the meaningfulness of social interactions, there are no expectations based on the literature between socio-demographic variables and unplanned meaningful social interactions on the street.

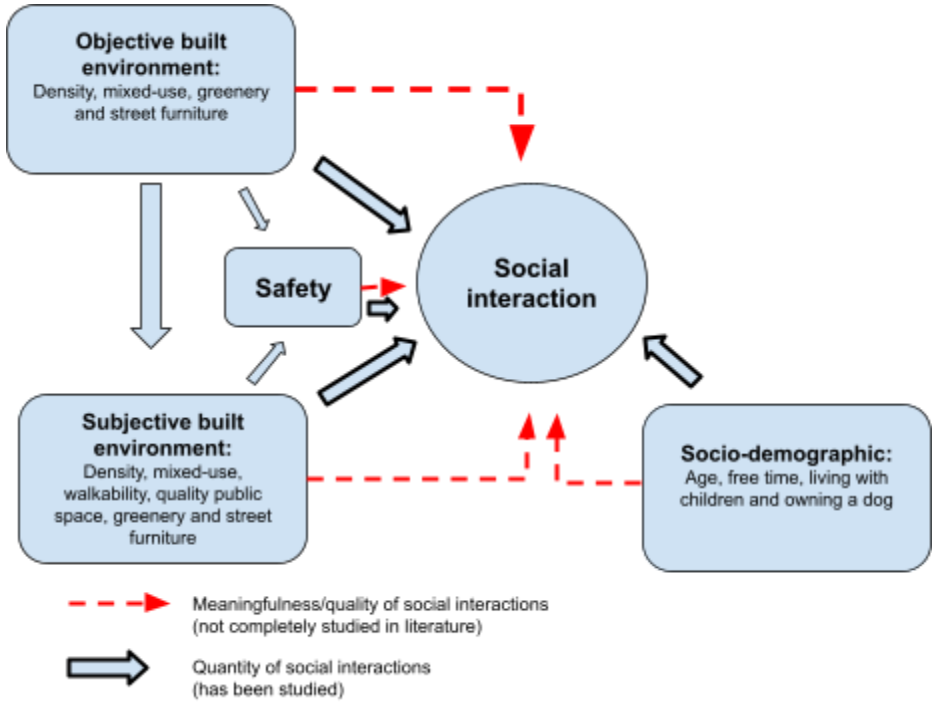

Figure 2: conceptual model

3. Methodology

3.1 Research Approach

This research aims to understand better how variables of the built environment correlate with unplanned social interactions between people in public open spaces. This research takes place in the municipality of Groningen. The municipality of Groningen has several urban renewal projects in which densification and liveability play an important role (Gemeente Groningen, 2021). Therefore, the municipality of Groningen is an interesting municipality to create a better understanding of how these built environment variables affect social interactions. The research questions are answered based on primary data collection. Surveys have been done before in the municipality of Groningen, focusing on the built environment, although this data is not publicly available for privacy reasons. Therefore, these datasets can not be used. For this research, a quantitative research approach is chosen because this research aims to generalise conclusions about the research population, and a quantitative approach is best for generalising conclusions (Punch, 2013). Because this research is looking at the built environment of different neighbourhoods, a large dataset is required to make generalised conclusions about differences in social interactions between neighbourhoods. In-depth interviews would not give suitable answers to make generic conclusions regarding this research.

For this research, an online questionnaire has been made and distributed in different neighbourhoods. The data collection happened in 6 different neighbourhoods of Groningen. In the next section, the case study selection is explained. Furthermore, the recruitment process, ethics, data preparation, and analysis are discussed in the Methodology.

3.2 Case Study Selection

The municipality of Groningen is the case study of this research. The municipality has 243.827 inhabitants, of whom a large number are students. It is estimated that there will be 273.000 people living in the municipality of Groningen by 2042 (Basismonitor, 2024). Most of this growth will be facilitated by densifying existing neighbourhoods.
The data collection for this study happened in the municipality of Groningen through primary data collection. In this study, 6 different neighbourhoods were chosen based on the following built environment characteristics: density, mixed-use and urban design (walkability, greenery, street furniture and quality public space). These characteristics are based on the conceptual model in Figure 2. As the model shows, density, mixed-use and urban design all have an effect on social interactions (Berg et al., 2017; Brown & Lombard, 2014; Dempsey, 2008; Lund, 2002). In the Netherlands, we use the term ‘wijken’ en ‘buurten’ with a reference to a neighbourhood. A ‘buurt’ is seen as a smaller portion of a ‘wijk’; a ‘wijk’ is subdivided into different ‘buurten’ (CBS, 2021). All the neighbourhoods in this study are officially ‘buurten’ and are referenced as a neighbourhood in this study. One criterion while selecting the 6 neighbourhoods was that the neighbourhoods are not located next to each other. Furthermore, all the neighbourhoods should have different objective characteristics regarding density, mixed-use and urban design. This creates a variance in the results from the subjective built environment characteristics, as the objective built environment affects the subjective built environment. None of the

neighbourhoods should have the exact same identification regarding density, mixed-use and urban design. To identify the different neighbourhoods for this case study, the neighbourhoods were chosen based on their different density. Afterwards, the mixed-use and urban design of these neighbourhoods were identified.

To start with the density, the definition of a high or low density differs per city and is also subjective towards perception (Dempsey et al., 2012). Although there is no standard definition of a high or low density in the municipality of Groningen, this study created its own definition of high and low-density neighbourhoods in Groningen. First, this research's density is defined as the number of addresses per square km. To define a high- and low-density neighbourhood, the average number of addresses per square km in Groningen is taken; this is 3.427 addresses per square km (Allecijfers a, 2023). In this research, when a neighbourhood has more than 25% addresses per square km compared to the average of Groningen, it is defined as having a high density. This means that a neighbourhood with more than 4.284 addresses per square km is defined as a high-density neighbourhood in this study. A neighbourhood with 25% fewer addresses per square km compared to the average of Groningen is defined as a low-density neighbourhood. So, a neighbourhood with 2.570 fewer addresses per square km is defined as a low-density neighbourhood. Anywhere between 2.570 and 4.284 addresses per square km is defined as a medium-density neighbourhood.

Density	Addresses (sq/km)
Low density	<2.570
Medium density	2.570 - 4.284
High density	4.284>

Table 1: Density

Besides population density, the neighbourhoods were chosen based on the mixed-use and urban design. Through observations in the neighbourhoods, the neighbourhood was categorised as a low, medium or high mixed-use neighbourhood. A mixed land use means there are different types of buildings for different uses, like residential, shops, offices and schools (Nabil & Abd Eldayem, 2015). While doing observations, the neighbourhood was observed to see if it has different amenities like schools, supermarkets, shops, offices, cafés/restaurants, and industrial sites. Industrial sites were implemented in the observations because the presence of industrial sites in neighbourhoods can increase street traffic (Wen et al., 2019). This eventually can influence the frequency of social interactions on the street (Hart & Parkhurst, 2011). The neighbourhoods were categorised into low mixed-use, medium mixed-use and high mixed-use. A low mixed-use means there are few to no different amenities besides residential buildings. A medium mixed-use means the neighbourhood has multiple different amenities (school, store, café, office services, industrial sites, etc.). A high mixed-use means there are a lot of different amenities (school, store, café, office services, industrial sites etc.) in this neighbourhood.

Concerning the neighbourhood's urban design, different variables indicate if the urban design is positive towards social interactions on the street. The urban design in the neighbourhoods was categorised as low, medium or high in terms of social interactions. Six different variables were used in the observations. To start with, several features of the public space stimulate walking behaviour, which eventually can encourage social interactions (Lund, 2002). First of all, the amount of greenery in the neighbourhood is positively correlated with walking behaviour in a neighbourhood (Sugiyama et al., 2008). Secondly, The quality of pedestrian paths stimulates people to walk more frequently (Lund, 2002). Thirdly, street traffic is associated with walking behaviour. When there is more car traffic on the streets, people are less likely to walk on the streets and interact with neighbours (Hart & Parkhurst, 2011). Besides the correlation between walkability and social interaction, other attributes of the public space do impact social interactions. First of all, the frequency and quality of street furniture in a neighbourhood are positively related to social interaction (Dempsey et al., 2012). Furthermore, the number of outdoor leisure facilities plays a role in the number of social interactions (Shehayeb & Eid, 2007). Lastly, the quality of public space has an impact on the frequency of social interaction. Public spaces that are perceived as better maintained and cleaner tend to stimulate more social interactions (Dempsey, 2008). Out of these six variables: greenery, pedestrian paths, street traffic, street furniture, quality public space and outdoor facilities, the different neighbourhoods were categorised as low, medium or high quality towards social interactions. Each variable was looked at to see if it was present in the neighbourhood. A neighbourhood with 5 or 6 variables was categorised as a high urban design. With 3 or 4 variables as medium and 1 or 2 as low.

The case selections started by identifying different low—or high-density neighbourhoods. Based on density, neighbourhood observations were made to identify mixed-use and urban design. The researcher's observations are rather subjective but still indicate differences in the built environment. The following neighbourhoods were chosen based on their respective density (addresses/square km).
De Hunze, with a density of 1.638 (Allecijfers b, 2023)
Ulgersmaborg with a density of 1.680 (Allecijfers c, 2023)
Wijert-Zuid with a density of 2.246 (Allecijfers d, 2023)
Oosterpoortbuurt with a density of 4.421 (Allecijfers e, 2023)
Gorechtbuurt with a density of 5.413 (Allecijfers f, 2023)
Oranjebuurt with a density of 5.593 (Allecijfers g, 2023)

In the table below, the density, mixed-use, and walkability of each neighbourhood are indicated.

Neighbourhood	Density	Mixed-use	Urban design
Ulgersmaborg	Low	High	Medium
De Hunze	Low	Low	High
Wijert-Zuid	Low	Low	Medium
Oosterpoortbuurt	High	High	Medium

Gorechtbuurt	High	medium	Medium
Oranjebuurt	High	medium	high

Table 2: Neighbourhood identification

3.3 Survey

To gather the data for this research, an online survey in Google forms was made. Two Google forms were made, one in English and one in Dutch. The survey consisted of several sections. The first section introduced the survey and research to the respondents. Furthermore, the ethical considerations were mentioned: all answers were anonymised, no data was shared with third parties, and the survey was done voluntarily. More about the ethics is explained later. Lastly, the possibility of winning a 25 euro voucher for bol.com was recalled; this was mentioned to stimulate respondents to participate in the survey. The second section asked socio-demographic questions like age, gender and the neighbourhood in which the respondent lives. The third section consisted of several statements about the perceived built environment, focusing on density, mixed-use, design, and safety. All the statements could be answered based on a 7-point Likert scale and focus on how the respondents perceived the built environment. The fourth section included six statements based on social interactions. Three questions focused on the quantity of social interactions, focusing on talking, greeting and non-verbal communication. The other three questions focused on the meaningfulness of social interactions, asking about the enjoyment, meaningfulness/positive and negative social interactions. These questions were answered on a ratio scale from 1-10, with 1 meaning strongly disagree and 10 strongly agree. The last section ended with two open questions; one question asked how the respondents think more social interactions can be stimulated through the built environment, and the other asked whether they wanted to participate in the giveaway for the bol voucher. In the Appendix, the full survey is shown.

3.4 Recruitment Process

The goal was to get at least 30 respondents from each neighbourhood. The research focused on adults (18+) living in the neighbourhoods Ulgersmaborg, De Hunze, Wijert-Zuid, Oranjebuurt, Gorechtbuurt and Oosterpoortbuurt. The questionnaires were distributed in different ways. Two recruitment strategies were used in the neighbourhoods. The sampling strategies that have been used are convenience and random sampling. Convenience sampling was used to distribute the questionnaire through the researcher's network. Random sampling was used by putting flyers with a QR code to the questionnaire in random mailboxes. A mixed method of data collection was used to ensure enough responses were gathered, considering financial and time limitations. The data collection can be divided into three phases. The data collection took place between April 8 and April 22.

The first phase started with making different posters for each neighbourhood. These posters (see appendix) were hung up at supermarkets and community centres. Afterwards, the researcher

used his network to distribute the survey to residents in the 6 neighbourhoods. The researcher asked if they could distribute the survey in different neighbourhood WhatsApp groups. Furthermore, the survey was put in two Facebook groups, one group for residents in de Hunze and one for the Oosterpoortbuurt. After this first phase, the goal of 30 respondents in de Hunze was reached. Furthermore, several (10+-) responses in the Oranjebuurt and Oosterpoortbuurt were gathered. In the Wijert-Zuid, Ulgersmaborg and Gorechtbuurt, around 1-4 responses were received.

In the second data collection phase, 600 flyers were distributed in the Wijert-Zuid, Oranjebuurt and Gorechtbuurt. A short introduction of the research and a QR code were placed on these flyers and printed on both sides. One side was in English, and the other one was in Dutch (See appendix). The flyers were put in mailboxes and given to people on the street. While the flyers were given to people, information about the research was told to encourage them to complete the survey. The exact response rate for the flyers is unknown because they were not asked how they learned about the research during the research. Although estimated, the response rate of the flyering was around 5%. After this phase, 15 responses from the Wijert-Zuid, Gorechtbuurt, and Oosterpoortbuurt were received'; and 20 reactions in the Oranjebuurt and 4 in Ulgersmaborg.

In the third phase, once again, the researcher's network was used to distribute the survey; the survey was put on Linkedin, which has been shared multiple times. Furthermore, more people were contacted to fill out the survey and distribute it to others. Besides the researcher's network, another 700 flyers were printed to distribute in different neighbourhoods. The flyers were printed on one side this time, only in Dutch. Only a few people used the English QR code during the data collection. Most of these people answered the open questions in Dutch, so it was assumed these people spoke/read Dutch. Therefore, it was decided to use only a one-sided flyer to reduce the printing costs. This time, the University of Groningen logo and the researcher's picture were put on the flyers. This was done to increase the trust of people who received a flyer and ultimately increase the response rate. These flyers were distributed in Ulgersmaborg, Gorechtbuurt and the Wijert-Zuid. The estimated response rate was around 8-10%. After the third phase, the data collection was completed by receiving at least 30 responses from each neighbourhood.

3.5 Ethics

Ethical considerations regarding data collection and processing were used during this research. For the data collection, no personal information was asked besides age and gender. However, it was an option to leave these questions open. People did not have to fill in their names while conducting the survey but could fill in their e-mail to participate in the giveaway for the voucher. During the data collection, it was made clear to the respondents how their data was processed and used. All the respondents filled in the survey voluntarily and were not forced to participate. At the beginning of the survey, the respondents were noted that their answers would be anonymised and only used for this research. Only the researcher and supervisor saw the answers

and data during the data processing, and no data was shared with other parties. All the answers have been anonymised and discretely used for this research only.

3.6 Data Preparation

The data preparation started before the data analysis. A total of 228 respondents filled out the survey. 9 of them filled in the English version of the questionnaire, and 219 the Dutch version. The data from the two Google forms was downloaded into two Excel sheets, after which both Excel sheets were combined into one Excel sheet with 228 responses. First of all, all the answers that were not useful for the data analysis were taken out. Some people who filled in the survey lived in a neighbourhood that was not part of the research, so these answers were taken out. Lastly, children were taken out of the dataset. Three people who filled in the survey were underage. After all these responses were taken out of the dataset, 221 responses were left and used for the analysis.

Before the data was transferred into SPSS, some of the answers to one question were changed manually. The question '*What is your age*?' was an open question, so some people used numbers and letters like' 47 jaar'. These letters were removed, so the answers had a numerical value.

The Excel sheet with the data was put into SPSS. Because the survey consisted of nominal and ordinal answers, the data had to be transformed into numerical data to be analysed based on the chosen data analysis. The data preparation in SPSS consisted of several parts. The first part of the survey consists mostly of sociodemographic questions. Almost all the variables from this section had to be transformed; the values were either nominal, ordinal or had letters in their answers. Table 3 shows all the socio-demographic variables and how they were transformed into their new values. All the nominal variables were transformed into dummy variables. The variables that were transformed into dummy variables are *Neighbourhood, Occupation, Mode of transport, gender, housing type*, *dog, car* and *children*. Several ordinal variables were transformed into new variables, such as *income, free time*, and *time neighbourhood*. These ordinal variables had letters in their answers; therefore, the letters were removed, creating numeric ordinal answers.

Question	**Variable**	**Old to new values**
What is your gender?	*Gender*	Dummy variables: Male = 0 Female = 1
In which neighbourhood do you live?	*Neighbourhood*	Dummy variables: De Hunze = 1, otherwise 0 Ulgersmaborg = 1, otherwise 0 Wijert-Zuid = 1, otherwise 0 Oosterpoortbuurt = 1, otherwise 0 Oranjebuurt = 1, otherwise 0 Gorechtbuurt = 1 otherwise 0

Are you currently working/student?	*Occupation*	Dummy variables: Working = 1, otherwise 0 Jobless = 1, otherwise 0 Student = 1, otherwise 0 Retired = 1, otherwise 0 Other = 1, otherwise 0
What is your income (Bruto per month)?	*Income*	Ratio: 0-1.000 euro's =1000 1.001-2.000 euro's = 2000 2.001-3.000 euro's = 3000 3.001-4.000euro's = 4000 4.001-5.000 euro's = 5000 More than 5.000 euro's = 6000 Rather not say = System-missing
How much free time do you have per day on average?	*Free_time*	Ratio: 0-1 hours = 1 1-2 hours = 2 2-3 hours = 3 More than 3 hours = 4
Do you have children living with you, if so, how old are they?	*Children*	Dummy variables: No = 0 Yes = 1
Do you have a dog?	*Dog*	Dummy variables: No = 0 Yes =1
Do you own a car?	*Car*	Dummy variables: No = 0 Yes = 1
How long do you live in your current neighbourhood?	*Time_neighbourhood*	Ratio: 0-1 years = 1 1-3 years = 3 3-5 years = 5 5-10 years = 10 More than 10 years = 15
Which mode of transport do you use the most?	*Mode_of_transport*	Dummy variables: Walking = 1, otherwise 0 Cycling = 1, otherwise 0 Car = 1, otherwise 0 Public transport = 1, otherwise 0
What is the most common type of housing in your neighbourhood?	*Housing_type*	Dummy variables: Detached single-family homes = 1, otherwise 0 Townhouses or row houses = 1, otherwise 0 Apartments (1-3 stories) = 1, otherwise 0 Apartments (4-6 stories) = 1, otherwise 0 Apartments (More than 6 stories) = 1, otherwise 0

Table 3: Transformed variables

The second part of the survey consisted of 7-point Likert scale questions. All these questions were transformed into numerical variables: strongly disagree (1), disagree (2), slightly disagree (3), neutral (4), slightly agree (5), agree (6) and strongly agree (7). No changes were made for the third section of the survey because all the values were already numeric. This section had questions regarding social interactions; the answers were on an interval scale of 1-10 and did not need to be transformed. All the questions regarding the built environment and social interactions can be found in the table below with the assigned variables.

Statements	**Variable**
There is a high diversity of ethnicity and age in my neighbourhood	*Perceived_Diversity*
Compared to other neighbourhoods I find my neighbourhood dense	*Perceived_Density*
There is a lot of activity on the street in my neighbourhood	*Perceived_Activity*
There are different shops in my neighbourhoods	*PerceivedAccess_Shops*
There are different services in my neighbourhood (doctor, barber, pharmacy etc.)	*PerceivedAccess_Services*
There are different schools in my neighbourhood	*PerceivedAccess_Schools*
There are different offices in my neighbourhood	*PerceivedAccess_Offices*
There are different cafés and restaurants in my neighbourhood	*PerceivedAccess_Cafés_Restaurants*
There are different outdoor facilities like playgrounds, sport facilities and meeting places in my neighbourhood	*PerceivedAccess_Sport_Recreation*
There are different industrial sites in my neighbourhood	*PerceivedAccess_IndustrialSites*
Which of the following facilities do you use in your neighbourhood	-
Most of the stores I use are within walking distance from my house	*Walkability_Shops*
The public space (streets, squares, parks etc.) in my neighbourhood is of good quality (trash free, maintenance, aesthetics etc.)	*Quality_Public_Space*
There is enough (public) street furniture like benches in my neighbourhood	*Street_Furniture_Availability*
I frequently make use of street furniture in my neighbourhood	*Street_Furniture_Usage*
There is a lot of green (trees, parks, grassfields etc.) in my neighbourhood	*Green_Availability*
I frequently make use of green spaces (parks, grassfields	*Green_Usage*

etc.) in my neighbourhood	
There are good sidewalks to walk on most of the streets in my neighbourhood	*Quality_Pedestrian_Paths*
There is too much street traffic in my neighbourhood which makes it difficult to walk in my neighbourhood	*Street_Traffic*
I enjoy walking through my neighbourhood	*Walkability_Enjoyment*
When I walk through my neighbourhood I feel safe	*Safety_Walking_Neighbourhood*
I overall feel safe in my neighbourhood	*Safety_Neighbourhood*
There are good streetlights in my neighbourhood	*Street_Lights*
There is a high crime rate in my neighbourhood	*Crime_Neighbourhood*
I often talk to people on the street in my neighbourhood	*Talking*
I frequently greet people on the street in my neighbourhood	*Greeting*
I frequently use non-verbal communication (node, wave etc.) towards people on the street	*Non_Verbal*
Social interactions on the street give me joy	*Pleasure_Interactions*
Overall, I see social interactions in my neighbourhood as something meaningful and positive	*Positive_Meaningfull_Interactions*
I do experience negative social interactions on the street in my neighbourhood	*Negative_Interactions*

Table 4: Variables

3.7 Data Analysis

The Excel sheet with all the collected data was imported into IBM SPSS 28 for data analysis. The data analysis starts with a section in which the descriptive statistics of the characteristics of the respondents are listed. Furthermore, all the neighbourhoods were put into a correlation matrix with the social interaction variables to test correlations between the different neighbourhoods. This was done to look for initial differences in social interactions between the neighbourhoods. All the social interaction variables that were used for this research are: *Talking, greeting, non-verbal, Pleasure_interactions, positive/meaningfull_interactions and negative_interactions*. The first three variables measured the quantity of social interaction, and the last three measured the quality of social interaction. The variables were not transformed into two variables because all 6 variables differ from each other and are therefore interesting to see if they are different.

The data analysis method that was used is a correlation analysis. With a correlation analysis, two quantitative variables are analysed to see if there is a correlation between the variables (Gogtay & Thatte, 2017). There is a significant correlation between two variables when the p-value of the correlation coefficient is $p<0.05$. When there is a significant correlation between two variables,

the correlation coefficient shows how strong the correlation is. If the correlation coefficient is between 0 and 0.3 (0 and -0.3), there is a weak positive (negative) linear relationship and between 0.3 and 0.7 (-0.3 and -0.7), a moderate positive (negative) relationship. Between 0.7 and 1.0 (-0.7 and -1.0), a strong positive (negative) relationship. A perfect positive or negative linear relationship exists when the correlation coefficient is 1 or -1 (Ratner, 2009).

A correlation analysis can be done with a Pearson's or Spearmen test. In this research, the Pearson's test was used. Although some variables are ordinal, they have a scale of 7, which means they can be used as a ratio scale. All the ordinal variables were transformed into numerical numbers. Therefore, all the variables that were used are interval or ratio and are thus suitable for a Pearson correlation test (Obilor & Amadi, 2018).
A correlation analysis was used as opposed to a regression analysis because this research looked for correlations between the built environment and social interaction. Because many variables were used in this research and there are several high correlations (0.7>) between different variables, not many variables could go into the same regression model. With a regression analysis, different independent variables should not be highly significantly correlated with each other. Therefore, it was decided only to use a correlation analysis.

The data analysis starts with a descriptive analysis of the respondents, after which the neighbourhoods were compared with each other. Afterwards, the socio-demographic variables were analysed in relation to the social interaction variables. Next, the results individually answered the sub-questions, starting with the land use variables; secondly, the urban design variables; thirdly, the safety variables; and in the last section, the open question regarding improvements in the built environment to stimulate social interactions.

3.7.1 Socio-Demographic

A correlation analysis was done to find out how socio-demographic variables correlate with the quantity and meaningfulness of social interactions. All the socio-demographic and social interaction variables were put into a correlation matrix to see if there were positive correlations ($p<0.05$). The following socio-demographic variables were used: *Age, Time_Neighbourhood, Income, Free_Time, Children, Dog, Mode_of_transport* and *Occupation*.

3.7.2 Land Use

What is the correlation between land use factors and the quantity and meaningfulness of unplanned social interactions on the street in neighbourhoods?
The respondents perceived density and mixed-use were used to find conclusions on how density and mixed-use affect the quantity and meaningfulness of social interactions. To start with density, the variable *Perceived_Density* and the dummy variables regarding the most common housing type were put into a correlation matrix with the social interaction variables. In the correlation matrix is looked for significant correlations, $P<0.05$.
For the mixed-use, the following variables were used: *PerceivedAccess_Shops, PerceivedAccess_Services, PerceivedAccess_Schools, PerceivedAccess_Offices, PerceivedAccess_Cafés_Restaurants, PerceivedAccess_Sport_Recreation* and PerceivedAccess*_IndustrialSites*. All these variables were put into a correlation matrix with the social interaction variables.

3.7.3 Urban Design

What is the correlation between urban design and the quantity and meaningfulness of unplanned social interactions on the street in neighbourhoods?

The perceived urban design was analysed with the social interaction variables. The design characteristics were divided into walkability and public open space. For the walkability, the following variables: *Walkability_Shops, Quality_Pedestrian_Paths, Street_Traffic* and *Walkability_Enjoyment* were put in a correlation matrix with the social interaction variables. The following variables were used for the public open space: Quality_Public_Space, Street_Furniture_Availability, Street_Furniture_Usage, Green_Availability, and Green_Usage. All these variables were put into a correlation matrix with the social interaction variables.

3.7.4 Safety

What is the correlation between the perceived safety and the quantity and meaningfulness of unplanned social interactions on the street in neighbourhoods?

To answer the subquestion regarding safety and social interactions, the following variables were used: *Safety_Walking_Neighbourhood, Safety_Neighbourhood, Street_Lights and Crime_Neighbourhood*. These variables were put into a correlation matrix with the social interaction variables to see if there were significant correlations ($p<0.05$).

3.7.5 Perspective Residents

What is the perspective of residents on factors in the built environment that would stimulate more unplanned social interactions?

An open question was asked in the questionnaire to answer the final subquestion. This subquestion is answered qualitatively through a content analysis. All the answers were categorised per neighbourhood, after which the content analysis took place. The respondents' answers were coded into the following categories: green and nature, facilities, quality public space and street furniture. With a quantitative content analysis, the frequency of certain words is looked for in a text (Krippendorf, 1989). The most common answers per neighbourhood were identified; furthermore, the difference per neighbourhood is discussed in the results section. The results from the content analysis were compared with the quantitative results.

4. Results and Discussion

4.1 Descriptive Statistics

During the data collection, a total of 228 respondents filled out the questionnaire. After the data preparation, 221 responses were left that were used for the data analysis. Significantly more women than men have filled in the survey, 149 women compared to 71 men, and 1 person defined themselves as other. The respondents were, on average, older people, with an average age of 48 years old. The number of respondents per neighbourhood is as follows: De Hunze (43), Ulgersmaborg (37), Wijert-Zuid (42), Oosterpoortbuurt (31), Oranjebuurt (32) and Gorechtbuurt (36). In all 6 neighbourhoods, a minimum of 30 respondents was reached. The table below shows a full overview of the respondents' descriptive statistics.

Gender	Male	32.1%
	Female	67.4%
	Other	0.5%
Neighbourhood	De Hunze	19.5%
	Ulgersmaborg	16.7%
	Wijert-Zuid	19.0%
	Oosterpoortbuurt	14.0%
	Oranjebuurt	14.5%
	Gorechtbuurt	16.3%
Occupation	Working	66.5%
	Student	7.2%
	Retired	19.5%
	Jobless	2.3%
	Overig	4.1%
Income	0-1000	8.1%
	1001-2000	7.7%
	2.001-3.000	22.2%
	3.001-4.000	28.1%
	4.001-5.000	13.6%
	More than 5.000	10.4%
	Prefer not to say	9.3%
Free time	0-1 hour	2.3%
	1-2 hours	14.5%
	2-3 hours	20.4%
	More than 3 hours	62.4%
Dog owner	No	88.2%
	Yes	10.9%

	System-missing	0.9%
Car owner	No	27.6%
	Yes	72.4%
Neighbourhood residency	0-1 year	10.0%
	1-3 years	10.9%
	3-5 years	14.9%
	6-10 years	13.1%
	More than 10 years	51.1%
Children living with you	No	70.1%
	Yes	29.9%
Mode of transport	Car	15.8%
	Cycling	73.8%
	Public transportation	0.9%
	Walking	9.5%
Most common building typology	Appartments (1-3 stories)	19.0%
	Apartments (4-6 stories)	0.9%
	Apartments (More than 6 stories)	0.5%
	Townhouses or rowhouses	75.1%
	Single detached houses	4.5%

Table 5: Descriptive statistics

4.2 Neighbourhood Comparison

All the mean results regarding the social interaction questions per neighbourhood are put in Table 6. The neighbourhood satisfaction is overall very high among the respondents, with a mean of 8.48 out of 10. The average means for the answers towards social interaction are: talking (5.95), greeting (7.57), non-verbal (7.31), pleasure from interactions (7.18), positive/meaningful interactions (8.05) and negative interactions (2.44). When taking a first look at Table 6, the neighbourhoods De Hunze, Ulgersmaborg, Wijert-Zuid, Oosterpoortbuurt and Oranjebuurt are relatively close to each other with the frequency and meaningfulness of social interactions. From the table below, it seems that people in Gorechtbuurt experience fewer (meaningful) social interactions than people from the other five neighbourhoods.

Neighbourhood	Neighbour-hood satisfaction	Talking	Greeting	Non-verbal	Pleasure	Positive/ Meaningful	Negative interactions
De Hunze	8.47	6.26	8.15	7.59	7.83	8.37	2.46
Ulgersmaborg	8.51	6.00	8.11	7.43	7.05	8.05	2.30
Wijert Zuid	8.64	6.19	7.88	7.45	6.95	7.81	2.02
Oosterpoortbuurt	8.45	6.16	7.35	7.16	7.52	8.16	2.32
Oranjebuurt	8.53	6.31	7.58	7.52	7.42	8.29	2.58
Gorechtbuurt	8.28	4.72	6.14	6.61	6.25	7.61	3.00
Mean	**8.48**	**5.95**	**7.57**	**7.31**	**7.18**	**8.05**	**2.44**

Table 6: Neighbourhood comparison

A correlation analysis was done to test these observations and see if there are significant differences. The neighbourhoods' dummy variables were put into a correlation matrix with the social interaction variables. The significance level that is used is $p < 0.05$. As can be seen from Table 7, there are a few significant correlations.

To start with, there are significant correlations in the Hunze. According to Table 2, the Hunze has a low density and mixed-use. These objective findings by the researcher are in line with the subjective perception towards density and mixed-use of residents in the Hunze (see appendix). According to the literature, neighbourhoods with low densities and mixed uses are expected to have fewer social interactions (Brown & Lombard, 2014; Nurul, 2015). This is not in line with the results of the Hunze, as residents in the Hunze greet each other significantly more ($r = .152$). Furthermore, it was expected that in lower-density neighbourhoods, more meaningful social interactions would occur (Mouratidas & Poorting, 2020). There is a significant correlation towards the pleasure that people experience from social interactions in the Hunze ($r = .160$). Besides land use, the Hunze has a high urban design, according to the observations in Table 2. These objective findings by the researcher are not in line with the subjective perceptions towards the urban design of residents (see appendix). There are no significant results towards any design element of the built environment in the Hunze. More in-depth discussions regarding urban design and social interactions will be discussed later in the results.

Besides the Hunze, there are significant correlations between people living in the Gorechtbuurt and social interactions. To start with, according to Table 2, the Gorechtbuurt has a high-density and medium mixed-use. These objective findings by the researcher are in line with the subjective findings from the perceived density and mixed-use of residents in the Gorechtbuurt (see appendix). In the Gorechtbuurt, people have fewer social interactions, talking ($r = .-248$), greeting ($r = .-342$) and non-verbal ($r = .-159$) compared to the other five neighbourhoods. It is expected from the literature that when a neighbourhood has a high density and higher mixed-use, there will be more social interactions on the street (Brown & Lombard, 2014; Nurul,

2015). However, these results show the opposite; with a higher density and mixed-use, there are significantly fewer social interactions on the street in the Gorechtbuurt. Besides the frequency of social interactions in the Gorechtbuurt, residents experience more negative social interactions (r = .160) on the street and less pleasure from social interactions (r = .-208). This was expected from the literature that there would be less pleasurable and more negative social interactions due to higher densities (Dempsey et al., 2012).
According to the researcher's objective observations, the Gorechtbuurt's urban design is medium (Table 2). Only the availability of street furniture is significant in the Gorechtbuurt, so not many urban design elements are significant in the Gorechtbuurt (appendix). An interesting finding from the Gorechtbuurt is that the perceived safety is very low. People in the Gorechtbuurt experience their neighbourhood as less safe for walking (r = .-184), and general safety (r = .-185) is also lower than other neighbourhoods. Furthermore, the perceived crime levels (r = .314) are also significantly higher in the Gorechtbuurt. These results towards social interaction are in line with the literature. When the perceived safety is lower and the crime levels higher, there are fewer social interactions and more negative interactions on the street (Dempsey, 2008; De Nadai et al., 2016).

In the other 4 neighbourhoods, there were no significant correlations towards the social interaction variables. The following sections discuss a more in-depth analysis of the correlations between socio-demographics, the perceived land use, urban design, and safety towards social interactions.

Neighbourhood		Talking	Greeting	Non-verbal	Pleasure	Positive/ meaningful	Negative interactions
De Hunze	Pearson correlation Sig. (2-tailed) N	.070 .300 220	**.152** **.025** **219**	.070 .302 220	**.160** **.018** **221**	.093 .167 220	.016 .817 221
Ulgersmaborg	Pearson correlation Sig. (2-tailed) N	.011 .870 220	.132 .051 219	.027 .687 220	-.028 .679 221	.002 .972 220	-.041 .544 221
Wijert Zuid	Pearson correlation Sig. (2-tailed) N	.055 .420 220	.083 .223 219	.034 .611 220	-.055 .413 221	-.071 .296 220	-.130 .054 221
Oosterpoortbuurt	Pearson correlation Sig. (2-tailed) N	.040 .554 220	-.046 .495 219	-.032 .642 220	.070 .301 221	.029 .669 220	-.030 .654 221
Oranjebuurt	Pearson correlation Sig. (2-tailed) N	.070 .305 220	.003 .963 219	.053 .438 220	.061 .365 221	.068 .315 220	.033 .627 221
Gorechtbuurt	Pearson correlation Sig. (2-tailed) N	**-.248** **<.001** **220**	**-.342** **<.001** **219**	**-.159** **.018** **220**	**-.208** **.002** **221**	-.119 .079 220	**.160** **.017** **221**

Table 7: correlation matrix neighbourhoods

4.3 Socio-Demographics and Social Interactions

All the socio-demographic variables have been put into a correlation analysis with the social interaction variables. The variables with fewer than 10 responses were taken out of the analysis. Some questions had only 1 or 2 answers and are therefore unsuitable for analysis. The following variables have been taken out: *MOT = Public transport* and *Occupation: Jobless*. The variables that are left are shown in a correlation matrix in Table 8.

To start with age, there is a positive correlation between the age of the respondents and the frequency with which they talk to neighbours (r = .239). This contradicts the claims of van den Berg et al. (2017), who claim elderly people have fewer social interactions with their neighbours. This could be explained by how long people live in their neighbourhood; people who are older are significantly more likely to have lived in their neighbourhood for a longer time (r = .682). As can be seen in Table 8, the number of years people live in their neighbourhood is positively correlated with talking (r = .299) and greeting (r = .172). People who live longer in the same neighbourhood are more likely to know their neighbours better and interact with them when seeing each other.

Another significant variable is income. Income is correlated to the frequency of social interactions. There is a significant correlation between income and the frequency of greeting (r = .213) and non-verbal communication (r = .182) between neighbours. This contradicts the claim from Bianchi & Vohs (2016) that income is negatively correlated with social interactions. Although this study was done in the United States, the study from Tolsma et al. (2009) conducted in the Netherlands corresponds with the results found in this study. People with higher incomes have more freedom to relocate to other neighbourhoods when they are not pleased with their current neighbourhoods, for example, the perceived safety in the neighbourhood (Tolsma et al., 2009). As will become clear at the end of this study, the perceived safety significantly influences social interactions.

Furthermore, the amount of free time is negatively correlated with non-verbal communication (r = -.139). So people that have more free time interact less frequently non-verbally with neighbours. This is in contradiction with the statements from Whillans & Dunn (2019), who claim that people with more free time experience more social interaction overall.

The socio-demographic variable with the most significant correlations to social interactions is the presence of children in a household. When children are present in a household, the adults talk (r = .250), greet (.265), and communicate more nonverbally (.179) with their neighbours. So, overall, there are significantly more social interactions between neighbours when children are present in the household. This corresponds with Dempsey et al.'s (2012) statement that households with children experience more social interaction. This could be explained by the fact that the presence of children in a household creates more social opportunities between neighbours. Adults are more likely to get into contact with neighbours due to the social opportunities their children create (Dempsey et al., 2012).

Besides the frequency of social interaction, adults with children in their households also experience more joy and pleasure from social interactions with neighbours on the street (r = .158). An explanation could be that there are significant positive correlations (r = .632, r = .482, r = .416) between the frequency of social interactions and the pleasure that people get from social interactions. So, when people experience more social interactions on the street, they also experience more pleasure and joy from these interactions. Furthermore, there are also significant correlations between the frequency of social interactions and the meaningfulness of social interactions. When people talk (r = .525), greet (r = .424), or communicate non-verbally (r = .370) more with others on the street, they experience more meaningful social interactions. There are no significant correlations between the frequency of social interactions and negative social interactions. These correlations are shown in the appendix in a correlation matrix.

Besides having children, other variables influence the frequency of talking and greeting other neighbours. Having a dog is positively correlated with the frequency of talking (r = .202) and greeting (r = .193) different neighbours. This is in line with the findings from McNicholas & Colic (2000). Having a dog stimulates conversations when people walk with their dog; therefore, people who own a dog are more likely to interact with others on the street. The presence of a dog is also correlated with the pleasure (.154) people experience during social interactions on the street. As mentioned, the frequency of talking and greeting other neighbours positively correlates with enjoyable social interactions.

According to van den Berg (2017), people who use cycling or walking as their most used mode of transport experience the most quantitative and meaningful social interactions. This can not be concluded from the results of this research. There are no significant correlations between the frequency of social interactions and cycling and walking as the most used mode of transport. The correlation coefficients between cycling, walking and the frequency of social interactions are negatively skewed. This suggests a non-significant negative relationship between biking, walking and the frequency of social interactions. Interestingly, people who use the car the most as their mode of transport experience significantly more non-verbal communication (r = .134). Also, the correlation coefficients towards talking (r = .108) and greeting (r = .129) are positive, although not significant. These findings are completely opposite of the literature, which stated that frequent walking and cycling are positively correlated with the frequency of social interactions (Putnam, 2000 & van den Berg et al., 2017).
Another interesting finding is that people who walk the most as their mode of transport experience significantly less pleasure (r = .-147) from social interactions and find them less meaningful (r = .-152). This was not expected based on the literature; van den Berg et al. (2017) stated a positive correlation between frequent walking and meaningful social interactions.

Lastly, there are some interesting results with regard to the occupation of residents and social interactions. People who work have significantly more non-verbal communication (r = .162) and greet (r = .174) their neighbours more. In contradiction, students have significantly less social interactions with their neighbours; they talk (r = .-242), greet (r = -.332) and have less non-verbal communication with their neighbours (r = -.215). This could be explained by the fact that students don't live in one place for a very long time (Rijksoverheid, 2024). As mentioned

before, the number of years living in a neighbourhood is positively correlated with the frequency of social interactions.

Socio-demographic		Talking	Greeting	Non-verbal	Pleasure	Positive/ meaningful	Negative interactions
Age	Pearson correlation Sig. (2-tailed) N	**.239** **<.001** **215**	.192 .005 214	.021 .759 215	.127 .063 216	.035 .611 215	-.126 .065 216
Time neighbour-hood	Pearson correlation Sig. (2-tailed) N	**.229** **<.001** **220**	**.172** **.011** **219**	.054 .430 220	.114 .090 221	.077 .255 220	-.062 .359 221
Income	Pearson correlation Sig. (2-tailed) N	.136 .057 198	**.213** **.003** **197**	**.182** **.010** **198**	.011 .879 199	-.032 .650 198	-.030 .672 199
Free time	Pearson correlation Sig. (2-tailed) N	-.108 .110 219	-.097 .157 218	**-.139** **.040** **219**	-.099 .145 220	-.068 .318 219	-.003 .968 220
Children	Pearson correlation Sig. (2-tailed) N	**.250** **<.001** **220**	**.265** **<.001** **219**	**.179** **.008** **220**	**.158** **.019** **221**	.068 .316 220	-.070 .300 221
Dog	Pearson correlation Sig. (2-tailed) N	**.202** **.003** **218**	**.193** **.004** **217**	.101 .138 218	**.154** **.022** **219**	.117 .083 219	-.072 .291 219
MOT = car	Pearson correlation Sig. (2-tailed) N	.108 .110 220	.129 .057 219	**.134** **.048** **220**	.049 .465 221	-.004 .950 220	-.035 .606 221
MOT = Walking	Pearson correlation Sig. (2-tailed) N	-.049 .472 220	-.091 .179 219	-.020 .763 220	**-.147** **.029** **221**	**-.152** **.024** **220**	-.022 .744 221
MOT = bike	Pearson correlation Sig. (2-tailed) N	-.043 .522 220	-.046 .502 219	-.094 .165 220	.080 .237 221	.119 .078 220	-.004 .958 221
Occupation: Working	Pearson correlation Sig. (2-tailed) N	.115 .090 220	**.174** **.010** **219**	**.162** **.016** **220**	.064 .345 221	.067 .319 220	.003 .965 221
Occupation: Retired	Pearson correlation Sig. (2-tailed) N	.086 .204 220	.039 .567 219	-.042 .531 220	.026 .704 221	.007 .913 220	-.036 .595 221

Occupation: Student	Pearson correlation Sig. (2-tailed) N	**-.242** **<.001** **220**	**-.332** **<.001** **219**	**-.215** **.001** **220**	-.096 .154 221	-.073 .283 220	.045 .507 221
Occupation: Other	Pearson correlation Sig. (2-tailed) N	.016 .817 220	-.014 .841 219	.002 .976 220	-.030 .655 221	-.006 .932 220	-.014 .836 221

Table 8: Correlation matrix socio-demographic

4.4 Land Use and Social Interactions

For this research, two different land uses were measured: the density and mixed-use of buildings and facilities. First, the density with regard to social interaction was analysed, after which the correlation between mixed-use and social interactions was analysed. All the built environment variables were about the subjective perception of residents towards these variables. Therefore, it looked at the perceived built environment of residents.

4.4.1 Density

A correlation analysis was used to analyse the density. First of all, the variables *Housing_type = Apartments (4-6)* and *Housing_type = Apartments (6>)* have been taken out because there were only 1 or 2 responses. The other variables regarding density are shown in a correlation matrix in Table 9 with the social interaction variables. To start with the perceived density, there is a significant negative correlation between people who perceive their neighbourhood as denser and the frequency of greeting their neighbours (r = .-145). The variables talking and non-verbal communication are not significant, although they also have a negative correlation coefficient (r = -.041 and r = .-042). This corresponds with the statement from Dempsey (2008), who states there is a weak negative correlation between density and social interactions. However, most of the literature suggests a positive correlation between a higher density and social interactions (Nurul, 2015; Mouratidas & Poorting, 2020). They expected that a higher density would lead to more encounters on the street, which would result in more social interactions, although this can not be concluded from the findings of this research.

Another interesting finding from Table 9, which complements the claim from Dempsey (2008), is that there is a significant positive correlation between neighbourhoods with predominantly rowhouses and the frequency of greeting (r = .226) and non-verbal (r = .136) interaction. Neighbourhoods with predominantly apartments (1-3) experience less social interactions with other neighbours; this is the case for talking (-.174), greeting (-.267) and non-verbal (-.161) communication towards other neighbours. These findings correspond with the variable perceived density. When a neighbourhood is perceived as denser, there are fewer social interactions on the street. These findings could be explained by Brueckner & Largey (2008), who stated that there is less social cohesion in higher-density neighbourhoods, which can result in fewer social interactions between neighbours. This is the result of neighbours knowing each other less when more people live close to each other in denser neighbourhoods (Brueckner & Largey, 2008). For the detached houses, there were no significant results towards social interaction.

Furthermore, people experience more negative social interactions when the perceived density is higher (r = .221). This corresponds with Dempsey et al. (2012), who stated that more negative social interactions happen in higher-density neighbourhoods. There are no significant results for the pleasure and meaningfulness of social interactions. However, the correlation coefficients do complement the findings that in a higher-density neighbourhood, there are fewer enjoyable and meaningful interactions between neighbours, although not significantly.
So, overall, in higher-density neighbourhoods, there are fewer social interactions on the street, and the likelihood of negative social interactions is higher.

Density		Talking	Greeting	Non-verbal	Pleasure	Positive/ meaningful	Negative interactions
Perceived density	Pearson correlation Sig. (2-tailed) N	-.041 .544 220	**-.145** **.032** **219**	-.042 .539 220	-.014 .834 221	-.041 .544 220	**.221** **<.001** **221**
Housing type = Detached	Pearson correlation Sig. (2-tailed) N	.096 .157 220	.016 .816 219	-.024 .725 220	-.031 .650 221	-.033 .626 220	-.090 .184 221
Housing type = Row houses	Pearson correlation Sig. (2-tailed) N	.106 .117 220	**.226** **<.001** **219**	**.136** **.045** **220**	.132 .051 221	.081 .232 220	-.046 .493 221
Housing type = Apartments (1-3)	Pearson correlation Sig. (2-tailed) N	**-.174** **.010** **220**	**-.267** **<.001** **219**	**-.161** **.017** **220**	-.102 .130 221	-.035 .605 220	.079 .244 221

Table 9: Correlation matrix density

4.4.2 Mixed-Use

Besides density, mixed-use was measured in this research, which was done by statements about accessibility to different buildings and facilities. Table 10 shows that there are barely any significant correlations between accessibility to facilities and social interactions. Only the accessibility towards sports and recreational facilities positively correlates with social interactions. People who have higher accessibility towards sports and recreational facilities are more likely to talk to other neighbours (r = .154). A reason could be that people who frequently make use of sports and recreational facilities also perceive the accessibility towards sports and recreational facilities as higher compared to people who do not use these facilities intensively. Besides, people who use sports facilities are more likely to interact with others, which could explain the findings in this research (Prins et al., 2012).
Furthermore, accessibility towards sports and recreational facilities is positively correlated with positive and meaningful interactions (r = .185), and people experience more pleasure (r = .164) from social interactions. So, it seems that mixed-use and accessibility towards different facilities do not stimulate frequent and meaningful social interactions on the street except for sports and recreational facilities. This contradicts the literature; according to Barton (2003), a mixed-use

neighbourhood leads to more social interactions on the street due to meeting opportunities. People are more likely to walk to different facilities, which creates opportunities to interact with others (Frank et al., 2004). Furthermore, Nural (2015) stated that there are more social interactions in mixed-use neighbourhoods than in residential neighbourhoods. All these claims from the literature contradict the findings of this research. As will become clear later on, the walkability does not stimulate more social interactions. This could explain why mixed-use is not significant towards social interactions. Frank et al. (2014) stated that mixed-use increases social interactions through walkability. However, as it becomes clear, walkability does not seem to stimulate more social interactions. Later, a more in-depth analysis of the correlations between walkability and social interactions is given.

According to Jacobs (1961), a high-density and mixed-use is necessary to create social interactions on the street. Furthermore, high-density and mixed-use neighbourhoods lead to urban vitality, stimulating social interactions (Brown & Lombard, 2014; Mouratidas & Poorting, 2020). The findings from this study contradict these claims. Overall, a mixed-use neighbourhood does not seem to stimulate social interactions on the street, except for sports and recreational facilities. Furthermore, perceived density influences the frequency of social interactions; when a neighbourhood is perceived as denser, fewer social interactions occur. Besides, more negative social interactions occur in higher-density neighbourhoods.

Mixed-use		Talking	Greeting	Non-verbal	Pleasure	Positive/ meaningful	Negative interactions
Access shops	Pearson correlation Sig. (2-tailed) N	-.039 .570 220	-.129 .057 219	-.030 .655 220	-.083 .219 221	-.046 .495 220	.055 .418 .036
Access services	Pearson correlation Sig. (2-tailed) N	.048 .474 220	-.101 .136 219	-.002 .975 220	.012 .862 221	.054 .425 220	.036 .597 221
Access schools	Pearson correlation Sig. (2-tailed) N	.078 .253 219	-.025 .712 218	.097 .153 219	.007 .923 220	-.023 .740 219	.019 .774 220
Access offices	Pearson correlation Sig. (2-tailed) N	.004 .957 220	-.015 .820 219	-.036 .591 220	-.060 .375 221	-.041 .547 220	-.025 .712 221
Access cafés and restaurants	Pearson correlation Sig. (2-tailed) N	.038 .579 220	-.106 .118 219	.008 .901 220	.012 .854 221	.047 .486 220	.055 .418 221
Access sport and recreation	Pearson correlation Sig. (2-tailed) N	**.154** **.022** **220**	.112 .098 219	.099 .143 220	**.164** **.015** **221**	**.185** **.006** **220**	-.057 .401 221
Access industrial sites	Pearson correlation Sig. (2-tailed) N	-.065 .334 220	-.043 .529 219	-.124 .066 220	-.087 .200 221	-.078 .249 220	-.054 .427 221

Table 10: Correlation matrix mixed-use

4.5 Urban Design and Social Interactions

Urban design is divided into two categories: walkability and public open space. First, walkability in correlation to social interactions is analysed, followed by public open space.

4.5.1 Walkability

According to the literature, walking stimulates social interactions (Lund, 2002). Different variables were used to measure the walkability in this study; all variables are shown in Table 11 in a correlation matrix. To start with, there are no significant correlations regarding walkability towards different shops. It was expected that if shops were within walking distance, people would walk more frequently and interact more with others (Lund, 2002; Owen et al., 2007). It was expected that the accessibility towards shops by foot would stimulate encounters on the street when people walk. Although, this is not the case. These findings are supported by the findings of the mixed-use, which also stated that the accessibility (by foot) towards different facilities does not stimulate more social interactions.

Secondly, the quality of pedestrian paths is positively correlated with positive and meaningful social interactions (r = .163). Interestingly, the other social interaction variables are not significant in relation to the quality of pedestrian paths. There is no clear explanation why the quality of pedestrian paths is only significantly correlated with meaningful social interactions. It was expected that the higher the quality of pedestrian paths, the more people would walk and consequently interact with others (Lund, 2002).

Furthermore, there are no significant correlations between street traffic and the frequency/meaningfulness of social interactions. It was expected that if the street traffic is lower, people would be more likely to interact with each other (Gehl, 2011). With less street traffic, there is more room for pedestrians to walk and interact with others. The same is true for when the street traffic is higher; people know their neighbours less and interact less with them. However, street traffic is significant towards negative social interactions. So, when the street traffic increases, so does the frequency of negative social interactions. This could be a result of negative interactions when people ride, cycle or walk on busier streets. These findings correspond with the literature, which also stated an increase in negative social interactions when street traffic increases (Hart & Parkhurst, 2011).

The only significant correlation towards the quantity of social interactions is the enjoyment of walking. When people enjoy walking through their neighbourhood, they are more likely to talk (r = .208), and communicate non-verbally (r = .180) towards neighbours.
This corresponds with the literature; when people enjoy walking, they are more likely to encounter other neighbours and interact with them while walking through the neighbourhood (Lund, 2002). Another reason could be that people who go for a leisurely walk are not pressured by time and have the possibility to interact longer with others. In contrast, people walking to go somewhere might be constrained by time and, therefore, interact less with others.

Overall, it seems that most factors that stimulate walking are not significantly related to social interactions. The most important results are that street traffic leads to negative social interactions and that being able to enjoy your walk does stimulate the quantity of social interaction. It seems, therefore, that walkability itself is not necessarily significant for social interactions except when it is a walk which gives people joy, for example, a leisurely walk However, this should be researched further in-depth to find out if people enjoy their walk because they go for a leisurely walk or if it is influenced by other built environment variables.

Walkability		Talking	Greeting	Non-verbal	Pleasure	Positive/ meaningful	Negative interactions
Walkability shops	Pearson correlation Sig. (2-tailed) N	.085 .208 219	-.044 .521 218	.005 .944 219	.022 .744 220	.057 .399 219	.033 .629 220
Quality pedestrian paths	Pearson correlation Sig. (2-tailed) N	.049 .471 219	.012 .857 218	.061 .369 219	.013 .853 220	**.163** **.016** **219**	-.042 .539 220
Street traffic	Pearson correlation Sig. (2-tailed) N	.095 .159 219	.061 .368 218	.107 .114 219	.072 .287 220	.016 .811 219	**.222** **<.001** **220**
Walkability enjoyment	Pearson correlation Sig. (2-tailed) N	**.208** **.002** **218**	.128 .059 217	**.180** **.008** **218**	.077 .259 219	.098 .146 219	-.069 .312 219

Table 11: Correlation matrix walkability

4.5.2 Public Open Spaces

With regard to public space, its quality is negatively correlated with negative social interactions (r = .-162). So, when public spaces' quality increases, the frequency of negative social interactions decreases. This was expected from the literature; when a public space is of better quality, there is more social cohesion, and negative social interactions are likely to occur less (Dempsey, 2008; Dempsey et al., 2012). Furthermore, when the quality of public spaces goes down, this can increase crime levels, which can result in an increase in negative social interactions. However, it was also expected that a rise in the quality of public spaces would lead to more social interactions (Dempsey et al., 2012). This is not the case based on the findings of this study.

Table 12 shows that the availability of street furniture is not significant towards social interactions. However, the usage of street furniture is significant towards talking (r = .222) and non-verbal communication (r = .148). This corresponds with Mehta & Bosson (2021) that the usage of street furniture stimulates social interactions. Furthermore, is the usage of street furniture correlated with enjoyable (r = .133) social interactions and interactions that are perceived as positive and meaningful (r = .165). So, people who use street furniture more frequently experience more meaningful interactions with their neighbours. A reason could be

that people who make use of street furniture will stay at a given location for a longer time, which could increase the likelihood of longer and more meaningful interactions with others.
The availability of street furniture does not seem to stimulate social interactions, although the usage of street furniture does have significant correlations towards social interactions. It is expected that if the usage of street furniture is significant, the availability of street furniture will also be significant in social interactions. When more street furniture is available, usage is expected to increase (Wan, 2008). This could be explained by the quality of street furniture; if there is enough street furniture present, but the quality is low and not inviting to use, people will not be making use of street furniture (Whyte, 1980). Street furniture invites people to stay when the quality is good, and there are proper seating places (Dempsey et al., 212; Gehl, 2011; Whyte, 1980). Therefore, it seems that the quality of street furniture is more important to social interactions than the quantity of street furniture.

Another significant variable is the availability of green in a neighbourhood. Neighbourhoods perceived as greener experienced more greetings (r = .217) and non-verbal communication (r = .158) between their residents. Krellenbert et al. (2014) stated the correlation between the availability of greenery and social interactions. When there is more greenery available, people are more likely to participate in social activities, which can result in social interactions (Shackleton & Blair, 2013). The availability of green is significant for talking and non-verbal communication, and so is its usage. The usage of green is significant towards talking (r = .278), greeting (r = .267) and non-verbal communication (r = .292). So, when people use green space, they have significantly more social interactions than those who do not. People who use green spaces are most likely to walk in these green spaces, which stimulates encounters and social interactions between people (Lund, 2002; Sugiyama et al., 2008). As became clear before, walkability in itself is not significant towards social interactions, although when people enjoy their walk, it is significant. Both the availability (r = .286) of green and usage (r = .343) are significant towards the enjoyment of walking. Therefore, green spaces are expected to stimulate the enjoyment of walking, which simultaneously increases social interactions. However, this statement should be researched in depth in the future. Besides the number of social interactions, the usage of green stimulates more pleasure (r = .156) from social interactions, and people perceive them as more positive and meaningful (r = .173). So, the use of green spaces stimulates more and meaningful interactions between people. This could be a result of the previously mentioned correlations between the quantity of social interactions and the meaningfulness of social interactions. When the quantity of social interactions increases, it is likely that meaningful and enjoyable social interactions will increase as well (see appendix for matrix).

Public open space		Talking	Greeting	Non-verbal	Pleasure	Positive/ meaningful	Negative interactions
Quality public space	Pearson correlation Sig. (2-tailed) N	.029 .672 218	.084 .216 217	.101 .136 218	-.022 .749 219	.048 .478 218	**-.162** **.016** **219**
Street furniture availability	Pearson correlation Sig. (2-tailed) N	.100 .140 219	-.015 .821 218	-.018 .792 219	-.003 .968 220	.055 .416 219	-.059 .387 220
Street furniture usage	Pearson correlation Sig. (2-tailed) N	**.222** **<.001** **219**	.093 .173 218	**.148** **.029** **219**	**.133** **.048** **220**	**.165** **.015** **219**	-.027 .696 220
Green availability	Pearson correlation Sig. (2-tailed) N	.098 .149 219	**.217** **.001** **218**	**.158** **.019** **219**	.003 .966 220	.103 .127 219	.014 .833 220
Green usage	Pearson correlation Sig. (2-tailed) N	**.278** **<.001** **219**	**.267** **<.001** **218**	**.292** **<.001** **219**	**.156** **.020** **220**	**.173** **.010** **219**	.024 .718 220

Table 12: Correlation matrix public open space

4.6 Safety and Social Interactions

All the safety variables were put into a correlation matrix with the social interaction variables in Table 13. Both the experienced safety while walking and neighbourhood safety are significant factors in the frequency of social interactions. When people feel safe while walking and experience their neighbourhood as safer, they talk (r =.249)(r =.280), greet (r = .204)(r = .223), and communicate non-verbally (r= .164)(r = .183) more with others. The experienced safety while walking is positively correlated with the enjoyment of walking(r = .349), which contributes to social interactions. When people feel safe while walking, they are more likely to walk through their neighbourhood, encounter other people, and interact with them. These findings correspond with Dempsey et al. (2012), who stated that safety stimulates people to go into the street and interact with each other. There is more activity on streets when people perceive neighbourhoods as safer, resulting in more social interactions (De Nadai et al., 2016). Overall, the results from this study correspond with the literature.
Furthermore, people experience more pleasure (r = .146)(r - .147) and meaningful (r = .205) (r = .202) interactions when they experience their neighbourhood as safe (while walking). This could be explained by the correlation between the frequency of social interactions and the meaningfulness of social interactions, as has been mentioned before. Lastly, there are fewer negative social interactions (r = .-.232)(r = .-.256) on the street when the perceived safety and safety while walking are considered higher.

Besides perceived safety, good street lights significantly increase greeting (r = .188) and non-verbal communication (r = .213). Furthermore, good street lights are positively correlated with more positive and meaningful interactions. It was expected from the literature that good street lights increase feelings of safety and would, therefore, increase the frequency of social

interactions (Dempsey, 2008; Johansson et al., 2011). Lastly, the perceived crime levels are correlated with talking (r = .-148) and greeting (r = .-210). When the crime levels are higher, people talk and greet each other less. This corresponds with Dempsey et al. (2012), who state that higher crime levels make people less likely to go into the streets and interact with others. Furthermore, there is a significant correlation between perceived crime and negative social interactions (r = .432). When the perceived crime levels are higher, there are significantly more negative social interactions on the street. Which was expected, as crime can lead to unpleasant interactions on the street (Dempsey et al., 2012).

Safety		Talking	Greeting	Non-verbal	Pleasure	Positive-meaningful	Negative interactions
Safety walking	Pearson correlation Sig. (2-tailed) N	**.249** **<.001** **218**	**.204** **.002** **217**	**.164** **.015** **218**	**.147** **.029** **219**	**.202** **.003** **218**	**-.232** **<.001** **219**
Safety neighbour-hood	Pearson correlation Sig. (2-tailed) N	**.280** **<.001** **219**	**.223** **<.001** **218**	**.183** **.007** **219**	**.146** **.030** **220**	**.205** **.002** **219**	**-.256** **<.001** **220**
Street lights	Pearson correlation Sig. (2-tailed) N	.124 .067 219	**.188** **.005** **218**	**.213** **.002** **219**	.114 .093 220	**.172** **.011** **219**	-.042 .534 220
Crime neighbour-hood	Pearson correlation Sig. (2-tailed) N	**-.148** **.028** **219**	**-.210** **.002** **218**	-.113 .096 219	-.037 .590 220	-.081 .232 219	**.432** **<.001** **220**

Table 13: Correlation matrix safety

4.7 Perspective of Residents

To answer the following sub-question: *What is the resident's perspective on factors of the built environment that would stimulate more unplanned social interactions?* An open question was asked in the questionnaire. A content analysis was done to analyse the answers. All the answers were coded according to the following characteristics of the built environment: green/nature, facilities, quality public space, and street furniture. In total, there were 115 responses to the open question. Some of the reactions mentioned they did not have an opinion or were completely irrelevant towards the built environment or social interactions. All the categories are analysed separately to give an idea of what residents want, which would stimulate unplanned social interactions on the street. Furthermore, these results are discussed in relation to the results from the quantitative data analysis. Almost all answers are in Dutch; when these answers are used as examples, they are translated into English.

4.7.1 Green and Nature

In total, 18 responses consisted of answers regarding improvements towards more green space and nature to stimulate social interactions. Most of the answers were from people who want more green space, grassfields, and trees in their neighbourhood. When looking at the quantitative results from this research, more green and nature do stimulate more social

interactions. This is especially true in neighbourhoods with a lack of green, where there is a lot of potential for improvement. An increase in the availability and usage of green is positively correlated with more social interactions. Interestingly, there is a difference between neighbourhoods in the desire for green. More than half of the respondents who mentioned a form of green/nature are from the Oosterpoortbuurt. Out of the 18 responses regarding green, 12 of them are from the Oosterpoortbuurt. This shows a lack of green in the Oosterpoortbuurt and the residents' desire for more green to stimulate more social interactions. One respondent mentioned: *'More squares with trees, definitely more trees, a lot more trees'*. The results show that green does stimulate more social interactions, but the desire for more green in a neighbourhood differs per neighbourhood.

4.7.2 Facilities

In total, 30 respondents mentioned a need for more different facilities to stimulate more social interactions. Especially café's and restaurants were mentioned frequently. Furthermore, community centres and shops were mentioned several times. There are not many interesting differences between the six neighbourhoods, except for Ulgersmaborg. The need for better quality playgrounds for children has been mentioned several times: '*Playgrounds for children should be improved*' and '*More facilities for children to play in'*. From the results before, it became clear that better accessibility to different facilities does not necessarily increase social interactions on the street. Although sports and recreational facilities do stimulate more social interactions.

4.7.3 Quality Public Space

18 respondents mentioned a change in the quality of public space to stimulate more social interactions. In the Hunze, two people stated a need for: '*better sidewalks*' and '*more sidewalks with lightning'*. Furthermore, several respondents mentioned that fewer parking spots for cars would stimulate more social interactions. Most of the answers (8) regarding the quality of public space are from respondents from the Wijert-Zuid. The answers differ from '*more meeting places for elderly'*, '*public chess board*', and '*less room for cars and more for cyclers and pedestrians*'. From the quantitative results, the only significant result is that an improvement in the quality of public spaces results in fewer negative social interactions. Furthermore, the improvement of sidewalks is not correlated with more social interactions.

4.7.4 Street Furniture

Most of the answers are regarding street furniture; a total of 40 respondents mentioned a need for more street furniture in their neighbourhood to stimulate more social interactions on the street. Interestingly, all neighbourhoods strongly desire more street furniture, except for the Wijert-Zuid. Only 2 respondents from the Wijert-Zuid mentioned street furniture in their answers. In the other five neighbourhoods, street furniture is frequently mentioned in their answers. Almost all the answers state that they want more benches or so-called 'picnic tables'. A few people mentioned a specific desire for more areas to sit: '*more places where you can sit cosily*', *'more hangout spots because of right now the streets are just meant for walking and not places to hang out'*. From the quantitative results, it became clear that the usage of street furniture is positively correlated with social interactions. Although, the availability of street

furniture is not significant. Therefore, the quality of good street furniture is important. As from the quantitative and qualitative results, it becomes clear that more and better street furniture is desired and can potentially stimulate more social interactions on the street.

An interesting outcome from the qualitative research in this study is that there are major differences between neighbourhoods. In some neighbourhoods, a desire for more green space or playgrounds is frequently mentioned. These results show that place-specific policies and interventions should be used to improve social interactions on the street. It is important to understand what residents need and want to improve social interactions on the street and whether these improvements help increase social interactions.

5. Conclusion

5.1 Summary of Research Findings

This research aimed to create a better understanding of the correlations between the built environment and the quantity and meaningfulness of social interactions on the streets at the neighbourhood level in Groningen. The main research question: '*What is the correlation between the built environment and unplanned social interactions of adults on the street on a neighbourhood level in Groningen?*' is answered based on 4 sub-questions. Three sub-questions are answered based on statistical analysis, and the last sub-question is answered based on a quantitative content analysis. All 4 sub-questions are individually answered based on the empirical data analysis, after which the main research question is discussed and answered. With each research question a policy advice is given on how to implement the results into practice. In the end, the limitations and future research are discussed. This research contributes to the literature regarding the correlations between the built environment and social interactions. It elaborates on the existing research done by Dempsey (2008) and Dempsey et al. (2012), who focused on the built environment and social cohesion/social sustainability.

5.2 Land Use and Social Interactions

The first sub-question is about the correlation between land use factors and the quantity and meaningfulness of social interactions. Stated as: 'What *is the correlation between land use factors and the quantity and meaningfulness of unplanned social interactions on the streets in neighbourhoods?*'.

The results from section 4.4.1 show that a lower perceived density leads to a higher quantity of social interactions on the street. Furthermore, the density is insignificant for meaningful interactions, although a higher density leads to more negative social interactions on the street. With regards to mixed-use, there are no significant correlations except for the accessibility of sports and recreational facilities. So, a mixed-use neighbourhood does not seem to stimulate more social interactions in neighbourhoods.

It is advised that neighbourhoods be created in which the density is not too high. However, with a housing shortage and a need for urban densification, this advice might be hard for policymakers to implement. However, it is advised to think critically about the density, and if the density is high, other built environment variables that stimulate social interactions should be implemented. With regards to mixed-use, there is no specific policy advice due to insignificant results, although more (high-quality) sports and recreational facilities should be built to stimulate (meaningful) social interactions in neighbourhoods.

5.3 Urban Design and Social Interactions

The second subquestion concerns urban design and social interactions. The question is: '*What is the correlation between urban design and the quantity and meaningfulness of unplanned social interactions on the streets in neighbourhoods?*'
From the results in section 4.5, it became clear that the neighbourhood's walkability does not seem to influence the quantity of social interactions. The only significant correlation towards the number of social interactions is when people enjoy their walks in their neighbourhoods. Furthermore, there are no significant correlations between walkability and meaningful social interactions.

With regard to public open space, the presence of green, the usage of green, and the usage of street furniture are positively correlated with the frequency of social interactions. With regard to street furniture, especially high-quality street furniture, contributes to more social interactions. Furthermore, the usage of green and street furniture is positively correlated with meaningful social interactions. Lastly, the quality of public space is negatively correlated with negative social interactions; when the quality of public spaces goes down, the frequency of negative social interactions increases.

Policymakers should focus on adding more greenery and (high-quality) street furniture in neighbourhoods. Green and street furniture can be added to streets, squares, and parks. This can stimulate more (meaningful) social interactions in neighbourhoods and contribute to the enjoyment of walking; with more greenery, people are more likely to enjoy their walk. Furthermore, the public space should be maintained well to reduce negative social interactions.

5.4 Safety and Social Interactions

The third subquestion regarding safety and social interactions is: '*What is the correlation between the perceived safety and the quantity and meaningfulness of unplanned social interactions on the streets in neighbourhoods?*'
The results in section 4.6 made it clear that higher perceived safety in neighbourhoods leads to more social interactions on the street. Street lights and lower crime levels also stimulate more social interactions. Furthermore, perceived safety contributes to more meaningful social interactions and fewer negative social interactions. Higher crime rates in neighbourhoods contribute to more negative social interactions on the street.

It is advised to create safe public spaces in which people feel safe going out into their neighbourhood and interact with others. This study has not researched how this could be achieved. Therefore, it is difficult to give policy advice on how to create safe public spaces based on the results of this research.

5.5 Perspective Residents

The last subquestion regarding improvements in the built environment is stated as: '*What is the perspective of residents on factors in the built environment that would stimulate more unplanned social interactions?*.
It seems that residents' perspectives differ per neighbourhood. For example, in Ulgersmaborg, respondents wanted improved playgrounds for kids. In the Oosterpoortbuurt, there was a desire for more green spaces, probably due to a lack of green spaces. Overall, people seemed to mention things that are not highly present within their neighbourhood. The most mentioned attribute that stimulates more social interactions is more street furniture. According to the quantitative results, this stimulates more social interactions. Furthermore, more facilities are frequently mentioned, although a mixed-use of facilities does not seem to stimulate more social interactions based on the quantitative results. Lastly, more green and better qualitative public spaces have been mentioned several times; more green spaces stimulate more social interactions based on the quantitative results. The quality of public spaces was not significant to social interactions, except for a reduction in negative social interactions.

Policymakers should identify what residents think is missing in their neighbourhood's built environment. Residents' opinions should be taken into account when determining how social interactions could be stimulated on the streets. Furthermore, they should examine whether this stimulates more social interactions. As the results show, residents' perspectives on how more social interactions could be stimulated differ per neighbourhood. Therefore, a place-specific approach should be used to improve the built environment.

5.6 Built Environment and Social Interactions

This research focused on the correlation between the built environment and social interactions. The main research question is: '*What is the correlation between the built environment and unplanned social interactions of adults on the streets on a neighbourhood level in Groningen?*'.
Different built environment variables correlate with social interactions. The most important built environment variables that stimulate more social interactions are the presence of green, green usage, street furniture usage, lower-density neighbourhoods, access to sports and recreational facilities, and enjoyment of walking. Besides these built environment variables, perceived safety is very important to social interactions on the street.
There are significant correlations between the quantity and meaningfulness of social interactions. It is, therefore, assumed that more meaningful social interactions could be stimulated by more social interactions in general. However, there are differences between the quantity and meaningfulness of social interactions. The most important variables that contribute to more enjoyable and meaningful social interactions are access to sports and recreational facilities, green usage, and street furniture usage. The perceived safety is also correlated with more meaningful social interactions. Negative social interactions on the street are stimulated by street traffic, lower quality of public space, higher density neighbourhoods, and lower perceived safety.

Besides the built environment variables, several socio-demographic variables have shown significant correlations towards social interactions. This shows that social interactions on the

street are stimulated by the built environment and socio-demographic variables. The most important variables towards more social interactions are age, number of years living in a neighbourhood, income, presence of children or a dog in a household, car use and people that work. With regard to meaningful social interactions, there are no significant correlations. Socio-demographic variables, therefore seem to not be important towards meaningful social interactions. However, the presence of a dog or children does stimulate more enjoyable social interactions between people on the street.

To implement all these findings into policy, it is advised to start with creating safe neighbourhoods, As the results show, this is the most significant variable in achieving more and meaningful social interactions on the street. However, as has been mentioned, this research did not focus on how to create safe neighbourhoods, and therefore, it is difficult to give policy advice regarding increasing neighbourhood safety.
Policymakers should exchange knowledge and ideas about the built environment with residents. As this research has shown, what residents desire differs per neighbourhood. Therefore, it is important for policymakers to understand what is already present in a neighbourhood and what is desired by its residents.
Regarding the built environment, it is advised to create neighbourhoods where people can go out for a walk that brings them joy. This could be created by adding more green to neighbourhoods, as the presence of green stimulates more enjoyable walks. Both variables are correlated with an increase in social interactions. Furthermore, creating lower—and medium-density neighbourhoods is advised, as this stimulates more social interactions. However, this might be hard to implement with a housing shortage and a need for urban densification. In that case, it is advised to focus on improving the usage of street furniture, usage of green and creating sports and recreational facilities. These three variables are all correlated with more and meaningful social interactions on the street. The use of greenery can be stimulated by creating more parks, grassfields, and green spaces. This can be combined with implementing sports and recreational facilities and high-quality street furniture. It is important that the street furniture is of high quality so people will actually make use of it. When this policy advice is implemented, it is expected that more (meaningful) social interactions will occur in neighbourhoods, which could eventually improve the overall well-being of people.

5.7 Limitations

This research has several interesting results, although there are some limitations with regard to the research and its results. First, some variables were removed due to a low response rate. Therefore, there are no results regarding ‘detached houses’ and more ‘high-rise apartments’. Furthermore, because a correlation analysis is done, it is unclear which variables are the most significant toward the social interaction variables while controlling for the effect of other variables. The built environment variables have not been tested in relation to the socio-demographic variables. Therefore, it is difficult to make generalisations regarding the results. A regression analysis should be done to determine which variables are the most significant. Furthermore, during the case selection, the researcher chose several neighbourhoods based on his ‘objective’ perceptions of the built environment. These objective perceptions were

not always in line with the subjective perceptions of the residents towards the built environment. Lastly, because a lot of variables have been used in this research, it did not go in-depth about the correlations between the built environment and social interactions. Therefore, it has not become completely clear why and how two variables correlate with each other.

5.8 Future Research

In future research, it would be good to do a regression analysis to better understand which variables are the most significant towards social interactions. Regression analysis will make it clearer how the built environment affects social interactions. A regression analysis controls for the effect of the independent variables (built environment and socio-demographics) on each other. In this way, it becomes clear which variables are the most significant towards the social interaction variables.

Furthermore, more qualitative, in-depth research would be interesting to see why some variables are significant, for example, in neighbourhoods where people experience more social interactions and street furniture is present. What makes people use this street furniture and interact with others? Another example is the variable of enjoyment of walking; in future research, it could be researched what makes a walk enjoyable. Is it the built environment, or because people walk for leisure, or do other variables play a role?

As mentioned before, the perceived safety is very important for more social interactions, although this study did not look into how this could be achieved based on the built environment. In future research, the built environment in relation to social interactions with perceived safety as mediating variables could be researched. In this way, it will become clearer how the built environment can create a higher perceived level of safety and simultaneously create more social interactions on the street.

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7. Appendices

7.1 Correlation Matrixes

Correlations

		Wat is uw leeftijd?	Time_neighbourhood
Wat is uw leeftijd?	Pearson Correlation	1	,682**
	Sig. (2-tailed)		<,001
	N	216	216
Time_neighbourhood	Pearson Correlation	,682**	1
	Sig. (2-tailed)	<,001	
	N	216	221

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 3: Correlation matrix age/time_neighbourhood

Correlations

		Talking	Greeting	Non-verbal	Importance_interactions	Positive/meangfull_interactions	Negative_interactions
Talking	Pearson Correlation	1	,638**	,560**	,632**	,525**	-,053
	Sig. (2-tailed)		<,001	<,001	<,001	<,001	,430
	N	220	218	219	220	219	220
Greeting	Pearson Correlation	,638**	1	,755**	,482**	,424**	-,097
	Sig. (2-tailed)	<,001		<,001	<,001	<,001	,155
	N	218	219	219	219	218	219
Non-verbal	Pearson Correlation	,560**	,755**	1	,416**	,370**	-,063
	Sig. (2-tailed)	<,001	<,001		<,001	<,001	,355
	N	219	219	220	220	219	220
Importance_interactions	Pearson Correlation	,632**	,482**	,416**	1	,773**	,024
	Sig. (2-tailed)	<,001	<,001	<,001		<,001	,727
	N	220	219	220	221	220	221
Positive/meangfull_interactions	Pearson Correlation	,525**	,424**	,370**	,773**	1	,017
	Sig. (2-tailed)	<,001	<,001	<,001	<,001		,798
	N	219	218	219	220	220	220
Negative_interactions	Pearson Correlation	-,053	-,097	-,063	,024	,017	1
	Sig. (2-tailed)	,430	,155	,355	,727	,798	
	N	220	219	220	221	220	221

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 4: Correlation matrix social interaction variables

Correlations

		Inwelkewijkwoontu=De Hunze	Density	Watisdemeestvoorkomendewoningtypeinuwwijk=Appartementen of flats (1-3 verdiepingen)	Watisdemeestvoorkomendewoningtypeinuwwijk=Appartementen of flats (4-6 verdiepingen)	Watisdemeestvoorkomendewoningtypeinuwwijk=Appartementen of flats (meer dan 6 verdiepingen)	Watisdemeestvoorkomendewoningtypeinuwwijk=Rijtjeshuizen	Watisdemeestvoorkomendewoningtypeinuwwijk=Vrijstaande huizen	Shops	Services	Schools	Offices	Cafés_Restaurants	Sport_Recreation	Industrial_sites
Inwelkewijkwoontu=De Hunze	Pearson Correlation	1	-,233**	-,238**	-,047	-,033	,230**	,003	-,610**	-,328**	-,672**	-,267**	-,554**	-,043	-,277**
	Sig. (2-tailed)		<,001	<,001	,487	,624	<,001	,965	<,001	<,001	<,001	<,001	<,001	,525	<,001
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Density	Pearson Correlation	-,233**	1	,331**	,106	,118	-,297**	-,094	,304**	,335**	,215**	-,044	,372**	,106	-,136*
	Sig. (2-tailed)	<,001		<,001	,115	,079	<,001	,163	<,001	<,001	,001	,516	<,001	,117	,043
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Watisdemeestvoorkomendewoningtypeinuwwijk=Appartementen of flats (1-3 verdiepingen)	Pearson Correlation	-,238**	,331**	1	-,046	-,033	-,842**	-,105	,382**	,329**	,232**	-,001	,286**	,065	-,025
	Sig. (2-tailed)	<,001	<,001		,494	,629	<,001	,118	<,001	<,001	<,001	,994	<,001	,336	,716
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Watisdemeestvoorkomendewoningtypeinuwwijk=Appartementen of flats (4-6 verdiepingen)	Pearson Correlation	-,047	,106	-,046	1	-,006	-,166*	-,021	-,031	,015	,017	,016	-,022	,008	,001
	Sig. (2-tailed)	,487	,115	,494		,924	,013	,758	,647	,830	,800	,813	,749	,904	,992
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Watisdemeestvoorkomendewoningtypeinuwwijk=Appartementen of flats (meer dan 6 verdiepingen)	Pearson Correlation	-,033	,118	-,033	-,006	1	-,117	-,015	,110	,104	,102	,076	-,081	,006	-,061
	Sig. (2-tailed)	,624	,079	,629	,924		,082	,828	,104	,124	,131	,258	,228	,932	,369
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Watisdemeestvoorkomendewoningtypeinuwwijk=Rijtjeshuizen	Pearson Correlation	,230**	-,297**	-,842**	-,166*	-,117	1	-,378**	-,344**	-,363**	-,293**	-,086	-,229**	-,071	,025
	Sig. (2-tailed)	<,001	<,001	<,001	,013	,082		<,001	<,001	<,001	<,001	,201	<,001	,296	,716
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Watisdemeestvoorkomendewoningtypeinuwwijk=Vrijstaande huizen	Pearson Correlation	,003	-,094	-,105	-,021	-,015	-,378**	1	-,028	,093	,132	,149*	-,028	,019	,015
	Sig. (2-tailed)	,965	,163	,118	,758	,828	<,001		,678	,166	,051	,027	,680	,783	,828
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Shops	Pearson Correlation	-,610**	,304**	,382**	-,031	,110	-,344**	-,028	1	,673**	,672**	,326**	,674**	,074	,031
	Sig. (2-tailed)	<,001	<,001	<,001	,647	,104	<,001	,678		<,001	<,001	<,001	<,001	,273	,648
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Services	Pearson Correlation	-,328**	,335**	,329**	,015	,104	-,363**	,093	,673**	1	,538**	,348**	,568**	,169*	-,074
	Sig. (2-tailed)	<,001	<,001	<,001	,830	,124	<,001	,166	<,001		<,001	<,001	<,001	,012	,276
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Schools	Pearson Correlation	-,672**	,215**	,232**	,017	,102	-,293**	,132	,672**	,538**	1	,391**	,562**	,204**	,034
	Sig. (2-tailed)	<,001	,001	<,001	,800	,131	<,001	,051	<,001	<,001		<,001	<,001	,002	,617
	N	220	220	220	220	220	220	220	220	220	220	220	220	220	220
Offices	Pearson Correlation	-,267**	-,044	-,001	,016	,076	-,086	,149*	,326**	,348**	,391**	1	,214**	,195**	,185**
	Sig. (2-tailed)	<,001	,516	,994	,813	,258	,201	,027	<,001	<,001	<,001		,001	,004	,006
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Cafés_Restaurants	Pearson Correlation	-,554**	,372**	,286**	-,022	-,081	-,229**	-,028	,674**	,568**	,562**	,214**	1	,125	,041
	Sig. (2-tailed)	<,001	<,001	<,001	,749	,228	<,001	,680	<,001	<,001	<,001	,001		,065	,549
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Sport_Recreation	Pearson Correlation	-,043	,106	,065	,008	,006	-,071	,019	,074	,169*	,204**	,195**	,125	1	,155*
	Sig. (2-tailed)	,525	,117	,336	,904	,932	,296	,783	,273	,012	,002	,004	,065		,021
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Industrial_sites	Pearson Correlation	-,277**	-,136*	-,025	,001	-,061	,025	,015	,031	-,074	,034	,185**	,041	,155*	1
	Sig. (2-tailed)	<,001	,043	,716	,992	,369	,716	,828	,648	,276	,617	,006	,549	,021	
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Figure 5: Correlation matrix de Hunze/land use

Correlations

		Inwelkewijkwoontu=De Hunze	Public_Space_Quality	Street_Furniture_Availability	Street_Furniture_Usage	Green_Availability	Green_Usage	Quality_Pedestrian_Paths	Too_Much_Traffic	Sport_Recreation
Inwelkewijkwoontu=De Hunze	Pearson Correlation	1	-,033	-,100	-,119	-,047	-,040	-,066	-,120	-,043
	Sig. (2-tailed)		,626	,140	,077	,486	,551	,326	,077	,525
	N	221	219	220	220	220	220	220	220	221
Public_Space_Quality	Pearson Correlation	-,033	1	,373**	,126	,237**	,208**	,479**	-,261**	,073
	Sig. (2-tailed)	,626		<,001	,063	<,001	,002	<,001	<,001	,279
	N	219	219	219	219	219	219	219	219	219
Street_Furniture_Availability	Pearson Correlation	-,100	,373**	1	,319**	,412**	,351**	,280**	-,138*	,115
	Sig. (2-tailed)	,140	<,001		<,001	<,001	<,001	<,001	,042	,088
	N	220	219	220	220	220	220	220	220	220
Street_Furniture_Usage	Pearson Correlation	-,119	,126	,319**	1	,111	,321**	,127	,037	,132
	Sig. (2-tailed)	,077	,063	<,001		,102	<,001	,060	,585	,051
	N	220	219	220	220	220	220	220	220	220
Green_Availability	Pearson Correlation	-,047	,237**	,412**	,111	1	,604**	,183**	-,244**	,291**
	Sig. (2-tailed)	,486	<,001	<,001	,102		<,001	,006	<,001	<,001
	N	220	219	220	220	220	220	220	220	220
Green_Usage	Pearson Correlation	-,040	,208**	,351**	,321**	,604**	1	,222**	-,155*	,317**
	Sig. (2-tailed)	,551	,002	<,001	<,001	<,001		<,001	,022	<,001
	N	220	219	220	220	220	220	220	220	220
Quality_Pedestrian_Paths	Pearson Correlation	-,066	,479**	,280**	,127	,183**	,222**	1	-,265**	,072
	Sig. (2-tailed)	,326	<,001	<,001	,060	,006	<,001		<,001	,287
	N	220	219	220	220	220	220	220	220	220
Too_Much_Traffic	Pearson Correlation	-,120	-,261**	-,138*	,037	-,244**	-,155*	-,265**	1	-,055
	Sig. (2-tailed)	,077	<,001	,042	,585	<,001	,022	<,001		,418
	N	220	219	220	220	220	220	220	220	220
Sport_Recreation	Pearson Correlation	-,043	,073	,115	,132	,291**	,317**	,072	-,055	1
	Sig. (2-tailed)	,525	,279	,088	,051	<,001	<,001	,287	,418	
	N	221	219	220	220	220	220	220	220	221

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Figure 6: Correlation matrix de Hunze/urban design

Correlations

		Inwelkewijkwoontu=Gorechtbuurt (Oosterparkwijk)	Safety_Walking_Neighbourhood	Perceived_Safety_Neighbourhood	Street_Lights	Crime_Neighbourhood
Inwelkewijkwoontu=Gorechtbuurt (Oosterparkwijk)	Pearson Correlation	1	-,184**	-,185**	,021	,314**
	Sig. (2-tailed)		,006	,006	,753	<,001
	N	221	219	220	220	220
Safety_Walking_Neighbourhood	Pearson Correlation	-,184**	1	,765**	,364**	-,371**
	Sig. (2-tailed)	,006		<,001	<,001	<,001
	N	219	219	219	219	218
Perceived_Safety_Neighbourhood	Pearson Correlation	-,185**	,765**	1	,412**	-,359**
	Sig. (2-tailed)	,006	<,001		<,001	<,001
	N	220	219	220	220	219
Street_Lights	Pearson Correlation	,021	,364**	,412**	1	-,077
	Sig. (2-tailed)	,753	<,001	<,001		,256
	N	220	219	220	220	219
Crime_Neighbourhood	Pearson Correlation	,314**	-,371**	-,359**	-,077	1
	Sig. (2-tailed)	<,001	<,001	<,001	,256	
	N	220	218	219	219	220

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 7: Correlation matrix Gorechtbuurt/perceivd safety

Correlations

		Inwelkewijkwoontu=Gorechtbuurt (Oosterparkwijk)	Density	Watisdemeestvoorkomendewoningtypeinuwwijk=Appartementen of flats (1-3 verdiepingen)	Watisdemeestvoorkomendewoningtypeinuwwijk=Appartementen of flats (4-6 verdiepingen)	Watisdemeestvoorkomendewoningtypeinuwwijk=Appartementen of flats (meer dan 6 verdiepingen)	Watisdemeestvoorkomendewoningtypeinuwwijk=Rijtjeshuizen	Watisdemeestvoorkomendewoningtypeinuwwijk=Vrijstaande huizen	Shops	Services	Schools	Offices	Cafés_Restaurants	Sport_Recreation	Industrial_sites
Inwelkewijkwoontu=Gorechtbuurt (Oosterparkwijk)	Pearson Correlation	1	,246**	,598**	,087	-,030	-,511**	-,096	,239**	,257**	,125	-,037	,098	,005	,010
	Sig. (2-tailed)		<,001	<,001	,196	,660	<,001	,155	<,001	<,001	,064	,589	,145	,945	,877
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Density	Pearson Correlation	,246**	1	,331**	,106	,118	-,297**	-,094	,304**	,335**	,215**	-,044	,372**	,106	-,136*
	Sig. (2-tailed)	<,001		<,001	,115	,079	<,001	,163	<,001	<,001	,001	,516	<,001	,117	,043
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Watisdemeestvoorkomendewoningtypeinuwwijk=Appartementen of flats (1-3 verdiepingen)	Pearson Correlation	,598**	,331**	1	-,046	-,033	-,842**	-,105	,382**	,329**	,232**	-,001	,286**	,065	-,025
	Sig. (2-tailed)	<,001	<,001		,494	,629	<,001	,118	<,001	<,001	<,001	,994	<,001	,336	,716
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Watisdemeestvoorkomendewoningtypeinuwwijk=Appartementen of flats (4-6 verdiepingen)	Pearson Correlation	,087	,106	-,046	1	-,006	-,166*	-,021	-,031	,015	,017	,016	-,022	,008	,001
	Sig. (2-tailed)	,196	,115	,494		,924	,013	,758	,647	,830	,800	,813	,749	,904	,992
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Watisdemeestvoorkomendewoningtypeinuwwijk=Appartementen of flats (meer dan 6 verdiepingen)	Pearson Correlation	-,030	,118	-,033	-,006	1	-,117	-,015	,110	,104	,102	,076	-,081	,006	-,061
	Sig. (2-tailed)	,660	,079	,629	,924		,082	,828	,104	,124	,131	,258	,228	,932	,369
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Watisdemeestvoorkomendewoningtypeinuwwijk=Rijtjeshuizen	Pearson Correlation	-,511**	-,297**	-,842**	-,166*	-,117	1	-,378**	-,344**	-,363**	-,293**	-,086	-,229**	-,071	,025
	Sig. (2-tailed)	<,001	<,001	<,001	,013	,082		<,001	<,001	<,001	<,001	,201	<,001	,296	,716
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Watisdemeestvoorkomendewoningtypeinuwwijk=Vrijstaande huizen	Pearson Correlation	-,096	-,094	-,105	-,021	-,015	-,378**	1	-,028	,093	,132	,149*	-,028	,019	,015
	Sig. (2-tailed)	,155	,163	,118	,758	,828	<,001		,678	,166	,051	,027	,680	,783	,828
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Shops	Pearson Correlation	,239**	,304**	,382**	-,031	,110	-,344**	-,028	1	,673**	,672**	,326**	,674**	,074	,031
	Sig. (2-tailed)	<,001	<,001	<,001	,647	,104	<,001	,678		<,001	<,001	<,001	<,001	,273	,648
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Services	Pearson Correlation	,257**	,335**	,329**	,015	,104	-,363**	,093	,673**	1	,538**	,348**	,568**	,169*	-,074
	Sig. (2-tailed)	<,001	<,001	<,001	,830	,124	<,001	,166	<,001		<,001	<,001	<,001	,012	,276
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Schools	Pearson Correlation	,125	,215**	,232**	,017	,102	-,293**	,132	,672**	,538**	1	,391**	,562**	,204**	,034
	Sig. (2-tailed)	,064	,001	<,001	,800	,131	<,001	,051	<,001	<,001		<,001	<,001	,002	,617
	N	220	220	220	220	220	220	220	220	220	220	220	220	220	220
Offices	Pearson Correlation	-,037	-,044	-,001	,016	,076	-,086	,149*	,326**	,348**	,391**	1	,214**	,195**	,185**
	Sig. (2-tailed)	,589	,516	,994	,813	,258	,201	,027	<,001	<,001	<,001		,001	,004	,006
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Cafés_Restaurants	Pearson Correlation	,098	,372**	,286**	-,022	-,081	-,229**	-,028	,674**	,568**	,562**	,214**	1	,125	,041
	Sig. (2-tailed)	,145	<,001	<,001	,749	,228	<,001	,680	<,001	<,001	<,001	,001		,065	,549
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Sport_Recreation	Pearson Correlation	,005	,106	,065	,008	,006	-,071	,019	,074	,169*	,204**	,195**	,125	1	,155*
	Sig. (2-tailed)	,945	,117	,336	,904	,932	,296	,783	,273	,012	,002	,004	,065		,021
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221
Industrial_sites	Pearson Correlation	,010	-,136*	-,025	,001	-,061	,025	,015	,031	-,074	,034	,185**	,041	,155*	1
	Sig. (2-tailed)	,877	,043	,716	,992	,369	,716	,828	,648	,276	,617	,006	,549	,021	
	N	221	221	221	221	221	221	221	221	221	220	221	221	221	221

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Figure 8: Correlation matrix Gorechtbuurt/land use

Correlations

		Inwelkewijkwoontu=Gorechtbuurt (Oosterparkwijk)	Public_Space_Quality	Street_Furniture_Availability	Street_Furniture_Usage	Green_Availability	Green_Usage	Quality_Pedestrian_Paths	Too_Much_Traffic	Sport_Recreation
Inwelkewijkwoontu=Gorechtbuurt (Oosterparkwijk)	Pearson Correlation	1	,017	,183**	,123	,112	,094	,055	,013	,005
	Sig. (2-tailed)		,804	,006	,069	,097	,167	,419	,845	,945
	N	221	219	220	220	220	220	220	220	221
Public_Space_Quality	Pearson Correlation	,017	1	,373**	,126	,237**	,208**	,479**	-,261**	,073
	Sig. (2-tailed)	,804		<,001	,063	<,001	,002	<,001	<,001	,279
	N	219	219	219	219	219	219	219	219	219
Street_Furniture_Availability	Pearson Correlation	,183**	,373**	1	,319**	,412**	,351**	,280**	-,138*	,115
	Sig. (2-tailed)	,006	<,001		<,001	<,001	<,001	<,001	,042	,088
	N	220	219	220	220	220	220	220	220	220
Street_Furniture_Usage	Pearson Correlation	,123	,126	,319**	1	,111	,321**	,127	,037	,132
	Sig. (2-tailed)	,069	,063	<,001		,102	<,001	,060	,585	,051
	N	220	219	220	220	220	220	220	220	220
Green_Availability	Pearson Correlation	,112	,237**	,412**	,111	1	,604**	,183**	-,244**	,291**
	Sig. (2-tailed)	,097	<,001	<,001	,102		<,001	,006	<,001	<,001
	N	220	219	220	220	220	220	220	220	220
Green_Usage	Pearson Correlation	,094	,208**	,351**	,321**	,604**	1	,222**	-,155*	,317**
	Sig. (2-tailed)	,167	,002	<,001	<,001	<,001		<,001	,022	<,001
	N	220	219	220	220	220	220	220	220	220
Quality_Pedestrian_Paths	Pearson Correlation	,055	,479**	,280**	,127	,183**	,222**	1	-,265**	,072
	Sig. (2-tailed)	,419	<,001	<,001	,060	,006	<,001		<,001	,287
	N	220	219	220	220	220	220	220	220	220
Too_Much_Traffic	Pearson Correlation	,013	-,261**	-,138*	,037	-,244**	-,155*	-,265**	1	-,055
	Sig. (2-tailed)	,845	<,001	,042	,585	<,001	,022	<,001		,418
	N	220	219	220	220	220	220	220	220	220
Sport_Recreation	Pearson Correlation	,005	,073	,115	,132	,291**	,317**	,072	-,055	1
	Sig. (2-tailed)	,945	,279	,088	,051	<,001	<,001	,287	,418	
	N	221	219	220	220	220	220	220	220	221

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Figure 9: Correlation matrix Gorechtbuurt/urban design

Correlations

		Green_Availability	Green_Usage	Walkability_Enjoyment
Green_Availability	Pearson Correlation	1	,604**	,286**
	Sig. (2-tailed)		<,001	<,001
	N	220	220	219
Green_Usage	Pearson Correlation	,604**	1	,343**
	Sig. (2-tailed)	<,001		<,001
	N	220	220	219
Walkability_Enjoyment	Pearson Correlation	,286**	,343**	1
	Sig. (2-tailed)	<,001	<,001	
	N	219	219	219

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 10: Correlation matrix green/walkability

7.2 Posters and Flyers

Figure 11: flyer English

Figure 12: Flyer Dutch

Figure 13: Second flyer

Figure 14: Poster

7.3 Questionnaire

Introduction:
I am Gijs and I am doing a research for my master thesis. This research is looking into how the built environment affects social interactions on the street. The research focuses on the following neighbourhoods: **De Hunze, Ulgersmaborg, Wijert-Zuid, Oosterpoortbuurt, Oranjebuurt and Gorechtbuurt.** The questionnaire will take approximately 10 minutes to take. All answers will registered anonymously and will be collectively used for analysis for my thesis. If you have any questions you can send an email to: g.j.rodenburg@student.rug.nl

Gender:
- Male
- Female
- Other

What is your age?

In which neighbourhood do you live?
- De Hunze
- Ulgersmaborg
- Wijert-Zuid
- Oosterpoortbuurt
- Oranjebuurt
- Grochtbuurt (Oosterparkwijk)
- Other neighbourhood

Occupation:
- Student
- Employed
- Unemployed
- Retired
- Other

Income per month (bruto)
- 0-1000
- 1000-2000
- 2000-3000
- 3000-4000
- 4000-5000
- 5000>
- Rather not say

Free time per day
0-1 hour
1-2 hour
2-3 hour
More than 3 hours

Do you have children living with you, if so, how old are they?
No
Yes, 0-5
Yes, 5-10
Yes 10-15
Yes 15+

Do you have a dog?
Yes
No

Do you own a car?
Yes
No

How long do you live in your current neighbourhood?
0-1 years
1-2 years
3-5 years
5-10 years
10+ years

On a scale from 1-10, how satisfied are you with living in your neighbourhood?
1: extremely unsatisfied
10: extremely satisfied

Which mode of transportation do you use most, rank them from most used (1) to least used (4)

1. Walking
2. Cycling
3. Car
4. Public transport

Built environment

What is the most common type of housing in your neighbourhood?

- Detached single-family homes?

- Townhouses or row houses of 1-3 stories
- Apartments of 1-3 stories
- Apartments of 4-6 stories
- Apartments of 7 or more stories
- Other

For the upcoming section, there are several statements. Please indicate how much you agree with the following statements.

There is a high diversity in ethnicity, race and age in my neighbourhood?
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

Compared to other neighbourhoods in Groningen I find my neighbourhood dense
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

There is a lot of activity on the street in my neighbourhood
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

There are different shops in my neighbourhood
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

There are a lot of different services (doctor, pharmacy, barber etc.) in my neighbourhood
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

There are different schools in my neighbourhood
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

There are offices in my neighbourhood
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

There are different cafés and restaurants in my neighbourhood
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

There are different outdoor facilities like playgrounds, sports facilities and meeting places in my neighbourhood
Strongly disagree
Disagree
Somewhat disagree

Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

There are different industrial sites in my neighbourhood
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

Which of the following facilities do you make use of in your neighbourhood? (if a facility is not present in your neighbourhood, you do not have to check this box, multiple boxes can be checked off):

- Grocery stores
- Other shops (printing, hobby, electronics etc.)
- Services (doctor, pharmacy, barber etc.)
- School
- Offices
- Cafés and restaurants
- Playgrounds/sport facilities
- Industrial sites

Most of the stores I use are within walking distance (10-15 min) from my house
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

The public space in my neighbourhood is of good quality (Trash, maintenance, aesthetics)
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree

Agree
Strongly agree

There is enough (public) street furniture in my neighbourhood (benches, tables etc.)
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

I frequently make use of street furniture (benches, tables etc.)
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

There is a lot of green (parks, trees, grass fields etc.) in my neighbourhood
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

I frequently make use of green spaces (parks, grass fields etc.) in my neighbourhood
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

There are good sidewalks (to walk) on most of the streets in my neighbourhood
Strongly disagree

Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

There is too much traffic on the street that it makes it more difficult for me to walk in my neighbourhood
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

I enjoy walking through my neighbourhood
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

When I walk on the street by myself I feel safe
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

I overall feel safe in my neighbourhood
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree

Strongly agree

There is good street lighting in my neighbourhood?
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

There is a high crime rate in my neighbourhood?
Strongly disagree
Disagree
Somewhat disagree
Neither agree nor disagree
Somewhat agree
Agree
Strongly agree

Social interaction

The following statements can be answered on a scale from -5 to 5. With a -5 meaning strongly disagree, 0 neither agree or disagree and a 5 meaning strongly agree.

I often talk to people in my neighbourhood on the street
-5: Strongly disagree
0: neither agree nor disagree
5: Strongly agree

I frequently greet people on the street in my neighbourhood
-5: Strongly disagree
0: neither agree nor disagree
5: Strongly agree

I frequently use non-verbal communication (node, wave, etc.) towards people on the street
-5: Strongly disagree
0: neither agree nor disagree
5: Strongly agree

Social interactions on the street in my neighbourhood give me joy
-5: Strongly disagree
0: neither agree nor disagree

5: Strongly agree

Overall, I see the social interactions in my neighbourhood as something meaningful and positive
-5: Strongly disagree
0: neither agree nor disagree
5: Strongly agree

I do experience negative social interactions on the street in my neighbourhood
-5: Strongly disagree
0: neither agree nor disagree
5: Strongly agree

What is something about the built environment in your neighbourhood that could be changed to improve the amount of social interactions on the streets?